Manual of

STANDARD SPECIFICATIONS

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A Manual for General Contractors and the Construction Industry

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UTAH CHAPTER
AMERICAN PUBLIC WORKS ASSOCIATION

UTAH CHAPTER
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

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PREFACE

This manual has been prepared to assist public works contracting agencies and contractors in the State of Utah. It is designed to:

- Be compatible with the "Manual of Standard Plans" which is published by the LTAP Center in Logan Utah.
- To provide uniform construction practice among counties, cities, and other public agencies in the State of Utah.
- To provide standard requirements for the supply and installation of materials and systems in the public works environment.
- To follow the present industry-consensus on uniform organization and sequencing of specifications.

Changes in a specification are listed in red in the top right corner of the initial page.

To recommend an improvement to this document, submit the following information to the chairman of the Standard Specifications and Drawings Subcommittee. The web site is (http://utah.apwa.net/). In your submission

- Identify the problem.
- Recommend a solution.
- Provide written text or drawing to support your recommendation.

Construction experts and design professionals will carefully review the proposed changes in open meetings.

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GENERAL CONDITIONS

PART 1 GENERAL

1.1 DEFINED TERMS

A. Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof.

1. **Addenda**: Written or graphic instruments issued before the opening of Bids which clarify, correct or change the Contract Documents.

2. **Agreement**: A written instrument which is part of the Contract Documents, and which when signed by the OWNER and CONTRACTOR, establishes the Contract Price, the Contract Time, the Punch List Time, the identity of the ENGINEER and other matters pertaining to the Construction Contract.

3. **Agreement Supplement**: A written instrument executed by OWNER and Bidder in the time period between the opening of Bids and the signing of the Agreement which clarifies, corrects or changes the Contract Documents.

4. **Application for Payment**: The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to include such supporting documentation required by the Contract Documents.

5. **Asbestos**: Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

6. **Bid**: The offer of the Bidder submitted on the prescribed form setting forth the price for the Work to be performed.

7. **Bid Documents**: The documents defined in the Bid, together with all Addenda and supplements issued before the Effective Date of the Agreement.

8. **Bid Security**: Bid bond, cashier's check, or cash. Amount equal to a minimum of five (5) percent of the Bid price.

9. **Bidder**: Any person, firm, joint venture or corporation submitting a Bid directly to the OWNER, as distinct from a sub bidder who submits a bid to a Bidder.

10. **Bonds**: Bid, performance and payment Bonds, cash, cashier's or certified bank check and other instruments of security.

11. **Change Order**: A written instrument prepared by the ENGINEER signed by CONTRACTOR and OWNER on or after the Effective Date of the Construction Contract, which authorizes an addition, deletion, or revision in the Work, or an adjustment in the Contract Price, Contract Time or both.

12. **Claimant**: An individual or entity having a direct contract with the CONTRACTOR or with a Subcontractor or Supplier of the CONTRACTOR to furnish labor, materials, supplies or equipment for use in the performance of the Work. The intent of this definition shall be to include without limitation in the terms "labor, materials, supplies or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Work, architectural and engineering services required for performance of the work of the CONTRACTOR and the CONTRACTOR's Subcontractors, and all other items for which a claim may be asserted where the labor, materials, supplies or equipment were furnished.

13. **Construction Contract**: The entire and integrated compact between the OWNER and CONTRACTOR memorialized in the Contract Documents concerning the Work to be performed which supersedes prior negotiations, representations or agreements, either written or oral.

14. **Contract Documents**: The Bid Documents, Agreement, Agreement Supplement, General Conditions, Supplementary Conditions, Specifications, Standard Specifications, Drawings, Standard Plans together with all Modifications issued pursuant to article 3.3 herein after the Effective Date of the Construction Contract.

15. **Contract Price**: The total money payable by OWNER to the CONTRACTOR under the Contract Documents as stated in the Agreement and subject to the provisions of Paragraph 11.7A herein in the case of Unit Price Work.

16. **Contract Time**: The number of consecutive calendar days or the date specified in the Agreement for Substantial Completion of the Work.

17. **CONTRACTOR**: The person, firm or corporation named as such in the Agreement.

18. **Cost of the Work**: The sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work (refer to article 11.4).

19. **Day**: Any 24 hour period measured from mid-night to the next mid-night.

20. **Defective**: An adjective which when modifying the word "work" refers to work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any Inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged before ENGINEER's Final Inspection (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with Paragraph 14.5A or 14.6B).

21. **Drawings**: The graphic and pictorial portions of the Contract Documents prepared or approved by ENGINEER, showing the design, location, and dimensions of the Work, and generally include, the plan, elevations, sections, details, schedules and diagrams. Drawings include OWNER's standard plans. Drawings are also known as Plans.

22. **Effective Date of the Construction Contract**: The date indicated in the Agreement on which the Construction Contract becomes effective. If no such date is indicated, it means the date on which the Construction Contract is signed and delivered by the last of the two parties to sign and deliver.

23. **ENGINEER:** The person, firm or corporation designated in the Agreement as the OWNER's representative and agent for the Construction Contract, acting within the scope of the particular duties entrusted to such a person, firm or corporation. The person may be a licensed architect, licensed landscape architect, licensed engineer, licensed land surveyor or other individual.

24. **Final Inspection**: An Inspection of the Work (or agreed to portion), conducted by ENGINEER, after Work (or agreed to portion) is Substantially Complete.

25. **General Requirements**: Sections of Division 1 of the Standard Specifications and Specifications.

26. **Hazardous Waste**: The term hazardous waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

27. **Inspection**: The term "inspection" or its derivatives means a review of the Project, including but not limited to a visual review of the work completed to date. It does not include or imply an exhaustive or detailed review of the Work, nor does it create a duty on the part of the ENGINEER or OWNER to detect latent defects.

28. **Laws and Regulations; Laws or Regulations**: Any federal, state, county, city, or local jurisdiction's laws, rules, regulations, ordinances, codes and orders.

29. **Lien**: A charge, security interest or encumbrances upon materials or equipment.

30. **Lump Sum Work**: Work to be paid for on the basis of a stipulated price.

31. **Major Unit Price Item of Work**: Any item of Unit Price Work which has a total value greater than five (5) percent of the initial Contract Price.

32. **Milestone**: A principal event specified in the Contract Documents relating to an intermediate completion date or time before Substantial Completion of the Work.

33. **Modification**: Any Addendum, Agreement Supplement, Change Order, or Work Directive Change.

34. **Notice of Intent to Award**: The written notice by OWNER to the apparent successful Bidder stating that on compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Construction Contract.

35. **Notice to Proceed**: A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Time will commence and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

36. **OWNER**: The public body or authority, corporation, association or firm with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

37. **Partial Utilization**: Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

38. **PCBs**: Polychlorinated biphenyl.

39. **Petroleum**: Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 deg. Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

40. **Plans**: Drawings.

41. **Project**: The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part.

42. **Project Manual**: The bound documentary package prepared for bidding and constructing the Work.

43. **Punch List**: The list of unacceptable, incorrectly accomplished, damaged or unfinished work items compiled by ENGINEER at Final Inspection.

44. **Punch List Time**: The number of Days specified in the Agreement for the completion of the Final Inspection Punch List Work.

45. **Radioactive Material**: Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

46. **Regular Working Hours**: Computation of regular working hours shall be based upon a 40 hour work week.

47. **Resident Project Representative**: The representative of ENGINEER assigned to the site or any part thereof.

48. **Shop Drawings**: All Drawings, diagrams, illustrations, schedules and other data prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by Suppliers and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

49. **Specifications**: Those portions of the Contract Documents consisting of written requirements for materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto. Bidding requirements, contract forms, and Conditions of the Contract are **not** Specifications.

50. **Standard Plans**: The graphical and text displays contained in the Manual of Standard Plans published by the Utah LTAP Center, Utah State University, Logan UT.

51. **Standard Specifications**: The specifications contained in this manual following these General Conditions.

52. **Subcontractor**: An individual, Supplier, firm or corporation having a contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work.

53. **Substantial Completion**: A point in time when, in the opinion of the ENGINEER as evidenced by ENGINEER's written notice, the Work (or a specified part thereof) has progressed to where it is sufficiently complete, and only occasional construction personnel and equipment are required for correcting unfinished or Defective Work. The remaining work will not interfere with the Work area's intended use or occupancy. The terms "substantially complete" and "substantially completed" as applied to any work refer to substantial completion thereof.

54. **Supplementary Conditions**: The part of the Contract Documents that amends or supplements these general conditions.

55. **Supplier**: A manufacturer, fabricator, distributor, material producer or vendor who provides products to CONTRACTOR or Subcontractors.

56. **Underground Facilities**: All pipelines, conduits, ducts, cables, wires, access chambers, Vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials; electricity, gases, steam, liquid Petroleum products, telephone or other communication, cable television, sewage and drainage removal, traffic or other control systems or water.

57. **Unit Price Work**: Work to be paid for on the basis of unit prices.

58. **Work**: The construction and services required to be furnished under the Contract Documents which may be the whole or part of the Project. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, as required by the Contract Documents.

59. **Work Completion**: The Work and all contractual obligations under the Contract Documents have been fulfilled and when final payment is due in accordance with Paragraph 14.9A.

60. **Work Directive Change**: A written directive to CONTRACTOR, issued on or after the Effective Date of the Construction Contract, prepared by the ENGINEER and signed by the OWNER, ordering an addition, deletion or revision in the Work as provided in article 10.1, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in article 4.2 or 4.3 or to emergencies under article 6.13. A Work directive change requires agreement by the OWNER and the ENGINEER and may or may not be agreed to by the CONTRACTOR.

PART 2 PRELIMINARY MATTERS

2.1 DELIVERY OF BONDS AND INSURANCE

A. When CONTRACTOR delivers the executed Agreement to OWNER, CONTRACTOR shall also deliver required Bonds and insurance certificates.

2.2 COPIES OF DOCUMENTS

A. OWNER shall furnish to CONTRACTOR the number of copies of the Contract Documents as are reasonably necessary for the execution of the Work (up to 10 copies) unless additional copies are provided for in the Specifications. Additional copies will be furnished, upon request, at the cost of reproduction.

2.3 COMMENCEMENT OF CONTRACT TIME - NOTICE TO PROCEED

A. **Contract Time**: Time is the essence of the contract. Unless indicated otherwise in the Bid Documents, addendum, or in a Change Order, in no event will the Contract Time commence later than the 74th Day after the Day of Bid opening or the 30th Day after the Effective Date of the Construction Contract, whichever date is earlier.

B. **Notice to Proceed**: A Notice to Proceed may be given at any time, even within 30 Days after the Effective Date of the Construction Contract.

2.4 STARTING THE WORK

A. CONTRACTOR shall start to perform work on the date when the time for the Contract Time commences. No work shall be done at the site before that date.

2.5 BEFORE STARTING CONSTRUCTION

A. **In General**: Before starting each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error or discrepancy that CONTRACTOR may discover and shall obtain a written interpretation or clarifications from ENGINEER before proceeding with any work affected thereby.

B. **Submittals**: Within 10 Days after the Effective Date of the Construction Contract, CONTRACTOR shall submit to ENGINEER, in reasonable detail and form acceptable to ENGINEER, copies of the following documents.

1. **Preliminary Progress Schedule**: The preliminary progress schedule shall show starting and completion dates for each construction sequence and:

   a. submittal dates and dates required for approved submittals for Shop Drawings, product data and samples;

   b. decision dates for products specified by allowances, selection of finishes and critical material or equipment release orders;

   c. product procurement and delivery dates;

   d. holiday cleanup preparations, And

   e. specific dates for all special Inspections required before any utilities "turn-on" including temporary power.

2. **Preliminary Shop Drawing Schedule**: A supplemental schedule to the preliminary progress schedule shall show all Shop Drawing submissions required for the Work.

3. **Preliminary Schedule of Values**: The preliminary schedule of values (for Lump Sum Work), which includes provisions set forth in quantities and prices of items aggregating the Contract Price, shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of work. Bond expense shall not be prorated, but shall be shown as a separate item.

4. **Mobilization Program**: The site mobilization program shall allow for field office and trailer locations, material storage locations, power requirements for trailers, if any, and sanitary facilities.

5. **Permits**: The listing of, and photocopies of permits that the CONTRACTOR is required to purchase and maintain in accordance with article 6.7.

6. **Quality Control Program**: The written program for the control of product quality and workmanship.

7. **Safety and Protection Plan**: The safety and protection plan shall comply with article 6.12.

C. **Field Office**: When specified, the CONTRACTOR shall establish and maintain a field office in such a location that ENGINEER may always contact CONTRACTOR for transmittal of Plans, instructions and dissemination of Project information. Unless waived by ENGINEER, CONTRACTOR shall provide and maintain a telephone and facsimile machine in the field office during work performance.

2.6 **PRECONSTRUCTION CONFERENCE**

A. Within 20 Days after the Contract Time starts to run, but before starting any work, CONTRACTOR shall attend a conference with ENGINEER and others:

1. To discuss the schedules referred to in Paragraph 2.5B;

2. To discuss procedures for handling Shop Drawings and other submittals;

3. To discuss procedures for processing applications for payment;

4. To establish a working understanding among the parties as to the Work;

5. To review or discuss other items deemed necessary by ENGINEER or CONTRACTOR, and

6. To designate the name of the individual who shall be CONTRACTOR's resident superintendent at all times while work is in progress. When the CONTRACTOR is comprised of two (2) or more persons, firms, partnerships or corporations functioning on a joint venture basis, before starting the Work, CONTRACTOR shall designate in writing the name of a representative who shall have the authority to represent and act for the joint venture persons, firms, partnerships or corporations at all times while the Work is in progress.

2.7 **FINALIZING SCHEDULES**

A. At least 10 Days before submission of the first Application for Payment, CONTRACTOR shall attend a conference with ENGINEER and others as appropriate to finalize the schedules submitted in accordance with Paragraph 2.5B.

1. **Progress Schedule**: The finalized progress schedule must be acceptable to ENGINEER as providing an orderly progression of the Work to completion within the Contract Time. The critical path must be fully defined. Acceptance will neither impose on ENGINEER responsibility for the progress or scheduling of the Work nor release nor relieve the CONTRACTOR from full responsibility therefore.

2. **Schedule of Shop Drawings:** The finalized schedule of Shop Drawings submissions must be acceptable to ENGINEER as providing a workable arrangement for processing the submissions.

3. **Schedule of Values**: The finalized schedule of values shall conform to the requirements of Articles 11.4 and 11.5 and must be acceptable to ENGINEER in form and substance.

2.8 **COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION**

A. Except as otherwise provided in the Contract Documents, or when direct communications have been specially authorized, the OWNER and CONTRACTOR shall communicate through the ENGINEER.

B. Communication by and with ENGINEER's consultants shall be through the ENGINEER.

C. Communications by and with Subcontractors and Suppliers shall be through the CONTRACTOR.

D. Communications by and with separate contractors shall be through the ENGINEER.

PART 3 CONTRACT DOCUMENTS, INTENT, AMENDING, REUSE

3.1 **INTENT**

A. **In general**: It is the intent of the Contract Documents to describe a functionally complete Project to be constructed in accordance with the Contract Documents.

B. **Contract Documents are Complementary**: The Contract Documents are complementary; what is required by one document or provisions thereof is binding as if required by all the documents or provisions thereof.

C. **Incidental Work**: Any work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be supplied by CONTRACTOR at no additional cost to the OWNER whether or not specifically referenced.

D. **Technical or Trade Words**: When words which have a well-known technical or trade meaning are used to describe the Work, materials or equipment, such words shall be interpreted in accordance with that meaning.

3.2 **RESOLVING DISCREPANCIES**

A. **References**: Reference to manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest manual, code or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Construction Contract, if there were no Bids), except as may be otherwise specifically stated.

B. **Duties of CONTRACTOR or ENGINEER Not Changed**: No provision of any referenced manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of CONTRACTOR or ENGINEER from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraphs 9.9C or 9.9D.

C. **Conflict, Error, Discrepancy, Omission in Contract Documents**: If, during the performance of the Work, CONTRACTOR finds or identifies a conflict, error, discrepancy, or omission in the Contract Documents, CONTRACTOR shall so report to ENGINEER in writing at once. Before proceeding with work affected thereby CONTRACTOR shall obtain a written interpretation or clarification from ENGINEER as provided in Article 9.4.

1. **Dimensions on Drawings**: In the event of any discrepancy between the measured dimensions on any Drawing and the written dimensions shown thereon, the written dimensions shall be taken as correct.

2. **Detail Drawings**: Detail Drawings, regardless of trade or item of work, shall prevail over general Drawings.

3. **Work shown on the Drawings**: Any part of the Work which is not mentioned in the Bid Documents or Specifications, but which is shown on the Drawings, shall be furnished and installed by CONTRACTOR as if fully described in the Bid Documents or Specifications and at no additional cost the OWNER.

4. **Irreconcilable Conflict**: Only in case of irreconcilable conflict between provisions within the Contract Document or between Contract Documents, the intent of the Contract Documents shall be interpreted in accordance within the following priorities.

   a. A particular Modification shall govern over all Contract Documents or Modifications issued before said particular Modification.

   b. These General Conditions shall govern over all Contract Documents except the Agreement, Agreement Supplement, Supplementary Conditions, Addenda and Modifications.

   c. The Specifications shall govern over Drawings, Standard Specifications, and Standard Plans.

   d. The Drawings shall govern over the Standard Specifications and Standard Plans.

5. **Notification Still Required**: The priority provisions of Paragraph 3.2C4 above shall not relieve CONTRACTOR of notifying OWNER of such an irreconcilable conflict.

D. **Capitalization**: Terms capitalized in these General Conditions include those which are (1) specifically defined, (2) the title of numbered Articles and identified references, and (3) the title of referenced documents. If any terms are capitalized which do not fit within these categories, the capitalization shall be ignored.

E. **Headings**: Any headings preceding the text of paragraphs in a Contract Document are inserted solely for convenience of reference and shall not affect its meaning, content or effect or be referred to in any interpretation thereof.

3.3 **AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS**

A. The Contract Documents may be amended on or after the Effective Date of the Construction Contract to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

1. A Work Directive Change (Paragraph 10.1B); or

2. A Change Order (Paragraph 10.1C).

B. As indicated in Articles 11.2 and 12.1, Contract Price and Contract Time may only be changed by a Change Order.

C. The requirements of the Contract Documents may be supplemented and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

1. ENGINEER's review of a Shop Drawing or sample (pursuant to Paragraphs 6.14F and 6.14G); or
2. ENGINEER's written interpretation or clarification (pursuant to Article 9.4).

3.4 REUSE OF DOCUMENTS

A. Neither CONTRACTOR nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or for ENGINEER, And they shall not reuse any of them on extensions of the Project or any other project without written consent of OWNER.

3.5 INTERPRETATION AND VENUE

A. The Contract Documents will be construed in accordance with the laws of the State of Utah. Any court action arising from the Construction Contract shall be brought in an appropriate federal or state court with appropriate jurisdiction in which the OWNER resides.

PART 4 AVAILABILITY OF LANDS, SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.1 AVAILABILITY OF LANDS

A. OWNER shall furnish the lands upon which the Work is to be performed, right-of-ways and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER unless otherwise provided in the Contract Documents. In the event of OWNER's delay in furnishing these lands, right-of-ways or easements, if CONTRACTOR believes that any delay entitles CONTRACTOR to an increase in the Contract Price or an extension of the Contract Time, CONTRACTOR may make a claim therefore as provided in Parts 11 and 12 hereof. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 PHYSICAL CONDITIONS - GENERAL

A. **Explorations and Reports**: Reference, when applicable, is made to geotechnical data in the Bid Documents for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such reports at the locations and the indicated depths where the data was obtained, but not upon the other information, interpretations or opinions contained therein or for the completeness thereof, expressed or implied. Except as indicated in the immediately preceding sentence and in Paragraph 4.2C, CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

B. **Existing Structures**: Reference, when applicable, is made to the Supplementary Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in article 4.3) which are at or contiguous to the site that have been utilized in preparing the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not upon the completeness thereof for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in Paragraph 4.2C, CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

C. **Differing Site Conditions**: If CONTRACTOR believes that any technical data on which CONTRACTOR is entitled to rely as provided in Paragraphs 4.2A and 4.2B is inaccurate, or any physical condition uncovered or revealed at the site differs materially from that indicated in the Contract Documents, or unknown physical conditions exist at the site which are of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Construction Contract, CONTRACTOR shall immediately notify ENGINEER in writing before performing any work in connection therewith. Failure by the CONTRACTOR to give notice about the inaccuracy or difference, and the performance of any work in connection

with said differing site conditions (except in an emergency as permitted by article 6.13), shall bar the CONTRACTOR from making any claim for additional compensation in connection therewith.

1. **ENGINEER's Review**: ENGINEER will review the alleged or claimed differing conditions and determine if it is necessary to obtain additional explorations or tests with respect thereto.

2. **Possible Document Change**: If the ENGINEER concludes that there is a material error in the Contract Documents, or that a change in the Contract Documents is required, a Change Order will be issued as provided in Part 10 to reflect and document the consequences of the inaccuracy or difference.

3. **Possible Price and Time Adjustments**: For such possible document change an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, may be allowable to the extent the ENGINEER determines that they are attributable to any such inaccuracy. If ENGINEER and CONTRACTOR are unable to agree as to the amount or length thereof, a claim may be made therefore as provided in Parts 11 and 12.

D. **Hazardous Substances**: Neither OWNER nor ENGINEER are aware of any hazardous substances which may be encountered in performance of the Work except as may be specifically disclosed elsewhere in the Contract Documents. Neither OWNER nor ENGINEER have specifically inspected the site to determine any such presence except as disclosed in the Contract Documents.

4.3 **PHYSICAL CONDITIONS - UNDERGROUND FACILITIES**

A. **Shown or Indicated**: The information shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. OWNER shall not be responsible for the accuracy or completeness of any such information.

1. **One-call Center**: The CONTRACTOR shall have full responsibility for reviewing and verifying all such information, with the one-call center (Blue Stake location center) or other utility coordination service a minimum of two (2) working Days before any excavation to locate all Underground Facilities shown or indicated in the Contract Documents. The CONTRACTOR shall have full responsibility for any damages to Underground Facilities or costs resulting from the damage to such facilities, in those instances where the CONTRACTOR did not dependently locate and verify the location of such facilities.

2. **Tolerances**: The information presented is considered accurate to within three (3) feet vertical and four (4) feet horizontal on each side of the utility location shown on the Drawings. Should a utility so shown not be within said tolerances, said utility shall be handled as outlined in Paragraph 4.3B below.

3. **Coordination**: The CONTRACTOR shall coordinate the Work with the owners of such Underground Facilities during construction and shall be responsible for the safety and protection thereof as provided in article 6.12.

4. **Costs**: If work is performed within the above referenced tolerances, the cost of all of the above including repair of any damages therein resulting from performance of the Work will be considered as having been included in the Contract Price and no additional compensation will be allowed therefore.

B. **Not Shown or Indicated**: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of, CONTRACTOR shall, promptly after becoming aware thereof and before performing any work affected thereby (except in an emergency as permitted by article 6.13), identify the owner of such Underground Facility and give written notice thereof to that owner and to ENGINEER.

1. **ENGINEER to Modify Contract Documents**: ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary.

2. **Safety and Protection**: During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in article 6.12.

3. **Contract Price or Contract Time Adjustment**: CONTRACTOR may be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents, or that was not identified by the CONTRACTOR where such identification could have been made through a reasonably prudent investigation by the CONTRACTOR.

4. **Claims**: If the parties are unable to agree as to the Contract Price or Contract Time adjustments, CONTRACTOR may make a claim therefore as provided in Parts 11 and 12.

4.4 **REFERENCE POINTS AND MONUMENTS**

A. OWNER shall provide land surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written permission of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

B. CONTRACTOR shall not disturb any survey monuments found on the line of the improvements until ordered by the ENGINEER. No survey monument shall be disturbed or moved until ENGINEER has been notified and ENGINEER has referenced the survey monument for resetting.

4.5 **ASBESTOS, PCBs, PETROLEUM, HAZARDOUS WASTE OR RADIOACTIVE MATERIAL**

A. Neither OWNER nor ENGINEER are aware of any hazardous substances which may be encountered in performing work except as may be specifically disclosed elsewhere in the Contract Documents. Neither OWNER nor ENGINEER has specifically inspected the site to determine any such presence except as disclosed in the Contract Documents. The provisions of articles 4.2 and 4.3 shall not apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

PART 5 BONDS AND INSURANCE

5.1 **PERFORMANCE, PAYMENT AND OTHER BONDS**

A. Reference is made to the Supplementary Conditions for identification of Bonds that may be or are required for the Work.

5.2 **INSURANCE**

A. Reference is made to the Supplementary Conditions for identification of the insurance policies required for the Work.

PART 6 CONTRACTOR'S RESPONSIBILITIES

6.1 **CONTROL OF THE WORK**

A. **Means, Methods, Techniques, Sequences, Procedures of Construction**: CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. CONTRACTOR shall be responsible to ensure that the completed work complies with the Contract Documents. CONTRACTOR shall supervise, direct and control the Work competently and efficiently. CONTRACTOR shall devote such attention thereto and applying such skill and expertise as necessary to perform work in accordance with the Contract Documents.

B. **Resident Superintendent**: CONTRACTOR shall designate in writing and keep on site at all times during progress of the Work, a competent resident superintendent. The superintendent shall not be replaced without written notice to ENGINEER except under extraordinary circumstances. The superintendent shall have authority to act on behalf of CONTRACTOR.

C. **Communications**: All communications given to the resident superintendent by ENGINEER shall be as binding as if given to CONTRACTOR. If CONTRACTOR's resident superintendent is not present on site or on any part of the Work, ENGINEER may give communications to an employee of the CONTRACTOR or to the CONTRACTOR's Subcontractor or Suppliers who may have charge of the particular portion of the Work in reference to which the communications are given. Without being contrary to the provisions of Paragraphs 9.9C or 9.9D, such communications shall be considered given by the ENGINEER to the CONTRACTOR when confirmed in writing and delivered to the CONTRACTOR's resident superintendent.

D. **CONTRACTOR not agent of OWNER**: ENGINEER's right to enforce provisions of the Contract Documents shall not make the CONTRACTOR, nor the CONTRACTOR's agents, employees, Subcontractors, or Suppliers, agents of the OWNER. The liability of the CONTRACTOR for all damages to persons or to public or private property, arising from CONTRACTOR's execution of the Work, shall not be diminished because of ENGINEER's enforcement of the Contract Documents.

6.2 **LABOR, MATERIALS AND EQUIPMENT**

A. **Personnel and Discipline:** CONTRACTOR shall provide competent, qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. If any Subcontractor or employee of the CONTRACTOR shall appear to ENGINEER to be incompetent or to act in a disorderly or disobedient manner, the person shall be immediately removed from the Project upon the request of the ENGINEER, and such person shall not be employed again on the Work.

B. **Regular Working hours:** Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during Regular Working hours.

C. **Overtime:** If CONTRACTOR permits overtime work or the performance of work on Saturday, Sunday or any legal holiday CONTRACTOR shall do so at no increase to the Contract Price and shall give prior written notice to ENGINEER.

D. **Temporary Facilities:** Unless otherwise specified in the Contract Document (e.g. OWNER-supplied materials, etc.), CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up, completion or suspension of the Work.

E. **Materials and Equipment:** All materials and equipment shall be applied installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents; but no provision of any such instructions shall be effective to assign to OWNER, ENGINEER, or any of OWNER's representatives, consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraphs 9.9C or 9.9D. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER.

1. **Adequate, Safe and Suitable Equipment**: The CONTRACTOR shall provide adequate, safe and suitable equipment to meet the work requirements, and when ordered by the ENGINEER, shall remove unsuitable equipment from the Work site.

2. **Operating Construction Equipment on Site**: No construction equipment or machinery shall be operated upon paved streets, sidewalks, landscaped areas or prepared roadway shoulders which may be injurious to said areas.

3. **Quality, New**: All materials and equipment to be installed in the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment.

4. **Certificate of Compliance:** The ENGINEER may permit the use of certain materials or assembly before sampling and testing if accompanied with a certificate of compliance stating that materials involved comply in all respects with the requirements of the Contract Documents subject to the following conditions:

   a. the form of a certificate of compliance and its disposition shall be as directed by the ENGINEER;

   b. the certificate shall be signed by the manufacturer of the materials or the manufacturer of the assembled material;

   c. the certificate must be furnished with each material or assembly of material delivered to the Work site and the material or assembly of material so certified must be clearly identified in the certificate;

   d. all materials used on the basis of a certificate of compliance may be contested at any time;

   e. the fact that material is used on the basis of a certificate of compliance shall not relieve CONTRACTOR from the responsibility of incorporating material in the Work which conforms to requirements of the Contract Documents and any such material not conforming to such compliance, whether or not in place, shall be removed and replaced at no additional cost to the OWNER, and

f. OWNER reserves the right to refuse to permit the use of material on the basis of a certificate of compliance.

6.3 **ADJUSTING PROGRESS SCHEDULE**

A. **Changes**: CONTRACTOR shall submit to ENGINEER adjustments in the progress schedule which reflect the impact thereon of changes to the Work.

1. Proposed adjustments in the progress schedule that will not change the Contract Time or Milestones will conform generally to the progress schedule then in effect and additionally will comply with any provisions of Paragraph 2.5. Such submittal must be accepted by ENGINEER before the adjusted schedule becomes effective.

2. Proposed adjustments in the progress schedule that will change the Contract Time or Milestones shall be submitted in accordance with the requirements of article 12.1. Such adjustments may only be made by a Change Order in accordance with article 3.3.

B. **Float Time**: Any float time used in the progress schedule shall not be owned solely by OWNER or CONTRACTOR.

1. Float time shall be allocated and used in the best interests of the Work.

2. CONTRACTOR's schedules shall reflect CONTRACTOR's use of float time and specify the reason for CONTRACTOR's use.

3. The progress schedule shall reflect OWNER's use of float time.

4. OWNER shall notify CONTRACTOR of OWNER's claim to use any float time and shall specify the reason for such use.

6.4 **SUBSTITUTES OR "OR-EQUAL" ITEMS**

A. **Proprietary Item or Particular Supplier**: Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, such naming is intended to establish the type, function, and quality required. Unless the Specification or description contains or is followed by words reading that no Substitution is permitted, material and equipment of other Suppliers may be accepted by ENGINEER. Review and acceptance of the "or equal" substitute item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the following requirements for acceptance of proposed substitute items:

1. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR;

2. CONTRACTOR shall first make written application to ENGINEER for acceptance of proposed substitute item of material or equipment;

3. CONTRACTOR shall certify that the proposed substitute will function and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified;

4. the application shall state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty;

5. All variations of the proposed substitute from that specified will be identified in the application and the nature and extent of available maintenance, repair and replacement service will be indicated;

6. the application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of separate contractors affected by the resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute;

7. all data to be provided by CONTRACTOR in support of any substitute item or proposed substitute item will be at CONTRACTOR's expense, And

8. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR's expense additional data which ENGINEER determines to be necessary to evaluate the proposed substitute item.

B. **Substitute Construction Methods or Procedures**: If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine

that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in Paragraph 6.4A as applied by ENGINEER and as supplemented in Section 01 25 00 of the General Requirements in the Standard Specifications.

C. **Time Required for Review of Substitute**: Proposed substitutes shall be made in ample time to permit review and written approval without delaying the Work. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing.

D. **Special Performance Guarantee**: OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. **OWNER's Costs**: CONTRACTOR shall reimburse OWNER for all charges or expenses incurred by OWNER regarding any request for Substitution per this Part whether or not such request is approved.

F. **No Extra Time for Review**: CONTRACTOR's request to use substitute materials and equipment or methods per this article and ENGINEER's review of such request shall not extend the Contract Time.

6.5 **SUBCONTRACTORS, SUPPLIERS AND OTHERS**

A. **General**: CONTRACTOR SHALL NOT employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER as indicated in Paragraph 6.5B), whether initially or as a substitute, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any work against whom CONTRACTOR has reasonable objection.

B. **Adjustment for Substitution of Subcontractor, Suppliers and Other Person**: If any Subcontractor, Supplier or other person or organization, which was identified by CONTRACTOR before the Effective Date of the Construction Contract, is to be replaced by the CONTRACTOR, or on request of the OWNER on the basis of reasonable investigation, CONTRACTOR shall propose in writing to the OWNER an acceptable Subcontractor, Supplier or other person or organization substitute. If OWNER's request is based upon Defective Work or CONTRACTOR's failure to comply with the Contract Documents, the Contract Price shall remain unchanged, otherwise, the Contract Price will be adjusted by the difference in the cost occasioned by such replacement and an appropriate Change Order signed. No acceptance by OWNER of any Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject Defective Work or any other right under the Contract Documents or under Law or Regulations.

C. **OWNER - CONTRACTOR - Subcontractor Relationships**: CONTRACTOR shall be fully responsible to OWNER for all acts and omissions of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for acts and omissions of CONTRACTOR's own agent or employee. Nothing in the Contract Documents shall create any contractual relationship between OWNER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

D. **Responsibility for Subcontractor Licensing**: Proper licensing under state or local Law and Regulations to perform the work of a subcontract shall be the responsibility of the CONTRACTOR and the Subcontractor or Subcontractors involved. OWNER does not assume any responsibility for the terms and conditions of the contract between CONTRACTOR and Subcontractor. OWNER's requirement that CONTRACTOR submit a Subcontractor and Supplier report shall not be construed as an assumption by OWNER of any responsibility for said licensing requirements or terms and conditions of subcontracts.

E. **Contract Documents Do Not Subdivide the Work**: The Divisions and Sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

F. **Subcontractor Agreements**: All work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate written agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER. If requested by OWNER, CONTRACTOR shall provide copies of such agreements to OWNER.

G. **Subcontractor or Supplier Default**: When any part of the Work has been subcontracted and is not being prosecuted in a manner satisfactory to ENGINEER, CONTRACTOR shall cause such failure to be corrected as

required by the Construction Contract. In such a case, no additional compensation will be paid to CONTRACTOR for completing the part of the Work.

H. **Conflict of Interest, Subcontractors**: No agency or company which is or has been under contract to the OWNER to provide design, design reviews, soil testing, material testing, surveying and any other such functions associated with the design phase of the Work shall be used as a Subcontractor by the CONTRACTOR.

6.6 **PATENT FEES AND ROYALTIES**

A. **In General**: CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents.

6.7 **PERMITS**

A. **In General**: Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all permits, licenses and Inspections. The CONTRACTOR shall, without additional cost to the OWNER, give all notices and pay all necessary fees (including Plan check fees) in connection with the performance of the Construction Contract. CONTRACTOR shall furnish a copy of permits and licenses (except permanent easements) to the ENGINEER before CONTRACTOR commencing Work there-under.

B. **Governmental Charges and Inspection Fees**: CONTRACTOR shall pay all governmental charges and Inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or if there are no Bids, on the Effective Date of the Construction Contract.

C. **Utility Connection Fees and Plant Investment Fees**: CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

D. **Temporary Utilities**: CONTRACTOR shall make all arrangements for electricity, sewer, gas and telephone from the appropriate utility companies. All utility lines will be on the surface of the ground, underground or placed on temporary poles and shall conform to the appropriate load requirements. No pole shall be erected without approval of the ENGINEER. Relocation of temporary utilities shall be paid for by the CONTRACTOR at no additional cost to the OWNER.

E. **Uniform Building Code**: CONTRACTOR shall arrange for all necessary Inspections required by the appropriate governmental authority(ies). Before final payment is issued, CONTRACTOR shall deliver to the ENGINEER copies of all certificates of Inspection.

F. **Waterworks Connections**: If CONTRACTOR desires to use OWNER's water, it shall first contact ENGINEER and make arrangements therefore. CONTRACTOR shall pay all necessary charges, and usage costs.

G. **Utah Pollutant Discharge Elimination System (UPDES) Permit**: An UPDES permit shall be secured by CONTRACTOR, at CONTRACTOR's sole expense, if the construction site requires such a permit under Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended. The agency responsible for verifying permit requirement is the State of Utah Department of Environmental Quality, Division of Water Quality.

6.8 **LAWS AND REGULATIONS**

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, OWNER shall not be responsible for monitoring CONTRACTOR's compliance with any Laws and Regulations nor the compliance of any of CONTRACTOR's agents, employees, Subcontractors, or Suppliers.

B. If CONTRACTOR observes that the Specifications or Drawings are at variance with any Laws or Regulations, CONTRACTOR shall give ENGINEER prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in Paragraph 3.3A. If CONTRACTOR performs any work knowing or having reason to know that it is contrary to such Laws or Regulations, and without such notice to ENGINEER, CONTRACTOR shall bear all costs arising therefrom.

6.9 **TAXES**

A. Except for OWNER-supplied material, CONTRACTOR shall pay all sales, consumer, use and other similar taxes which are required to be paid during the performance of the Work in accordance with applicable Laws and Regulations.

6.10 **USE OF PREMISES**

A. **Use of Premises, Damage**: CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, right-of-ways, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any such land or areas contiguous thereto, resulting from the performance of the Work.

B. **Clean Work Site**: During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of each portion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER.

C. **Restoration of Property, Clean Neighborhood, Costs**: CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents. Failure by CONTRACTOR to repair damage or disturbance or to maintain the job site, adjacent areas and haul routes in a clean and neat condition in accordance with Contract Documents will result in OWNER, after reasonable notice to CONTRACTOR, providing the equipment and labor necessary to clean up the said areas and charging the costs thereof to CONTRACTOR. "Cleanliness" requires removal of rocks, dirt, and spillage.

D. **Load Safety**: CONTRACTOR shall not load or permit any part of any structure at the Work site to be loaded in any manner that will endanger the structure. CONTRACTOR shall not subject any part of the Work or adjacent property to stresses or pressures that will endanger either of them.

E. **CONTRACTOR to Indemnify, Save OWNER Harmless**: CONTRACTOR shall assume full responsibility for any damage to:

1. the Project site, land and areas identified in and permitted by the Contract Documents and Laws and Regulations, rights-of way, permits, easements, And

2. other property which may be damaged by CONTRACTOR, Subcontractors or Suppliers during the performance of the Work such as walls, utilities, streets, ways, sidewalks, curbs gutters and property of third parties including other governmental agencies.

Should any claims be made against OWNER by any owner or occupant of any land or area damaged by CONTRACTOR, Subcontractors or Suppliers during performance of the Work, CONTRACTOR shall promptly attempt to resolve the claim. CONTRACTOR shall indemnify and save OWNER harmless from and against all claims, damages, losses and expenses (including, but not limited to fees of engineers, architects, attorneys and other professionals and court costs arising directly, indirectly or consequentially out of an claim brought by any such other party against OWNER arising out of CONTRACTOR's performance of the Work.

6.11 **RECORD DOCUMENTS**

A. CONTRACTOR shall maintain in a safe place at the Work site one record copy of all Contract Documents and written interpretations and clarifications (issued pursuant to article 9.4) in good order and annotated to show all changes made during construction. These Record Documents, together with all acceptable Samples and a counterpart of all reviewed Shop Drawings, shall be available to ENGINEER for reference. Upon completion of the Work, these Record Documents, Samples and Shop Drawings shall be delivered to ENGINEER for OWNER.

B. CONTRACTOR shall maintain thorough records of all transactions and shall give the OWNER and other agencies required by Law or Regulation, access to and the right to examine all records, books, papers, or documents to all operations funded in whole or in part under the Construction Contract for a period of three (3) years following Work Completion.

6.12 **SAFETY AND PROTECTION**

A. **In General**: CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

B. **Protection Against Damage, Injury, Loss**:

1. **CONTRACTOR's Responsibility**: CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

a. all employees on the Work and other persons and organizations who may be affected thereby;

b. all work and materials and equipment to be incorporated therein, whether in storage on or off the site except as otherwise specifically directed by OWNER, e.g. OWNER-supplied materials, builder's risk insurance, etc., And

c. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, Pavements, roadways, curbs, gutters, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

2. **Risk**: Except as provided above, until Substantial Completion or as indicated in other Contract Documents, CONTRACTOR shall have the charge and care of the Work and materials and shall bear the risk of damage, injury or loss to any part thereof by any acts of God or the elements or from any other cause. Except as provided above, OWNER, its officers, employees and agents and the ENGINEER shall not be answerable nor accountable in any manner for any damage or loss that may occur to the Work or any part thereof; for any material or equipment used in performing the Work; for property damage, personal injury, or death; or for damage to adjoining property from any cause whatsoever during the progress of the Work or at any time before Substantial Completion.

C. **Repairs by CONTRACTOR**: All damage, injury or loss to any property referred to in Paragraph 6.12B.1.b or 6.12B.1.c above, caused directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR at no additional cost to the OWNER.

D. **Safety, Warnings**: CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. CONTRACTOR shall erect and maintain, as required by existing conditions and performance of the Work, reasonable safeguards for safety, and protection, including posting danger signs and other warning against hazards, and promulgating and giving notice of safety regulations.

E. **Notification**: CONTRACTOR shall notify owners of adjacent property, Underground Facilities and separate utilities when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property.

F. **Temporary Repairs by OWNER**: When not performed by CONTRACTOR within the time requested by ENGINEER, OWNER may make or cause to be made such temporary repairs as are necessary to restore to service any damaged facility. The cost of such repairs shall be borne by the CONTRACTOR and, if paid by OWNER, may be deducted from any monies due or to become due the CONTRACTOR.

G. **Safety Representative**: CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR's resident superintendent unless designated otherwise in writing by CONTRACTOR.

H. **Hazard Communications Standards (Employee Right to Know)**: During performance of the Work, CONTRACTOR shall be subject to federal regulations outlined in 29 CFR 1910.1200 entitled Hazard Communication Standard. CONTRACTOR shall be solely responsible for any and all violations of the hazard communication standard resulting from the negligent or intentional acts or omission or commission of officers, employees, representatives, agents, servant, Subcontractors, Suppliers, successors and assigns of CONTRACTOR. CONTRACTOR and Subcontractor personnel required under the terms of the Contract Documents to work with or in close proximity to hazardous materials and Hazardous Wastes shall have completed and be current with the personal training required by Occupational Health and Safety Administration (OSHA) regulations as outlined in 29 CFR 1910.1200. CONTRACTOR and Subcontractor personnel required under the terms of the Contract Documents to work with hazardous materials or Hazardous Wastes, or perform services in an area identified as a hazardous material or Hazardous Waste remediation site, shall have completed and be current with the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training program as outlined in 29 CFR 1910.120.

I. **Encountering Hazardous Substances**: In the event the CONTRACTOR encounters on the site substance reasonably believed to be Asbestos or polychlorinated biphenyl (PCB) or any other Hazardous Waste or substance which may endanger the health of those persons performing the Work or being on the site, which has not been rendered harmless, the CONTRACTOR shall immediately stop work in the area affected and immediately report the condition to the ENGINEER and OWNER, and confirm the report immediately in writing. The OWNER shall retain

a special consultant qualified to investigate, evaluate and mitigate any potentially hazardous substances. The work in the affected area shall be resumed in the absence of Asbestos, polychlorinated biphenyl (PCB) or said Hazardous Waste or substance, or when it has been rendered harmless according to the federal and state health standards. Except to the extent provided otherwise in the Contract Documents, the CONTRACTOR shall not be required to perform, without consent, any work relating to Asbestos, polychlorinated biphenyl (PCB) or any other Hazardous Waste substance. In the event of OWNER's delay in investigating, evaluating and mitigating any potentially hazardous substances, if CONTRACTOR believes that any delay entitles CONTRACTOR to an increase in the Contract Price or an extension of the Contract Time, CONTRACTOR may make a claim therefor as provided in Parts 11 and 12 hereof.

J. **Using Hazardous Substances**: When use or storage of explosives or other hazardous substances or construction equipment or unusual methods are necessary for execution of the Work, the CONTRACTOR shall notify OWNER in writing of where and when such will be used and shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

K. **Cost to Protect or Repair in Contract Price**: The full cost of furnishing all labor, materials, tools equipment and incidentals and for doing all the work involved in protecting or repairing property and for insuring against risk of loss or damage shall be deemed included in the Contract Price and no additional compensation shall be allowed therefore.

6.13 **EMERGENCIES**

A. **CONTRACTOR to Act:** In emergencies affecting the safety or protection of persons, the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER, shall prevent threatened damage, injury or loss.

B. **Written Notice:** CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused by responding to such an emergency.

C. **Change Order:** If ENGINEER determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Change Order will be issued to document the consequences of such actions.

6.14 **SHOP DRAWINGS AND SAMPLES**

A. **Not Contract Document**: Shop Drawings, product data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate, for those portions of the Work for which submittals are required, the way the CONTRACTOR proposes to conform to the information given and the design concept expressed by the Contract Documents.

B. **Shop Drawings:** CONTRACTOR shall submit Shop Drawing to ENGINEER for review and acceptance in accordance with the accepted schedule for submissions (see Paragraph 2.7A), or for other appropriate action if so indicated in the Supplementary Conditions.

1. Before submission, CONTRACTOR shall check and verify all field measurements and comply with applicable procedures specified in the General Requirements.

2. All submissions will be identified as ENGINEER may require, and will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to CONTRACTOR's review of the submission, including those of CONTRACTOR's Subcontractors.

3. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to review the information as required.

C. **Samples**: CONTRACTOR shall also submit to ENGINEER for review with such promptness as to cause no delay in work, all Samples required by the Contract Documents.

1. all samples, whether supplied by CONTRACTOR, or CONTRACTOR's Subcontractors, or CONTRACTOR's Suppliers shall be checked by the CONTRACTOR. Such samples shall be accompanied by a specific written annotation indicating that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to CONTRACTOR's review of the sample.

2. all submissions will be identified clearly as to material and Supplier.

3. pertinent data such as catalog numbers and the use for which intended shall be indicated.

D. **Verifications**: Before submission of each Shop Drawing or sample, CONTRACTOR shall have determined and verified the following.

1. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto;
2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, And
3. all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

E. **Notice of Variance:** At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents. In addition, CONTRACTOR shall cause a specific notation to be made on each Shop Drawing submitted to ENGINEER for review and approval of each such variation. CONTRACTOR shall direct specific attention in writing to CONTRACTOR's or other's revisions other than the corrections called for by ENGINEER on previous submittals.

F. **Review by ENGINEER:** ENGINEER will review with reasonable promptness Shop Drawings and samples. ENGINEER's review will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents. ENGINEER's review shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review.

G. **Accuracy of Dimensions, Errors and Omissions:** ENGINEER's review of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for accuracy of dimensions and details or any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission, as required by Paragraph 6.14E, and ENGINEER has reviewed each such variation and given specific written notation thereof incorporated in or accompanying the Shop Drawing or sample submittal. Such review by ENGINEER will not relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the provisions of Paragraph 6.14D above.

H. **Distribution of Drawings:** The CONTRACTOR shall furnish prints of final Shop Drawings, erection drawings, equipment layouts, and other data to CONTRACTOR's Subcontractors and Suppliers for the proper coordination of their work. CONTRACTOR shall keep 1 complete set of the approved documents with the Record Documents on the premises at all times.

I. **Compensation:** Full compensation for furnishing all Shop Drawings and samples shall be considered as included in the prices paid for the items of work to which such drawings relate and no additional compensation will be allowed therefor.

J. **Work Performed Before ENGINEER's Review:** Where a Shop Drawing or sample is required by the Specifications, any related work performed by CONTRACTOR, before ENGINEER's review of the pertinent submission will be at CONTRACTOR's sole risk of non-acceptance. Correction of non-acceptable work shall be at CONTRACTOR's expense.

K. **Rejection**: No extra contract time shall be given for rejection of Shop Drawings or samples.

L. **Certificate of Compliance**: The ENGINEER may permit the use of certain materials or assembly before sampling and testing if accompanied with a certificate of compliance stating that materials involved comply in all respects with the requirements of the Contract Documents. The certificate shall be signed by the manufacturer of the materials or the manufacturer of the assembled material. The certificate of compliance must be furnished with each line of material delivered to the Work and the line so certified must be clearly identified in the certificate. All materials used on the basis of a certificate of compliance may be contested by ENGINEER at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve CONTRACTOR from the responsibility of incorporating material in the Work that conforms to requirements of the Contract Documents and any material not conforming, whether or not in place, shall be removed and replaced at the CONTRACTOR's expense. OWNER reserves the right to refuse to permit the use of material on the basis of a certificate of compliance. The form of a certificate of compliance and its disposition shall be as ordered by the ENGINEER.

6.15 CONTINUING THE WORK

A. **During Disputes or Disagreements**: CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending

resolution of any disputes or disagreements, except as permitted by article 15.3 or as CONTRACTOR and OWNER may otherwise agree in writing.

B. **No Damage for Delay**: CONTRACTOR shall not be entitled to any claim against OWNER due to hindrance or delays from any cause whatsoever except if caused solely by OWNER. CONTRACTOR's sole and exclusive remedy for any delay shall be limited to a claim for an extension of the Contract Time as provided in Part 12.

6.16 **CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE**

A. **Defects or Damage Exclusion**: CONTRACTOR warrants and guarantees to OWNER that all work will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or
2. normal wear and tear under normal usage.

B. **CONTRACTOR's Continuing Obligation**: CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform work in accordance with the Contract Documents:

1. observations by ENGINEER;
2. recommendation of any progress or final payment by ENGINEER;
3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;
4. use or occupancy of the Work or any part thereof by OWNER;
5. any acceptance by OWNER or any failure to do so;
6. any review and approval of a Shop Drawing, sample or product data submittal or the issuance of a notice of acceptability by ENGINEER;
7. any Inspection, test or approval by others; or
8. any correction of Defective Work by OWNER.

C. **Acceptance is Not a Waiver of OWNER's Rights**: OWNER's acceptance of Defective Work shall not release or relieve CONTRACTOR from warranty and guarantee provisions of this article.

D. **Survival of Obligations**: All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

6.17 **INDEMNIFICATION**

A. **Indemnification of OWNER**: CONTRACTOR shall indemnify defend and hold harmless OWNER and ENGINEER, and their agents, officals and employees from and against any and all claims, damages, losses and expenses, direct, indirect or consequential (including, but not limited to fees and charges of engineers, architects, attorneys and other professionals and court costs) arising out of or resulting from the negligent acts or omissions in performance of the Work by CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not the claim, damage, loss, etc. arising from the act or omission is caused in part by a party indemnified hereunder or arises by or is imposed by Law and Regulations regardless of the negligence of any such party.

B. **Indemnification Not Limited**: In any claims against OWNER or ENGINEER or any of their agents, officials or employees by any employees of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.17A shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor or other person or organization under worker' compensations acts, disability benefit acts or other employee benefit acts.

C. **Liability of ENGINEER, etc.**: The obligations of CONTRACTOR under Paragraph 6.17A shall not extend to the liability of ENGINEER, OWNER's consultants, agents or employees arising out of the preparation or approval of maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

D. **CONTRACTOR to Hold OWNER Harmless**: CONTRACTOR shall assume the OWNER's defense, and hold OWNER harmless from any claims directly or indirectly arising from CONTRACTOR's use or alleged use of patented or trademarked materials, design, equipment, devices, product or processes on or incorporated in the Work, whether or not such claims are ultimately successful. In the event of such claims:

1. OWNER shall promptly notify CONTRACTOR and CONTRACTOR shall defend against such claims, in OWNER's name, but at CONTRACTOR's expense;

2. OWNER shall have the right to be represented by counsel, but such representations shall be at the OWNER's own expense, and

3. at the request and expense of CONTRACTOR, the OWNER shall actively cooperate and assist CONTRACTOR to the fullest reasonable extent in the defense of any such proceedings.

4. In the event that CONTRACTOR shall fail to defend against any such claims, the OWNER may, in addition to any other legal remedies which the OWNER might have, defend such suit and be reimbursed by CONTRACTOR for all reasonable expenses (including attorney's fees and costs) incurred by the OWNER in this connection, and CONTRACTOR shall pay all damages and costs awarded or otherwise suffered by OWNER in any such claim against OWNER.

6.18 HAZARDOUS WASTE GENERATION

A. **In General**: The CONTRACTOR shall be responsible for ensuring that all services the CONTRACTOR and its Subcontractors are required to provide under the terms of the Contract Documents are performed in accordance with applicable federal, state, and local environmental regulations and within generally accepted professional performance standards for the services to be provided.

B. **Hazardous Wastes Generated by CONTRACTOR**: The CONTRACTOR shall be responsible for the interim handling, evaluation, and disposal of any hazardous materials and Hazardous Wastes generated by the CONTRACTOR or any of its Subcontractors during the performance of any services under the terms of the Contract Documents, and shall ensure that handling, evaluation, and final disposal of all hazardous materials and Hazardous Wastes are performed in accordance with the requirements outlined in 40 CFR Parts 261 and 262 and Utah Administrative Code R-450-5.

1. The CONTRACTOR shall notify the ENGINEER immediately upon discovery that the CONTRACTOR or its Subcontractors has generated a Hazardous Waste material. If the Hazardous Waste material was generated as the result of a hazardous material spill, the CONTRACTOR shall be responsible for completing spill reporting requirements for all applicable environmental regulatory programs.

2. The CONTRACTOR shall also provide the ENGINEER with documentation within eight (8) hours of the discovery indicating:

   a. the date of waste generation;

   b. specific waste classification or characterization;

   c. waste quantity;

   d. waste profile and acceptance identifying the intended disposal facility, And

   e. copies of all "Uniform Hazardous Waste Manifest" documenting off-site transportation and disposal activities.

3. CONTRACTOR shall contain hazardous material and protect workers and the public from exposure.

C. **Hazardous Wastes Generated by OWNER**: The CONTRACTOR shall ensure that any services the CONTRACTOR or its Subcontractors perform under the terms of the Contract Documents that involve the interim handling, evaluation, and disposal of any hazardous materials and Hazardous Waste generated by, or the responsibility of the OWNER, shall be performed in accordance with the requirements outlined in 40 CFR Parts 261 and 262 and Utah Administrative Code R-450-5.

1. The CONTRACTOR shall also provide the ENGINEER with documentation indicating:

   a. the date of waste generation;

   b. specific waste classification or characterization;

   c. waste quantity;

d. waste profile and acceptance identifying the intended disposal facility,

e. copies of all Uniform Hazardous Waste Manifest documenting off-site transportation and disposal activities.

2. If handling of Hazardous Wastes generated by OWNER is not indicated in the Contract Documents, such cost of handling shall be determined as indicated in article 11.3.

D. **Final Disposal of Hazardous Materials and Hazardous Wastes**: CONTRACTOR shall be responsible for ensuring that all hazardous materials and Hazardous Wastes, identified as subject to the provisions of Paragraphs 6.18A, B and C above, regardless of generator, be submitted to a facility or facilities permitted and qualified to recycle, process, or perform final disposal as required for the type of hazardous material or Hazardous Waste being submitted.

E. **Documentation**: CONTRACTOR shall provide OWNER with documentation of appropriate disposal.

PART 7 OTHER WORK

7.1 RELATED WORK AT SITE

A. **Owners of Utilities and Franchises to Enter Upon the Premises**: The right is reserved to the owners of utilities and franchises to enter upon the premises for the purposes of making repairs or changes of their property that may become necessary by the Work.

B. **Separate Work**: OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to CONTRACTOR before starting any such other work. If CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the extent thereof, CONTRACTOR may make a claim therefor as provided in Parts 11 and 12.

C. **Access to Site**: CONTRACTOR shall coordinate all phases of the Work and afford each utility owner and other contractor who is a party to such a contract (or OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs.

D. **Cutting, Fitting and Patching**: CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected.

E. **Delays Caused by Other Work, Defects or Deficiencies in Other Work**: If the proper execution or results of any part of CONTRACTOR' work depends upon work performed by others under this Part 7, CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's work except for latent or non-apparent defects and deficiencies in the other work.

7.2 COORDINATION

A. **Coordinating Agent, Identified in Supplementary Conditions**: If OWNER contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the Supplementary Conditions. The specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided in the Supplementary Conditions. If not otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

B. **Ceasing Work Temporarily**: If other contractors under separate OWNER contracts are unable to join their work in a manner acceptable to all, ENGINEER will decide if CONTRACTOR or other contractors shall cease work temporarily. Should CONTRACTOR be adversely affected by the work of other contractors, additional compensation or Project completion time will be granted provided the delays or interference are not the results of the

CONTRACTOR's own actions or inactions. The OWNER also reserves the right to deduct from sums of money due the CONTRACTOR for all costs incurred by the OWNER which are the result of the CONTRACTOR not properly coordinating work.

7.3 **UTILITY REARRANGEMENTS**

A. Should CONTRACTOR desire a rearrangement made in any utility facility for CONTRACTOR's convenience in order to facilitate construction operations, which is in addition to or different from the arrangements indicated on the Drawings or in the Specifications, CONTRACTOR shall make such arrangements as are necessary with the utility and bear all expenses in connection therewith.

7.4 **WORK DONE BEYOND THE SITE**

A. Any work done beyond the limits shown on the Drawings or established in writing by ENGINEER, will be considered as unauthorized and no payment will be made therefor.

PART 8 OWNER'S RESPONSIBILITIES

8.1 **OWNER'S RESPONSIBILITIES**

A. **Communications**: OWNER shall issue all communications to CONTRACTOR through ENGINEER as per article 2.8.

B. **Tests and Observations**: OWNER's responsibility in respect of certain Inspections, tests and observations is set forth in article 13.3.

C. **Work Suspension**: In connection with OWNER's right to stop work or suspend work, see article 15.1. article 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

D. **Furnishing Data**: OWNER shall promptly furnish the data required of OWNER under the Contract Documents.

E. **Prompt Payment**: OWNER shall promptly make payments to CONTRACTOR after they are due as provided in Paragraphs 14.4 and 14.9.

PART 9 ENGINEER'S STATUS DURING CONSTRUCTION

9.1 **OWNER'S REPRESENTATIVE**

A. **General**: ENGINEER will be OWNER's representative and agent during the Contract Time, until final payment is due and, with the OWNER's concurrence, from time to time during the correction period described in article 13.7.

B. **Limitations**: ENGINEER shall have the authority to act on behalf of the OWNER only to the extent provided in the Contract Documents.

C. **Changing Representative**: ENGINEER may be changed by the OWNER upon written notice to the CONTRACTOR.

9.2 **PROJECT REPRESENTATIVE**

A. ENGINEER may furnish a Resident Project Representative and such other assistants as ENGINEER deems necessary to observe that the materials to be furnished and the work done strictly conforms to the Contract Documents.

9.3 **AUTHORITY AND DUTIES OF RESIDENT PROJECT REPRESENTATIVE**

A. **General**: The Resident Project Representative:

1. shall be permitted to observe all work done and all material furnished. Such observation may extend to all or any part of the Work and to the preparation, fabrication, or manufacture of the materials to be used;

2. is not authorized to revoke, alter, or waive any requirement of the Contract Documents;

3. is authorized to call the attention of CONTRACTOR to any Failure of the Work or materials to conform to the Contract Documents;

4. shall have authority to reject materials and suspend all or any part of the Work until any question at issue can be referred to and decided by the ENGINEER, And

5. shall in no case act or be considered as CONTRACTOR's foreman or perform duties for CONTRACTOR.

B. **Limitations**: Any advice that the Resident Project Representative may give the CONTRACTOR, other than set forth in Paragraph 9.3A above, shall not be binding upon the ENGINEER or OWNER. Nor shall such advice release or relieve CONTRACTOR of compliance with the Contract Documents.

C. **Suspension of Work**: If Work is to be suspended; the Resident Project Representative shall issue a written order giving the reason for shutting down the Work. In the absence of such written order, CONTRACTOR shall not deem the Work to be suspended. After placing the order in the hands of the CONTRACTOR's agent in charge at the site, any work done thereafter may not be accepted, at ENGINEER's discretion.

9.4 CLARIFICATIONS AND INTERPRETATIONS

A. Should it appear that the Work or any of the matters relative thereto are not sufficiently detailed or explained in the Contract Documents, the CONTRACTOR shall request the ENGINEER to provide such further explanations as may be necessary for CONTRACTOR. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of drawings or otherwise) as ENGINEER may determine necessary. These shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. CONTRACTOR shall conform to such explanations as part of the Work.

B. Any order or instruction given to the CONTRACTOR by the ENGINEER shall either be given or confirmed in writing. However, the ENGINEER's failure to put such an order or instruction in writing shall not relieve the CONTRACTOR of CONTRACTOR's responsibility to comply with the terms and conditions of the Contract Documents.

C. If CONTRACTOR disputes ENGINEER's explanation or interpretation of the requirements of the Contract Documents, CONTRACTOR may request dispute resolution as specified in Part 16.

9.5 AUTHORIZED VARIATIONS IN WORK

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Work Directive Change. If CONTRACTOR believes that an increase in the Contract Price or an extension of the Contract Time is justified, and the OWNER and the CONTRACTOR are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Part 11 or 12.

9.6 REJECTING DEFECTIVE WORK

A. ENGINEER has the authority to reject work which ENGINEER believes to be defective or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER also has the authority to require special Inspection or testing of the work, whether or not the work is fabricated, installed or completed. The failure of the ENGINEER to reject such work shall not release or relieve CONTRACTOR from conformance to the Contract Document requirements.

9.7 NOTICE OF INTENTION TO APPEAL

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR and will review with CONTRACTOR any preliminary determinations on such matters before rendering a written decision. ENGINEER's written decisions will be final and binding upon CONTRACTOR, unless, within 10 Days after the receipt of any such decision CONTRACTOR delivers to ENGINEER written notice of intention to appeal such a decision. Such an appeal may be taken in accordance with the provisions of Part 16 of these General Conditions and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the work and adhere to the progress schedule as provided in article 6.15.

9.8 DECISIONS ON DISPUTES

A. **Interpretation of Contract Documents**: ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims or disputes concerning a question of fact or other matters relating to the acceptability of the Work, the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work or claims under Part 11 and 12 in respect of changes in the Contract Price or Contract Time will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. ENGINEER will render decision in writing within three (3) Days

of submission of the request for decision. Failure by ENGINEER to respond within said time shall be deemed a denial of CONTRACTOR's request for relief.

B. **Time for Notice of Dispute**: CONTRACTOR shall submit written notice of each claim or dispute to ENGINEER promptly after occurrence of the event(s) giving rise thereto, but in no case shall said notice be delivered later than 30 Days after said occurrence. Failure to submit said notice within said 30 Days shall be deemed a waiver thereof by CONTRACTOR. CONTRACTOR shall also submit all written supporting data to ENGINEER within 60 Days after said occurrence unless ENGINEER allows an additional period of time.

C. **Effect of ENGINEER's Decision**: ENGINEER's decision concerning such claim or dispute (except any which have been waived by the making or acceptance of final payment as provided in Paragraph 14.9) will be the final expression of OWNER's position on said claim or dispute. Further, said decision shall be a condition precedent to any exercise by OWNER or CONTRACTOR of any rights or remedies as either may have under the Contract Documents or by law in respect of any such claim or dispute. ENGINEER's decision as to any allowable deviations shall be final and binding on CONTRACTOR.

9.9 LIMITATIONS ON ENGINEER'S RESPONSIBILITIES

A. **ENGINEER Not** CONTRACTOR**'s Agent**: Neither ENGINEER, ENGINEER's representative or OWNER shall act nor be considered as the CONTRACTOR's, Subcontractor's, Supplier's or surety's superintendent, foreman or part of their work force in any manner or form nor shall they perform work or duties of the CONTRACTOR.

B. **Evaluate the Work for Contract Compliance**: Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective does not assign to ENGINEER or OWNER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraphs 9.9C or 9.9D. Neither ENGINEER's taking or failing to take such actions or make any such reviews shall release or relieve the CONTRACTOR from CONTRACTOR's responsibility to comply with the Contract Document requirements.

C. **Not Responsible for CONTRACTOR's Construction Operations**: Neither the ENGINEER nor the OWNER will be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto. ENGINEER and OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents. Any advice which ENGINEER may give the CONTRACTOR, other than as set forth in Paragraph 9.3A above, shall not be binding in any way upon the ENGINEER or the OWNER. Such instruction or statement shall not release or relieve the CONTRACTOR from compliance with all of the terms and conditions of the Contract Documents.

D. **Not Responsible for CONTRACTOR's Acts or Omissions**: ENGINEER and OWNER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

E. **Intimidation of ENGINEER**: ENGINEER or ENGINEER's representatives shall at all times be free to perform ENGINEER's duties without any intimidation. At ENGINEER's request, the CONTRACTOR shall remove from the Work site any employee causing such intimidation. Failure to do so shall be sufficient reason for ENGINEER to recommend to OWNER and for the OWNER's cancellation or termination of the Construction Contract.

PART 10 CHANGES IN THE WORK

10.1 ADDITIONS, DELETIONS, REVISIONS

A. **Modifications**: Without invalidating the Construction Contract and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. These will be authorized by a Work Directive Change or a Change Order.

B. **Work Directive Change**: Work Directive Changes shall be issued by the ENGINEER. If the Contract Price or Contract Time are affected by a Work Directive Change, the Work specified in the Work Directive Change shall be incorporated in a subsequently issued Change Order following negotiations by the CONTRACTOR and ENGINEER

as to its effect on the Contract Price and Contract Time. During disputes or disagreements with the OWNER or ENGINEER regarding a Work Directive Change, the CONTRACTOR shall promptly proceed with the Work described in the Work Directive Change as indicated in article 6.15.

C. **Change Order**: OWNER, and CONTRACTOR shall execute appropriate Change Orders covering changes in the Work, Contract Price or Contract Time which are agreed to by the parties.

D. **Drawings**: Drawings accompanying Work Directive Changes and Change Orders shall be deemed a part of such documents.

E. **Payment**: It is understood and agreed by the OWNER and CONTRACTOR that no money will be paid to the CONTRACTOR for any new or additional labor, materials or equipment furnished, unless a Change Order for such has been made in writing and executed by the OWNER and CONTRACTOR.

10.2 **WORK NOT REQUIRED BY CONTRACT DOCUMENTS**

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in article 3.3 except in the case of an emergency as provided in article 6.13 and except in the case of uncovering work as provided in paragraph 13.5B.

10.3 **NOTICE TO SURETY**

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

PART 11 CHANGE OF CONTRACT PRICE

11.1 **CONTRACT PRICE**

A. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2 **CONTRACT PRICE ADJUSTMENT**

A. **In General**: The Contract Price may only be changed by Change Order. No claim for an adjustment on the Contract Price will be considered or paid if not submitted in accordance with the requirements of this article 11.2.

B. **Written Notice**: Any claim for an increase or decrease in the Contract Price shall be based on written notice. Notice shall be promptly delivered by the party making the claim to the other party (but in no event later than 30 Days) after the occurrence of the event giving rise to the claim. The notice shall state the general nature of the claim.

C. **Deadline for Claim Submittal**: A complete detailed statement of the amount and nature of the claim, with all necessary supporting data shall be delivered within 60 Days after such occurrence. ENGINEER may allow an additional period of time to ascertain more accurate data in support of the claim.

D. **Notice Required**: Failure to submit the notice, and detailed statement referenced above shall bar Claimant from pursuing said claim in any other forum, judicial or administrative.

E. **Acknowledgement**: The notice shall be accompanied by Claimant's written statement that the amount claimed covers all known cost amounts (direct, indirect and consequential costs, including without limitation, delay costs, third party costs, lost profits and any other costs) to which the Claimant is entitled as a result of the occurrence of said event.

F. **All Claims Determined by ENGINEER**: All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with Paragraph 9.8A if OWNER and CONTRACTOR cannot otherwise agree.

11.3 **DETERMINING CONTRACT PRICE ADJUSTMENT**

A. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined by ENGINEER in one of the following ways:

1. **Unit Prices**: Where the Work involved is covered by unit prices contained in the Contract Documents, the Contract Price change will be recalculated by application of unit prices to the quantities of the items involved (subject to the provisions of article 11.7).

2. **Lump Sum Price**:

a. **Contract Price Increases**: The CONTRACTOR and OWNER may mutually accept a stipulated sum (which may include an allowance for overhead and profit not necessarily in accordance with article 11.5).

b. **Contract Price Decreases**: The amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in the Contract Price will be the net amount of the decrease plus a deduction in CONTRACTOR's fee. The deduction in the CONTRACTOR's fee shall be 10 percent of the net amount of the decrease.

3. **Force Account (Cost of the Work plus CONTRACTOR's Fee)**: If the cost of Unit Price Work cannot be calculated or the cost of Lump Sum Work cannot be agreed to, Contract Price adjustment shall be calculated on the basis of the Cost of the Work (determined as provided in article 11.4) plus a CONTRACTOR's Fee for overhead and profit (determined as provided in article 11.5).

11.4 **COST OF THE WORK**

A. **Cost of the Work Includes**: Except as otherwise agreed to in writing with OWNER, the Cost of the Work (1) shall be in amounts no higher than those prevailing in the locality of the Project, (2) shall not include any of the costs itemized in Paragraph 11.4B, and (3) shall include only the following items:

1. **Certified payroll costs**: Certified payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. These expenses of performing work after Regular Working hours, on Saturday, Sunday or legal holidays, shall be included in the above only to the extent such work was authorized by OWNER.

2. **Cost of all materials and equipment**: Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. **Payments made by CONTRACTOR to Subcontractors**: If required by ENGINEER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to ENGINEER who will then determine, which bids will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

4. **Costs of Special Consultants**: Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors and accountants) employed for services specifically related to the Work.

5. **Supplemental Costs**: Supplemental costs include the following:

a. **Expenses of Employees**: The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees reasonably incurred in discharge of duties connected with the Work, except the following:

1) costs for commute between residence and the work site;

2) meals taken at locations within commuting distance of the work site, and

3) clothing.

b. **Consumable Products and Equipment**: Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by

the workers, which are consumed in the performance of the Work, and cost, less the difference in market value, of items used but not consumed which remain the property of CONTRACTOR.

c. **Depreciation**: Cost, less the difference in market value, of items used but not consumed which remain the property of CONTRACTOR.

d. **Rentals**: Rentals of all construction equipment and machinery and the parts thereof, whether rented from CONTRACTOR or others, in accordance with rental agreements approved by ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof all in accordance with terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

e. **Sales, Consumer, Use or Similar Taxes**: Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

f. **Royalty Payments, Fees for Permits and Licenses, Deposits**: Royalty payments, fees for permits and licenses, and deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable.

g. **The Cost of Utilities**: The cost of utilities, fuel and sanitary facilities at the site in connection with the Work.

h. **Minor Expenses**: Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, express delivery and similar petty cash items in connection with the Work.

i. **Additional Bonds and Insurance**: Cost of premiums for additional Bonds and insurance required solely because of changes in the Work and premiums for property insurance coverage.

B. **Cost of Work Does Not Include:** The term Cost of the Work shall not include overhead or general expense costs including, but not limited to, the following:

1. **Payroll Costs and Other Compensation**: Payroll costs and other compensation of CONTRACTOR's officers, employees and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.4A.1 or specifically covered by Paragraph 11.4A.4.

2. **Principal and Branch Offices**: Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

3. **Capital Expenses**: Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. **General Bonds and General Insurance**: Cost of premiums for Bonds and insurance not directly related to the Work, whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by Paragraph 11.4A.5.i above).

5. **Negligence**: Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of Defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property or payments for personal injury or death.

6. **Other Expenses**: Other overhead or general expense cost of any kind and the costs of any item not specifically and expressly included in Paragraph 11.4A.

7. **Dispute Costs**: Cost of court fees, attorneys or experts retained for presenting evidence pertaining to any dispute with OWNER and ENGINEER concerning CONTRACTOR's cost of work.

C. **Documentation Supporting Cost of the Work**: Whenever the cost of any work is to be determined, CONTRACTOR will submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

1. Reports by Subcontractors or others shall be submitted through the CONTRACTOR. In the event of irreconcilable disagreement, pertinent notes shall be entered on the daily reports by each party to explain points which cannot be resolved immediately.

2. For work covered by force account at the close of each working Day, the CONTRACTOR shall submit such daily report to the ENGINEER together with applicable delivery tickets listing all labor, materials and equipment involving the force account work for that Day. Failure to submit the daily report by the close of the next working Day will waive any rights for that Day. The report shall be signed by CONTRACTOR and ENGINEER.

11.5 **CONTRACTOR'S FEE**

A. **Allowable Fee**: The CONTRACTOR's fee allowed for overhead and profit shall be determined as follows:

1. A mutually acceptable fixed fee; or,

2. If no acceptable fixed fee can be agreed upon, a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 11.4A.1 and 11.4A.2, the CONTRACTOR's fee shall be 15 percent;

b. For costs incurred under Paragraph 11.4A.3, the CONTRACTOR's Fee shall be five (5) percent.

c. If a subcontract is on the basis of Cost of the Work Plus a Fee, and no fixed fee is agreed upon, the maximum allowable to the Subcontractor who actually performs or furnishes work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.4A.1 and 11.4A.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five (5) percent of the amount paid to the next lower tier Subcontractor.

d. No fee shall be payable on the basis of costs itemized under Paragraphs 11.4A.4, 11.4A.5 and 11.4B.

B. **Adjustment to CONTRACTOR's Fee**: When both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.5A.2.a through 11.5A.2.c, inclusive.

C. **Allowable Credit**: The amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual decrease plus a deduction in CONTRACTOR's fee by an amount equal to the equivalent amount authorized under Paragraph 11.5A above.

11.6 **CASH ALLOWANCES**

A. **In General**: Cash allowances, if indicated in the Contract Documents, are provided for the payment of fees or the purchase and installation of products, the cost of which is to be determined upon performance of the Work. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents. CONTRACTOR shall cause the Work so covered to be done for such sums within the limit of the allowances as may be acceptable to ENGINEER.

B. **Allowances Include**: CONTRACTOR agrees:

1. that the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes, And

2. CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances. No demand for additional payment on account of any thereof will be valid.

C. **Allowances Payment**: Before final payment, an appropriate Change Order shall be issued to reflect actual amounts due the CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.7 **UNIT PRICE WORK**

A. **Contract Price**:

1. **Initial Contract Price**: Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, the Contract Price shall initially include, for all Unit Price Work, an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed. They are solely for the purpose of comparing Bids and determining an initial Contract Price.

2. **Actual Contract Price**: The actual Contract Price shall be established when CONTRACTOR accepts final payment from OWNER. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with article 9.7.

B. **Overhead and Profit**: Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item and no additional payment for overhead or profit will be claimed or paid.

C. **Quantity of Unit Price Work**: An increase in the quantity of any Unit Price Work which does not involve any basic change in the nature or conditions of the work will be paid for at the unit prices. Where Work alterations increase, diminish or eliminate any of the Unit Price Work, CONTRACTOR shall be paid for the work actually done

and materials supplied at the Unit Prices. Unit Prices that have not been set as stated in Paragraph 11.7B above shall be adjusted to comply with said paragraph before payment for such changes is made.

D. **Adjusting Contract Price**: If a claim is made to the ENGINEER, which states the quantity of an item of Unit Price Work performed by the CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement, and if CONTRACTOR or OWNER believes that an increase or a decrease of expenses as a result thereof has occurred, CONTRACTOR or OWNER may claim for an increase or decrease in the Contract Price if:

1. there is an enlargement or reduction of the Work under the original Contract Documents by more than 25 percent; or
2. there is an increase or decrease of more than 25 percent of the initial Contract Price; or
3. there is an increase or decrease of more than 25 percent in the quantity of a Major Unit Price Item of Work.

Notwithstanding the foregoing, the OWNER and the CONTRACTOR shall be entitled to claim a cost increase or decrease only for that portion of the Cost of the Work which exceeds 25 percent.

E. **Adding Unit Price Work to the Contract Documents**: If new, additional, or unforeseen work or material is required which, due to the nature or conditions or the Work, or locations, does not conform to the quantities and classifications of Unit Price Work provided for in the Contract Documents, then such work or material will be considered as additional work. The work shall be executed by the CONTRACTOR, in the manner and under the quantities and classifications of Unit Price Work set forth in a Change Order which will be entered into between the OWNER and the CONTRACTOR.

11.8 FORCE ACCOUNT WORK (COST OF THE WORK PLUS CONTRACTOR'S FEE)

A. **In General**: When Contract Price adjustments cannot be agreed upon in advance of additional work requested by ENGINEER, OWNER may require CONTRACTOR to do such work on a force account basis.

B. **Determining Contract Price Adjustment**: The value of the force account work shall be determined in accordance with Paragraph 11.3A.3.

C. **OWNER Furnished Materials**: OWNER reserves the right to furnish part or all materials or equipment and CONTRACTOR shall have no claim for profit on the cost of such material or equipment so furnished.

PART 12 CHANGE OF CONTRACT TIME

12.1 CONTRACT TIME ADJUSTMENT

A. **In General**: The Contract Time or Milestones may only be changed by a Change Order. No claim for an adjustment in the Contract Time or Milestones will be valid if not submitted in accordance with requirements of this article 12.1.

B. **Preliminary Written Notice**: Except for delays due to weather, any claim for an extension or shortening of the Contract Time shall be based on a preliminary written notice delivered by the party making the claim to the other party promptly (but in no event later than 15 Days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim.

C. **Deadline for Submitting Claim Data Notice**: Final notice of the extent of the claim with supporting data shall be delivered within 60 Days after such occurrence. ENGINEER may allow an additional period of time to ascertain more accurate data in support of the claim.

D. **Acknowledgement**: The final notice shall be accompanied by CONTRACTOR's written statement that the amount claimed is the entire adjustment to which the CONTRACTOR has reason to believe the CONTRACTOR is entitled as a result of the occurrence of said event.

E. **No Time for Lack of Submittal**: No time extensions will be allowed in the progress of the Work attributable to CONTRACTOR's failure to make submittals required by article 2.5.

F. **All Claims Determined by ENGINEER**: All claims for adjustment in the Contract Time shall be determined by ENGINEER in accordance with Paragraph 9.8A if OWNER and CONTRACTOR cannot otherwise agree.

12.2 **DELAY NOT CAUSED BY CONTRACTOR**

A. Delays caused by war, public enemy or acts of God shall be considered just cause for OWNER to grant time extensions.

B. CONTRACTOR shall be granted time extensions for which liquidated damages will not be claimed when the delay is determined to be caused by the OWNER, or other contractors or utility companies working at OWNER's request, except when such delays are the result of CONTRACTOR's own lack of project coordination or work effort.

12.3 **DELAYS RELATED TO WEATHER**

A. Delay related to weather shall only be reviewed or considered by ENGINEER after 90 percent or more of the Contract Time has been expended.

B. In requesting weather time CONTRACTOR shall:

1. Submit all weather data to ENGINEER, and
2. Provide a written explanation of how weather prevented work on an item on the progress schedule's critical path.

C. The OWNER shall grant additional time for weather delays if OWNER finds:

1. Both the amount and length of inclement weather were excessive or unexpectedly severe for the time and season the work was scheduled to be performed;
2. The inclement weather prevented work pursuant to a scheduled critical path item of work. If the CONTRACTOR's progress schedule during the inclement weather does not show the anticipated critical path, ENGINEER will judge which activities were critical, And
3. Appropriate measures were taken by the CONTRACTOR to mitigate the effects of inclement weather.

D. No time will be granted if the work claimed to have been delayed would not have been on the critical path except for earlier delays caused by CONTRACTOR.

E. No time extensions will be granted for weather delay outside of the Contract Time period or the Punch List Time period.

PART 13 TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.1 **NOTICE OF DEFECTS**

A. Prompt notice of all Defective Work of which OWNER or ENGINEER have actual knowledge will be given to CONTRACTOR. All Defective Work, whether or not in place, may be rejected, corrected or accepted as provided in this Part 13.

13.2 **ACCESS TO WORK**

A. ENGINEER and ENGINEER's representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

13.3 **TESTS AND INSPECTIONS**

A. **In General**:

1. **Determining Contract Compliance and Acceptance**: Testing, or work for determining contract compliance shall be performed by CONTRACTOR. OWNER anticipates performing tests and Inspections or having tests and Inspections performed as part of its acceptance procedure.
2. **CONTRACTOR Furnish Labor**: CONTRACTOR shall furnish, at no additional cost to the OWNER, such labor as may be required to enable a thorough Inspection and culling of all materials.
3. **CONTRACTOR Furnish Samples**: Upon ENGINEER's request, CONTRACTOR shall furnish to ENGINEER such samples of materials as proposed to be used, in sufficient amounts as required to make proper tests.
4. **Notice, 24 hours**: CONTRACTOR shall give ENGINEER at least 24 hours notice of readiness of the work for all required observations, tests and Inspections.

B. **Inspections, Tests and Retests**:

1. If ENGINEER determines that material or equipment fails the contract requirements, ENGINEER may reject such material or equipment, or accept such as Defective Work in accordance with article 13.8.

2. Inspection and testing of materials and equipment made by ENGINEER shall not release or relieve CONTRACTOR from compliance with the Contract Documents.

3. Any re-Inspection and retesting of work or materials rejected by ENGINEER after the initial testing or Inspection shall be at CONTRACTOR's expense until a retest meets the requirements of the Contract Documents.

C. **Costs of Inspections Assessable to**:

1. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefore, pay all costs in connection therewith and furnish ENGINEER the required certificates of Inspection, testing or approval.

2. CONTRACTOR shall be responsible for and shall pay all costs in connection with any Inspection or testing required in connection with OWNER's or ENGINEER's acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval before CONTRACTOR's purchase thereof for incorporation in the Work. Adequate facilities shall be furnished free of charge to make the necessary Inspection. ENGINEER assumes no obligation to observe materials at the source of supply nor does such Inspection assure conformance to the Contract Documents.

3. The cost of all Inspections, tests and approvals in addition to the above which are required by the Contract Documents shall be paid by OWNER (unless otherwise specified in the Supplementary Conditions).

13.4 **DEFECTIVE WORK**

A. Any work or materials not in accordance with the Contract Documents that may be discovered before Work Completion shall be corrected at no additional cost to the OWNER. Failure on the part of ENGINEER to discover, condemn or reject materials or work shall not be construed to imply acceptance of the same should their noncompliance become evident before or after Work Completion. It is expressly understood that nothing in this paragraph waives any of the OWNER's rights under the guarantee provision of this Part 13.

B. Work may be judged defective by ENGINEER regardless of cause, except when such defect or Failures are the result of ENGINEER's design deficiencies, acts of God, misuse by OWNER, or due to vandalism.

C. CONTRACTOR shall immediately remove all rejected materials and equipment from the premises and to such a point distant therefrom as ENGINEER may require.

13.5 **UNCOVERING WORK**

A. If any work is covered contrary to ENGINEER's written request, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and be recovered at CONTRACTOR's expense.

B. If ENGINEER considers it necessary or advisable that covered work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, Inspection or testing as ENGINEER may require, that portion of the Work in question. CONTRACTOR shall furnish all necessary labor, material and equipment.

1. If it is found that such work is defective, CONTRACTOR shall bear all direct, indirect and consequential costs of such uncovering, exposure, observation, Inspection and testing and of satisfactory reconstruction, including, but not limited to, fees and charges of engineers, architects, and other professionals. If OWNER accepts such Defective Work, OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Parts 11of these General Conditions.

2. If such work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, Inspection, testing and reconstruction. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Parts 11 and 12.

13.6 **CORRECTION OR REMOVAL OF DEFECTIVE WORK BY CONTRACTOR**

A. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all Defective Work, whether or not fabricated, installed or completed, or, if the work has been rejected by ENGINEER, remove it from the site and replace it with non-Defective Work. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work unless approval in writing has been given by the ENGINEER. CONTRACTOR

shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of OWNER, engineers, architects, and other professionals) made necessary thereby.

13.7 **CORRECTION PERIOD**

A. If any portion of the Work is found to be defective within 1 year after the date of Substantial Completion, CONTRACTOR shall correct it or replace it with non-Defective Work. The one year correction period may be superseded by such longer period of time as prescribed in the Contract Documents or by special guarantee terms required by the Contract Documents.

B. If CONTRACTOR fails to correct Defective Work within 15 Days after rejection or notice by OWNER or ENGINEER, or in an emergency where notice and delay would cause serious risk of loss or damage, OWNER may have the Defective Work corrected or removed and replaced. The CONTRACTOR and CONTRACTOR's surety shall be liable for and pay for all direct, indirect and consequential costs of such correction or removal and replacement by OWNER (including but not limited to fees and charges of engineers, architects, and other professionals).

C. In circumstances where a portion of the Work or a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that work or item may start from an earlier date if so provided in the Contract Documents or by Change Order.

D. If material or equipment fails during the one year correction period or during its warranty or guarantee period and is therefore repaired or replaced by CONTRACTOR, the one year correction period or the warranty or guarantee period shall be extended by the CONTRACTOR for such repair or replacement from the date of such repair or replacement for a length of time equal to the original one year correction period or warranty or guarantee period.

13.8 **ACCEPTANCE OF DEFECTIVE WORK**

A. **Acceptance is OWNER's Choice**: OWNER may accept Defective Work instead of requiring correction or removal and replacement. CONTRACTOR shall bear all direct, indirect and consequential costs attributable to ENGINEER's evaluation of and determination to accept such Defective Work (such costs to be approved by ENGINEER as to reasonableness and may include, but are not limited to, fees and charges of engineers, architects, and other professionals).

B. **Decrease in Contract Price**: If acceptance of Defective Work occurs before final payment, a Change Order will be issued in the case of Lump Sum Work, or in the case of Unit Price Work, the quantities will be adjusted accordingly. Any necessary revisions in the Contract Documents with respect to the Work will be described and the OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Parts 11.

C. **Acceptance is Not a Waiver of OWNER's Rights**: OWNER's acceptance of Defective Work shall not release or relieve CONTRACTOR from warranty and guarantee provisions of this Part 13.

13.9 **OWNER MAY CORRECT DEFECTIVE WORK**

A. **OWNER may correct and remedy any Work deficiency**:

1. if CONTRACTOR fails after 15 Days' written notice of ENGINEER to proceed to correct Defective Work or to remove and replace rejected work as required by ENGINEER in accordance with article 13.6; or
2. if CONTRACTOR fails to perform work in accordance with the Contract Documents; or
3. if CONTRACTOR fails to comply with any other provision of the Contract Documents.

B. **OWNER to Expedite Work**: In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may:

1. exclude CONTRACTOR from all or part of the site;
2. take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto;
3. take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site, And
4. incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere.

C. **CONTRACTOR to Allow Access**: CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees such access to the site as may be necessary to enable OWNER to exercise the rights and remedies under this article.

D. **Direct, Indirect and Consequential Costs**: All direct, indirect and consequential costs of OWNER in exercising such rights and remedies will be charged against CONTRACTOR in an amount determined to be reasonable by ENGINEER. A Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work and the OWNER shall be entitled to an appropriate decrease in the Contract Price. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, and other professionals, all court costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's Defective Work.

E. **CONTRACTOR Can Appeal**: CONTRACTOR may appeal OWNER's claim in accordance with the dispute resolution process established in the Agreement.

F. **Contract Time Extension**: CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies.

PART 14 PAYMENTS TO CONTRACTOR AND COMPLETION

14.1 BASIS FOR PROGRESS PAYMENTS

A. **Lump Sum Work**: The schedule of values (as defined in Paragraph 2.5B.3 and established as provided in article 2.7) will serve as the basis for progress payments and will be incorporated into an Application for Payment form acceptable to ENGINEER.

B. **Unit Price Work**: Progress payments will be based on the number of units completed.

14.2 APPLICATION FOR PROGRESS PAYMENTS

A. **Once a Month**: Progress payments shall not be processed more often than once a month.

B. **Contents of Applications**: To request payment, CONTRACTOR shall submit to ENGINEER a signed Application for Payment which accurately reflects the Work completed as of the date of the Application and which is accompanied by such supporting documentation as is required by the Contract Documents.

1. Such application may include requests for payment on account of changes in the Work which have been properly authorized by Work Directive Changes but not yet included in a Change Order, if such request does not exceed the current Contract Price.

2. Such applications may not include requests for payment of amounts the CONTRACTOR does not intend to pay to a Subcontractor or Supplier because of dispute or other reason.

C. **Materials and Equipment Supplied but Not Installed**: Payment may be made for materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing if the CONTRACTOR satisfies the following requirements:

1. a bill of sale, invoice or other documentation shall be attached to the Application warranting that OWNER has received the materials and equipment free and clear of all Liens,

2. evidence shall be provided which indicates the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, and

3. all documentation shall be satisfactory to the ENGINEER.

D. **Withholding of Payment**: The OWNER reserves the right to withhold the first and all subsequent partial payments due the CONTRACTOR until submittals listed in Paragraph 2.5B are submitted in a form acceptable to the ENGINEER.

E. **Retainage**: The amount of retainage (if any) with respect to progress payments will be as stipulated in the Agreement or Supplementary Conditions.

14.3 CONTRACTOR'S WARRANTY OF TITLE

A. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens or other claims.

14.4 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

A. **Submittal**: ENGINEER will, within 10 Days after receipt of each Application for Payment, either process the Application or return the Application to CONTRACTOR indicating reasons for refusing to approve payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Within 30 Days after presentation of an approved Application for Payment, the amount approved will (subject to the provisions of Paragraph 14.4C) be paid by OWNER to CONTRACTOR.

B. **ENGINEER May Reject Submission**: ENGINEER may refuse to approve the whole or any part of any payment if, in ENGINEER's opinion:

1. the Work is unsafe or inaccessible and therefore ENGINEER cannot determine if the Work is acceptable;
2. the Work is defective, or completed Work has been damaged requiring correction or replacement;
3. the OWNER has been required to correct Defective Work or complete Work in accordance with article 13.9;
4. the ENGINEER has actual knowledge of the occurrence of any of the events enumerated in article 15.2; or
5. subsequently discovered evidence, or the results of subsequent tests, nullify any payments previously made.

C. **OWNER May Reject Submission**: OWNER may refuse to make payment of the full amount because:

1. claims have been made against the OWNER on account of CONTRACTOR's performance or furnishing of the Work;
2. Liens or claims have been filed in connection with the Work and remain unsatisfied more than 45 Days;
3. there are other items (e.g. pay reductions for Defective Work) entitling OWNER to an off-set against the amount recommended, and OWNER has given CONTRACTOR written notice stating the reasons for such action;
4. the OWNER does not have in its possession an accurate updated construction progress schedule; or
5. subsequently discovered evidence, or the results of subsequent tests, nullify any payments previously made to the extent necessary, in ENGINEER's opinion, to protect OWNER from loss.

14.5 **SUBSTANTIAL COMPLETION**

A. **CONTRACTOR to Certify Work is Substantially Complete**: When CONTRACTOR considers the Work (or portion thereof) ready for its intended use, CONTRACTOR shall certify in writing to ENGINEER that the Work (or portion thereof) has been completed in accordance with the Contract Documents. CONTRACTOR shall include in such written certification a list of any items not finished.

B. **ENGINEER to Review CONTRACTOR's Certification**: Within five (5) Days after ENGINEER receives CONTRACTOR certification and list of Work items not finished, ENGINEER will issue written notice either agreeing the Work is Substantially Complete or stating reasons why the Work is not Substantially Complete.

C. **Final Inspection**: If Substantially Complete, ENGINEER shall within a reasonable time, schedule a Final Inspection preparatory to writing the Final Inspection Punch List.

D. **OWNER's Rights**: OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the Final Inspection Punch List.

14.6 **PARTIAL UTILIZATION**

A. **In General**: No occupancy or separate operation of part of the Work will be accomplished before execution of a Change Order between OWNER and CONTRACTOR which fully describes the liability between OWNER and CONTRACTOR in respect of property insurance.

B. **Part of the Work is Substantially Complete**: Any finished part of the Work may be used by the OWNER before Substantial Completion of all of the Work if:

1. the part of the Work has specifically been identified in the Contract Documents; or
2. the ENGINEER and the CONTRACTOR agree the finished parts constitutes a completed separately functioning and usable part of the Work which can be used without significantly interfering with CONTRACTOR's performance of the remainder of the Work;
3. the OWNER requests in writing that the OWNER is to be permitted to use any such part of the Work, and
4. the CONTRACTOR agrees any finished part of the Work may be used by the OWNER before Substantial Completion of all of the Work. CONTRACTOR will certify in writing to OWNER that said part of the Work is ready for its intended use and is Substantially Complete.

C. **Part of the Work is Not Substantially Complete**: Any unfinished part of the Work may be used by the OWNER before Substantial Completion of all of the Work if:

1. the OWNER has requested in writing that it is to be permitted to take over operation of any part of the Work although it is not Substantially Complete;

2. the CONTRACTOR and the ENGINEER has made an Inspection of that part of the Work to determine its status of completion and they have prepared a list of the items remaining to be completed or corrected thereon before final payment;

3. the CONTRACTOR does not object to OWNER taking over that part of the Work which is not ready for separate operation by OWNER;

4. the ENGINEER has prepared and delivered to the CONTRACTOR a list of items to be completed or corrected;

5. the ENGINEER has prepared written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work, which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing), And

6. during such operation and before Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the list provided by the ENGINEER and to complete other related work.

D. **CONTRACTOR to Have Access**: During OWNER's occupancy and operation within said part of the Work, OWNER shall allow CONTRACTOR access to complete or correct items on the above-referenced list and to complete other related work.

14.7 **FINAL INSPECTION**

A. When ENGINEER agrees the Work (or portion of the Work) is Substantially Complete, ENGINEER will make Final Inspection. ENGINEER will prepare a Final Inspection Punch List and will deliver such list to CONTRACTOR in writing.

B. Except for hidden or latent defects, damage due to Punch List rework, fraud, gross mistakes amounting to fraud, or work required by the Contract Documents, the list shall be considered complete and final.

C. Delivery of the Final Inspection Punch List or accomplishment of the Work thereon by CONTRACTOR does not relinquish any of the OWNER's rights under the CONTRACTOR's warranty and guarantee.

14.8 **FINAL APPLICATION FOR PAYMENT**

A. **In General**: After CONTRACTOR has completed all Punch List Work to the satisfaction of ENGINEER and after ENGINEER has indicated that the Work is acceptable (subject to the provisions of article 14.10), CONTRACTOR may follow the procedures for progress payments and make application for final payment.

B. **Submittals Required for Final Payment**: Final payment (including any remaining retained money) shall not become due until CONTRACTOR submits all documentation called for in the Contract Documents and the following:

1. an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the OWNER or the OWNER's property might be responsible or encumbered, have been paid or otherwise satisfied;

2. a current or additional certificate evidencing that insurance required by the Contract Documents, which is to remain in force after final payment, is currently in effect and will not be canceled or allowed to expire until OWNER has been given at least 30 Days prior written notice, by certified mail, return receipt requested;

3. a written statement that the CONTRACTOR knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents;

4. if previously requested by CONTRACTOR's surety, consent of surety to final payment;

5. a certificate of occupancy if required by Law, Regulation or Contract Documents;

6. all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of Inspection, marked up Record Documents (article 6.11) and other documents required by the Contract Documents: and

7. if required by the OWNER, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of Liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the OWNER. If a Subcontractor refuses to furnish a release or waiver

required by the OWNER, the CONTRACTOR shall furnish a bond satisfactory to the OWNER to indemnify the OWNER against such claim. If such claims remain unsatisfied after payments are made, CONTRACTOR shall refund to the OWNER all money that the OWNER may be compelled to pay in discharging such Liens or claims, including all costs and reasonable fees and charges.

14.9 **FINAL PAYMENT AND ACCEPTANCE**

A. **ENGINEER'S Determinations**: ENGINEER shall review CONTRACTOR's final Application for Payment and, based upon ENGINEER's observation of the Work during construction and Final Inspection, submission by CONTRACTOR of all required documentation and determination of CONTRACTOR's compliance with the Contract Documents, either forward the application to OWNER for payment or return it to CONTRACTOR.

B. **Work Has Been Completed**: When forwarding the application to OWNER, ENGINEER shall state in writing that the Work is acceptable, subject to the provisions of article 14.10.

C. **Work Has Not Been Completed**: If the Work has not been completed, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment. CONTRACTOR shall make the necessary corrections and resubmit the Application. Unless indicated otherwise in the Contract Documents, and subject to provisions of Paragraph 14.4B, 40 Days after presentation to ENGINEER of the Application and accompanying documentation, and with ENGINEER's recommendation and notice of acceptability, the amount requested by CONTRACTOR and confirmed by ENGINEER will become due and owing by OWNER to CONTRACTOR.

D. **Delays not CONTRACTOR's fault**: If after Substantially Completion of the Work, final completion is materially delayed through no fault of CONTRACTOR, or by issuance of Change Orders affecting final completion, CONTRACTOR may submit final Application for Payment as stated above. Upon ENGINEER's recommendation, OWNER may, without terminating the Construction Contract, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be deemed a final payment, except that it shall not constitute a waiver of claims.

14.10 **WAIVER OF CLAIMS**

A. The making and acceptance of final payment constitutes:

1. a waiver of all claims by OWNER against CONTRACTOR, except from unsettled Liens, claims from Defective Work appearing after Final Inspection pursuant to article 14.7 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein. Further, however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's continuing obligations under the Contract Documents or of claims which have been specifically reserved by the OWNER, And

2. a waiver of all claims by CONTRACTOR under the Contract Documents except those previously made in writing and still unsettled, or remaining in dispute after processing as required by article 9.8.

PART 15 SUSPENSION OF WORK AND TERMINATION

15.1 **OWNER MAY SUSPEND WORK**

A. **Notice**: By written notice to the CONTRACTOR, the OWNER shall have the authority to suspend the Work or any portion thereof) for a period of not more than 160 Days upon the occurrence of any one or more of the following events:

1. if the Work is defective;
2. if CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment;
3. if CONTRACTOR fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents; or
4. the occurrence of unsuitable weather or other such conditions ENGINEER considers unfavorable for suitable prosecution of the Work.

B. **Suspension Shall Not Benefit CONTRACTOR**: This right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER or ENGINEER to exercise this right for the benefit of CONTRACTOR or any other party.

C. **Safe, Secure and Smooth Site**: If Work is suspended by the OWNER, the CONTRACTOR shall do work necessary to provide a safe and secure site. If pedestrian or vehicular access is required, a smooth and unobstructed passageway shall be provided through the construction site. In the event the CONTRACTOR fails to perform this work, the OWNER may perform such work and the cost thereof will be deducted from money due or to become due the CONTRACTOR.

D. **Contract Time During Suspension**: If a suspension of Work is ordered by OWNER or ENGINEER because the CONTRACTOR refuses or fails to comply with the Contract Documents, the Days on which the suspension order is in effect shall be considered as part of the Contract Time. Such suspension of Work shall not release or relieve the CONTRACTOR from the CONTRACTOR's responsibilities set forth in the Contract Documents.

E. **Resumption of the Work**: The suspended Work shall be resumed on the date fixed by ENGINEER, which date shall be the earlier of 120 Days after the issuance of the suspension order or the date all of the conditions cited in the order are satisfied.

F. **Work Suspension Claims**: Except as listed below, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, if CONTRACTOR makes an approved claim as provided for in Parts 11 and 12.

1. Any work done during the suspension of the Work will not be accepted and paid for unless approved in writing by the ENGINEER.

2. There shall be no claim against or liability on the part of the OWNER and ENGINEER for failure on the part of the CONTRACTOR to comply with the Contract Documents.

15.2 **OWNER MAY TERMINATE**

A. **Notice, and Reason Therefore**: OWNER may terminate the services of the CONTRACTOR and exclude the CONTRACTOR from the site after giving CONTRACTOR and the surety 10 Days written notice. Such termination by OWNER may result from the occurrence of any one or more of the following events:

1. if a petition is filed against CONTRACTOR under any chapter of the bankruptcy code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency, and if such involuntary petition remains unsatisfied for more than 30 Days;

2. if CONTRACTOR makes a general assignment for the benefit of creditors;

3. if a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR's creditors;

4. if CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

5. if CONTRACTOR fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under Paragraph 2.7A.1. as revised from time to time);

6. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

7. if CONTRACTOR disregards the authority of ENGINEER; or

8. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents.

B. **Completion of Work by Others**: OWNER may, to the extent permitted by Laws and Regulations, either allow the surety to complete the Work or take possession of the Work and of all CONTRACTOR'S tools, appliances, construction equipment and machinery at the site and use the same to complete the Work (without liability to CONTRACTOR for trespass or conversion). OWNER may incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as ENGINEER may deem expedient. CONTRACTOR shall cooperate in any way necessary to allow the Work to be completed.

C. **Adjustment to Cost of the Work**:

1. Upon terminating the services of the CONTRACTOR, the CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. Final payment to CONTRACTOR or CONTRACTOR reimbursement to the OWNER shall be as follows:

a. if the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, and other professionals), such excess will be paid to CONTRACTOR, And

b. if the direct, indirect and consequential costs of completing the Work exceed the unpaid balance, CONTRACTOR and the surety shall be liable to pay the OWNER for such costs exceeding the unpaid balance.

2. Such direct, indirect and consequential costs incurred by the OWNER to complete the Work will be incorporated in a Change Order. To secure such a Change Order, when exercising any rights or remedies under this paragraph ENGINEER shall not be required to obtain the lowest price for the Work to be performed.

D. **Waiver of Any Default**: Waiver of any default shall not be deemed to be a waiver of any subsequent default. Waiver of breach of any provision of the Contract Documents shall not be construed to be a Modification of the Contract Documents, unless stated to be such in a Change Order, signed by OWNER.

E. **Termination will Not Affect Any Right or Remedies**: Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

F. **Termination for OWNER's Convenience**: Upon 10 Days' written notice to CONTRACTOR, OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Construction Contract. In such case, CONTRACTOR shall be paid for all work executed and any expense sustained plus reasonable termination expenses, which will include, but is not limited to, direct, indirect and consequential costs. Anticipated profit upon terminated work shall not be included as part of CONTRACTOR's termination costs.

15.3 TERMINATION OF WORK BY CONTRACTOR

A. **In General**: If the Work is stopped for a period of more than 120 Days through no act or fault of the CONTRACTOR or CONTRACTOR's agents or employees or any other persons performing portions of the Work under contract with any of the above, the CONTRACTOR may terminate the Construction Contract in accordance with 15.3B herein below for any of the following reasons:

1. the OWNER has persistently failed to fulfill fundamental OWNER's obligations under the Contract Documents with respect to matters important to the progress of the Work;

2. issuance of an order of a court or other public authority having jurisdiction, except that where the CONTRACTOR has standing, the CONTRACTOR must cooperate in efforts to stay or appeal such order;

3. an act of government, such as a declaration of national emergency, making necessary materials unavailable; or

4. unavoidable casualties or other similar causes as acts of God or of the public enemy, acts of the state or federal government in either their sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather which materially interfere with CONTRACTOR's ability to complete the Work, but in every case the failure to perform must be beyond the control and without the fault or negligence of the CONTRACTOR or anyone for whom the CONTRACTOR may be liable.

B. **Notice**: If one of the reasons for termination in 15.3A still exists after the CONTRACTOR gives an additional 10 Days written notice to the ENGINEER, the CONTRACTOR may terminate the Construction Contract and recover from the OWNER payment for Work executed and for proven loss with respect to materials, equipment, tools, construction equipment and machinery, including reasonable overhead. Anticipated profit on Work not performed shall not be allowed.

C. **Continuing the Work**: The provisions of 15.3A and 15.3B shall not release or relieve the CONTRACTOR from CONTRACTOR's obligation under article 6.15 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with the OWNER.

PART 16 DISPUTE RESOLUTION

16.1 APPEALS PROCESS

A. Any written decision rendered by ENGINEER pursuant to Paragraph 9.8A may be appealed by CONTRACTOR. Such appeal may be taken from any such decision in accordance with any provisions provided in the Agreement or Supplementary Conditions concerning dispute resolution and with applicable Laws and Regulations.

B. During any such appeal, OWNER may issue a Work Directive Change requiring the CONTRACTOR to perform such disputed Work and to continue the Work as provided in article 6.15.

C. No demand for dispute resolution of any claim, dispute or other matter that is required to be referred to ENGINEER initially for decision in accordance with Paragraph 9.8A will be made until (a) the ENGINEER has rendered a written decision or (b) by the 31st Day after the claim, dispute or other matter was presented to the ENGINEER.

D. No demand for dispute resolution of any claim dispute or other matter will be made later that 30 Days after the date on which ENGINEER has rendered a written decision in respect thereof in accordance with Paragraph 9.8, And the failure to demand dispute resolution within said 30 Days' period will result in ENGINEER's decision being final and binding upon OWNER and CONTRACTOR.

E. If the ENGINEER renders a decision after dispute proceedings have been initiated, such decision may be entered as evidence but will not supersede the dispute resolution proceedings, except where the decision is acceptable to the parties concerned.

F. No demand for dispute resolution of any written decision of ENGINEER rendered in accordance with Paragraph 9.8 will be made later than 10 Days after the party making such demand has delivered written notice of intention to appeal as provided in Paragraph 9.7.

G. Notice of the demand for dispute resolution will be filed in writing with the ENGINEER. The demand for dispute resolution will be made within the 30 Day or 10 Day period specified in Paragraph 16.1C and 16.1F as applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

PART 17 MISCELLANEOUS

17.1 GIVING NOTICE

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly received if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or it is received by registered or certified mail, postage prepaid or by facsimile.

B. Notices sent as required by Paragraph 17.1A shall be effective on the date on which such notice was sent.

C. Facsimile notice shall be effective on the date of transmission provided that a confirmation establishing the successful transmission of the notice is sent by first-class mail, postage prepaid, along with a copy of the notice transmitted, no later than 24 hours after the facsimile notice is transmitted.

D. If any notice requires a period of less than seven (7) Days for response, the notice shall be sent by facsimile.

E. Sureties shall receive notice at the business addresses shown on the Bonds.

F. CONTRACTOR shall receive notice at the business address shown on the Agreement.

17.2 COMPUTATION OF TIME

A. When any period of time is referred to in the Contract Documents by Days, it will be computed to exclude the first and include the last Day of such period. If the last Day of any such period falls on a Saturday or Sunday or on a Day made a legal holiday by Laws or Regulations, such Day will be omitted from the computation.

17.3 NOTICE OF CLAIM TIME LIMITS

A. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

17.4 CUMULATIVE REMEDIES

A. The duties, obligations, rights and remedies imposed by these General Conditions are in addition to any right and remedies available to OWNER and CONTRACTOR under available Laws or Regulations, special warranty or special guarantee. All representations, warranties and guarantees made in the Contract Documents will survive final payment and termination or completion of the Construction Contract.

END OF DOCUMENT

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

****
This section is intended as a guide for ENGINEER's use to include in the Project Manual a section for identification of the Work, type of contract, plus, as a broad-scope section, a flexible number of optional articles to accommodate various administrative requirements needed to tailor the documents to specific Project needs. Such needs may include but not be limited to the following:
****

PART 1 GENERAL

1.1 **WORK COVERED BY CONTRACT DOCUMENTS**

A. Indicate type of Work, name of Project and its location, and name of OWNER. This article is not a scope of work.

1.2 **WORK BY OTHERS**

A. Include the person or organization having authority and responsibility for coordinating activities among prime contractors.

1.3 **FUTURE WORK**

1.4 **WORK SEQUENCE**

1.5 **CONTRACTOR USE OF PREMISES**

1.6 **OWNER OCCUPANCY**

1.7 **PARTIAL OWNER UTILIZATION**

1.8 **PREORDERED PRODUCTS**

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 24 00
VALUE ANALYSIS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedure for evaluating alternate or substitute proposals for materials or equipment for the purpose of the betterment of the Work or reducing the Cost of the Work.

B. Each proposal will be compared for Effective Cost.

1.2 VALUE ENGINEERING - MEASUREMENT AND PAYMENT

A. If a cost reduction proposal is accepted in whole or in part, OWNER will pay 50 percent of the net savings and the cost of developing the proposal minus 50 percent of ENGINEER's cost of investigating a cost reduction proposal.

B. In determining the estimated net savings, the right is reserved to disregard the Contract Bid prices.

C. Payment constitutes the full reimbursement for any cost reduction proposal. OWNER may use the proposal in future work as it deems needful.

1.3 DEFINITIONS

A. **Design Life**: The time life span of the product used in the Work established by ENGINEER.

B. **Effective Cost**: Total cost of material or equipment in today's dollars. The cost includes First Cost, any Replacement Costs during the Design Life, and any residual value at the end of the Design Life. Three possible cases exist for determining effective cost:

1. Case 1 - Service Life equals Design Life.
2. Case 2 - Service Life is less than Design Life.
3. Case 3 - Service Life is greater than Design Life.

C. **First Cost**: The bid price for an alternate material or equipment and installation. Historical data may be used to determine an appropriate value for pre-Bid evaluations.

D. **Replacement Cost**: The cost in today's dollars to replace material or equipment.

E. **Service Life**: The time life span of material or equipment before Failure occurs or before cost of maintenance justifies replacement. Service life shall be established by ENGINEER.

1.4 SUBMITTALS

A. At any time after award of Contract, CONTRACTOR may submit written proposals for modifying the Contract Documents.

1.5 EVALUATION OF PROPOSALS

A. Compute each proposal’s least cost using the appropriate steps in the following table. Rank the proposals in order of lowest Effective Cost.

Table 1 – Least Cost Analysis

Step	Longest Lived First		
1. Project Design Life			
2. Assigned Service Life, n, years			
3. Lowest Responsive Bid, P, Each Alternate			
4. Total Replacement Cost = $P\left[1+\left(\frac{1+I}{1+i}\right)^{n}+\left(\frac{1+I}{1+i}\right)^{2n}+\ldots+\left(\frac{1+I}{1+i}\right)^{mn}\right]$ Replacement Costs shall be calculated using a difference between interest and inflation. Replacement Costs = 2 percent (i-I) unless specified otherwise			
5. Present Value, Residual Amount = $P\left(\frac{n_L - n_S}{n_L}\right)\left(\frac{1+I}{1+i}\right)^{n_S}$			
6. Effective Cost Case 1: (Step 3), or Case 2: (Step 3 + Step 4), or Case 3: (Step 3 – Step 5)			

$\left(\frac{1+I}{1+i}\right)^{n}$

i-I	n, years								
%	20	25	30	40	50	60	75	80	90
1.0	0.835	0.798	0.762	0.697	0.636	0.581	0.508	0.485	0.443
2.0	0.695	0.635	0.580	0.484	0.403	0.336	0.256	0.234	0.196
3.0	0.590	0.518	0.454	0.349	0.268	0.206	0.139	0.122	0.093
4.0	0.490	0.410	0.343	0.240	0.168	0.118	0.069	0.058	0.041
5.0	0.415	0.333	0.268	0.172	0.111	0.072	0.037	0.030	0.019

Where
- I = Inflation Rate
- i = Interest Rate
- m = Total number of material or equipment replacements
- n = Assigned Service Life, years
- n_L = Service Life longer lived alternate, years
- n_S = Service Life shorter lived alternate, years
- P = Lowest responsive Bid, each alternate

B. ENGINEER will announce as soon as possible the Effective Cost ranking of the most responsible cost proposal.

C. Should a Service Life longer than that assigned be included in a cost reduction proposal, written documentation supporting the proposed Service Life must be submitted to the ENGINEER. The documentation must be in a form satisfactory to the ENGINEER. ENGINEER is not obliged to accept the proposed Service Life, but may elect to use the announced Service Life.

1.6 **ACCEPTANCE**

A. ENGINEER shall be sole judge of the acceptance of a cost reduction proposal.

B. ENGINEER may accept wholly or in part or reject the proposal, as judgment deems correct.

C. OWNER and ENGINEER are not liable for failure to accept or act upon any cost reduction proposal.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 25 00

PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements for selection of product and the substitution of product.

B. Substitution of product occurs after the Effective Date of the Construction Contract. Before Effective Date, OWNER only considers options for selecting alternate products.

1.2 DEFINITIONS

A. **Options**: The choices that the CONTRACTOR has in selecting products after award of the Contract. The conditions and choices are as follows:

1. Products Specified by Reference Standards or by Description Only: Any product meeting the reference standard or description.
2. Products Specified by Naming One or More Manufacturers: No options or Substitutions.
3. Products Specified by Naming a Manufacturer with an “or equal” Phrase: Any manufacturer not specifically named will be allowed after approval by ENGINEER.

B. **Substitutions**: Changes requested by CONTRACTOR after award of the Contract which affects products, materials, equipment, and methods of construction required by Contract Documents. The following are NOT considered substitutions:

1. Revisions to Bid Documents requested by Bidders during the bidding period, and accepted before award of contract, are considered as included in the Contract Documents and are not subject to requirements specified in this section for substitutions.
2. Revisions to Contract Documents requested at any time by OWNER or ENGINEER.
3. Specified Options of products and construction methods included in Contract Documents.
4. The CONTRACTOR's determination of and compliance with governing Laws and Regulations and orders issued by governing authorities.

1.3 SUBMITTALS

A. After Notice of Intent to Award, submit four (4) copies of the list of product Options that are proposed. Include name of manufacturer.

B. Tabulate products by specification section number, title, and article number.

C. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

D. ENGINEER will reply in writing stating whether there is objection to listed items. Failure to object to a listed item shall not relieve CONTRACTOR from compliance with the requirements of the Contract Documents.

1.4 LIMITATIONS ON SUBSTITUTIONS

A. Substitutions will not be considered when indicated on Shop Drawings or Product Data submittals without separate formal request, when requested directly by Subcontractor or Supplier, or when acceptance will require substantial revision of Contract Documents.

B. Substitute products shall not be ordered or installed without written acceptance.

C. ENGINEER to determine acceptability of Substitutions.

1.5 REQUEST FOR SUBSTITUTIONS

A. Allow ENGINEER 10 days to evaluate Substitution requests.

B. Submit separate request for each Substitution. Document each request with complete data substantiating compliance and compatibility of proposed Substitution with requirements of Contract Documents.

C. Identify product by specification's section and article numbers. Provide manufacturer's name, address, phone number, trade name of product, and model or catalog number. List fabricators and Suppliers as appropriate.

D. Attach product data as indicated in Section 01 33 00.

E. Give itemized comparison of proposed Substitution with specified product, listing variations, and reference to specification's section and article numbers.

F. Give quality and performance comparison between proposed Substitution and the specified product.

G. Give cost data comparing proposed Substitution with specified product, and amount of net change to Contract Price.

H. List availability of maintenance services and replacement materials.

I. Indicate effect of Substitution on progress schedule, and change required in other work or products.

1.6 **CONTRACTOR REPRESENTATION**

A. Request for Substitution constitutes a representation that CONTRACTOR:

1. Has investigated proposed product and determined that it is equal to or superior in all respects to specified product.

2. Shall provide same warranty for Substitution as for specified product unless warranty for substituted product is larger.

3. Shall coordinate installation of accepted substitute, making such changes as may be required for Work to be complete in all respects.

4. Certifies that cost data presented is complete and includes all related costs.

5. Waives claims for additional costs related to Substitution that may later become apparent

1.7 **SUBMITTAL PROCEDURES**

A. After the Effective Date of the Construction Contract, submit copies of each Substitution request in the form and per procedures required for Change Order proposals (refer to Section 01 26 00).

B. For accepted products, submit Shop Drawings, product data, and Samples; Section 01 33 00.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for initiating and authorizing contemplated changes to the Work.

1.2 DEFINITIONS

A. **Request for Proposal (RFP)**: Written or verbal inquiry by ENGINEER to the CONTRACTOR that asks for information pertinent to OWNER's contemplated changes to the Work.

B. **Request for Change (RFC)**: Written or verbal inquiry by the CONTRACTOR to the ENGINEER that asks for changes to the Work.

1.3 PRELIMINARY PROCEDURES

A. **Changes Proposed by ENGINEER**: ENGINEER may initiate changes by issuing a Request for Proposal (RFP) to CONTRACTOR. Such request is for information only, and is not an instruction to execute the changes, or to stop work in progress. The request will include:

1. A specific statement from the CONTRACTOR advising the ENGINEER whether or not the proposed change affects the Progress Schedule's critical path.
2. Description of the proposed change, products required in the change, and location of the change in the Project.
3. Supplementary or revised Drawings and Specifications.
4. The projected time span for making the change, and a specific statement as to whether overtime work is, or is not, authorized.
5. A specific period of time during which the requested price will be considered valid.

B. **Changes Proposed by CONTRACTOR**: CONTRACTOR may propose changes by submitting a written Request for Change (RFC) to the ENGINEER, containing:

1. A specific statement of the effect that the contemplated change has on the Progress Schedule's critical path.
2. Description of the proposed change.
3. Statement of the reason for making the changes.
4. Statement of the effect on the work of separate contractors.
5. Documentation supporting any change in the Contract Price or Contract Time as appropriate.
6. Documentation of any Substitutions per Section 01 25 00.

C. **Work Directive Change**: Instead of a Request for Proposal (RFP), ENGINEER may issue a Work Directive Change for CONTRACTOR to proceed with work which will be included in a subsequent Change Order.

1. The Work Directive Change will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change, and will designate the method of determining any change in the Contract Price and any change in Contract Time.
2. CONTRACTOR may sign and date the Work Directive Change to indicate agreement with the terms therein.
3. ENGINEER will sign and date the Work Directive Change as authorization for the CONTRACTOR to proceed with the changes.

D. **Force Account**: When Contract Price or Contract Time cannot be determined before executing a Change Order for contemplated work:

1. ENGINEER will issue a Work Directive Change instructing the CONTRACTOR to proceed with the contemplated work.
2. At completion of the contemplated work, CONTRACTOR shall submit itemized accounting and supporting data as provided in the General Conditions.

3. ENGINEER will determine the allowable cost of such contemplated work, as provided in the General Conditions.
4. CONTRACTOR signs and dates the Change Order to indicate agreement therewith.
5. ENGINEER signs and dates the Change Order to establish the change in Contract Price and Contract Time.

1.4 **DOCUMENTATION REQUIRED FOR PROPOSALS OR CLAIMS**

A. Support each proposal or claim with sufficient substantiating data to allow ENGINEER to evaluate the quotation. Provide the following data.

1. Existing work affected (change to progress schedule).
2. Labor required.
3. Equipment required.
4. Products required.
   a. Recommended source of purchase and unit cost.
   b. Quantities required.
5. Taxes, insurance and bonds.
6. Credit for work deleted from Contract, similarly documented.
7. Overhead and profit.
8. Justification for any change in Contract Time.

B. Support each claim on a time and materials (force account) basis, with documentation as required for a lump-sum proposal, plus additional information:

1. Name of OWNER's authorized agent who ordered the work, and date of the order.
2. Dates and times work was performed, and by whom.
3. Time record, summary of hours worked, and hourly rates paid.
4. Receipts and invoices for:
   a. Equipment used, listing dates and time of use.
   b. Products used, listing of quantities.
   c. Subcontracts.

C. Document requests for Substitutions for products as specified in Section 01 25 00.

1.5 **PREPARATION OF CHANGE ORDER**

A. ENGINEER will prepare the Change Orders.

B. The Change Order will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.

C. The Change Order will provide an accounting of the adjustment in the Contract Price and the Contract Time.

D. Several Request for Proposal (RFP) and Request for Changes (RFC) may be included in one Change Order.

1.6 **LUMP SUM OR FIXED PRICE CHANGE ORDER**

A. The content of a Change Order in a lump sum contract will be based on, either:

1. ENGINEER's Request for Proposal (RFP) and CONTRACTOR's responsive proposal as mutually agreed between ENGINEER and CONTRACTOR; or
2. CONTRACTOR's Request for Change (RFC), as recommended by ENGINEER to OWNER.

B. CONTRACTOR may sign and date the Change Order to indicate agreement with the terms therein.

C. ENGINEER will sign and date the Change Order as authorization for the CONTRACTOR to proceed with the contemplated work.

1.7 **UNIT PRICE CHANGE ORDER**

A. Content of a unit price Change Order will be based on:

1. ENGINEER's definition of the scope of the required changes;

2. CONTRACTOR's proposal for a change, as recommended by ENGINEER; or
3. Survey of completed work.

B. The amounts of the unit prices to be:

1. Those stated in the Agreement; or
2. Those mutually agreed upon between ENGINEER and CONTRACTOR and accepted by the OWNER.

C. When quantities of each of the items affected by the Change Order can be determined before start of the contemplated work:

1. CONTRACTOR signs and dates the Change Order to indicate agreement with the quantities and terms therein.
2. ENGINEER signs and dates the Change Order as authorization for CONTRACTOR to proceed with the contemplated work.
3. CONTRACTOR completes contemplated work and is paid total amount indicated on the Change Order.

D. When quantities of the items cannot be determined before start of the contemplated work:

1. ENGINEER prepares Change Order using his best estimate of needed quantities.
2. CONTRACTOR signs and dates Change Order to indicate agreement with the terms therein.
3. ENGINEER signs and dates Change Order as authorization for CONTRACTOR to proceed with the contemplated work.
4. CONTRACTOR completes contemplated work and is paid for work quantities completed.

1.8 **CORRELATION WITH CONTRACTOR'S SUBMITTALS**

A. Periodically revise Schedule of Values and request for payment forms to record each change as a separate item of Work, and to record the adjusted Contract Price.

B. Periodically revise the Progress Schedule to reflect each change in Contract Time. Revise sub-schedules to show changes for other items of work affected by the changes.

C. Upon completion of Change Order work, enter pertinent changes in the Record Documents, Section 01 78 39.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment procedures, forms, submission requirements, and price adjustments.

1.2 SUBMITTAL PROCEDURES

A. Submit at least two copies of each Application for Payment. Each application must be signed by CONTRACTOR.

B. Submit an updated progress schedule with each Application for Payment.

C. When ENGINEER requires substantiating information, submit data.

1.3 UNIT PRICE PAY REQUEST FORMS

A. **Application Form**: ENGINEER prepared or one acceptable to the ENGINEER.

B. **Schedule of Prices**: ENGINEER prepared or one acceptable to the ENGINEER.

1.4 LUMP SUM PAY REQUEST FORMS

A. **Application Form**: Use AIA Form G702 - Application and Certificate for Payment; or AIA G722 - Project Application and Project Certificate for Payment; or EJCDC Form 1910-8-E - Application for Payment; or CONTRACTOR's standard form; or electronic media printout following one of the above standard forms.

B. **Schedule of Values Form**: Use AIA Form G703 - Application and Certificate for Payment Continuation Sheet and AIA G723 - Project Application Summary, or EJCDC Form 1910-8-E, or CONTRACTOR's standard form, or electronic media printout following one of the above standard forms. Follow the outline presented in the Bid Form. For each item, provide a column (or row) for listing each of the following:

1. Item number.
2. Description of work.
3. Scheduled values.
4. Previous applications.
5. Work in plan and stored materials under this application.
6. Authorized Change Orders.
7. Total completed and stored to date of application.
8. Percentage of completion.
9. Balance to finish.
10. Retainage.
11. Overhead and profit.

C. **Submission Schedule**: Comply with time requirement of Paragraph 2.5B of the General Conditions when submitting the Schedule of Values (Within 10 Days after the Effective Date of the Construction Contract.)

D. **Revisions**: Revise schedule of values to list approved Change Orders, with each Application for Payment.

1.5 MEASUREMENT

A. **General**:

1. Measurement methods specified in individual Sections of the Standard Specifications are intended to compliment the criteria of this Section.
2. ENGINEER will take all measurements and compute all quantities.
3. CONTRACTOR will,
   a. Furnish labor to assist ENGINEER in obtaining and handling test Samples at site or sources.

b. Provide all equipment, workers, and survey crews to assist ENGINEER in making measurements.

c. Verify ENGINEER's measurements and computations.

B. **Unit of Measurement**: Refer to the Bid Form. It identifies the unit of measurement to be used for unit price items.

C. **Weight Basis**: Measured by scale or by handbook weights for the type and quantity of material actually furnished and used.

1. For material to be measured and paid for by weight, furnish accurate scales. Use platform scales of sufficient size and capacity to permit the entire vehicle or entire combination of vehicles to rest on the scale platform while being weighed. Combination vehicles may be weighed as separate units provided they are disconnected while being individually weighed. Pay for all costs incurred as a result of regulating, adjusting, testing, inspecting, and certifying scales.

2. ENGINEER may be present to witness weighing and to check and compile daily records of such scale weights; however, in any case, furnish weigh slips and daily summary weigh sheets. Furnish duplicate weigh slip or a load slip to each vehicle weighed and deliver the slip to ENGINEER at the point of delivery of the material.

3. If the material is shipped by rail, certified car weights will be accepted. Only actual weight of material will be paid for and not minimum car used for assessing freight tariff. Car weights will not be used for material to be passed through mixing plants.

4. Trucks used to haul material shall be weighed empty daily and at such additional times as directed. Each truck shall bear a plainly legible identification mark. ENGINEER may require the weight of the material verified by weighing empty and loaded trucks on other scales.

D. **Area Basis**: Measured by square dimension using mean length and width or radius.

E. **Linear Basis**: Measured by linear dimension at the item centerline or mean chord.

F. **Volume Basis**: Measured by cubic dimension using mean length, width and height or thickness.

1. Volumes will be determined and based upon material compacted in-place (not loose measure as per delivery ticket).

2. When it is impractical to determine the volume by rectilinear measurements in place or by the specified method of measurement, or when requested by the CONTRACTOR in writing and accepted in writing, the material will be weighed in accordance with the requirements specified for weight measurement. Such weights will be converted to volume measurement for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined and shall be agreed to by CONTRACTOR before such method of measurement of pay quantities will be accepted.

G. **Each Basis**: Measured by the unit.

H. **Lump Sum Basis**: Measured on a percent complete basis.

1.6 **PAYMENT**

A. Payment covers all labor, products, tools, equipment, paint, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

B. Quantities supplied or placed in the Work and measurements agreed to by CONTRACTOR determine payment.

C. The final payment sum may be as great as twice the value of Punch List work or at least equal to the value of the work declared defective by the ENGINEER.

1.7 **INCIDENTAL WORK**

A. No separate measurement or payment for incidental work, (paragraph 3.1C of the General Conditions (Document 00 72 00)).

1.8 **PRODUCT**

A. No separate measurement and payment for:

1. Product or work provided by ENGINEER or OWNER;

2. Product wasted or disposed of in a manner that is not acceptable;

3. Product determined as unacceptable before or after placement;

4. Product not completely unloaded from the transporting vehicle;

5. Product placed beyond the lines and levels of the required Work;
6. Product remaining on hand after completion of the Work; or
7. Loading, hauling and disposing of rejected product.

1.9 **MATERIALS AND EQUIPMENT ON-HAND**

A. CONTRACTOR may include in partial payment applications, an advanced payment item for acceptable non-perishable products purchased or manufactured expressly for the Work, if:

1. Certified copies of product invoices are approved.
2. The maximum sum to be included in partial payment applications does not exceed 75 percent of the value of the product shown on the invoice or 75 percent of the in place price, whichever sum is less.
3. Product is stored in the vicinity of the Project or when the approved storage location is other than the site, evidence is furnished that the stored product is irrevocably obligated to the Work.
4. CONTRACTOR is responsible for any damages, loss or theft of product until product is incorporated in the Work and accepted.

B. Payment for materials shall not constitute acceptance of any materials which do not conform to the Contract Documents.

C. No partial payment will be made on living, or perishable plant materials until planted.

1.10 **PRICE ADJUSTMENT**

A. **Defective Work or Non-complying Material**: If ENGINEER determines it is not practical to remove and replace Defective Work or non-complying material, any of the following remedies may be applied:

1. Defective Work or non-complying material may remain, but the price reduced up to 50 percent.
2. If non-complying material has been installed and no price for the material is specified, apply price reduction against cost of work requiring complying material as part of its installation.
3. Defective Work or non-complying material will be partially repaired and the price will be adjusted to a new price.
4. Pay for Defective Work on a pay factor basis:
   a. Where two (2) or more pay factors apply to one item of Defective Work or material (even if pay factors are determined using separate specification sections), the smallest pay factor shall be used to determine price adjustment.
   b. Pay factors shall not be cumulative.
   c. Pay factors shall be applied to unit prices in either the bid form or a Change Order.

B. **Contract Price Adjustment**: In lump sum contracts, Contract Price adjustment shall be effected by Change Order. In unit price contracts, Contract Price adjustment shall be effected by adjusting unit quantities.

C. **Early Completion**: No additional money will be due CONTRACTOR:

1. If CONTRACTOR completes Work or any portion of Work before Contract Time, or
2. If early completion is delayed.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 31 13
COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination among CONTRACTOR's employees and Subcontractors, and any utility company, separate contractor, property owner, OWNER, and authority having jurisdiction.

1.2 COORDINATING WITH ENGINEER

A. Cooperate with ENGINEER, inspectors, and separate contractors to establish on-site lines of authority for communication.

B. Develop procedures for handling submittals, reports, records, recommendations, coordination drawings, and schedules.

C. Notify in writing of problems that develop during construction.

D. Ensure agency responsible for operation and maintenance of the completed facility is advised before a project or parts thereof are open for use.

E. Maintain and operate the Work until accepted and turned over to the agency responsible for operation and maintenance.

1.3 COORDINATING WITH PRIVATE AND PUBLIC AGENCIES

A. Notify private and public agencies affected by the proposed construction, coordinate required adjustments, and arrange for all necessary adjustments of utilities within or adjacent to the limits of construction.

B. Obtain utility locations from the one call center (Blue Stake) or other utility coordination service two (2) to seven (7) working Days before any excavation. Locations must be updated every 14 Days.

C. All utilities and utility appurtenances within the limits of the Work that are to be relocated or adjusted shall be moved by the affected utility company, unless specified otherwise.

D. Notify police, fire and transit authority.

1.4 COORDINATING WITH SEPARATE CONTRACTORS

A. Coordinate with separate contractors at no additional cost to OWNER to leave Work complete and finished.

B. Inspect and promptly report any apparent discrepancies or defects in work done by separate contractors that render Work unsuitable for proper execution and results. Failure to inspect and report shall constitute acceptance of separate contractor's work as fit and proper to receive work of this contract, except as to defects that may develop in the other separate contractor's work after the execution of the CONTRACTOR's work.

1.5 COORDINATING WITH ADJACENT PROPERTY OWNER

A. **Notice**: Notify property owner 10 Days before the start of construction and at least 48 hours in advance of the interruption of utility service or the interruption of access, or the installation of bituminous material.

B. **Access**: Provide all weather access to property owner at all times, unless property owner or ENGINEER approve otherwise.

C. **Easements**: Where work is on easements on private property, coordinate work with the property owner so that work will minimize inconvenience to property owner.

D. **Refuse Collection**:

1. Inform all affected property owners ahead of time by written notice of the place of deposit and time when their refuse will be collected.
2. If necessary haul refuse to nearest point of suitable collection as determined by the refuse collection agency.

E. **Mail**: Cooperate with the U.S. Postal Service in the delivery of mail.

1.6 **INTERRUPTION OF UTILITIES**

A. Notify fire and police services in local jurisdiction if emergency is safety related or if construction activities interrupt any utility service.

B. Contact the affected utility company. Find out how soon repairs can be made as well as when the repairs will begin.

C. Contact the affected local residences or businesses. Inform when repairs will begin and how long it will take to complete them.

D. Inform ENGINEER and OWNER.

1.7 **INTERRUPTION OF OWNER'S OPERATIONS**

A. If any aspect of normal OWNER operations needs to be interrupted for completion of the Work, notify ENGINEER in writing.

B. Submit notice with an alternate plan to cover contingency problems. In the alternate plan allow for maintenance of utilities or other essential services that must be interrupted for any period otherwise deemed necessary by OWNER to be unacceptable for necessary OWNER operations.

C. Shutdown of utilities must be accomplished during approved hours at no additional cost to OWNER. If work requires a longer shutdown, it must then be accomplished during separate periods.

D. Do not proceed with proposed shutdown without written approval.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 31 19

PRECONSTRUCTION CONFERENCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR participation in preconstruction conference.

1.2 PRECONSTRUCTION CONFERENCE

A. Before commencement of Work at site, a preconstruction conference will be held at a mutually agreed time and place attended by CONTRACTOR, its' superintendent, and its' Subcontractors as appropriate. Other attendees will be:

1. ENGINEER and Resident Project Representative.
2. Representatives of OWNER.
3. Representatives of affected utility companies.
4. Governmental representatives as appropriate.
5. Others as requested by CONTRACTOR, OWNER, or ENGINEER.

B. Unless previously submitted, bring to the conference one copy of each of the following:

1. Progress schedule.
2. Procurement schedule of major equipment and materials and items requiring long lead time.
3. Schedule of submittals.
4. Schedule of values (lump sum price breakdown) for progress payment purposes.
5. Schedule of OWNER furnished items.

C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR before the meeting date, which may include the following:

1. CONTRACTOR's tentative schedules.
2. Transmittal, review and distribution of CONTRACTOR's tentative schedules.
3. Processing applications for payment.
4. Maintaining Record Documents.
5. Critical work sequencing.
6. Field decisions and Change Orders.
7. Use of Project site, office and storage areas, security, housekeeping, and OWNER's needs.
8. Major equipment deliveries and priorities.
9. CONTRACTOR's assignments for safety and first aid.

D. ENGINEER will preside at preconstruction conference and will arrange for recording and distributing minutes to all persons in attendance.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 31 20
PARTNERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative guidelines for partnering.

1.2 PARTNERING INITIATIVE

A. The OWNER desires to create a foundation for a voluntary partnership with the CONTRACTOR and the CONTRACTOR's Subcontractors and Suppliers. The partnership will be structured to draw on the strengths of the OWNER and the CONTRACTOR to achieve the following goals:

1. To expedite the project in full compliance with the plans and specifications with all issues among the OWNER, the CONTRACTOR, the CONTRACTOR's sub-contractors, and interested outside agencies resolved in a timely manner at the appropriate decision making level.
2. To mitigate to the fullest extent possible any disruptions to the CONTRACTOR's and OWNER's use of the facilities at the construction site;
3. To emphasize value engineering and expedite submittal and review of all proposals;
4. to foster atmospheres of trust and team work;
5. To appreciate the fiscal objectives of all participants in the partnership; and
6. To insure there are no unsettled issues at the completion of the work.

B. This partnering initiative will not change the legal relationship of the parties to the Construction Contract or release nor relieve either party from any of the terms of the Construction Contract.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 32 16
PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for preparing and submitting a construction progress schedule for ENGINEER's use in determining if Work can be Substantially Complete within the Contract Time.

1.2 TYPE OF SCHEDULE

A. Bar chart schedule or critical path schedule if not indicated elsewhere.

1.3 SUBMITTALS

A. **Before construction**, submit a preliminary progress schedule per paragraph 2.5B1 of the General Conditions (Document 00 72 00).

B. **During construction** submit:

1. Updated progress schedule on a monthly basis.
2. A narrative report when the schedule does not reflect the Work process. Discuss recovery procedures shown in the schedule because of problem areas. Identify any costs to be paid by OWNER.
3. Promptly deliver to ENGINEER a revised progress schedule if work cannot be completed per the current schedule.

C. **At any time upon ENGINEER's request** and at no additional cost to the OWNER, submit a critical path schedule, in place of a bar chart schedule if work falls more than seven (7) Days behind schedule.

1.4 BAR CHART SCHEDULE (GANTT CHART)

A. Plan and record construction of Project using a conventional activity schedule chart analysis system. Include activities of Subcontractors and Suppliers:

1. Show complete sequence of construction activity networks as time scaled (squared) with starting time for all activities, in no less than weekly divisions from left to right, and with activities scheduled from **right to left**.
2. Provide a minimum of **25 activities** showing construction prosecution or preparation activities. Unit price contracts with ten or fewer bid items shall have a minimum of **10 activities**. Use the table of contents or bid schedule as the basis for defining activities.
3. Note periods of non-work when the non-working period exceeds three consecutive calendar days.
4. When employing "S" curve analysis, plot contract time vs. percent of contract completed.

1.5 CRITICAL PATH SCHEDULE

A. Plan and record construction of Project using a conventional critical path network analysis system:

1. Use activity-on-node (AON) or activity-on-arrow (AOA) format.
2. Divide long activities into small units so no single activity exceeds a total flow time (including float time) of **20 calendar days**.
3. Show finish to start path of activities. Schedule activities from right to left. Show longest construction time.

B . Precedence diagramming method (PDM) with start-to-start, finish-to-finish, and start-to-finish relationships are not acceptable.

1.6 CONTENT OF SCHEDULES

A. **Title Block**: Show on each page:

1. Project title, number and CONTRACTOR's name.
2. Date of submittal, revision number, page number, and Project status cutoff date.
3. Approval signatures for each Subcontractor.
4. Legend of symbols, codes and abbreviations.

5. Network nomenclature, e.g., "Detailed" or "Summary" or "Building Area" identification.

B. **Activities**: The following is provided as a guide in the development of schedule activities. Show:

1. Start and end dates of each phase of work.
2. Any special order and delivery dates.
3. Shop Drawings, product data and Sample submittal dates, and dates required for submittal approvals.
4. Decision dates for product specified by allowances, Selection of finishes, and critical material or equipment release order.
5. Product procurement and delivery dates.
6. Detailed construction activities, including all Subcontractors' work, oriented to identifiable work areas.
7. Fabrication of special material, equipment and their installation and testing.
8. Coordination activities, including utility relocations, separate contractors, etc.
9. Constraints between interrelated activities. Ensure that those constraints are compatible and coordinated with separate contractors.
10. Anticipated weather impacts, holidays, and change orders.
11. Certificates of compliance, submittal reviews, Substantial Completion review and progress schedule reviews, especially if submittals or schedules are not approved.
12. Specific dates for all special Inspections required before any utility "turn-on" including temporary power.
13. Cleanup, Final Inspection, Punch List.
14. Submittal of Record Drawings and maintenance manuals.
15. Anything that affects Work Completion.

C. **Float Time:**

1. Where float time exists, show activities at late-start/late-finish times and periods.
2. Allocate float time in the best interests of the Work. Float time shall not be owned solely by CONTRACTOR.
3. ENGINEER may notify CONTRACTOR of OWNER's claim to use any float time at any time.

1.7 **REVISIONS**

A. Revise the progress schedule if work falls behind.

B. Provide written narratives describing cause of delay for each impacted activity. Identify any cost to be charged against the OWNER.

C. Indicate progress of each activity, and new completion date of each activity.

D. Identify changes in scope and other changes since previous submittal.

E. Identify all planned actions for construction recovery such as:

1. Use of overtime or extended work hours and extended workweek.
2. Use of additional equipment.
3. Use of additional crews, or other auxiliary forces.
4. Projected cost to the OWNER.

F. Add extra work to schedule at no additional cost to OWNER, except as identified by Change Order.

1.8 **DISTRIBUTION**

A. Distribute copies of schedule per the General Conditions. Instruct recipients to promptly report, in writing, problems anticipated by projections shown.

1.9 **PERFORMANCE**

A. Prosecute Work in accordance with and measure all progress against the progress schedule.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General procedures and requirements for submittals during the course of construction.

1.2 CONTRACTOR REVIEW

A. Review submittals before transmittal. Determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

B. Coordinate submittals with requirements of Work and of Contract Documents.

C. Sign or initial each sheet of Shop Drawings and product data, and each sample label to certify compliance with requirements of Contract Documents. Notify ENGINEER in writing at time of submittal, of any deviations from requirements of Contract Documents.

D. Do not fabricate products or begin work that requires submittals until return of submittal with ENGINEER acceptance.

1.3 PROCEDURE

A. Transmit submittals to ENGINEER under transmittal form. Submit the number of copies that CONTRACTOR requires, plus the number of copies required by ENGINEER.

B. Comply with submittal sequences shown in the progress schedule.

C. When required by Laws and Regulations, affix licensed professional's stamp to submittal documents.

D. Identify pertinent Drawing sheet and detail number, and Specification section number.

E. Identify deviations from Contract Documents.

F. Identify the date when ENGINEER must complete review of submittal.

G. Provide space for CONTRACTOR and ENGINEER review stamps.

H. After ENGINEER's review of submittal, revise and resubmit as required, identifying changes made since previous submittal.

I. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.

1.4 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Title each drawing with Project name and number. Identify each element of drawings by reference to sheet number and detail or equipment schedule.

B. Identify field dimensions. Show relation to adjacent or critical features or work or products.

C. Provide sheet size adequate for ENGINEER's review.

1.5 PRODUCT DATA

A. Submit only pages which are pertinent. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

B. Modify product data by deleting information that is not applicable to the Work or by marking each copy to identify pertinent data.

C. Supplement standard information, if necessary, to provide additional information applicable to the Work.

D. Provide manufacturer's preparation, assembly and installation instructions.

1.6 SAMPLES

A. Submit 1 of each Sample required by Contract Documents. Samples shall show the quality, type, range of color, finish and texture of the material.

1.7 **CERTIFICATES**

A. Submit certificates, in duplicate, in accordance with requirements of each specification section.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 35 10
ACCEPTANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. ENGINEER responsibilities for acceptance.

B. Dispute resolution.

1.2 DEFINITIONS

A. **Acceptance Testing**: Testing done to verify product or work complies with the Contract Documents. ENGINEER usually accomplishes testing. CONTRACTOR's control testing is sometimes used.

B. **Independent Testing Agency**: A testing agency NOT owned by, affiliated with, or in any way associated with CONTRACTOR, or any of CONTRACTOR's Subcontractors and Suppliers, that is accredited by a national authority.

C. **Lot**: A lot is an isolated quantity of material produced essentially by the same process. Example: One (1) day production or 1500 tons.

D. **Sample**: A sample is one (1) measurement or count that represents a part or all of the Lot. Example: Five density measurements that represent the days' production (or Lot) are five (5) separate Samples.

1.3 ACCEPTANCE

A. **Acceptance of Product and Material**: Based upon visual examination or physical testing. ENGINEER may have such examination or testing done by a separate agency.

B. **Control Testing**: ENGINEER retains right to accept or reject material or work based upon CONTRACTOR's control testing. Should ENGINEER choose to use CONTRACTOR's control testing for acceptance, the following conditions must be met:

1. CONTRACTOR's testing agency meets Section 01 45 00 requirements.
2. CONTRACTOR has and follows an acceptable quality control plan.
3. Test results are submitted within 48 hours of test.
4. Acceptance criteria are met.

C. **Acceptance of Lots**: Samples in a Lot will be randomly collected:

1. A Lot may be evaluated on the basis of fewer Samples when the minimum specified number of Samples cannot be collected.
2. A Lot will not be accepted until ENGINEER accepts all sub-lots.
3. A Lot with a defective sub-lot may be accepted at reduced pay if an appropriate pay factor is used to determine pay adjustment for the whole Lot. **DO NOT apply reduced pay only against defective sub-lots.**

D. **Submittals**: Acceptance of submittal data supersedes specified criteria. Example: Mix design acceptance may alter specified mix design criteria.

1.4 DEFECTIVE WORK

A. Failure to detect any defective work or materials does not prevent later rejection when such defect is discovered, nor does it obligate ENGINEER for acceptance.

B. If work or material is obviously defective, it must be corrected even if it or they are not a part of a set of random samples.

C. Product or work that is assessed a pay adjustment or is later found defective does not reduce or change warranty provisions.

1.5 DISPUTE RESOLUTION

A. CONTRACTOR must provide basis of disagreement in writing to ENGINEER.

B. If CONTRACTOR desires to do any retesting, CONTRACTOR must submit a written plan to ENGINEER for approval. Any testing done without ENGINEER's written approval will be rejected.

C. Retesting must be performed by a mutually acceptable Independent Testing Agency.

D. Retesting for acceptance will be done at no cost to the OWNER.

E. ENGINEER reserves sole right not to utilize the retest results for evaluation of the work.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 42 19
REFERENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acronyms used in Contract Documents for reference standards.

B. Applicability of referenced standards.

C. Provision of referenced standards at site.

1.2 QUALITY ASSURANCE

A. For products or workmanship specified by trade association or government agency, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The latest edition of the standards and their supplements referenced as a part of any Section are incorporated in that Section to the extent specified therein. In any case of conflict, the requirements of the Section shall prevail. The date of the standard is that in effect as of the bid date, or date of OWNER-CONTRACTOR agreement when there are no bids, except when a date is specified.

C. When required by individual specification Section, obtain copy of standard. Maintain copy at job site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.3 TRADE ASSOCIATIONS

A. Acronyms for industry standards.

AAMA American Architectural Manufacturer's Association.
AAN American Association of Nurserymen, Inc.
AASHTO American Association of State Highway and Transportation Officials:
ACI ACI Standards:
ACPA American Concrete Pipe Association.
AGC Associated General Contractors of America.
AI Asphalt Institute.
AIA American Institute of Architects.
AISC American Institute of Steel Construction.
AMRL Aashto Materials Reference Library.
AISI American Iron Standards Institute.
ANSI American National Standards Institute.
APA American Plywood Association.
APWA American Public Works Association.
ASME American Society of Mechanical Engineers.
ASPA American Sod Producers Association.
ASSE American Society of Sanitary Engineering.
ASTM American Society for Testing and Materials.
ATSSA American Traffic Safety Services Association, Inc.
AWPA American Wood-Preservers' Association.
AWPB American Wood-Preservers' Bureau.
AWS American Welding Society.
AWWA American Water Works Association.
BIA Brick Institute of America.
CLFMI Chain Link Fence Manufacturers Institute.
CRSI Concrete Reinforcing Steel Institute:
CSI Construction Specifications Institute.
EIA Electronic Industries Association.
GRI Geosynthetic Research Institute
ICBO International Conference of Building Officials.
ICEA Insulated Cable Engineer's Association.

ICPI Interlocking Concrete Pavement Institute.
IMIAC International Masonry Industry All-Weather Council.
IMSA International Municipal Signal Association.
ISA International Society of Arboriculture.
ITE Institute of Transportation Engineers.
MBMA Metal Building Manufacturer's Association.
NAA National Arborist Association.
NASSCO National Association of Sewer Service Companies
NEC National Electric Code (from NFPA).
NEMA National Electric Manufacturers Assoctiation.
N.F.P.A. National Forest Products Association.
NFPA National Fire Protection Association.
NPA National Particleboard Association.
NPCA National Precast Concrete Association.
NSF National Sanitation Foundation.
PCA Portland Cement Association.
PCI Prestressed Concrete Institute.
PPI Plastic Pipe Institute.
S.D.I. Steel Door Institute.
SSPC Steel Structures Painting Council.
UBC Uniform Building Code (from ICBO).
UL Underwriters' Laboratories, Inc.
WAQTC Western Alliance for Quality Transportation Construction.
WWPA Western Wood Products Association.

1.4 **GOVERNMENT AGENCIES**

A. Acronyms for Federal and State governments.
CE Corps of Engineers.
CS Commercial Standard.
DOT Department of Transportation (Federal Highway Administration).
FS Federal Specification (General Services Administration).
MIL Military Standardization Documents.
NBS National Bureau of Standards.
PS Product Standard of NBS.
REA Rural Electrification Administration.
UAC Utah Administrative Code
UCFC Utah Community Forest Council.
UDOT Utah Department of Transportation.
USPS United States Postal Service.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 43 00
QUALITY ASSURANCE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. CONTRACTOR responsibilities for quality assurance.

1.2 **WORKMANSHIP**

A. Employ workers, Subcontractors and Suppliers who can produce the specified quality.

B. Supervise and manage workmanship and site conditions so work complies with Contract Documents.

C. Comply with industry standards except where more restrictive tolerances, specified requirements, or precise workmanship is required.

1.3 **INSTALLER**

A. **Qualifications**: Employ installers with at least three (3) years of successful installation experience on work similar to that required for Project.

B. **Certificates**: When required or request by ENGINEER, submit copy of installer's certifications issued by certification agency.

C. **Field Services**:

1. Examine areas and conditions under which materials and products are to be installed.
2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
3. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration and racking.
4. Make new finishes match adjacent or old finishes.

1.4 **MANUFACTURER**

A. **Qualifications**: Employ firms regularly engaged in manufacture of materials and products of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. **Instructions**: When required in individual Section, submit manufacturer's instructions in the quantity required for product data, delivery, handling, storage, assembly, installation, start-up, adjusting, balancing, and finishing as appropriate:

1. Should instructions conflict with Contract Documents, request clarification before proceeding.
2. Require compliance with instructions in full detail, including each step in sequence.

C. **Certificates**: When required or request by ENGINEER, prove that manufacturer's product meets or exceeds specified requirements.

D. **Field Services**: Provide qualified representative to observe field conditions, conditions of surfaces and installation, quality of workmanship and start-up of equipment. Test, adjust, and balance equipment. Make written report of observations and recommendations to ENGINEER.

1.5 **MOCK-UPS**

A. Erect field samples and mock-ups in location(s) acceptable to ENGINEER.

B. Assemble and erect complete, with specified attachment and anchorage devices, flashings, seals, finishes, and similar items.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 43 40

RESIDENT SUPERINTENDENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Minimum qualifications.

B. Duties in general.

1.2 QUALIFICATIONS

A. Fluent in English.

B. Completed at least three (3) projects of similar size and nature as the one specified in the Contract Documents.

C. Capable and authorized to take prompt corrective measures to protect the environment and public health, and to protect the health and safety of workers.

D. Authorized to approve Change Orders.

1.3 DUTIES IN GENERAL

A. **On-site Presence**: Be on-site during work activity.

B. **English Proficiency**: Keep a person at each work location who is fluent in English who can respond to the concerns of anybody affected by construction.

C. **Contract Documents**:

1. Know the content and intent of the Contract Documents.

2. Keep on-site all construction Plans; Project Manual; Plans or Specifications associated with updates and Change Orders, Submittals; traffic control plans; copies of the Standard Plans and Standard Specifications.

D. **Labor**: Provide adequate labor to operate construction equipment, finish concrete, perform land survey work, or to monitor or adjust traffic and pedestrian barricades.

E. **Subcontractors and Suppliers**: Direct means and methods of work so their work complies with Plans and Specifications.

F. **Safety and Protection**: Enforce the work site safety plan. Protect ENGINEER's personnel, the general public and the environment per state or federal Laws and Regulations.

G. **Quality Assurance**: When materials and installed work require laboratory testing, verify required laboratory personnel are present to do the tests and the tests are made per industry standard.

H. **Conflicts**: Notify ENGINEER of any drawing, specification, or design conflict so it can be resolved before construction is adversely affected. Recommend any desirable changes to ENGINEER.

1.4 CONTRACTOR's DUTIES

A. Empower Resident Superintendent with all necessary authority, equipment, product, labor and budget to prosecute the Work within the Contract Time.

B. Suspend Work if Resident Superintendent is not on-site or if any of the Section requirements in this manual are not being met. Contract Time shall continue to run.

C. Replace the Resident Superintendent with one acceptable to the ENGINEER when directed by the ENGINEER.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. CONTRACTOR responsibilities for quality control.

1.2 **QUALITY ASSURANCE**

A. Employ an agency or staff to assure installed product and materials comply with Contract Documents, and to assure inspections, tests, and other services comply with industry standards.

B. Use an AMRL (AASHTO Materials Reference Library) certified laboratory that has personnel certified by WAQTC (Western Alliance for Quality Transportation Construction).

C. When requested by ENGINEER, provide a professional opinion from a testing agency concerning test results and quality of work covered by testing performed.

D. Do more testing, if, in ENGINEER's opinion, work is not being adequately controlled.

1.3 **TESTING AGENCY**

A. Provide sufficient personnel and cooperate with ENGINEER and CONTRACTOR in performing testing service.

B. Obtain and secure samples using procedures specified in the applicable testing code.

C. Perform product testing in accordance with applicable requirements of the Contract Documents.

D. Correlate tests with ENGINEER's acceptance tests.

E. When an out-of-tolerance condition exists, perform additional control testing until tolerance is attained.

F. Report any non-compliance of materials and mixes to CONTRACTOR and ENGINEER immediately.

1.4 **SUBMITTALS – CONTRACTOR**

A. **Before Construction**: Identify:

1. Name, address and telephone number of testing agency.
2. Person whom agency has charged with engineering managerial responsibility.
3. Licensed professional for testing agency who is to review services.
4. Names and levels of certification and years of experience of testing agency's laboratory and field technicians.

B. **During Construction**: Submit quality control test data requested by ENGINEER to demonstrate work performed complies with Contract Documents.

1.5 **SUBMITTALS – TESTING AGENCY**

A. **During Construction**: Submit field test results immediately to ENGINEER and CONTRACTOR or not later than day of test. Submit laboratory test results within 48 hours of determination.

B. **After Construction**: Submit a final summary report in tabular form. Show each failed test and its corresponding passing test.

C. **Reports**: Include on all reports:

1. Project title, number and date.
2. Date, time and location of test.
3. Name and address of material Supplier.
4. Identification of product being tested and type of test.
5. Testing results and interpretation of results.
6. Name of technician(s) who sampled and who performed test.

1.6 **LIMITS ON TESTING AGENCY**

A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency may not suspend work.

C. Agency has no authority to determine acceptance for ENGINEER.

D. Samples must be collected and secured only by the testing agency.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Material furnished from sources that have been found satisfactory under OWNER’s or ENGINEER's normal testing and sampling procedures may be used in the Work.

B. Materials that are supported with a Supplier's certificate of compliance may be used in the Work. Certificate must be in possession of CONTRACTOR for review by ENGINEER before use.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Traffic control requirements.

1.2 REFERENCES

A. ASTM D4956: Retroreflective Sheeting for Traffic Control.

B. ATSSA: American Traffic Safety Services Association, Inc.

C. Instructions to Flaggers. Publication of UDOT.

D. MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

E. Work Zone Traffic Control Guide: Publication of the Utah LTAP Center.

1.3 SUBMITTALS

A. Traffic control plan within 10 days of receiving the Notice of Intent to Award.

B. Flagger or traffic control technician certificates when requested by ENGINEER.

1.4 TRAFFIC CONTROL PLAN

A. Create a traffic control plan using the following resources. Resolve discrepancies between resources in descending order shown:

1. MUTCD.
2. Work Zone Traffic Control Guide.
3. ATSSA.

B. Include the following documentation as part of the traffic control plan.

1. Written description of phasing.
2. Drawing showing phasing (if required for clarity).
3. Drawing showing placement of traffic control devices.

C. Show how to move pedestrians through or around the Work site.

D. Show how to handle signalized intersections.

E. Meet grade, slope and protection requirement of the Americans with Disabilities Act (ADA).

1.5 TRAFFIC CONTROL TECHNICIAN

A. Certified by ATSSA or AGC.

1.6 FLAGGER

A. Certified by ATSSA, AGC or UDOT.

B. Equipment:

1. 24” x 24” “Stop/Slow” sign.
2. 6” to 8” long red wand for night flagging.
3. Light plant for night flagging.

C. Clothing:

1. Clothed; full length pants and long or short sleeved shirt.
2. Hard toed shoes.
3. Orange or orange/lime green with 50-percent greater orange Type III safety vest. Type III required both day and night.
4. Orange hard hat with 10 square inches of retroreflective material.

5. Night clothing to be reflectorized.

PART 2 PRODUCTS

2.1 PAVEMENT MARKINGS, SIGNS, BARRICADES

A. MUTCD.

B. Channelizing Devices: Crash worthy plastic cones, drums and barricades.

C. Reflective Sheeting: ASTM D4956.

D. Pavement Markings: Section 32 17 23.

PART 3 EXECUTION

3.1 FLAGGING

A. MUTCD.

3.2 TRAFFIC CONTROL DEVICES

A. Install before work activities begin.

B. Maintain to ensure proper, continuous function.

C. Remove when no longer needed.

3.3 TEMPORARY PAVEMENT MARKINGS

A. Renew if stripes and markings have lost their original visual effectiveness.

END OF SECTION

SECTION 01 57 00
TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for controlling surface and subsurface environmental conditions at a construction site, and related areas under the CONTRACTOR's responsibility.

B. Requirements for removal of physical evidence of temporary controls upon completion of the Work.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 121 Straw bale barrier.

Plan 122 Silt Fence

Plan 123 Diversion Dike

Plan 124 Inlet protection

Plan 125 Equipment and vehicle wash down area.

Plan 126 Stabilized roadway entrance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Temporary Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 NOISE CONTROL

A. Use equipment that is equipped with noise attenuation devises. Comply with local Laws and Regulations.

B. Control construction noise in residential areas from 9:00 pm to 7:00 am.

3.2 DUST AND MUD CONTROL

A. Comply with Utah State air quality regulations.

B. Provide suitable equipment to control dust or air pollution caused by construction operations.

C. Provide suitable mud and dirt containment, so Work site, access roadways and properties adjacent to the Work site are kept clean. Typical containments are shown in the Drawings or APWA Plan 121, 122, 123, and 124.

3.3 SURFACE WATER CONTROL

A. Control on-site surface water. Provide proper drainage so flooding of site or adjacent property does not occur.

B. Provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the site.

C. Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of Work site area.

D. Provide berms or channels as necessary to prevent flooding or saturation of Subgrade. Promptly remove all water collecting in depressions.

E. Dispose of water in a manner that will not cause damage to adjacent areas or facilities.

3.4 **GROUND WATER CONTROL**

A. Provide a dewatering system sufficient to maintain excavations and foundations dry and free of water on a 24-hour basis.

B. Notify ENGINEER, in writing, if groundwater conditions differ from conditions shown in the Bid Documents, or in any soil test data that has been supplied.

C. Remove all dewatering facilities when no longer required.

D. Dispose of water in a manner that will not cause damage to adjacent or downstream areas or facilities.

3.5 **POLLUTION CONTROL**

A. **Soil**: Prevent contamination of soil from discharge of noxious substances (including engine oils, fuels, lubricants, etc.). Typical arrangements are shown in the Drawings for APWA Plans 125 and Plan 126. Excavate and legally dispose of any such contaminated soil off-site and replace with acceptable compacted fill and topsoil.

B. **Water**: Prevent disposal of wastes, effluent, chemicals, or other such substances adjacent to or into streams, waterways, sanitary sewers, storm drains, or public waterways. Perform any emergency measures required to contain any spillage.

C. **Air**: Control atmospheric pollutants.

3.6 **EROSION CONTROL**

A. Use measures such as berms, dikes, dams, sediment basins, fiber mat netting, gravel, mulches, slopes, drains and other erosion control devices or methods to prevent erosion and sedimentation.

B. Provide construction and earthwork methods which control surface drainage from cut, fill, borrow, and waste disposal areas, to prevent erosion and sedimentation.

C. Inspect earthwork during execution to detect any evidence of the start of erosion. Apply corrective measures as required.

END OF SECTION

SECTION 01 64 00

OWNER-FURNISHED PRODUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. OWNER and CONTRACTOR responsibilities for items furnished by the OWNER.

1.2 OWNER'S RESPONSIBILITIES

A. Arrange for delivery of Shop Drawings, product data, Samples, manufacturer's instructions, and certificates to CONTRACTOR.

B. Deliver Supplier's bill of materials to CONTRACTOR.

C. Arrange and pay for delivery to site in accordance with CONTRACTOR's progress schedule.

D. Inspect deliveries jointly with CONTRACTOR.

E. Submit claims for transportation damage.

F. Arrange for replacement of damaged, defective, or missing items.

G. Arrange for manufacturer's field services. Arrange for and deliver manufacturer's warranties and bonds to CONTRACTOR.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Designate submittal and delivery dates for each product in a schedule of OWNER furnished items. Submit this schedule concurrently with the first submission of the progress schedule.

B. Review Shop Drawings, product data, Samples, and other submittals.

C. Inspect deliveries jointly with ENGINEER, record shortages, and damaged or defective items.

D. Handle products at site, including uncrating and storage.

E. Protect products from damage, and from exposure to element.

F. Assemble, install, connect and adjust products.

G. Arrange for installation Inspections required by public authorities.

H. Repair or replace items damaged or lost.

1.4 CONSTRUCTION DELAY

A. If OWNER furnished items may cause delay in the critical path of progress schedule notify ENGINEER in writing. Only changes to the critical path will be evidence as changes in the Contract Time.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 65 00

PRODUCT DELIVERY AND HANDLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic requirements for product delivery and handling on site.

1.2 DELIVERY

A. Arrange for delivery of products in accordance with progress schedule to facilitate instruction before installation.

B. Coordinate deliveries to avoid conflict with work, conditions at site, and:

1. Work of separate contractors, or OWNER.
2. Limitations of storage space.
3. OWNER's use of premises.

C. Deliver products in undamaged condition in original containers or packaging, with identifying labels for handling, storing, unpacking, protecting and installing intact and legible.

D. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts, and to facilitate assembly.

E. Immediately upon delivery, inspect shipment to determine:

1. Product complies with requirements of Contract Document reviewed submittals.
2. Quantities are correct.
3. Containers and packages are intact, labels are legible.
4. Products are properly protected and undamaged.

1.3 PRODUCT HANDLING

A. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction space.

B. Coordinate delivery with installation time to ensure minimum holding time for items that are hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

C. Handle products to prevent bending or over-stressing.

D. Lift heavy components at designated lifting points.

E. Discard damaged products.

1.4 ACCESS

A. Identify access to CONTRACTOR's work and office area by use of signs so agents, delivery trucks, and other parties desiring contact with CONTRACTOR may do so.

B. In security zones, prevent unauthorized personnel from proceeding outside of CONTRACTOR's work and office areas.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND PROTECTION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Storage, handling, and protection of products to be incorporated in the Work.

1.2 **SUBMITTALS**

A. Submit a copy of written permission if property other than OWNER's is used to store materials or equipment.

1.3 **STORAGE**

A. Store products immediately on delivery, per manufacturer's instructions, with seals and labels intact and legible.

B. Store products subject to damage by elements in weather-tight enclosures:

1. Maintain temperatures within ranges required by manufacturer's instructions.
2. Provide humidity control for sensitive products, as required by manufacturer's instructions.
3. Store unpacked products on shelves, in bins or in neat piles, accessible for Inspection.

C. Provide substantial platforms, blocking or skids to support fabricated products above ground, to prevent soiling or staining. Cover products, subject to discoloration or deterioration from exposure to the elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation.

D. Store loose granular materials on solid surfaces to prevent mixing with foreign matter. Provide surface drainage to prevent flooding or ponding of rainwater. Prevent mixing with refuse or injurious materials. Do not store construction materials and equipment in municipal rights-of-way for more than five (5) days.

E. Arrange storage in manner to provide easy access for inspection.

1.4 **STORAGE ON SIDEWALK, CURB AND GUTTER**

A. Do not remove, block, or otherwise render sidewalks unusable by either storage of construction equipment and materials, or construction procedures used, unless a safe, usable, alternate walkway at least four (4) feet wide is provided.

B. Maintain curb and gutter clean and clear of debris, dirt, or excavated materials at all times.

1.5 **MAINTENANCE OF STORAGE**

A. Maintain periodic system of inspection of stored products on scheduled basis to assure that:

1. State of storage facilities is adequate to provide required conditions.
2. Required environmental conditions are maintained.
3. Surfaces of products exposed to elements are not adversely affected.

B. Any weathering of products, coatings and finishes is not acceptable.

1.6 **STORAGE AREA RESTORATION**

A. Remove all plant, equipment and stockpiles from the work site.

B. Restore all storage areas and service roads to prior condition without any additional cost to OWNER.

1.7 **PROTECTION**

A. Installed Product: Provide protection of installed products to prevent damage from subsequent operations. Remove when no longer needed, before completion and acceptance of Work.

B. Finished Surfaces: Provide coverings to protect finished surfaces from damage:

1. Cover projections, wall corners, jambs, sills and soffits of openings, in areas used for traffic and for passage of products in subsequent work.
2. Protect finished floors and stairs from dirt and damage:
   a. In areas subject to foot traffic, secure heavy paper, sheet goods, or other materials in place.

b. For movement of heavy products, lay planking or similar materials in place.

c. For storage of products, lay tight wood sheathing in place.

d. Cover walls and floor of elevator cars, and unprotected surfaces of car doors when used by construction personnel.

C. Waterproofed and roofed surfaces:

1. Prohibit use of surfaces for traffic of any kind, and for storage of any products.

2. When some activity must take place in order to complete work, obtain recommendations of Supplier and installer for protection of surface.

a. Install recommended protection and remove on completion of that activity.

b. Restrict use of adjacent unprotected areas.

D. Security: Provide security for materials, equipment and tools. OWNER will not protect Work from vandalism.

1.8 **PROTECTION OF LAWNS AND LANDSCAPING**

A. Protect planted lawn and landscaped areas from pedestrian and vehicular traffic.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 71 13
MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mobilization and demobilization requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 412 Invert Cover.

1.3 DEFINITIONS

A. **Mobilization** includes bringing all necessary equipment to the site to do the Work. It includes all labor, materials, and equipment to set up temporary offices, buildings, facilities, signs, and utilities.

B. **Demobilization** includes removing all construction equipment and debris so site is left clean.

1.4 TEMPORARY FACILITIES

A. Field Office: CONTRACTOR's choice.

B. Utilities: Provide power, telephone, water, storm and sanitary facilities, and all other temporary utilities required.

C. Security and Protection: Construct and maintain temporary fencing for the protection of materials, tools, and equipment. Obtain prior approval for all fence locations.

D. Construction and Support: Set up and maintain in a neat and orderly manner temporary roads and paving, dewatering facilities, enclosures, identification signs and bulletin boards, waste disposal and temporary heat. Provide and maintain temporary all weather pedestrian walk ways and road detours.

E. Invert Cover: Install covers as shown in APWA Plan 412 or Drawings. Installation must be tight so no debris can by-pass the cover and enter the piping below.

PART 2 PRODUCTS

2.1 MATERIALS

A. Temporary Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 INSTALLATIONS

A. Relocate and modify temporary facilities as required.

B. Install temporary utility service or connect to existing service.

C. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access. Use of gasoline-burning, open flame, or salamander type heating units is prohibited.

D. Use local standards and codes for erection of adequate fences and barricades. Maintain all signing, barricades, fencing, drainage, and other items as required to protect public and private property from damage caused by construction operations.

E. Coordinate location of storage areas to avoid interference with drainage, traffic, or private property.

F. Provide and maintain all temporary signage required by the Work.

3.2 REMOVALS

A. Completely remove temporary materials and equipment:

1. When construction needs can be met beause of permanent installation, and
2. At completion of the Work.

B. Clean or repair damage caused by installation or use of temporary facilities.

C. Restore areas to original or to specified conditions at completion of the Work.

END OF SECTION

SECTION 01 71 23
CONSTRUCTION LAYOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction surveying requirements.

1.2 SUBMITTALS

A. Before contract closeout submit:

1. Documentation to verify accuracy of survey work.
2. When required by Laws and Regulations, submit a certificate signed by a licensed professional certifying that elevations and locations of improvements conform with the Contract Documents.
3. All survey data, survey information showing dimensions, location angles and elevations of construction on contract Record Documents.

1.3 SURVEY REFERENCE POINTS

A. Known basic horizontal and vertical control points for the Project are indicated.

B. Locate and protect survey control points before starting site work, and preserve all permanent reference points during construction.

C. Notify ENGINEER in writing within 24 hours of any survey work changes or clarifications required for Project. Secure written authorization before making any changes or relocations.

D. Report in writing when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

E. Replace construction stakes damaged or destroyed by CONTRACTOR at no additional cost to OWNER.

PART 2 PRODUCTS Not used

PART 3 EXECUTION

3.1 PROJECT SURVEY REQUIREMENTS

A. Any work done without line and grade established by CONTRACTOR is at CONTRACTOR's own risk.

B. Locate and layout by instrumentation and similar appropriate means to include but not limited to:

1. Pavement subgrade and finish grade.
2. Site improvements:
   a. Stakes for grading, fill and topsoil placement.
   b. Slope elevations.
   c. Utility locations and invert elevations.
3. Batter boards for structures.
4. Retaining wall locations and elevations.
5. Curb and gutter alignment and grade.
6. Building foundations, column locations and floor levels.
7. Controlling lines and levels required for civil, mechanical, and electrical trades.

END OF SECTION

SECTION 01 71 34
SURVEY REFERENCING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of reference marks.

B. Making permanent records of marks set.

1.2 **REFERENCES**

A. **APWA (Utah) Standards:**

Plan 271 Corner and boundary markers.

Plan 272 Monument cap and base.

1.3 **SUBMITTALS**

A. Field notes in 8 1/2 inches x 11 inches format or in standard field book form. Before construction begins and after construction ends show the following:

1. All corners, points, or monuments which may be disturbed, damaged, moved, removed, covered, or destroyed by construction activity. Describe their kind, size, location, and any other data relating thereto.

2. All corners, points, or monuments which are replaced, established, or reestablished, lines of survey, bearings, basis of bearings, scale of drawing, structures containing reference marks, and picture drawings of each mark installed.

3. Found corners, points, or monuments, describing in detail the size, type, location and ownership.

4. A north arrow, length of lines, scale of drawing, weather, temperature, errors of closure, and method of adjustment.

5. Land surveyor's signature and seal on each tie-sheet record.

B. If any survey point, monument, or line is disturbed or destroyed before referencing (tie-out), reestablish that point, monument, or line at no additional cost to OWNER, and submit a record of survey plat to the governing agency to show how its location was reestablished.

C. “Corner File Report” that complies with applicable Laws and Regulations.

1.4 **QUALITY ASSURANCE**

A. Comply with all pertinent surveying codes, Laws and Regulations including but not limited to Utah State Code Title 17 Chapter 23 – County Surveyor.

PART 2 PRODUCTS

2.1 **BRASS TAG**

A. Imprinted with land surveyor's license number or business name fastened with a 1-inch-long brad to:

1. a 3/8-inch diameter and 1 1/4-inch-deep lead plug pounded into a hole drilled in a concrete structure, or

2. a cement water paste poured into the top of a two (2) inches diameter 24 inches long cast iron pipe driven into the ground.

B. Depress tag and brad a minimum of 1/8-inch below surface plane of concrete structure or end of pipe.

2.2 **MONUMENTS**

A. Provide cap as shown in the Drawings or APWA Plan 272. Cap bears the license number, business name, or government agency name.

2.3 **CORNER, BOUNDARY, REFERENCE MARKS**

A. On rebar, pipe markers, and on flat mortar or concrete surfaces free from movement, provide surveyor's tag as shown in the Drawings or APWA Plan 271.

2.4 **RECORD OF SURVEY**

A. Mylar sheet complying with applicable Laws and Regulations for providing plat survey control.

2.5 **OTHER MATERIALS**

A. Select all other materials, not specifically described but required for proper completion of work of this Section.

PART 3 EXECUTION

3.1 **REFERENCE MARKS**

A. Furnish and install reference marks set in concrete or mortar in sufficient number and durability to assure the perpetuation of facile replacement of any survey point, monument, or line.

B. Install reference marks where location of section corner or survey monuments are likely to be disturbed or destroyed, or where difficult terrain is encountered.

C. When specified or for new subdivision work, install reference marks for lot lines in concrete curbs or sidewalks. If not available, install witness monuments in approved locations.

3.2 **REFERENCE SURVEY MONUMENTS BEFORE DISTURBANCE**

A. Obtain local jurisdiction's monument permit not less than 72 hours before disturbing, damaging, moving, removing, covering, or destroying any existing survey monument.

B. Pay all costs and submit all pertinent data when replacing monuments not referenced.

3.3 **REFERENCING SURVEY POINTS AND LINES**

A. Reference all survey points and lines which may be disturbed or destroyed by construction operations using reference marks.

B. Locate reference marks on lines or extensions of lines that the survey points designate.

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cutting and patching to:
   1. Fit several parts together, to integrate with other work.
   2. Uncover work to install work done out of sequence.
   3. Remove and replace defective and non-conforming work.
   4. Remove Samples of installed work for testing.
   5. Provide openings in non-structural elements for penetrations of mechanical and electrical work.

1.2 SUBMITTALS

A. Submit written request in advance of cutting and patching that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather-exposed or moisture-resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight-exposed elements.
   5. Work of OWNER or separate contractor.

B. Include in request:
   1. Identification of Project.
   2. Location and description of affected work.
   3. Necessity for cutting and patching.
   4. Description of proposed work, and products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on work of OWNER or separate contractor.
   7. Written permission of affected separate contractor.
   8. Date and time work will be executed.

PART 2 PRODUCTS

2.1 MATERIALS

A. Those required for original installation.

B. For any change in materials, submit request for substitution, Section 01 25 00 requirements.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions, including elements subject to damage or movement during modifications to completed work.

B. After uncovering, inspect conditions affecting performance of work.

C. Beginning of Modification work constitutes acceptance of existing conditions.

3.2 **PREPARATION**

A. Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of work from damage.

B. Provide protection from elements for areas which may be exposed by work.

3.3 **PERFORMANCE**

A. Execute work by methods to avoid damage to existing structures and other work, and which will provide proper surfaces to receive patching and finishing.

B. Employ original installer if possible to be responsible for modification work on weather-exposed and moisture-resistant elements, and exposed to view surfaces.

C. Restore Work with new products per requirements of Contract Documents.

D. Fit Work, to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

E. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 13
PROGRESS CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning and disposal of waste materials, debris, and rubbish.

B. Cleaning of Work before Final Inspection.

1.2 SUBMITTALS

A. Before Project Closeout: Certificate of disposal of Hazardous Waste if applicable.

1.3 JOB CONDITIONS

A. On Site Burning: Not permitted.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

A. Use only materials which will not create hazards to health or property, and which will not damage surfaces.

B. Use only cleaning materials recommended by manufacturer of item being cleaned.

PART 3 EXECUTION

3.1 CLEANING DURING CONSTRUCTION

A. Initiate and maintain a specific cleaning program to prevent accumulation of debris. Maintain areas under CONTRACTOR's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Provide covered containers for deposit of debris and rubbish.

C. Periodically clean interior areas to provide suitable conditions for finish work.

D. Remove debris and rubbish from closed or remote spaces before closing the space.

E. Broom clean interior areas before start of surface finishing, and continue cleaning on an as-needed basis.

F. Control cleaning operations so dust and other particulate will not adhere to wet or newly-coated surfaces.

3.2 DISPOSAL DURING CONSTRUCTION

A. Regularly remove and legally dispose of waste materials, debris, and rubbish from site.

B. Provide additional collections and disposal of debris whenever the periodic schedule is inadequate to prevent accumulation.

3.3 CLEANING BEFORE FINAL INSPECTION

A. Site:

Clean exposed-to-view surfaces.

Remove waste, debris, and surplus materials from site.

Clean grounds; paved areas and sweep clean.

Rake clean other surfaces.

B. Building:

Clean interior and exterior exposed-to-view surfaces.

Remove temporary protection and labels not required to remain.

Clean finishes free of dust, stains, films and other foreign substances.

Clean transparent and glossy materials to a polished condition. Polish reflective surfaces to a clear shine.

Vacuum clean carpeted and similar soft surfaces.

Clean resilient and hard-surface floors.

Clean surfaces of equipment; remove excess lubrication.

Clean plumbing fixtures to sanitary condition.

Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.

Clean lighting fixtures and lamps.

Continue cleaning until acceptance.

Remove waste and debris from roofs, gutters, area ways, and drainage systems.

END OF SECTION

SECTION 01 75 16

STARTUP PROCEDURES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Procedural requirements for start-up, testing, adjusting and balancing systems.

1.2 **COORDINATION**

A. Coordinate services with work of various trades to ensure rapid completion of services.

B. Report any deficiencies noted during performance of services to allow immediate corrective action.

1.3 **JOB CONDITIONS**

A. Before start of testing, adjusting and balancing, verify required job conditions:

1. Systems installation is complete and in full operation.
2. Conditions are within a reasonable range relative to design conditions.
3. Special equipment such as electronic equipment are in full operation.

B. Verify that special product or equipment requirements for preparation, testing and balancing have been met for elements of each of the systems that require testing.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Provide material required to perform start-up of each respective item of equipment and system before beginning of test, adjust and balance procedures.

2.2 **VERIFICATION OF PERFORMANCE**

A. Provide an independent certifying association to provide information and assistance required to adjust and balance system.

PART 3 EXECUTION

3.1 **START-UP**

A. Start up completed facility with appropriate personnel present.

B. Perform specified services and if necessary employ and pay for a manufacturer approved organization to perform specified services.

C. Provide appropriate utilities and instrumentation required for starting, testing, adjusting and balancing operations:

1. Make instruments available to ENGINEER to facilitate spot checks during testing.
2. Retain possession of instruments, remove from site at completion of services.

D. Comply fully with procedural standards of certifying association under whose standards service will be performed.

1. Execute each step of the prescribed procedure without omission.
2. Accurately record the required data.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of operation and maintenance manual to include compilation of product data, related information, and instructions for systems and equipment.

B. Instruction of OWNER's personnel in maintenance of products and in operation of equipment and systems

C. Schedule of required submittals.

1.2 FORMAT

A. Prepare data in the form of an instructional manual.

B. Consult with ENGINEER to determine format requirements.

1.3 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of ENGINEER and CONTRACTOR with name of responsible parties, Schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Record Documents as maintenance drawings.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

F. Guaranties and Warranties: Copies of each showing dates of expiration.

1.4 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Give function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.

C. Include as installed color coded wiring diagram.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequence. Include regulation, control, stopping, shutdown and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair and reassembly instructions: and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide as-installed control diagrams by controls manufacturer.

K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

L. Include test and balancing reports.

M. Additional Requirements: As specified in individual Sections.

1.5 **INSTRUCTION OF OWNER'S PERSONNEL**

A. Before Substantial Completion, instruct OWNER's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in Operating and Maintenance Manual when need for such data becomes apparent during instruction.

1.6 **SUBMITTALS**

A. Submit two (2) copies of preliminary draft or proposed formats and outlines of contents before start of Work.

B. For equipment, or component parts of equipment put into service during construction and operated by OWNER, submit documents within 10 days after acceptance.

C. Submit one (1) copy of completed volumes in final form 15 days before Final Inspection. Revise content of documents as required before final submittal.

D. Submit six (6) copies of revised volumes of data in final form within 14 calendar days after complete system start-up.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for collecting, maintaining, updating, and submitting Record Documents.

1.2 DEFINITIONS

A. **Record Documents**: Those documents maintained and annotated by CONTRACTOR during construction for recording "as built" condition of the Work.

1.3 CONSTRUCTION PHOTOGRAPHS

A. Provide electronic photographs when specified in the Contract Documents starting with a series of photographs before the start of any physical construction, and continuing for as long as the Work progresses:

1. Provide not less than 12 different subjects or angles of view each time from different locations in the Project area at intervals not exceeding one (1) month.
2. On each photograph indicate the date, job title, photograph identification, and direction the camera was facing.
3. With each request for payment.
4. Upon completion of the Work, submit all electronic pictures on disc. ENGINEER may request hard copies of the pictures.

B. Secure ENGINEER's approval if a video tape is to be substituted for the photograph prints.

1.4 DOCUMENTS ON SITE

A. Keep at job site 1 copy of each of the following, if issued for the Work:

1. Contract Drawings.
2. Project Manual.
3. Addenda.
4. Reviewed Shop Drawings, product data and Samples.
5. Modifications to the Contract Documents.
6. Field test records.
7. Inspection certificates.
8. Manufacturer's certificates.
9. Survey documentation.
10. Storm water pollution prevention plan (SWPPP).
11. All related permits.

B. Do not use record documents for construction purposes.

C. Store Record Documents in a location, apart from documents used for construction.

D. Maintain Record Documents in a clean, dry, legible condition.

E. Provide adequate files and racks for storage of Record Documents that will allow ready access for review and updating.

F. Make Record Documents available at all times for review and Inspection by ENGINEER.

1.5 MARKING DEVICES

A. Red colored waterproof for all marking unless requested otherwise.

1.6 RECORDING

A. Clearly and legibly label each document "PROJECT RECORD".

B. Number Record Documents in a manner which will allow ready retrieval of documents and allow indexing of documents for submittal to ENGINEER.

C. Update Record Documents as work occurs to show the current status of the Work.

D. Do not permanently cover or conceal any work until all required information has been recorded on the Record Documents.

E. Contract Drawings: Legibly mark contract Drawings to record following actual construction information:

1. Measured depths of various elements of foundation or finish grading in relation to finish floor datum or other permanent benchmark.
2. Measured horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
3. Measured location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of construction.
4. Field changes of dimension and detail.
5. Changes made by contract Modifications.
6. Details not contained in original contract Drawings.

F. Project Manual and Addenda: Legibly update each to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by contract Modifications.
3. Other technical matters and details included in the Work, but not originally specified.

G. Shop Drawings: Maintain reviewed Shop Drawings as Record Documents; legibly annotate drawings to record changes made to Shop Drawings.

H. Product Data and Samples: Maintain reviewed product data and Samples as Record Documents; update and document any variations from the reviewed product data and Samples after acceptance.

1.7 SUBMITTAL OF DOCUMENTS

A. At the completion of the Work, submit all Record Documents.

B. Accompany the submittal with a transmittal letter, in duplicate, containing:

1. Submittal date.
2. Project title and number.
3. CONTRACTOR's name and address.
4. Title and number of each Record Document.
5. Certification that each document as submitted is complete and accurate.
6. Signature of CONTRACTOR, or CONTRACTOR’s authorized representative.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 78 50

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative provisions for Substantial Completion, acceptance of work, and Final Inspection.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 110 Arrow diagram for project close-out.

1.3 SUBSTANTIAL COMPLETION

A. When Work, or designated portion thereof, is substantially complete, submit written notice with list of any outstanding items to be completed or corrected.

B. After receipt of CONTRACTOR's certification of Work Completion, ENGINEER will make final inspection to determine status of completion.

C. Should Work not be substantially complete, remedy deficiencies and re-submit a written notice.

1.4 ACCEPTANCE OF WORK

A. Protect Work until it is accepted.

B. Neither ENGINEER's determination that Work is complete, nor acceptance thereof by the OWNER, shall operate as a bar to claim against the CONTRACTOR under the provisions of the contract documents.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: Section 01 78 39.

B. Operation and Maintenance Data; Section 01 78 23.

C. Evidence of payment to Subcontractors and Suppliers: Document 00 72 00, Final Application for Payment.

D. Final Summary Report of CONTRACTOR’s Testing Agency: Section 01 45 00 requirements.

1.6 CLOSEOUT SCHEDULE

A. See APWA Plan 110 requirements.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

DIVISION 02

EXISTING CONDITIONS

SECTION 02 41 13
SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove site structural and site utility items and dispose of them off site.

B. Salvage.

1.2 PAYMENT PROCEDURES

A. Payment for structures or obstructions that are not designated for removal and disposal in the Bid documents, that cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for **by Change Order**.

B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with ENGINEER and with representatives of any utility in the work zone.

B. Locate and preserve all active utilities which are to remain in service.

C. Implement traffic control plan requirements, Section 01 55 26.

3.2 PROTECTION

A. Protect irrigation systems.

B. Protect structures to be removed and their contents from vandalism and theft.

C. Protect trees:

1. Avoid or minimize damage to trees and tree roots.

2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

D. Repair or replace damage at no additional cost to OWNER.

3.2 STRUCTURE DEMOLITION

A. Remove structures and incidentals such as foundations, fences, outbuildings, etc.

B. Remove foundation walls at least two (2) feet below finished grade or two (2) feet below natural ground surface. Remove floor slab or break it into pieces no larger than three (3) feet square.

C. Backfilling and compaction of excavations for structures, Section 31 23 23.

D. Building components, Section 02 41 19.

3.3 PIPELINE DEMOLITION

A. General:

1. Abandoned pipelines not to be salvaged are considered as incidental excavation work, Section 31 23 16.

2. Do not damage pipe or structures that remain in service or are to be salvaged for OWNER.

B. Gravity Pipe Demolition:

1. Plug abandoned pipe with a permanent, water-tight concrete plug extending into the abandoned pipe at least two (2) feet.
2. Seal openings in walls of remaining manholes, catch basins, or structures with water-tight plugs.

C. Pressure Pipe Demolition:

1. Coordinate demolition with ENGINEER and agency owning the utility pipe.
2. Plug abandoned pipe with a permanent water-tight plug.
3. Cap and restrain the active pipe with a blind flange or equivalent type of plug.
4. For service line demolition or abandonment, disconnect the line from the mainline and shut off the corporation stop.

3.4 **BRIDGE AND ABUTMENT DEMOLITION**

A. Remove existing bridges and abutments indicated.

B. Remove structures so that no remaining portion is closer than three (3) feet to any water course or closer than two (2) feet to the Subgrade and Embankment surface, or within two (2) feet of the natural ground surface.

C. Remove structures so compacted backfill can be provided as required in backfilling operation, Section 31 23 23.

3.5 **BURIED FUEL TANK DEMOLITION**

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with Laws and Regulations.

B. Do not spill fuel on Subgrade.

C. Comply with the local authority having jurisdiction over fuel tank removals.

3.6 **MISCELLANEOUS DEMOLITION**

A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements:

1. Backfill is stable.
2. Burial does not interfere with construction.
3. Permission to do so is obtained from ENGINEER.
4. No remaining portion is within two (2) feet of the final ground surface contours.

3.7 **SALVAGE**

A. Salvage designated equipment and materials for OWNER.

B. All other material becomes the property of CONTRACTOR unless such materials are not owned by OWNER.

END OF SECTION

SECTION 02 41 14
PAVEMENT REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove roadway Pavement.

B. Remove curb, gutter, sidewalk, Driveway Approach, waterway and similar flat work.

1.2 MEASUREMENT PROCEDURES

A. Double saw cutting required for pavement removal or T-patches will not be measured or paid for separately.

1.3 REFERENCES

A. **APWA (Utah) Standards**:

Plan 256 Concrete pavement patch.

Plan 412 Invert cover.

Plan 802 Defective concrete.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Preserve all active utilities.

D. Notify neighborhood at least 48 hours before day and time of operation.

E. Mark on redline drawings the location of any existing and active utility that is discovered.

3.2 PROTECTION

A. Install Invert Covers as shown in the Drawings of APWA Plan 412. Installation must be tight so no debris can by-pass the cover and enter the piping below.

B. Trees:

1. Avoid or minimize damage to trees and tree roots.

2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

C. Existing Surfaces:

1. Protect adjacent surfaces including concrete walls, planters, carriage walks, driveway approaches, rock walls, rock gardens, concrete steps, sidewalks, and curb cut assemblies. Replace damaged facilities at no additional cost to OWNER.

2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.

3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

D. Environment:

1. Control dust, Section 01 57 00.

2. Protect plant and animal habitat. Follow federal, state, or local protection requirements.

E. Repair or replace any damage at no additional cost to OWNER.

3.3 REMOVE PORTLAND CEMENT CONCRETE PAVEMENT

A. Identify concrete pavement to be removed as shown in the Drawings or APWA Plan 802. If removal is not scheduled, secure removal approval from ENGINEER.

B. Identify concrete pavement to be removed as shown in the Drawings or APWA Plan 256 Sheet 1 or Sheet 2 as applicable.

C. Cutting:

1. DO NOT use machine mounted impact hammers.

2. Make concrete cuts straight, vertical, true, full-depth.

3. Cut along perimeter of panel to be removed. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

4. Cut along any edge that is damaged during construction, including cavities underneath caused by construction or concrete removal.

D. Removal:

1. Remove concrete to the nearest expansion joint or vertical saw cut.

2. Remove panels without damaging remaining panels.

3. Remove all bonding inhibitors.

3.4 REMOVE BITUMINOUS CONCRETE PAVEMENT

A. Cutting:

1. Use any method that produces a true, vertical, full-depth cut.

2. When bituminous pavement overlays Portland cement concrete Pavement, DO NOT use machine mounted impact hammers.

3. If an edge of an existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

4. Re-cut along any edge that is damaged during construction, and where cavities underneath pavement is caused by construction.

B. Remove Pavement: Remove pavement without damaging remaining.

3.5 REMOVE CONCRETE FLAT WORK

A. Saw cut flat work at weakened plane joints. Saw cut full depth.

B. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Saw along any edge that is damaged during construction, including cavities underneath caused by construction.

D. If flat work that is not scheduled for removal is damaged, remove and replace the flat work at no additional cost to OWNER.

3.6 CLEANING

A. Remove all debris and dust. Clean surrounding rails, sidewalks, Driveways, Driveway approaches, landscaping, concrete flat work, and other objects in vicinity of work.

END OF SECTION

SECTION 02 41 15

CURB AND TRIP HAZARD REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Saw cut and remove a curb.

B. Remove a trip hazard by saw cutting, grinding, or jacking.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 222 Saw cut driveway approach.

Plan 235 Corner curb cut assembly.

Plan 236 Tangent curb cut assembly.

Plan 237 Island and median.

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

1.4 SITE CONDITIONS

A. Control dust, Section 01 57 00.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PROTECTION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Do not damage abutting surfaces that are not scheduled for cutting or removal.

C. Protect plant and animal habitat. Follow federal, state or local protection requirements.

3.2 CURB REMOVAL FOR NEW DRIVEWAY APPROACH

A. Remove curb as shown in APWA Plan 222.

B. At the Apron: Saw off curb so surface of curb cut matches slope of apron. **Do not provide a lip at flow-line** unless indicated elsewhere.

C. At the Curb Flare: Saw off curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.

2. If the flare is NOT in a pedestrian walking area, make the length of the curb cut slope (parallel to the flow-line) three (3) feet minimum.

D. Remove blade marks on sawed surfaces by grinding.

3.3 CURB REMOVAL FOR NEW CURB CUT ASSEMBLY

A. For assembly types see APWA Plans 235, 236, and 237.

B. Curb Ramp or Blended Transition: Saw off curb to match the surface slope of the Curb Ramp or Blended Transition.

C. Curb Flare: Saw off the curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.
2. If the flare is NOT in a pedestrian walking area, typical horizontal length of the curb cut slope is two (2) feet.

D. Remove blade marks on sawed surfaces by grinding.

3.4 **TRIP HAZARD REMOVAL**

A. **DO NOT cut or grind concrete structures** such as bridge decks, catch basins, manholes, concrete borders, culverts, etc. ENGINEER must determine other means of trip hazard removal.

B. Remove trip hazards greater than 1/4 inch high but less than 1 1/2 inches high. ENGINEER must determine acceptable means for removing trip hazards higher than 1 1/2 inches.

C. Make saw cut slopes, grinding slopes, and milled slopes not steeper than 10 percent (1:10) measured in direction of pedestrian travel. Grind sawed or milled surfaces to remove blade marks or to make smooth.

D. If flat work is jacked (Section 32 01 29), jack until displacement differential is less than 1/4 inch. Repair adjacent flat work elevations if adversely moved out of place because of the jacking process. Repair damaged form strip irrigation system or vegetation if growth is adversely affected.

3.5 **CLEANING AND REPAIR**

A. Remove debris and dust from work site.

B. Clean surrounding rails, concrete flat work, Driveways aprons, landscaping and other objects in vicinity of work.

C. Repair damage at no additional cost to OWNER.

END OF SECTION

SECTION 02 41 19

SELECTIVE BUILDING DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of building components.

1.2 DEFINITIONS

A. **Remove**: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain OWNER's property unless indicated otherwise by ENGINEER.

B. **Remove and Salvage**: Items indicated to be removed and salvaged remain OWNER's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to OWNER's designated storage area.

C. **Remove and Reinstall**: Remove items indicated. Clean, service, and otherwise prepare them for re- use. Store and protect against damage. Reinstall them in locations indicated.

D. **Existing to Remain**: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by ENGINEER, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.3 PROJECT CLOSEOUT

A. Record removals on Drawings. Submit Record Documents, Section 01 78 39.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition.

B. All furnishing, accessories, equipment, etc. that are to be removed from site shall remain property of OWNER. ENGINEER shall determine appropriate action for property in question.

C. If OWNER occupies portions of building immediately adjacent to selective demolition area, conduct selective demolition so OWNER's operations will not be disrupted. Provide not less than 72 hours notice to OWNER of activities that will affect OWNER's operations. Also submit 72 hour notifications to ENGINEER.

D. OWNER assumes no responsibility for actual condition of buildings to be selectively demolished.

3.2 DEMOLITION

A. Comply with Laws and Regulations before, during, and after selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Photograph or videotape existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

C. Storage or sale of removed items or materials on site will not be permitted.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete.

B. Openings in formwork for other affected work.

C. Form accessories such as snap ties, bracing, etc.

D. Stripping formwork.

1.2 REFERENCES

A. **ACI Standards**.

347 Recommended Practice for Concrete Formwork.

1.3 DEFINITIONS

A. **Shoring**: The activity to support formwork.

B. **Reshoring**: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.4 SUBMITTALS

A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.

B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.5 QUALITY ASSURANCE

A. Designer's Qualifications: Structural design professional who complies with Utah licensing law, has experience in concrete formwork, and is acceptable to the authority having jurisdiction.

B. Design Forms:

1. With sufficient strength to maintain finished tolerances indicated in Section 03 35 00, to support loads, pressures, and allowable stresses as outlined in ACI 347 and for design considerations such as wind loads, allowable stresses, and other applicable requirements of local Laws and Regulations.
2. To permit easy removal.
3. For required finishes.

C. Design, engineering, and construction of formwork is CONTRACTOR's responsibility.

1.6 JOB CONDITIONS

A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.

B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.7 FIELD SAMPLES

A. Prepare field Samples and submit per Section 01 33 00.

B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork to include vertical and horizontal form joints and typical rustication joints when required.

C. Size panel to indicate special treatment or finish required, including form release agent.

D. Remove formwork after casting concrete.

1.8 **ACCEPTANCE**

A. Secure ENGINEER's inspection of form layout for concrete flat work.

PART 2 PRODUCTS

2.1 **FORM MATERIALS**

A. Faced with material which will produce smooth and uniform texture on concrete, unless indicated otherwise.

B. Arrange facing material orderly and symmetrical, keeping number of seams to a minimum.

C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.2 **FORMWORK ACCESSORIES**

A. Form Ties:

1. Use ties constructed so end fasteners can be removed without spalling concrete faces.

2. After end fasteners of ties have been removed, embedded portion of ties are to terminate not less than two (2) times the diameter or thickness of the fasteners from formed faces of concrete, but in no case greater than 3/4 inch.

3. When formed face on concrete is not exposed, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends or an approved equal for water retaining structures.

B. Premolded Expansion Joint Filler: F1 sheet, Section 32 13 73 unless indicated elsewhere.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, impair natural bonding or color characteristics of concrete. To prevent contamination, agents used on potable water structures are subject to review by ENGINEER before use.

D. Fillets for Chamfered Corners: Wood strips 1 inch x 1 inch size, maximum length possible.

PART 3 EXECUTION

3.1 **INSPECTION**

A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 **FORM CONSTRUCTION**

A. Make forms sufficiently tight to prevent loss of concrete.

B. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.

C. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges, jacks, Shores, and struts to take up all settlement during concrete placing operation.

E. Provide temporary ports in formwork to facilitate cleaning and Inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. At construction joints, overlap forms over hardened concrete at least six (6) inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

G. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.

H. Fasten wedges used for final adjustment of forms before concrete placement in position after final check.

I. Anchor formwork to Shores, supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.

J. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.

K. Position expansion joint material and other embedded items accurately and support to prevent displacement.

L. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.

M. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.

N. For underground concrete work, do not use soil walls for forming unless authorized by ENGINEER.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings for elements embedded in or passing through concrete.

B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories per manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.

B. For As-cast Finishes:

1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
2. Where panel joints are recessed or otherwise emphasized, locate form ties within joints, not within panel areas.
3. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.

C. Textured Finishes: As indicated.

3.5 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork per manufacturer's instructions. Apply before placing reinforcing steel, anchoring devices, and embedded items.

3.6 FORM REMOVAL

A. Do not pry against face of concrete. Use only wooden wedges.

B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.

D. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other members not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no Reshoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.

G. Where Reshoring is planned, supporting formwork may be removed when concrete has reached 70 percent of specified strength, provided Reshoring is installed immediately.

H. When Shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing Shores and supports, facing material may be removed at an earlier age.

3.7 RESHORING

A. When Reshoring is permitted or required, plan operations in advance and obtain approval.

B. During Reshoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of Reshoring.

C. Place Reshores as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.

D. Tighten Reshores to carry required loads without over-stressing.

E. Leave Reshores in place until the concrete being supported has reached its specified strength.

F. For floors supporting Shores under newly placed concrete, level original supporting Shore or Reshore:

1. Reshoring system shall have a capacity to resist anticipated loads in all cases equal to at least 1/2 the capacity of the Shoring system.

2. Unless otherwise specified locate Reshores directly under a Shore.

3. In multistory buildings, extend Reshoring through a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and supporting Shores are not exceeded.

G. Design, engineering, and construction of Shoring and Reshoring is the responsibility of the CONTRACTOR.

3.8 **REMOVAL STRENGTH**

A. When removal of formwork or Reshoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions has been met:

1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.

2. When concrete has been cured per Section 03 39 00 for the same length of time as the site-cured cylinders that reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 deg F and concrete has been damp or sealed from evaporation and loss of moisture.

3.9 **REUSE OF FORMS**

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.

B. Thoroughly clean and properly coat forms before reuse.

3.10 **FIELD QUALITY CONTROL**

A. Before commencing a pour, verify connections, form alignment, ties, inserts and Shoring are placed and secure.

B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.

C. If during construction any weakness develops and false-work shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false-work.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.2 REFERENCES

A. **AASHTO Standards**:

M254 Corrosion Resistant Coated Dowel Bars.

B. **ACI Standards**:

301 Structural Concrete for Buildings.

315 Concrete Reinforcement.

C. **ASTM Standards**:

A82 Steel Wire, Plain, for Concrete Reinforcement.

A185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

C1116 Fiber-Reinforced Concrete and Shotcrete.

D3963 Epoxy-Coated Reinforcing Steel.

D. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

E. **CRSI Standards**:

Manual of Standard Practice.

1.3 SUBMITTALS

A. **Manufacturer's Certificate**: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.

B. **Welder's certification**.

C. **Shop Drawings**:

1. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.

2. When required, prepare Shop Drawings by an engineer who complies with Utah licensing law and is acceptable to agency having jurisdiction.

1.4 QUALITY ASSURANCE

A. Perform concrete reinforcement work per CRSI Manual of Standard Practice.

B. Comply with ACI 301.

C. Welders: Certified to comply with AWS D1.1 or AWS D1.4 as applicable.

1.5 ACCEPTANCE

A. Unless specified otherwise, chairs for supporting reinforcement in flat slabs are spaced as follows:

1. Three (3) feet maximum for No. 5 and smaller bars.

2. Five (5) feet maximum for bars larger than No. 5.

B. Dowels are placed on dowel baskets and properly aligned.

C. Epoxy and galvanized coatings are not chipped or cut. Ends of cut bars are epoxy coated or galvanize painted before placement.

D. Minimum covering over reinforcement is as specified.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fiber Reinforcement: Glass, ASTM C1116.

B. Reinforcement:

1. Grade 60 ksi deformed steel bars, ASTM A615 and supplementary requirements S1 or ASTM A706 for welding.

2. Welded wire fabric. Plain steel type, ASTM A185 in flat sheets or coiled rolls. Dimensions of the mesh 4”x 4” or as indicated.

C. Stirrups: Steel, ASTM A82.

D. Dowel Bars for Expansion Joints: Grade 60 ksi smooth steel bar, ASTM A615.

1. Galvanized or epoxy coated in roadway Pavements.

2. Provide plastic cap to permit longitudinal movement of dowel bar within concrete section equal to joint width plus 1/4 inch.

3. For load transfer joints, paint bars with 1 coat of paint conforming to AASHTO M254 and coat 1/2 with grease.

E. Coatings for Corrosion Protection:

1. Epoxy coat, ASTM D3963.

2. Galvanized, Section 05 05 10.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or an acceptable patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 FABRICATION

A. Fabricate reinforcement, ACI 315 providing for concrete cover.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars; with AWS D1.4.

PART 3 EXECUTION

3.1 PLACING

A. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.

B. Place all reinforcement in the exact position indicated. With tie wire, tie bars together at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

C. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

D. Overlap sheets of metal mesh one square plus six (6) inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

E. Flat Slab Work:

1. Support reinforcing steel of formed flat slabs with plastic chairs, precast concrete blocks or other non-oxidizing slab bolsters.
2. Size chairs or bolsters to position the steel in the exact location indicated.
3. Space chairs and bolsters not more than five (5) feet on centers in each direction.
4. Coat metal supports in contact with forms to prevent rust.
5. Tie down deck steel to beams or forms at regular intervals of not more than five (5) feet on centers along the beams or forms to prevent movement of steel during concrete placement.

3.2 **SPLICING**

A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without ENGINEER's knowledge. Stagger splices where possible.

B. Unless indicated otherwise, overlap reinforcing bars a minimum of 30 diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.

C. Do not use lap splices on bars greater than No. 11 diameter unless approved.

D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.

E. Do not bend reinforcement after embedding in hardened concrete.

F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.3 **PLACING EMBEDDED ITEMS**

A. Place all sleeves, inserts, anchors and embedded items before concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.

B. Give all trades whose work is related to the concrete section (Section 03 30 04) ample notice and opportunity to introduce or furnish embedded items before concrete placement.

END OF SECTION

SECTION 03 30 04
CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Material requirements.

1.2 RELATED SECTIONS
A. 03 30 05 Concrete Testing
B. 03 30 10 Concrete Placement
C. 03 35 00 Concrete Finishing
D. 03 39 00 Concrete Curing
E. 03 40 00 Precast Concrete

1.3 REFERENCES
A. **ACI Standards**:
- 211.1 Selecting Proportions for Normal-Density and High-Density Concrete.
- 211.2 Selecting Proportions for Structural Lightweight Concrete.
- 211.3 Standard Practice for Selecting Proportions for No-Slump Concrete.
- 214 Evaluation of Strength Test Results of Concrete.
- 301 Specifications for Structural Concrete for Buildings.
- 305 Hot Weather Concreting.
- 306 Cold Weather Concreting.
- 318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:
- C33 Concrete Aggregates.
- C39 Compressive Strength of Cylindrical Concrete Specimens.
- C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- C94 Ready-Mixed Concrete.
- C117 Material Finer than 75µ (No. 200) Sieve in Mineral Aggregates by Washing.
- C123 Lightweight Particles in Aggregate.
- C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- C142 Clay lumps and Friable Particles in Aggregates.
- C143 Slump of Hydraulic-Cement Concrete.
- C150 Portland Cement.
- C172 Sampling Freshly Mixed Concrete.
- C227 Potential Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).
- C231 Air Content of Freshly Mixed Concrete by the Pressure Method.
- C260 Air-Entraining Admixtures for Concrete.
- C289 Potential Reactivity of Aggregates (Chemical Method).
- C494 Chemical Admixtures for Concrete.
- C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C595 Blended Hydraulic Cements.

C618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C1116 Fiber-Reinforced Concrete and Shot Crete.

C1157 Blended Hydraulic Cement.

C1240 Use of Silica Fume as a Mineral Admixture in Hydraulic Cement Concrete, Mortar, and Grout.

C1260 Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

C1293 Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

C1567 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

C1602 Mixing Water Used in The Production of Hydraulic Cement Concrete.

CRD C662 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

STP 15-C Manual on Quality Control of Materials.

1.3 **SUBMITTALS**

A. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM and ACI standards.
2. Mixing Equipment: Submit certification of plant equipment.

B. **Mix Design**: Allow ENGINEER 10 days to evaluate the submittal. Provide the following information.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Physical properties of the aggregate (this section article 2.3). Test results shall not be older 455 days from the date of submission. The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed.
3. Identify whether mix is for hot, cold, or normal weather placement.
4. Cement source, type and chemical composition.
5. Aggregate soundness and potential reactivity.
6. Average Strength (f_{cr}), per quality control chart.
7. Allowable range of slump and air content.
8. Water cement ratio.
9. Proportions of materials in the mix.
10. Unit weight.
11. Analysis of water if water is not potable.
12. Mortar bar or prism test results if a pozzolan is included in the mix.
13. Technical data sheets for additives to be used at the plant and at the job site. Certify additives are compatible with each other.

C. **Pre-approved Mix Design**: Submit name and address of Supplier and Suppliers mix design number if available.

D. **Before Changing Mix Design**: Submit a new design and allow ENGINEER 10 days to evaluate the changes.

1.4 **QUALITY ASSURANCE**

A. **General**:

1. Use a laboratory that follows and complies with ASTM C1077.
2. Reject concrete that does not meet requirements of this section.

3. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

B. **At Source**:

1. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures except as allowed by mix design.
2. Store bagged and bulk cement in weatherproof enclosures. Exclude moisture and contaminants.
3. Prevent segregation and contamination of aggregate stockpiles.
4. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

C. **At Site**: Admixtures may be used for meeting hot or cold weather placement requirements with field or trial batch verification.

1.5 **ACCEPTANCE**

A. **Materials**:

1. Aggregate Source:
   a. Verify suitability of aggregate source.
   b. Verify aggregate gradation.
   c. Verify percent of combined aggregate passing No. 200 sieve.
2. At the Site:
   a. Verify mix identification, batch time, slump, air content, and temperature.
   b. Verify drum rotation is less than 300 revolutions.
3. At the Laboratory: Verify strength in 28 days.

B. **Defective Material**: Popouts, scaling, etc.

1. Price adjustment, Section 01 29 00 and Section 03 30 10.
2. Dispute resolution, Section 01 35 10.

PART 2 PRODUCTS

2.1 **CEMENT**

A. **General**:

1. Do not use air entraining cement except for hand mixed applications.
2. Do not use cement containing lumps or is partially set.
3. Do not mix cement originating from different sources.

B. **Hydraulic Cement**:

1. Hydraulic cement based on Sulfate Exposure Class as per ACI 318.

C. **Blended Hydraulic Cement**: The following are cement equivalencies when substituting blended cement for a Portland cement.

Table 1 – Cement Equivalencies

Portland Cement	Blended Cement	
ASTM C150	ASTM C595	ASTM C1157
Type I	IP/IL/IT	GU
Type 1L(MS)	IP/IL/IT (MS)	MS
Type III	IP/IL/IT (HE)	HE
Type IV	--	--
Type V	IP/IL/IT (HS)	HS

D. **Rapid Set Cement**: As above and as follows:

1. Initial set time: 15 minutes minimum.

2. Color: Acceptable to the ENGINEER.

2.2 **WATER**

A. Clean, non-staining, non-detrimental per ASTM C1602.

B. Screen out extraneous material.

C. Do not use alkali soil water.

2.3 **AGGREGATES**

A. Gravel, crushed gravel, crushed stone, crushed concrete, slag, sand or combination with the following physical properties.

Table 2 – Physical Properties

		Standard	Min	Max
Coarse Aggregate				
Wear (hardness or toughness), percent (a)		(a)	--	50
Soundness (5 cycles), percent	Na_2SO_4	C88	--	12
	Mg_2SO_4	C88	--	18
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	7
Material finer than 200 sieve, percent		C117	--	1.0
Fine Aggregate				
Soundness (5 cycles), percent	Na_2SO_4	C88	--	10
	Mg_2SO_4	C88	--	15
Fineness modulus		C33	2.3	3.1
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	3.0
Aggregate blend (meets one of the following)				
1. Average prism length change in 12 months, percent (c)		C1293	--	0.04
2. Average mortar bar length change in 16 days, percent (c)		C1260	--	0.10
3. Petrography limits, percent				
Quartz ..... (d)		C295	--	5.0
Chert or chalcedony.....			--	3.0
Tridymite or cristobalite			--	1.0
Opal			--	0.5
Natural glass in volcanic rock			--	3
4. Historical data acceptable to ENGINEER				

NOTES

(a) Wear retained on No. 8 sieve. For aggregate less than 1 1/2" use ASTM C131. For larger aggregates use ASTM C535.

(b) Organic impurities producing a dark color concrete may cause rejection.

(c) Prism length change and mortar bar length change based upon unmodified ASTM tests.

(d) Quartz must NOT be optically strained, micro-fractured, or microcrystalline in nature.

2.4 **ADDITIVES**

A. Calcium Chloride: Not allowed in reinforced concrete.

B. Air Entrainment: ASTM C260. For extrusion enhancement use non-vinsal resin.

C. Set Enhancement and Water Reducing Agents: ASTM C494.

1. Type A: Water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer). *
7. Type G: High range water reducing and set retarding. *

* Keep the relative durability factor of water reducing additives not less than 90 and the chlorides content (as Cl^-) not exceeding 1 percent by weight of the admixtures.

D. Pozzolan:

1. Natural or fly ash per ASTM C618.
2. Silica fume per ASTM C1240.

E. Special Admixtures: Allowed if mix design submittal is accepted:

1. Lithium nitrate based solution for control of reactive aggregates.
2. Calcium nitrite based solution for corrosion protection of reinforced structures subject to chloride-induced corrosion.
3. Shrinkage reducer for controlling drying shrinkage in concrete.
4. Viscosity modifier for enhancement of self-consolidating concrete or for workability.

2.5 **MIX DESIGN**

A. **Class**: Unless specified elsewhere, as follows.

1. Above Ground: 5000 minimum.
2. At Ground Level: 4000 minimum.
3. Underground: 4000 minimum.

B. **Selection of Cement**: ASTM C150, C595 or C1157.

1. Use Type II (or equivalent) cement unless otherwise specified.

C. **Selection of Aggregates**:

1. Maximum Particle Size:
   a. 1/5 of narrowest dimension between forms.
   b. 1/3 of depth of slab.
   c. 3/4 of minimum clear spacing between reinforcing bars.
2. Gradation: ASTM C33.
   a. Coarse Aggregate: Choose from the following grades. Gradations are based upon percent of material passing sieve by weight.

Table 3 – Coarse Aggregate Gradation				
Sieve	**Grade**			
	357 (2")	**467 (1.5")**	**57 (1")**	**67 (3/4")**
2-1/2"	100	--	--	--
2 Inch	95 - 100	100	--	--
1-1/2"	--	95 – 100	100	--
1"	35 – 20	--	95 – 100	100
3/4"	--	35 – 70	--	90 – 100
1/2"	10 – 30	--	25- 60	--
3/8"	--	10 – 30	--	20 – 55
No. 4	0 – 5	0 – 5	0 – 10	0 – 10

b. Fine Aggregate:

Table 4 – Fine Aggregate Gradation	
Sieve	**Percent Passing by Weight**
3/8"	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

c. Silts and Clays: The amount of material smaller than the No. 200 sieve in any combined gradation sample is limited to the following percentages by weight of the combined sample:

1) 1.75 percent maximum for concrete subject to abrasion.

2) 3.0 percent maximum for all other concrete.

3. Optimized Gradation: ASTM C33.

a. A well-graded combined aggregate gradation may replace the gradation requirements in Tables 4 and 5 for all concrete classes when designed and approved as such.

b. Proportion well-graded combined aggregates to meet the Tarantula Curve Gradation Band in Table 5. The combined gradation must be within the boundary limits for each sieve size. Refer to the UDOT Materials Manual of Instruction, Section 975: Guidelines for Well-Graded Combined Aggregate Gradations for a graphical representation of the Tarantula Curve.

1) Slip formed pavements: retain at least 15 percent on the sum of the #8, #16 and #30 sieves.

2) Slip formed pavements: retain between 24 and 34 percent of fine sand on the sum of the #30 through #200 sieves.

3) Flowable applications: retain at least 20 percent on the sum of the #8, #16 and #30 sieves.

4) Flowable applications: retain between 25 and 40 percent of fine sand on the sum of the #30 through #200 sieves.

Table 5 – Tarantula Curve Gradation Band	
Sieve	**Percent Retained by Weight**
2 in.	0
1 ½ in.	0 to 5
1 in.	0 to 16
¾ in.	0 to 20
½ in.	4 to 20
3/8 in.	4 to 20
No. 4	4 to 20
No. 8	0 to12
No. 16	0 to 12
No. 30	4 to 20
No. 50	4 to 20
No. 100	0 to 10
No. 200	0 to 2.3

D. **Selection of Pozzolan**:

1. General: If a blended aggregate passes an unmodified ASTM C1293 test, use of a pozzolan is CONTRACTOR's choice. If aggregate does not pass ASTM C1293, select a pozzolan (or blended cement, or both) and determine the effective dosage to meet one of the following tests:

a. ASTM C1567. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.

b. ASTM C1260. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.

c. CRD C662 (Lithium Mitigation). The expansion of a cement-pozzolan-aggregate job-mix mortar bar determined after 28 days of exposure.

d. Submit to ENGINEER a quality history of the mitigator identifying a minimum of 20 of the most current ASTM C618 analysis.

2. Fly Ash (Class F): Allowed as a cement replacement under the following conditions:

a. If utilized, replace minimum 10 percent of the cement.

b. Use replacement percentage as required to meet performanve tests (C1260, C1293, C1567, or CRD C662) and project performance requirements.

3. Natural Pozzolan (Class N): Allowed as a cement replacement if the 14-day expansion test (ASTM C1567) with job aggregates, job cement and natural pozzolan does not exceed the 14-day expansion test of job aggregates, job cement and Class F fly ash.

4. Silica Fume: Allowed as a supplemental cementitious material or cement replacement material.

5. Lithium: Allowed as a cement replacement if the 28-day expansion test (CRD C662) with job aggregates, job cement and lithium does not exceed the 28 day expansion test

E. **Selection of Mix Properties**: Select and proportion the mix to produce appropriate strength, durability and workability. Use ACI 211.1, 211.2, or 211.3, and meet the following properties and limitations:

Table 6 – Mix Properties and Limitations						
Properties		**Standard**	**Class**			
			2000	**3000**	**4000**	**5000**
Compressive Strength (f_c') at 28 days, psi, minimum		C39	2000	3000	4000	5000
Compressive Strength at 7 days, psi, (for reference only)		C39	1340	2010	2680	3350
Average Strength, psi (f_{cr})		214	(a)	(a)	(a)	(a)
Cement content, bags, minimum (b)		--	4.5	5.5	6.5	7.5
Water-cement ratio (by weight), maximum (c)		318	(d)	(d)	0.44	
Entrained air, percent (based upon aggregate size) (e)	2" 1-1/2" 1" 3/4"	C231	3.0 to " " "	4.5 to 7.5 " " "	4.0 to 7.0 4.5 to 7.5 5.0 to 7.5 5.0 to 7.5	
Slump		C143	(d)	(d)	(d)	(d)

NOTES

(a) The amount by which average strength (f_{cr}) exceeds compressive strength (f_c') is based upon statistical assurance that no more than 1 test in 100 tests will fall below compressive strength (f_c').

(b) May be adjusted by supplier to meet project strength and cure time requirements. Demonstrate compliance through trial batch.

(c) Includes all cementitious materials including Portland Cement, fly ash, pozzolans or other cementitious additives.

(d) Specific to exposure conditions and finishing need.

(e) Comply with ACI 211.1 if air content is changed.

(f) 1 bag of cement = 94 pounds.

1. Cold Weather: Follow ACI 306 temperature requirement as per Section 03 30 10 CONCRETE PLACEMENT, Article 3.4 Concrete Placement.

2. Hot Weather: Follow ACI 305 temperature requirement as per Section 03 30 10 CONCRETE PLACEMENT, Article 3.4 Concrete Placement.

3. Concrete Deposited Under Water: Increase cement content one (1) class for concrete placed under water or use viscosity modifying admixture.

F. **Selection of Fiber Reinforcement**: The basis for determining material proportions of fiber-reinforced concrete is the Supplier's responsibility per ASTM C1116 subject to mix property requirements of this Section. Unless specified otherwise provide synthetic fibers.

2.6 **SOURCE QUALITY CONTROL**

A. **General**: Collect Samples randomly. Do not change source quality control sampling point.

B. **Aggregate**:

1. Soundness, ASTM C88.
2. Alkali-silica reactivity, ASTM C289, C1567, C1260, C227 and C1293.
3. Petrographically examine fine and coarse aggregate sources once every three (3) years, ASTM C295.

C. **Concrete Mix**: Obtain samples per ASTM C172 and run the following tests:

1. Compressive strength, ASTM C39.
2. Unit weight, ASTM C138.
3. Slump, ASTM C143.

4. Air, ASTM C231.
5. Temperature, ASTM C1064.

D. **Concrete Quality Charts**: Comply with ACI 214 and ACI 301. Plot new results and identify trends on quality control charts that comply in form to ASTM STP 15-C. Show the Specified Strength (f_c'), the required Average Strength (f_{cr}), and the compressive strength versus date of Sample.

E. **Equipment**: Certify at least every two (2) years through the services of a design professional licensed in the State of Utah, that plant equipment complies with requirements of the National Ready Mixed Concrete Association and ASTM C94.

1. Transit Trucks: Equip transit trucks with plates indicating total volume, agitating volume and mix volume.
2. Weights and Measures: Comply with regulatory requirements of State of Utah.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement, Section 03 30 10.

3.2 FIELD QUALITY CONTROL

A. Truck Mixed Concrete (Dry Batch): ASTM C94.

1. Truck Mixer: Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm).
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).

B. Mixing Plant: ASTM C94.

1. Use option C and requirements in this Section for preparing ready-mixed concrete.
2. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
3. Mixing time must exceed 80 seconds after adding air entrainment admixture.

C. Hand Mixing:

1. Do not hand mix batches larger than 0.5 cubic yard.
2. Hand mix only on a watertight platform.
3. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency before adding water.

END OF SECTION

SECTION 03 30 05
CONCRETE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete sampling and testing requirements.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C31 Making and Curing Concrete Test Specimens in the Field.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C143 Slump of Portland Cement Concrete.

C172 Sampling Freshly Mixed Concrete.

C173 Air Content of Freshly Mixed Concrete by Volumetric Method.

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C567 Unit Weight of Structural Lightweight Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

1.3 SUBMITTALS

A. **Concrete Supplier**: If requested, submit reports and material certificates verifying concrete quality control.

B. **Laboratory**: Promptly submit test data results for seven (7) and 28 day breaks to Supplier, CONTRACTOR and ENGINEER**.**

1.4 QUALITY ASSURANCE

A. Provide an ASTM C1077 compliant and ACI certified laboratory.

B. Provide level I ACI certified field sampling technicians.

1.5 SITE CONDITIONS

A. **Assist ENGINEER**: Furnish labor to assist ENGINEER in obtaining and handling acceptance Samples at site or sources.

B. **Store and Cure Test Specimens**: Safely store and cure concrete test specimens and acceptance test specimens for first 24 hours:

1. Follow ASTM C31 in making and curing cylinders or beams at site. Do not move the cylinders or beams for the initial 16 hour cure period. Provide initial cure temperature as follows:
   a. 60 to 80 deg F for Class 4,000 or less.
   b. 68 to 78 deg F for Class 5,000 or greater.
2. Equip storage device with an automatic 24 hour temperature recorder with an accuracy of plus or minus two (2) deg F
3. Use water containing hydrated lime if water is to be in contact with cylinders or beams.

4. Ensure the device(s) can accommodate the required number of test cylinders or beams. Lack of capacity will cause the placement of concrete to cease.
5. Have the storage devices available at the point of placement at least 24 hours before placement.
6. A 24 hour test run may be required.

1.6 **ACCEPTANCE**

A. At the Laboratory:

1. Compressive strength, ASTM C31.
2. Flexure strength, ASTM C78.

B. At the Site:

1. Acceptance: Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.
2. Sampling Protocol: ASTM C172. Unless indicated otherwise follow Table 1 sampling frequency requirements. Collect sample at discharge chute before placement, or at pumper hose after priming grout has been wasted.

Table 1 – Sampling Frequency

Rate of Placement (Cubic Yard / Day)	Temperature	Air	Slump	Strength
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction thereof	1	1	1	1

3. Testing Protocol:
   a. Temperature, ASTM C1064.
   b. Air content, ASTM C231 or ASTM C173 if lightweight aggregate is used.
   c. Slump, ASTM C143.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 **PRECAST PRODUCTS**

A. Obtain composite Samples from different portions of the batch.
B. Make and cure concrete test specimens for acceptance, ASTM C31.
C. Cure all precast products with water vapor or water.
D. Do not damage precast products by stripping forms or handling before the concrete reaches its specified strength.

3.2 **CAST-IN-PLACE PRODUCTS**

A. Obtaining Samples:

1. Batch samples, ASTM C172.
2. Core samples, ASTM C42.

B. Identify location of tests on test reports.
C. Compressive strength, ASTM C39:

1. Mold four (4) test specimens, ASTM C31.

2. For strength test perform slump, air, unit weight, and temperature test.

3. Break 1 cylinder at seven (7) days and three (3) cylinders at 28 days. The average strength of three (3) cylinder breaks shall be considered the test result.

4. If any one cylinder in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the cylinder. The average strength of the remaining cylinders shall be considered the test result.

D. Tensile (flexural) strength, ASTM C78:

1. Mold four (4) test specimens, ASTM C31.

2. For strength test perform slump, air, unit weight, and temperature test.

3. Break 1 beam at seven (7) days and three (3) beams at 28 days. The average strength of the three (3) beam breaks shall be considered the test result.

4. If any one beam in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the beam. The average strength of the remaining beams shall be considered the test result.

E. Aggregate, ASTM C136 for fine and coarse aggregate.

F. Slump test, ASTM C143.

G. Air Test:

1. Normal weight concrete, ASTM C231.

2. Light weight concrete, ASTM C173.

H. Unit Weight:

1. Normal weight concrete, ASTM C138.

2. Light weight concrete, ASTM C567.

I. When requested, test in-place concrete by impact hammer, sonoscope, or other non-destructive device:

1. To determine relative strengths in various locations in Work.

2. To aid in evaluating concrete strength.

3. To select areas to be cored.

4. To verify quality control in the absence of control testing.

3.3 RETESTING DEFECTIVE CONCRETE STRENGTH

A. If CONTRACTOR desires to do a retest, a request to ENGINEER for retesting must be made within 35 days from time of concrete placement. No coring or retesting shall be done after 40 days have elapsed from the time of placement:

1. Choose three (3) random test locations and verify choice with ENGINEER. Obtain retest samples per ASTM C42 and test compressive strength per ASTM C39 or flexure strength per ASTM C78.

2. Establish a chain of custody for all test samples.

3. If concrete placed in the Work will be dry under service condition, air dry cores for seven (7) days before tests. Unless otherwise specified, use air temperature 60 to 80 deg F and relative humidity less than 60 percent.

4. If concrete placed in the Work will be more than superficially wet under service conditions, test cores after moisture conditioning (liquid or vapor water cure).

5. If more than 1 core shows evidence of having been damaged before testing provide replacement cores, otherwise evaluation will be done on two (2) or more core samples.

6. Evaluate cores in accordance with ACI 318 requirements.

7. If core tests are inconclusive, or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be used and evaluated in accordance with ACI 318 requirements.

B. Coat sides of core hole with concrete epoxy resin adhesive. Fill core holes with non-shrink concrete mortar. Match color and texture of surrounding concrete.

C. Within 40 days from time of placement publish the chain of custody record and the results of retesting.

END OF SECTION

SECTION 03 30 10
CONCRETE PLACEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete placement for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.2 REFERENCES

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

309 Consolidation of Concrete.

B. **ASTM Standards**:

C881 Epoxy-Resin-Base Bonding Systems for Concrete.

C1059 Latex Agents for Bonding Fresh to Hardened Concrete.

1.3 SUBMITTALS

A. **Batch Delivery Ticket**: For each batch delivered to site, identify:

1. Date and Project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of concrete.
8. Type and amount of cement.
9. Total water and water/cement ratio.
10. Water added for receiver of concrete and receiver's initials.
11. Admixture types.
12. Separate weights of fine and coarse aggregate.
13. Statement of whether batch is pre-mixed at plant or mixed in transit.

B. **Record of Placed Concrete**: Identify date of record, location of pour, quantity, air temperature, and CONTRACTOR's quality control test Samples taken.

C. **Bonding Compound**: Identify product name, type, and chemical analysis.

1.4 QUALITY ASSURANCE

A. Provide ACI certified finishers.

B. Remove and replace any placed concrete suffering hot or cold weather damage.

C. For control testing follow Section 03 30 05 requirements.

1.5 ACCEPTANCE

A. General:

1. Price adjustment, Section 01 29 00. CONTRACTOR may request ENGINEER determine appropriate Modifications or payment adjustments to pay for Defective work.
2. Retesting by CONTRACTOR, Section 01 35 10 and Section 03 30 05.

B. Concrete work that fails to meet any of the following requirements will be considered defective. Replace Defective Work at no additional cost to OWNER:

1. Placement:

a. Reinforcing steel size, quantity, strength, position, damage, or arrangement is not as specified or does not comply with code.

b. Formwork differs from required dimensions or location in such a manner as to reduce concrete's strength or load carrying capacity or physical esthetics.

c. Workmanship likely to result in deficient strength.

2. Finishing:

a. Concrete exposed to view has defects that adversely affect appearance.

b. Slab tolerances of Section 03 35 00 are not met.

3. Protection:

a. Method of curing is not as specified.

b. Inadequate protection of concrete during early stages of hardening and strength development from:

1) temperature extremes.

2) rapid moisture loss.

c. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Section 03 30 04. Class as indicated:

1. For roadway cuts, Section 33 05 25.

B. Bonding Compound: ASTM C1059. Either polyvinyl acetate base or acrylic base latex:

1. Use type I in areas not subject to high humidity or immersion in water with minimum bond strength of 400 psi.

2. Use type II in areas subject to high humidity or immersion in water with minimum bond strength of 1250 psi.

C. Vapor Retarder: 10 mil thick clear polyethylene sheet. Type recommended for below grade application.

D. Forms: Section 03 11 00.

E. Reinforcement: Section 03 20 00.

F. Concrete Curing: Section 03 39 00.

G. Shrinkage Compensating Grouts: Section 03 61 00.

H. Epoxy Adhesive: Section 03 61 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items to be cast into concrete are accurately placed and held securely.

B. Verify slump, air content range, mix identity, and batch time on delivery ticket matches mix design.

C. Verify slab steel mats are supported by steel chairs, precast concrete blocks, or other slab bolsters. Do not pour if absent.

3.2 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Notify ENGINEER no later than 24 hours before commencement of concrete placement.

C. Do not allow construction loads to exceed structural capacity.

D. Clean previously placed concrete. Apply bonding compound per manufacturer's instructions.

E. At locations where new concrete is dowelled to existing work, drill, remove dust, insert and pack steel dowels with shrink compensating grout, and expansion caps where required.

3.3 **DELIVERY**

A. Concrete Temperature: Keep mixed concrete temperature before placement between 60 deg F. and 90 deg F.

B. Slump and Air Content: Keep within allowable ranges.

C. Transport Time:

Air Temperature	**Time After Initial Batching**
Less than 90 deg F	1–1/2 hours
Greater than 90 deg F	1–hour (without retarder)
Greater than 90 deg F	1–1/2 hours (with retarder)

To increase time past 1-1/2 hours, a hydration stabilizer that is acceptable to Supplier may be used.

D. Tempering:

1. Water may be added if all following conditions are met:
   a. The mix design water/cement ratio is not exceeded.
   b. The delivery ticket allows for addition of water based upon water/cement ratio.
   c. The amount of water added is accurately measured to within 1 gallon of the design addition.
   d. Water addition is followed by three (3) minutes of mixing at mixing speed before discharge.
   e. Supplier and CONTRACTOR mutually agree on who is authorized to add water.
2. **Do not add water after 1 cubic yard of concrete has discharged from the delivery vehicle.**

E. Super-plasticizer: Comply with manufacturer's requirements. If none, then as follows:

1. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing admixture to concrete. Before discharge, mix for a minimum of five (5) minutes at a drum rate not less than 12 rpm or more than 15 rpm.

2. If added at plant, do not deliver to site unless batch delivery ticket displays water/cement ratio before super-plasticizer addition.

3.4 **CONCRETE PLACEMENT**

A. In General: ACI 301.

1. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
2. Do not break or interrupt successive pours such that cold joints occur.
3. Honeycomb or embedded debris in concrete is not acceptable.

B. Hot Weather Placement: ACI 305. If the rate of evaporation approaches 0.2 lb./ft^2/hr. precautions against plastic shrinkage cracking are necessary. (i.e. dampening Subgrade and forms; placing concrete at the lowest possible temperature; erecting windbreaks and sunshades; fog sprays; use of evaporation retardants; or rescheduling time of placement).

C. Cold Weather Placement: ACI 306. Accelerating admixture may be used in concrete work placed at ambient temperatures below 50 deg F Use of admixtures will not relax cold weather placement, curing, or protection requirements. . If air temperature is forecasted to fall below 32 deg F. within 14 days of placement, proceed as follows:

1. Provide cold weather protection (cover, insulation, heat, etc.).

2. Do not use chemical "anti-freeze" additives in the concrete. (NOTE: this does not apply to normal accelerators.)

3. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 35 degrees F and ambient temperature is ascending.

4. Protect the concrete from freezing until a compressive strength of at least 90 percent of design strength has been achieved, determined by either:

a. Maturity meter. Refer to AASHTO T 325, or.

b. Field cured cylinders.

5. Adequately vent combustion-type heaters that produce carbon monoxide.

6. When applying external heat, maintain moist conditions to avoid excessive moisture loss from concrete.

7. When removing heat, limit drop in temperature of concrete surfaces to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.

D. Concrete Temperature: Keep mixed concrete temperature at time of placement between 60 deg F and 90 deg F

E. Do not disturb reinforcement, inserts, embedded parts, and formed joints.

F. Do not break or interrupt successive pours such that cold joints occur.

G. Honeycomb or embedded debris in concrete is not acceptable.

3.5 JOINTS AND JOINT SEALING

A. Steel edging and jointing tools are acceptable. Preferred are magnesium, aluminum or wood tools

B. Pavement joint sealing, Section 32 13 73.

3.6 CONSOLIDATION

A. Keep spare vibrator available during concrete placement operations.

B. Follow ACI 309 requirements.

3.7 CURING

A. Section 03 39 00. Use a membrane forming compound unless specified otherwise.

3.8 FINISHING

A. Section 03 35 00 and as follows.

Table 1 – Finishes

Type of work	Finish
Sidewalks, garage floors, ramps, exterior concrete Pavement	Broom or belt
Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials	Non-slip
Surfaces intended to receive bonded applied cementitious applications	Scratched
Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces that are future floors or sand bed terrazzo	Floated
Floors and roof surfaces that are floors intended as walking surfaces or to receive floor coverings	Troweled
Unpainted concrete surfaces not exposed to public view	Rough as-cast form finish
Unpainted concrete surfaces exposed to public view	Smooth as-cast form finish
Concrete surfaces to receive paint or plaster	Grout cleaned finish

3.9 PROTECTION AND REPAIR

A. Protection, Section 01 66 00:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, graffiti, and mechanical injury.

2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Repair:

1. Modify or replace concrete not conforming to required levels, lines, details, and elevations.

2. Structural analysis and additional testing may be required at no additional cost to OWNER when the strength of a structure is considered potentially deficient.

3. To patch imperfections refer to Section 03 35 00 requirements.

4. Remove graffiti and mechanical injury.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing interior and exterior concrete surfaces.

1.2 REFERENCES

A. **ACI Standards**:

303 Guide to Cast-in-Place Architectural Concrete Practice.

1.3 SUBMITTALS

A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 PROJECT CONDITIONS

A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protection as required and remove from site at completion of Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Masonry Mortar and Grout: Section 04 05 16.

B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.

C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing blended materials. Use such compounds per manufacturer's recommendations.

D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than two (2) pounds fluosilicate per gallon and does not interfere with adhesives and bonding.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper finishing.

C. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISHING HORIZONTAL SLABS

A. **Do not apply water (i.e. sprinkle) to any surface of concrete when finishing slabs.**

B. Edges and Joints: Tools may be made out of steel. Preferred is wood, aluminum or magnesium.

C. Tolerances:

1. Class A: 1 in 1000.
2. Class B: 1 in 500.
3. Class C: 1 in 250.

D. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating:

1. Begin floating when water sheen has disappeared and surface has sufficient stiffness.

2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at two (2) or more different angles.

3. Cut down high spots and fill low spots to the required tolerance.

4. Refloat slab immediately to a uniform sandy texture.

E. Trowel Finish:

1. Do not use steel trowel or a power trowel on exterior concrete or on concrete that contains more than three (3) percent air.

2. First troweling shall produce smooth surface relatively free of defects but which may still show some trowel marks.

3. Second troweling after surface has stiffened shall make finished surface essentially free of trowel marks, uniform in texture and appearance.

4. On surfaces intended to support floor coverings, grind off defects that would show through floor covering.

F. Broom or Belt Finish: Sweep surface with brushes, rakes, tines or burlap belt before final set.

G. "Dry Shake" Finish: Give the surface a floated finish. Evenly apply approximately 2/3 of a blended unsegregated material:

1. Begin floating immediately after application of first "dry shake".

2. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.

3. Make second application heavier in any areas not sufficiently covered by first application.

4. Immediately follow with second floating.

5. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.

H. Non-slip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

I. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone:

1. Embed aggregate into surface by light tamping.

2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.

3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.

4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.

5. Continue until aggregate is uniformly exposed.

6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.

J. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrices terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface per manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.3 **FINISHING FORMED SURFACES**

A. General:

1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.

2. Revise the finishes as needed to secure approval.

B. As-Cast Form Finish:

1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.

2. Smooth: Patch tie holes and defects and remove fins completely:

a. When surface texture is impaired and form joints misaligned, grind, bush-hammer, or correct affected concrete.

b. Slurry grout areas evidencing minor mortar Leakage to match adjacent concrete.

c. Repair major mortar Leakage as a defective area.

d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.

C. Rubbed Finishes:

1. Smooth: Remove forms and perform necessary patching as soon after placement as possible:

a. Finish newly hardened concrete no later than 24 hours following form removal.

b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.

2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible:

a. Wet surface of concrete sufficiently to prevent absorption of water from grout.

b. Apply grout uniformly.

c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.

d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.

e. After surface whitens from drying, rub vigorously with clean burlap.

f. Keep damp for at least 36 hours after final rubbing.

3. Cork Floated: Remove forms within two (2) to three (3) days of placement where possible:

a. Remove ties.

b. Remove all burrs and fins.

c. Dampen wall surface.

d. Apply mortar with firm rubber float or with trowel, filling all surface voids.

e. Compress mortar into voids.

f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.

g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish:

1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.

2. Float to texture that is reasonably consistent with formed surfaces.

3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.

E. Blasted Finish:

1. Perform abrasive blasting within 24 to 72 hours after casting.

2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.

3. Reapply curing protection after blast finishing

F. Architectural Finish, ACI 303:

1. Tooled Finish:

a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.

b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish:

1. Repair defective areas:

a. Remove honeycomb and defective concrete to sound concrete.

b. Make edges perpendicular to surface or slightly undercut.

c. Feather edges are not permitted.

d. Dampen area to be patched and at least six (6) inches surrounding it to prevent absorption of patching mortar water.

e. Prepare bonding grout.

f. Mix to consistency of thick cream.

g. Brush into surface.

2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.

3. Make patches in concrete closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry:

a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.

b. Use a minimum amount of mixing water.

c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.

4. After surface water has evaporated from patch area, brush bond coat into surface:

a. When bond coat begins to lose water sheen, apply patching mortar.

b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.

c. Leave undisturbed for at least one (1) hour before final finish.

d. Keep patched area damp for 72 hours or apply curing compound.

e. Do not use metal tools in finishing an exposed patch.

5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.

6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate:

a. Outer 1 inch of patch shall contain same aggregate as surrounding concrete.

b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.

c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete curing requirements.

1.2 REFERENCES

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

B. **ASTM Standards**:

C171 Sheet Materials for Curing Concrete.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 SUBMITTALS

A. Curing agent data sheet.

B. Curing plan. Describe estimated cure quantity and procedure.

C. Manufacturer certificates, Section 01 33 00 that shows product meets performance criteria.

D. Manufacturer's recommended installation procedures which, when accepted by ENGINEER, will become the basis for accepting or rejecting installed product.

1.4 QUALITY ASSURANCE

A. Use workers knowledgeable of ACI 301, 305, 306.

1.5 PRODUCT HANDLING

A. Protect materials of this Section before, during, and after installation.

B. Protect the work and materials of other trades.

C. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

1.6 WEATHER LIMITATIONS

A. Above 75 deg F, ACI 305

B. Below 55 deg F, ACI 306.

PART 2 PRODUCTS

2.1 COVERS

A. Water or Fog-spay: Clean, non-staining and non-detrimental to concrete.

B. Sheet Coverings: White waterproof paper, polyethylene film, or polyethylene coated burlap sheet complying with ASTM C171.

C. Mat Coverings: Clean roll goods of cotton or burlap fabric.

D. Insulating Coverings: Non-staining curing blankets.

2.2 MEMBRANE FORMING COMPOUND

A. Material:

1. Styrene-acrylic.
2. Styrene-butadiene.
3. Alpha-methylstyrene.

B. Reference: ASTM C1315:
1. Type II Class A or B (white pigmented).
2. Type ID Class A (clear with fugitive dye).

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. *DO NOT DILUTE CURING COMPOUNDS.*

B. Do not use membrane forming curing compound on surfaces that are to receive hardeners.

C. Commence curing operation within 20 minutes after finishing.

3.2 APPLICATION – COVERS

A. Water: Apply water-fog spray or ponding.

B. Absorptive Mat: Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers. Thoroughly saturate with water and keep continuously wet.

C. Moisture-Retaining Sheet: Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss. Repair any holes or tears during curing period.

D. Formed Surface Curing: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If forms are removed before curing completion, applying cure film or penetrant or use methods indicated above, as applicable.

3.3 APPLICATION – MEMBRANE FORMING COMPOUND

A. Apply coating continuously and uniformly. Follow manufacturer's recommendations.

B. Protect continuity of film coatings and repair damage during cure period.

C. If forms are removed before expiration of cure period, apply coating to unprotected areas.

3.4 CONCRETE CURE TEMPERATURE

A. During cure period, eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete.

3.5 SCHEDULE

A. Concrete Exposed to Potable Water (as in Water Storage reservoirs):
1. Moisture cover curing, or
2. Acrylic cure, or
3. Styrene acrylic silane co-polymer cure.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-cast concrete, complete with required connecting and supporting devices.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete. This reference standard includes ASTM material standards.

B. **ASTM Standards**:

A36: Structural Steel.

C478 Precast Reinforced Concrete Manhole Sections.

C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C858 Underground Precast Concrete Utility Structures.

C891 Installation of Underground Precast Concrete Utility Structures.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

D. **PCI Standards**:

Design Handbook.

MNL-116 Quality Control and Assurance for Plant Production of Prestressed Concrete.

MNL-117 Quality Control and Assurance for Plant Production of Architectural Precast Concrete.

1.3 DESIGN CRITERIA

A. Design structural precast concrete units, ACI 318 and PCI design handbook.

B. Design utility precast units, ASTM C857 and C858.

C. Under direct supervision of a design professional who is fully experienced in design of units.

D. Design units to support required stripping and handling loads, and live, dead and construction loads.

E. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.4 SHOP DRAWINGS

A. Prepare Shop Drawings under seal of a licensed design professional.

B. Submit Shop Drawings, Section 01 33 00.

C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.

D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.5 QUALITY ASSURANCE

A. Manufacturer:
1. Prestressed: PCI certified.
2. Precast Concrete Units: PCI or NPCA certified
3. Precast Utility Structures and Pipe: ACPA certified.

B. Transporter: Acceptable to manufacturer.

C. Erector:
1. Prestressed: PCI certified.

2. Precast: Has five (5) years minimum experience in erecting precast units.

D. Welders: Certified, AWS D1.1 and AWS D1.4.

1.6 **DELIVERY, STORAGE AND HANDLING**

A. Handle precast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.

C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, nonstaining, and will not inhibit uniform curing of exposed surfaces.

D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.

E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Above Ground: 5000 psi minimum, Section 03 30 04 and ACI 318.

B. Underground: Class 4000 minimum, Section 03 30 04 and ASTM C478 or ASTM C858.

2.2 **ACCESSORIES**

A. Connecting and Supporting Devices: Steel, ASTM A36.

B. Bolts, Nuts, and Washers: High-strength steel. Section 05 05 23.

C. Reinforcement: Grade 60 billet steel bars, Section 03 20 00 plain finish

2.3 **FABRICATION**

A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to ENGINEER.

B. Use molds which are rigid and constructed of material that will result in uniform finished products.

C. If self consolidating concrete is NOT used, vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.

D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts and accessories.

E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored and property located.

F. Ensure finished surfaces of precast structural units are uniform.

G. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

2.4 **DESIGN DEVIATIONS**

A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.

B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a licensed design professional.

2.5 **OPENINGS**

A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.6 **FINISHES**

A. General: Required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, provide Standard Finish.

B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spall are acceptable if approved. Major or unsightly imperfections, honeycomb or structural defects are not acceptable.

C. Commercial Finish: Produced in forms such as plywood or lumber that impart texture to concrete. Remove fins and large projections. Fill holes over 3/8 inch. Make faces true and well defined. Correct exposed ragged edges by rubbing or grinding.

D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.

E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch.

F. Special Finishes: Sandblasting, acid washing, retarders or form liners as approved by ENGINEER. Special finishes require submittal of two 12 x 12 inch Samples showing a representative color and texture to be used.

G. Painted Finishes: On concrete to be painted, use a form release agent acceptable to the paint manufacturer.

2.7 **REPAIR**

A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.8 **ALLOWABLE TOLERANCES**

A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as indicated.

B. End Squareness: 1/2 inch maximum.

C. Blockouts: 1 inch of centerline location indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Do not install precast units until concrete has attained its design compressive strength.

B. Install members plumb, level, and in alignment within PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.

C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

D. Install underground utility precast units per ASTM C891.

3.2 **PERFORMANCE REQUIREMENTS**

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. Rejection: Units may be rejected for any one of the following:
1. Exceeding specified installation tolerances.
2. Damaged during construction operations.
3. Exposed-to-view surfaces which develops surface deficiencies.
4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

END OF SECTION

SECTION 03 61 00
CEMENTITIOUS GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-mixed non-metallic shrinkage resistant grout, pre-mixed water stop hydraulic cement grout, epoxy grout, and Portland cement grout:

1. Grout for leveling beds of structural steel plates.
2. Sealing of joints and gaps between piping and structures.
3. Sealing of joints between construction components.

1.2 REFERENCES

A. ASTM Standards:

C109 Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).

C144 Aggregate for Masonry Mortar.

C150 Portland Cement.

C190 Tensile Strength of Hydraulic Cement Mortars.

C207 Hydrated Lime for Masonry Purposes.

C472 Physical Testing of Gypsum Plasters and Gypsum Concrete.

C595 Blended Hydraulic Cements.

C881 Epoxy - Resin - Base Bonding Systems for Concrete.

C1090 Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.

C1107 Packaged Dry Hydraulic Cement (Non-Shrink).

C1157 Blended Hydraulic Cement.

D570 Water Absorption of Plastics.

D638 Tensile Properties of Plastics.

D695 Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Grout mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits Project requirements.

B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

A. Cement:

1. Portland: Natural color Type II (normal) or Type IIA (air entrained), ASTM C150.
2. Blended: ASTM C595 or C1157.

B. Lime: Type S, hydrated, ASTM C207.

C. Water: Clean, non-staining, non-detrimental.

D. Aggregate: Standard masonry type, ASTM C144.

2.2 **PORTLAND CEMENT GROUT**

A. Proportions by Volume: One part Portland cement, and sand equal to 2-1/2 to three times sum of volumes of cement and lime.

B. Mix thoroughly with water to form a stiff workable plastic putty.

C. Compressive Strength: 2800 psi in 28 days, ASTM C109.

2.3 **GYPSUM PLASTER GROUT**

A. Premixed, prepackaged, wood fiber gypsum plaster with an ASTM C472 minimum average dry compressive strength of 2000 psi in 28 days.

B. Mix with water per manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.4 **CEMENT BASED SHRINKAGE RESISTANT GROUT**

A. Grade B or Grade C: ASTM C1107. Premixed, non-metallic, non-gaseous product at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through flow cone after slight agitation, in temperatures of 40 deg F to 90 deg F

B. Bleeding: None.

C. Compressive Strength: 6500 to 9000 psi in 28 days, ASTM C109.

D. Non-shrink percentage: 0.5 percent, ASTM C1090.

2.5 **EPOXY ADHESIVE GROUT**

A. Two component material, ASTM C881. Suitable for use on dry or damp surfaces, 100 percent solids, high modulus, moisture insensitive:

1. Tensile Strength: 5000 psi minimum in 14 days, ASTM D638.
2. Tensile Elongation: Two (2) percent minimum, ASTM D638.
3. Compressive Strength: 6500 psi minimum in 24 hours and 70 deg F, 12,500 psi in 28 days and 70 deg F , ASTM D695.
4. Water Absorption: One percent maximum, ASTM D570.
5. Bond Strength:
   a. Direct Shear: 400 psi.
   b. Direct Tension: 250 psi.
   c. Beam Break: 800 psi.
6. Pot Life: Five minutes maximum at 70 deg F

2.6 **BONDING GROUT**

A. Of approximately one part cement to one part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.7 **PNEUMATICALLY PLACED PLASTER ("GUNITE" OR "SHOTCRETE")**

A. Materials: Portland cement, lime, water and sand.

B. Compressive Strength: 2800 psi in 28 days, ASTM C109.

C. Proportioning: One part cement to not more than five parts sand.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Fill joints, voids, and pockets, completely.

B. Comply with manufacturer's instructions and UBC Chapter 47.

C. Finish surfaces exposed to view smooth.

D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than 25 percent of the total sand in any batch.

END OF SECTION

DIVISION 04

MASONRY

SECTION 04 05 16

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar and grout for masonry work.

1.2 REFERENCES

A. **ASTM Standards**:

C144 Aggregate for Masonry Mortar.

C150 Portland Cement.

C207 Hydrated Lime for Masonry Purposes.

C270 Mortar for Unit Masonry.

C404 Aggregates for Masonry Grout.

C476 Mortar and Grout for Reinforced Masonry.

C780 Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

C1019 Sampling and Testing Grout.

1.3 SUBMITTALS

A. Certification of Material: Submit manufacturer's mill test certificates covering materials shipped. Bags shall show contents meet specifications herein.

B. Design Mix: Indicate proportions of Portland cement, hydrated lime and sand to be used, required environmental conditions, and admixture limitations.

1.4 DELIVERY, STORAGE AND HANDLING

A. Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

B. Maintain materials and surrounding air temperature to at lease 50 deg F before, during and 48 hours after completion of masonry work.

1.5 QUALITY ASSURANCE

A. Follow ASTM C780 for testing mortar mix.

B. Follow ASTM C1019 for testing grout mix.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: Natural color, Type II (normal) or Type IIA (air entraining), ASTM C150.

B. Water: Clean, non-staining, non-detrimental.

C. Hydrated Lime: Type S, ASTM C207. No substitutes permitted.

D. Mortar Aggregate: Standard masonry type except containing not more than 10 percent material passing through No. 100 sieve, ASTM C144. Measure damp and loose throughout batches.

E. Grout Aggregate, ASTM C404:

1. Fine aggregate (no. 4 through no. 100 sieves): Size 2.
2. Coarse aggregate (1/2 inch through no. 16 sieves): Size 8.

2.2 MORTAR MIXES

A. Refer to ASTM C270. Vary volumes of materials in mix design only slightly to assist workability:

1. Type S Mix (1,800 psi at 28 days): For reinforced masonry with high flexural bond strength. Use for all walls.

2. Type M Mix (2,500 psi at 28 days): For structural masonry, frost resistance, below grade masonry and masonry in contact with earth.

3. Mixing: Mix for a minimum of three (3) minutes.

B. Admixtures: Not permitted.

C. Color: Natural gray.

2.3 **GROUT MIXES**

A. Refer to ASTM C476. Vary volumes of materials in mix design only slightly to assist workability:

1. Reinforced masonry; 2,000 psi at 28 days.

2. Do not use antifreeze additives.

B. Mixing: Mix at least five (5) minutes to a slump of 10 inches plus or minus 1 inch at time of placement.

C. Admixtures: Not permitted.

D. Color: Natural gray.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Use mortar or grout within two (2) hours after mixing at temperatures of 80 deg F or greater or 2-1/2 hours at temperatures under 50 deg F

B. Use fine grout for filling concrete masonry unit cores and when pumping is required.

C. Use fine or coarse grout for bond beams or where grout does not have to pass through openings less than two (2) inches.

END OF SECTION

SECTION 04 21 00
CLAY UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clay unit masonry, reinforcement anchorages and accessories.

1.2 REFERENCES

A. **ASTM Standards**:

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C62 Building Brick (Solid Masonry Units Made from Clay or Shale).

C216 Facing Brick (Solid Masonry Units Made From clay or Shale).

B. **BIA Standards**:

A606 Cold Weather Masonry Construction.

1.3 SUBMITTALS

A. Submit 10 Samples of units to illustrate color range and texture. Refer to Section 01 33 00.

B. Submit manufacturer's certificate that brick masonry units and reinforcing steel materials meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Mock up: When indicated, construct for review of laying, and jointing of units:

1. 4 x 6 feet minimum.
2. If not acceptable, construct additional walls until acceptable.
3. Preserve wall during construction as a standard of quality.
4. Remove when directed.
5. Sample wall may be built into permanent wall provided sample area is readily identifiable during construction.

B. Inspect masonry units upon delivery to ensure color matches sample wall.

C. Deliver units on pallets with tight covers or deliver in cubes and store in dunnage.

D. Maintain coverings in place until use.

1.5 PROJECT CONDITIONS

A. Cold Weather: In accordance with BIA Publication A606 requirements protect from damage by rain, snow, inclement weather, wind, freezing temperatures, and other trades. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrate. Remove and replace masonry damaged by frost or freezing. No antifreeze materials permitted.

B. Protection:

1. Cover tops of masonry walls with tarp or reinforced plastic each day at end of work and when work is not in progress. Keep walls covered and protected until final wall copings are installed.
2. Brace and protect walls during erection against damage by storm and wind. Maintain bracing in place until permanent floors, walls and roof framing are installed.

C. Temperature: Temperature of masonry units when laid shall not be less than 20 deg F Maintain masonry work above 50 deg F before, during, and 48 hours after completion. Do not use salamander heaters or other Petroleum type heaters that cause excessive drying or smoke. Use heaters on both sides of wall under construction.

D. Heating Materials: Heat materials to at least 50 deg F but not more that 160 deg F to produce material temperature of between 50 deg F and 120 deg F

PART 2 PRODUCTS

2.1 BRICK UNITS MADE FROM SHALE OR CLAY

A. Facing Brick: Type FBS (normal size and color variations), Grade SW; modular sized to 2-1/4" x 3-3/4" x 8", ASTM C216. Color selected by ENGINEER.

B. Building (Common) Brick: Grade SW, Type F, ASTM C62. Size and color selected by ENGINEER.

C. Special Shape: Of same brick type as above, shaped to profile indicated, surface texture on one side and end.

2.2 REINFORCEMENT, ANCHORS AND TIES

A. Joint Reinforcement: Truss type galvanized steel construction; 3/16 inch side rods with No. 9 cross ties. Do not use drip cross ties.

B. Anchors: Flexible two (2) piece steel; 0.1875 inch diameter minimum 0.25 inch maximum.

C. Wall Ties: Bent wire 0.1875 inch minimum but not greater than 1/2 mortar joint thickness.

D. Reinforcement: Grade 60 billet steel bars, ASTM A615 plain finish.

2.3 MASONRY FLASHINGS

A. Plastic Flashings: Sheet polyethylene or PVC, 10 mil.

B. Copper and Kraft Paper Flashings: Two ounces per square foot copper bonded to layer of fiber reinforced asphalt and backed with Kraft paper.

C. Sheet Metal Flashing: Galvanized steel, 22 gage minimum.

D. Plastic and Kraft Paper Flashings: Three (3) mil thick sheet polyethylene bonded to layer of fiber reinforced asphalt and backed with Kraft paper.

2.4 ACCESSORIES

A. Control Joints: Preformed neoprene.

B. Joint Filler: Closed cell polyethylene oversized 50 percent, Self-expanding; 1 inch wide by maximum length.

C. Nailing Strips: Western softwood, preservative treated, sized to masonry joints.

D. Weep Holes: PVC tubes or open vertical joints between units on bottom course.

2.5 MORTAR AND GROUT

A. Section 04 05 16.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that items provided for work are properly sized and located.

B. Establish lines, levels, and coursing. Protect from disturbance.

C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.

3.2 COURSING

A. Place brick to lines and levels required.

B. Maintain brick courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.

C. Unless indicated otherwise, lay brick units in running or stacked bond course, three (3) brick courses and three (3) mortar joints to equal eight (8) inches. Form concave, raked, flushed, or beveled joints as required.

3.3 PLACING AND BONDING

A. Lay masonry in full bed of mortar, properly jointed with other work. Do not butter corners of joints or make deep or excessive furrowing of mortar joints.

B. Fully bond intersections, external and internal corners.

C. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made remove mortar and replace.

D. Remove excess mortar.

E. Perform job site cutting with masonry saws to provide straight unchipped edges. Do not break masonry unit corners or edges.

F. Do not install broken or cracked units.

3.4**CAVITY SPACE**

A. Do not let mortar fall into cavity air space or plug weep holes; clean out promptly if any occurs.

B. Install cavity vents or weep holes in veneer as indicated or as approved.

3.5 **TOLERANCES**

A. Alignment of Columns and Pilasters: Maximum 1/4 inch from true lines.

B. Variation from Unit to Adjacent Unit: 1/32 inch maximum.

C. Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

D. Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch maximum in two stories or more.

E. Variation from Level Coursing: 1/8 inch in three (3) feet; 1/4 inch in 10 feet; 1/2 inch maximum.

F. Variation of Joint Thickness: 1/8 inch in three (3) feet.

G. Maximum Variance from Cross-Sectional Thickness of Walls: Plus or minus 1/4 inch.

3.6 **REINFORCEMENT AND ANCHORAGES**

A. Unless indicated otherwise, install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 16 inches minimum each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum six (6) inch. Extend 16 inch minimum each side of opening.

E. Verify that anchorages embedded in concrete or attached to structural steel members are properly placed. Embed anchorages in every second joint.

F. Secure wall ties to backup for veneer with a minimum of one tie for each two (2) square feet of wall. Place at maximum three (3) inches of each way around perimeter of openings, within 12 inches of openings.

G. Reinforce joint corners and intersections with strap anchors 16 inches on center.

H. Use clips only where ties cannot be used.

I. Place horizontal and vertical wall reinforcement as indicated.

3.7 **MASONRY FLASHINGS**

A. Extend flashings through veneer, turn up minimum eight (8) inches and bed into mortar joints of masonry, seal to substrate as required.

B. Lap end joints minimum six (6) inches and seal watertight.

C. Use flashing manufacturer's recommended sealant.

3.8 **LINTELS**

A. Supply and install loose steel lintels as indicated.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled. Construct or shop fabricate lintels using grout fill and reinforcing. Maintain minimum eight (8) inches bearing on each side of opening.

C. Use reinforcing bars of one piece lengths only.

D. Place and consolidate grout fill without disturbing reinforcing.

E. Allow lintels to reach strength before removing temporary supports.

3.9 **CONTROL JOINTS**

A. Do not continue horizontal joint reinforcing across control joints.

B. Install resilient control joint in continuous lengths. Heat or solvent weld butt and corner joints in accordance with manufacturer's instructions.

3.10 BUILT-IN WORK

A. Build in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items.

B. Build items plumb and level.

C. Do not build in organic materials.

3.11 CUTTING AND FITTING

A. Modify completed work for chases, pipes, conduit, sleeves, grounds, and others items as required. Cooperate with other sections of work to provide correct size, shape, and location.

B. Obtain approval before modifying any area not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING AND PROTECTION

A. Brush off excess mortar as work progresses. Dry brush at end of each day's work.

B. Final Cleaning: After mortar is thoroughly set and cured and damaged surfaces are repaired, clean a sample wall area of approximately 20 square feet. Obtain ENGINEER's approval of sample cleaning before proceeding to clean masonry work.

1. Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if necessary.

2. Scrub down wall with stiff fiber brush and either a solution of 1/2 cup of trisodium phosphate and 1/2 cup of household detergent dissolved in 1 gallon water, or approved masonry cleaner.

3. Rinse walls by washing off cleaning solution, dirt, and mortar crumbs using clean, 100 percent soluble pressurized water.

C. Sealing: Siloxane, Section 07 19 00 on indicated surfaces.

D. Protection: Maintain conditions acceptable to installer to ensure unit masonry work remains undamaged.

END OF SECTION

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete masonry units, reinforcement, anchorages and accessories.

1.2 REFERENCES

A. **ACI Standards**:

315 Details and Detailing of Concrete Reinforcement.

B. **ASTM Standards**:

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C55 Concrete Building Brick.

C90 Hollow Load-Bearing Concrete Masonry Units.

C145 Solid Load-Bearing Concrete Masonry Units.

D226 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

D1056 Flexible Cellular Materials - Sponge or Expanded Rubber.

D2000 Rubber Products in Automotive Applications.

D2287 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D. **BIA Standards**:

A606 Cold Weather Masonry Construction.

E. **UBC Standards**:

Chapter 24 Masonry.

1.3 SUBMITTALS

A. Submit 10 Samples of units to illustrate color range and texture, Section 01 33 00.

B. Indicate bar sizes, spacing, locations, and quantities of reinforcing steel, and wire fabric, bending and cutting schedules, and support and spacing devices.

C. Prepare Shop Drawings under seal of a design professional licensed in the State of Utah and acceptable to ENGINEER.

D. Submit manufacturer's certificate that concrete masonry units and reinforcing steel materials meet or exceed specified requirements.

1.4 PROJECT CONDITIONS

A. Cold weather: In accordance with BIA Publication A606 requirements protect from damage by rain, snow, inclement weather, wind, freezing temperatures, and other trades. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrate. Remove and replace masonry damaged by frost or freezing. No antifreeze materials permitted.

B. Protection:

1. Cover tops of masonry walls with tarp or reinforced plastic each day at end of work and when work is not in progress. Keep walls covered and protected until final wall copings are installed.

2. Brace and protect walls during erection against damage by storm and wind. Maintain bracing in place until permanent floors, walls and roof framing are installed.

C. Temperature: Temperature of masonry units when laid shall not be less than 20 deg F Maintain masonry work above 50 deg F before, during, and 48 hours after completion. Do not use salamander heaters or other Petroleum type heaters that cause excessive drying or smoke. Use heaters on both sides of wall under construction.

D. Heating Materials: Heat materials to at least 50 deg F but not more that 160 deg F to produce material temperature of between 50 deg F and 120 deg F

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow Load Bearing Units: Grade N, Type I, light weight, ASTM C90.

B. Solid Load Bearing Units, Grade N, Type I, light weight, ASTM C145.

C. Decorative Units, ASTM C90 or C145:

1. Interior Location: Grade S, Type I, single scored horizontally, single scored vertically, double scored vertically, triple scored vertically, ribbed or ribbed and split as indicated.

2. Exterior Locations: Grade N units.

D. Concrete Brick: Grade N, Type I, normal weight, ASTM C55.

E. Masonry Units: Modular sized to 7-5/8 x 7-5/8 x 15-5/8 inches or as indicated; provide special units for 90 degree corners, bond beams, lintels, covered base, and bull-nose corners as required.

2.2 REINFORCEMENT, ANCHORS AND TIES

A. Single Wythe Joint Reinforcement: Truss type, galvanized steel, 3/16 inch side rods with No. 9 cross ties.

B. Double wythe walls without drip cross ties.

C. Reinforcement: Grade 60 deformed billet steel bars, ASTM A615.

2.3 MASONRY FLASHINGS

A. Plastic Flashings: Sheet polyethylene or PVC; 10 mil thick.

B. Copper and Kraft Paper Flashings: two (2) ounces per square foot copper bonded to layer of fiber reinforced asphalt and backed with Kraft paper.

C. Sheet Metal Flashing: Galvanized steel, 22 gage minimum.

D. Plastic and Kraft Paper Flashings: Three (3) mil thick sheet polyethylene bonded to layer of fiber reinforced asphalt and backed with Kraft paper.

2.4 ACCESSORIES

A. Nonmetallic Expansion Joint Strips: Grade RE41E1 premolded, flexible cellular neoprene rubber filler strips, ASTM D1056, capable of compression up to 35 percent of width and thickness indicated.

B. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall, Size and configuration as indicated:

1. Styrene-butadiene rubber compound complying with ASTM D2000, Designation 2AA-805, or

2. Polyvinyl chloride compound complying with ASTM D2287, General Purpose Grade, Designation PVC-63506.

C. Bond Breaker Strips: Type I (No. 15 asphalt-saturated organic roofing felt), ASTM D226.

D. Joint Filler: Closed cell polyethylene oversized 50 percent, self expanding, 1 inch wide by maximum lengths.

E. Building Paper: Asphalt saturated felt 16 pound type, ASTM D226.

F. Nailing Strips: Western softwood, preservative treated, sized to masonry joints.

G. Weep Holes: PVC tubes or open vertical joints between units on bottom course.

2.5 MORTAR AND GROUT

A. Section 04 05 16.

PART 3 EXECUTION

3.1 PREPARATION

A. Supply metal anchors to framing or structural erector where required and direct the placement of the anchors for anchoring the masonry work to other structural members.

B. Verify items provided by other sections of work are properly sized and located.

C. Establish lines, levels, and coursing. Protect from disturbance.

D. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.

E. Provide safe and secure scaffolding, staging, and ladders that conform to current Laws and Regulations.

3.2 COURSING

A. Place masonry to lines and levels required.

B. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.

C. Unless indicated otherwise, lay concrete masonry units in running or stacked bond as indicated. Course one block unit and one mortar joint to equal eight (8) inches. Form concave, raked, flush, or bevelled mortar joints as required.

3.3 PLACING AND BONDING

A. Lay masonry in full bed of mortar, properly jointed with other work. Do not butter corners of joints or make deep or excessive furrowing of mortar joints.

B. Fully bond intersections, external and internal corners.

C. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.

D. Remove excess mortar.

E. Perform job site cutting with masonry saws to provide straight unchipped edges. Do not break masonry unit corners or edges.

F. Do not install broken or cracked units.

G. Strike mortar joints of concrete masonry units flush where bitumen damp-proofing is applied.

3.4 REINFORCEMENT AND ANCHORAGES

A. Unless indicated otherwise, install horizontal joint reinforcement 16 inches on center; 24 inches on center if used in veneer. Joint reinforcement is in addition to bond beams.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 16 inches minimum each side of opening.

C. Bond beams at all floors, roofs, 48 inches on center maximum, and at top of walls.

D. Lap joint reinforcement ends minimum six (6) inches. Extend 16 inches minimum each side of opening.

E. Embed wall ties in masonry backup for veneer at maximum 16 inches on center vertically and 18 inches on center horizontally. Place so that no single tie will support more than two (2) square feet of veneer. Place at maximum three (3) inches on center each way around perimeter of opening within 12 inches of openings. Use joint reinforcement for veneer ties on masonry walls.

F. Reinforce joint corners and intersections with reinforcement anchor systems.

3.5 REINFORCING STEEL

A. Place reinforcement, ACI 315 and UBC Chapter 24.

B. Locate reinforcing splices at points of minimum stress. Review location of splices with ENGINEER.

C. Weld reinforcement, AWS D1.1.

D. Place reinforcing bars supported and secured against displacement. Maintain position within 1/2 inch of true dimension.

E. Verify reinforcement is clean, free of scale, rust, dirt, and other foreign coatings that would reduce bond to grout.

3.6 **TOLERANCES**

A. Alignment of Columns and Pilaster: 1/4 inch maximum from true line.

B. Variation from Unit to Adjacent Unit: 1/32 inch maximum.

C. Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

D. Variation from Plumb: 1/4 inch per story non-cumulative, 1/2 inch maximum in two (2) stories or more.

E. Variation from Level Coursing: 1/8 inch in three (3) feet, 1/4 inch in 10 feet, 1/2 inch maximum.

F. Variation of Joint Thickness: 1/8 inch in three (3) feet.

G. Maximum Variance from Cross-Sectional Thickness of Walls: 1/4 inch plus or minus.

3.7 **MASONRY FLASHINGS**

A. Extend flashings through veneer, turn up minimum eight (8) inches and bed into mortar joints of masonry, seal substrate as required.

B. Lap end joints six (6) inches minimum and seal watertight.

C. Use flashing manufacturer's recommended sealant.

3.8 **LINTELS**

A. Furnish and install steel lintels as indicated.

B. Install precast concrete lintels as indicated.

C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled. Construct or shop fabricate lintels using grout fill and reinforcing. Maintain eight (8) inches minimum bearing or each side of opening.

D. Do not splice reinforcing bars in lintels.

E. Allow lintels to reach full strength before removing temporary supports.

3.9 **GROUTED COMPONENTS**

A. Reinforce bond beams as indicated. Use "H" blocks for bond beams and "U" blocks for lintels.

B. Reinforce pilaster as indicated.

C. Lap splices minimum 40 bar diameters.

D. Place and consolidate grout fill without disturbing reinforcing. Grout lifts greater than eight (8) inches shall be mechanically vibrated. Do not consolidate by rodding or shaking the vertical bars.

E. At bearing points fill masonry cores with grout a minimum of 24 inches wide from bearing point to lower support member or bond beam.

3.10 **CONTROL JOINTS**

A. Do not continue horizontal joint reinforcing across control joints.

B. Form control joint by use of sheet building paper bond breaker one side fitted to hollow contour of block unit end. Fill created core with grout fill. Rake joint at exposed faces of rod and sealant.

C. Install resilient control joint in continuous lengths. Heat or solvent weld butt and corner joints in accordance with manufacturer's instructions.

3.11 **BUILT-IN WORK**

A. Build in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items. Place all anchor bolts in solid grouted cores.

B. Build items plumb and level.

C. Bed anchors of metal door and glazed frames in mortar joints. Fill frame voids solid with mortar. Fill masonry cores with grout for one core from framed openings.

D. Do not build in organic materials.

3.12 **CUTTING AND FITTING**

A. Modify completed work for chases, pipes, conduit, sleeves, grounds, and other items as required. Cooperate with other sections of work to provide correct size, shape, and location.

B. Obtain approval before modifying any area not indicated or where appearance or strength of masonry work may be impaired.

3.13 **CLEANING AND SEALING**

A. Brush off excess mortar as work progresses. Dry brush at end of each day's work.

B. Final Cleaning: After mortar is thoroughly set and cured and damaged surfaces are repaired, clean sample wall area of approximately 20 square feet. Obtain ENGINEER's approval of sample cleaning before proceeding to clean masonry work:

1. Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if necessary.

2. Scrub down wall with stiff fiber brush and either a solution of 1/2 cup of trisodium phosphate and 1/2 cup of household detergent dissolved in 1 gallon of water, or approved masonry cleaner.

3. Rinse walls by washing off cleaning solution, dirt, and mortar crumbs using clean, 100 percent soluble pressurized water.

C. Sealing: Siloxane, Section 07 19 00 on indicated surfaces.

3.14 **PROTECTION**

A. Maintain protective boards at exposed external corners that may be damaged by construction activities.

B. Provide protection without damaging completed work.

C. At day's end, cover unfinished walls to prevent moisture infiltration.

D. Protect adjacent finished surfaces from damage.

END OF SECTION

DIVISION 05

METALS

SECTION 05 05 10
METAL GALVANIZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of a zinc coating on fabricated metal items.

B. Repair of damaged galvanized surfaces.

1.2 REFERENCES

A. **ASTM Standards**:

A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

A780 Repair of Damaged Hot-Dip Galvanized Coatings.

B6 Zinc (Slab Zinc).

E376 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.

B. **FS Standards**:

TT-P-641 Primer Coating, Zinc Dust - Zinc Oxide (for Galvanized Surfaces).

C. **Military Standards**:

P-21035 Paint, High Zinc Dust Content, Galvanizing Repair.

1.3 QUALITY ASSURANCE

A. When requested, verify weight of zinc coating in accordance with ASTM E376.

PART 2 PRODUCTS

2.1 ZINC METAL

A. Use zinc for coating that conforms to ASTM B6 and is at least equal to the grade designated as "Prime Western".

PART 3 EXECUTION

3.1 GALVANIZING

A. Provide a zinc coating for those items indicated or specified to be galvanized as follows:

1. ASTM A123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strips 1/8 inch thick and heavier.

2. ASTM A153 for galvanizing iron and steel hardware.

3.2 WEIGHT OF COATING

A. Apply zinc on 1/8 inch to 3/16 inch thick steel at a rate of at least two (2) ounces per square foot of surface area.

B. Apply zinc on 1/4 inch and thicker steels at a rate of at least 2.3 ounces per square foot with no individual test measuring less than two (2) ounces per square foot of surface area.

3.3 REPAIR OF DAMAGED COATING

A. Shop Damage: Repair galvanized surfaces by the metallizing, hot stick or zinc rich paint, ASTM C780 process.

B. Field Damage: Repair cut, burned or uncoated surfaces by coating with a dust-zinc oxide paint conforming to FS TT-P-641 or MIL P-21035.

END OF SECTION

SECTION 05 05 23
BOLTS, NUTS AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel bolts, nuts, washers, clamps, straps, rods and accessories.

B. Galvanize bolts, nuts and accessories unless specified otherwise.

1.2 REFERENCES

A. **AISC Standards**:

M011: Manual of Steel Construction.

B. **ASME Standards**:

B1.1 Unified inch Screw Threads (UN and UNR Thread Form), Supplement.

C. **ASTM Standards**:

A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

A197 Cupola Malleable Iron.

A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

A325 High-Strength Bolts for Structural Steel Joints.

A506 Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Regular Quality and Structural Quality.

A575 Steel Bars, Carbon, Merchant Quality, M-Grades.

F593 Stainless Steel Bolts, Hex Cap Screws, and Studs.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Galvanize bolts, nuts, and accessories, Section 05 05 10, (except if stainless steel is required).

2. All sizes bolts and nuts, American Standard machined heavy hexagon heads with class two (2) fit and threads, ASME B1.1.

B. Standard Bolts: Steel, ASTM A307.

C. High Strength Bolts: Steel, ASTM A325.

D. Anchor Bolts: Steel, ASTM A307, or ASTM F593 if stainless steel is indicated.

E. Washers: Grey iron, ASTM A126.

F. Clamps and Straps: Steel, ASTM A506.

G. Rods: Steel, ASTM A575.

H. Rod Coupling: Mallable iron, ASTM A197.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Torque all nuts and bolts by procedures contained in AISC M011 to secure items requiring fastening.

B. Extend bolt through nut not less than 1/4 inch beyond nut.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural steel framing members, structural steel support members, struts, and miscellaneous structural steel members with required bracing, welds, and fasteners.

B. Base plates, shear stud connectors, expansion joint plates, and related structural steel items.

1.2 REFERENCES

A. **AISC Standards**:

S302 Steel Buildings and Bridges.

S326 Cold-Formed Structural Members for Buildings.

S329 Structural Joint Using ASTM A325 or A 490 Bolts.

B. **ASTM Standards**:

A6 General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.

A27 Steel Castings, Carbon, for General Application.

A36 Structural Steel.

A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

A242 High-Strength Low-Alloy Structural Steel.

A307 Carbon Steel, Bolts and Studs, 60,000 psi Tensile Strength.

A325 High-Strength Bolts for Structural Steel Joints.

A441 High-Strength Low-Alloy Structural Manganese Vanadium Steel.

A446 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

A490 Heat-Treated Steel Structural Bolts, 150 ksi (1035 MPa) Minimum Tensile Strength.

A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

A501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

A502 Steel Structural Rivets.

A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

A606 Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

A607 Steel Sheet and Strip, High-Strength, Low-Alloy, Columbium and or Vanadium, or Both, Hot-Rolled and Cold-Rolled.

A611 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D. **FS Standards**:

TT-P-31 Paint, Oil: Iron Oxide, Ready-Mixed, Red and Brown.

1.3 SUBMITTALS

A. Heat of Steel or Iron: Before fabrication, submit a mill certified test report for each heat of steel or iron from which the material is to be fabricated containing the results of chemical and physical tests required by ASTM specifications for the materials. Select the material from as few heat numbers as possible and furnish certified mill test reports for each of the heat numbers. Submit two (2) Samples from each heat number; one for the tension test

and one for the cold-bend test. If the heat numbers cannot be identified ENGINEER may select random specimens from unidentifiable heats.

B. Certification of Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the previous 12 months on the same type of work to be done. If recertification of welders is required, retesting will be CONTRACTOR's responsibility.

1.4 **QUALITY ASSURANCE**

A. Codes and Standards:

1. AISC S302, AISC S326, AISC S329.
2. ASTM A6 and AWS D1.1.

B. Qualify welding processes and welding operators in accordance with AWS.

C. Supplementary Tests:

1. ENGINEER reserves right to require or make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in case of Failure of the material to comply with ASTM requirements, more tests may be made or the materials rejected:
   a. Structural Steel: One complete test for each heat number or each 10 tons of identifiable stock.
   b. Rivets: One complete test for each size.
   c. Bolts: One complete test for each lot.
2. "Identifiable stock" is material for which authentic records of the chemical and physical properties are available.
3. Cut and machine test specimens in accordance with ASTM specifications for material to be tested.

D. When fabrication is to be done using material already in stock, obtain approval before fabrication.

E. Furnish steel with rolling and cutting tolerances, permissible variations in weight and dimensions, defects, and imperfections that meet the limits contained in ASTM A6.

1.5 **SHOP DRAWINGS**

A. Submit Shop Drawings, Section 01 33 00.

B. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, fasteners, cambers, loads, and any special details.

C. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

D. Under seal of a structural professional engineer prepare Shop Drawings structural connections, setting drawings, templates, and directions for installation for anchor bolts and other anchorages to be installed by others.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver anchor bolts and anchorage devices which are to be embedded in concrete or masonry in ample time to not delay work.

B. Store materials to permit easy access for Inspection and identification. Keep steel members off the ground using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Do not store materials on structure in a manner that might cause deterioration or damage to members or supporting structures. Repair or replace damaged materials or structures.

PART 2 PRODUCTS

2.1 **GENERAL**

A. For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness.

B. Remove blemishes by grinding or by welding and grinding before cleaning, treating, and application of surface finishes.

2.2 STRUCTURAL STEEL FRAMING MATERIALS

A. Stock Materials: Select the material intended for use from stock and place it in a location apart from other stock material and accessible for Inspection and sampling.

B. Structural Steel Shapes, Plates, and Bars: ASTM A36 steel.

C. High Strength Low-Alloy Structural Steel: In accordance with ASTM A242, A 441, A 606, A 607, or A 446 (Grades C, D, or E) as indicated.

D. Tubing:

1. Cold-formed steel, ASTM A500, Grade B.
2. Hot-formed steel, ASTM A501.

E. Pipe: ASTM A53 steel Type E or S, Grade B with black finish, except where indicated to be galvanized.

F. Copper Bearing Structural Steel: ASTM A36, A 446, A 570, or A 611 as indicated.

G. Castings: ASTM A27 Grade 65-35, medium strength carbon steel.

2.3 STEEL ACCESSORIES

A. Anchor Bolts: Galvanized steel; Section 05 05 23.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon steel bolts and nuts with hexagonal heads and nuts for all connections.

C. High Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers. Quenched and tempered medium carbon steel bolts, nuts, and washers complying with ASTM A325. For high strength low alloy steel, provide Type 3 fasteners of similar composition as members to be connected.

D. Rivets: ASTM A502, high strength, hot-driven type or carbon-manganese steel.

E. Welding Materials: Refer to AWS D1.1; type required for materials being welded. For high strength, low alloy steel provide electrodes, welding rods, and filler metals equal in strength and compatible in appearance with parent metal joined.

F. Primer: FS TT-P-31, red paint.

2.4 FABRICATION

A. Fabricate structural steel members in accordance with AISC specifications and as indicated on approved Shop Drawings.

B. Fabricate and assemble structural members in shop to greatest extent possible. Provide camber in structural members where indicated. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials. Where finishing is required, complete assembly, including welding of units before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

C. Connections: Weld or bolt shop connections as indicated. Bolt field connections except where welded connections or other connections are indicated. Provide high strength, threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

D. High Strength Bolted Construction: Install high strength, threaded fasteners in accordance with AISC S329.

E. Welded Construction: Comply with AWS welding code for procedures, appearance, and quality of welds and methods used in correcting welding work. For high strength, low alloy steels follow welding procedures recommended by steel producer for exposed and concealed connections.

F. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members as shown on approved Shop Drawings. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work. Cut, drill, or punch items as indicated to receive other work. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.5 SHOP PAINTING

A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial two (2) inches of embedded areas only. Do not paint surfaces which are to be welded or high strength bolted with friction type connections. Do not paint surfaces of exposed high strength, low alloy steel members. Apply two (2) coats of paint

to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. Surface Preparation: After Inspection and before shipping clean steel work to be painted. Remove loose rust, loose mill scale, spatter, slag, or flux deposits. Clean steel per Steel Structures Painting Council (SSPC) standards.

2.6 **NON-SHRINK GROUT**

A. Cement based, Section 03 61 00.

PART 3 EXECUTION

3.1 **INSPECTION**

A. Examine areas and conditions under which structural steel work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 **ERECTION**

A. Erect structural steel in accordance with AISC Specifications.

B. Have all torque wrenches or impact wrenches certified by a testing laboratory before starting erecting.

C. Make provisions for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Do not field cut or alter structural members without approval.

E. Clean concrete and masonry bearing surfaces. Clean bottom surface of base and bearing plates. Set loose and attached base plates and bearing plates for structural members on jack nuts for leveling adjustments.

F. Tighten anchor bolts after supported members have been positioned and plumbed.

G. Pack non-shrink grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

H. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances.

I. Establish required leveling and plumbing measurements on mean operating temperature of structure.

J. Splice members only where indicated and accepted on Shop Drawings.

K. On exposed welded construction remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

L. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

M. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

N. Do not use gas cutting torches for correcting fabrication errors in structural framing.

O. Immediately after erection clean field welds, bolted connections, and abraded area of shop paint. Apply paint to exposed area with same materials as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of two (2) mils.

END OF SECTION

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel stair frame of structural sections with open or closed risers and balusters and handrailing.

B. Open grate, checkered plate, pan to receive concrete fill, shop cast concrete, stair treads, and landings.

1.2 REFERENCES

A. **ANSI Standards**:

A202.1 Metal Bar Grating.

B. **ASTM Standards**:

A36 Standard Specification for Structural Steel.

A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

A446 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

A501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D. **FS Standards**:

TT-P-636 Paint, Coating, Alkyd, Wood and Ferrous Metal.

TT-P-641 Primer Coating, Zinc Dust - Zinc Oxide (for Galvanized Surfaces).

1.3 STRUCTURAL REQUIREMENTS

A. Unless indicated otherwise, fabricate stair assembly to support uniform live load of 100 pounds per square foot with deflection of stringer not to exceed L/180 of span, minimum or a concentrated load of 300 pounds.

B. Unless indicated otherwise, railing assembly, wall rails, and attachments to resist lateral force of 50 pounds minimum per lineal foot or a 200 pound vertical or horizontal concentrated load without damage or permanent set.

1.4 SHOP DRAWINGS

A. Submit Shop Drawings, Section 01 33 00.

B. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, openings, size and type of fasteners, and accessories.

C. Include erection drawings, elevations, and details where applicable.

D. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

E. Prepare Shop Drawings under seal of a structural professional engineer.

1.5 SAMPLES

A. Submit Samples, Section 01 33 00.

B. Submit 12 inches long Sample of plastic handrail covering when used.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural steel, ASTM A36.

B. Tubing: Steel:

1. ASTM A500, Grade B, ASTM A501, or
2. ASTM A53, Grade B, Schedule 40.

C. Sheet Steel: ASTM A446, Grade B, structural quality with 0.25 ounce/square foot, galvanized, Section 05 05 10 when indicated.

D. Plastic Handrail Cover: Extruded PVC of the shape and color indicated.

E. Bolts, Nuts, and Washers: Steel, Section 05 05 23.

F. Gratings: Steel or aluminum as indicated and per ANSI A202.1.

G. Welding Materials: Type required for materials being welded, AWS D1.1.

H. Primer: Red; for shop application and field touch-up,; FS TT-P-636,

I. Touch-up for Galvanized Surfaces: FS TT-P-641 primer.

J. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure.

K. Stair Treads: Shop cast concrete in metal pan as indicated.

2.2 **FABRICATION - GENERAL**

A. Verify dimensions indicated before shop fabrication.

B. Fabricate items with joints tightly fitted and secured.

C. Fit and shop assemble sections in largest practical sizes for handling through building openings.

D. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

E. Make exposed joints butt tight, flush, and hairline.

F. Accurately form components required for anchorage of stairs, landings, and railing to each other and to structure.

G. Install continuous plastic handrail cover if indicated. Heat weld joints and trim smooth.

2.3 **FABRICATION - PAN STAIRS AND LANDINGS**

A. Fabricate stairs with closed or open risers and treads of pan construction to receive concrete as indicated.

B. Form treads and risers from minimum 12 gage sheet stock.

C. Secure tread pans to stringers by welding or bolting in place.

D. Form stringers of rolled steel channels or rectangular hollow sections as indicated.

E. Form landings from minimum seven (7) gage sheet stock. Reinforce underside with angles or metal tees to attain design load requirements.

F. Form balusters of 1-1/2 inch diameter or square steel sections, weld or bolt to stringers.

G. Prime paint components.

2.4 **FABRICATION - CHECKERED PLATE STAIRS AND LANDINGS**

A. Form treads from minimum seven (7) gage checkered steel plate; primer paint or galvanize as indicated. Weld or bolt to stringer support clips. Bend nosing to a 1 inch radius and return down 1-1/2 inch.

B. Form stringers of rolled steel channels or rectangular hollow sections, and prime paint or galvanize as indicated.

C. Form landings from minimum seven (7) gage checkered steel plate; prime paint or galvanize finish as required. Reinforce underside with angles or metal tees to attain design load requirements.

D. Form balusters of 1-1/2 inch diameter or square steel sections, and weld or bolt to stringers; prime paint or galvanize finish as required.

2.5 **FABRICATION - OPEN GRATING STAIRS AND LANDINGS**

A. Fabricate treads 1 inch thick in accordance with ANSI A202.1 of welded steel bars, welded or bolted to supports; galvanized finish.

B. Form stringers of rolled steel channels or rectangular hollow sections; galvanize finish.

C. Form landings 1 inch thick in accordance with ANSI A202.1 (same as treads); galvanized finish. Reinforce underside with angles or metal tees to attain design load requirements.

D. Form balusters of 1-1/2 inch diameter or square steel sections, welded or bolted to stringers; galvanized finish.

2.6 **FABRICATION - UNIT STAIR TOWERS**

A. Fabricate self-supporting steel stair towers with formed treads and risers, steel channel stringers; landing platforms, sectioned for transport; corner structural support members designed to support full weight of complete stair tower plus design live load; with steel railings, posts, and balusters.

B. Fabricate stair towers in height not exceeding 40 feet, designed for stacking to height of building as a self-supporting structure.

2.7 **FINISH**

A. Clean surfaces of rust, scale, grease, and foreign matter before finishing.

B. Do not prime surfaces in direct contact with fresh concrete or where field welding is required.

C. Prime paint items specified with one coat.

D. Galvanize items to minimum 1.25 ounces per square foot zinc coating.

PART 3 EXECUTION

3.1 **ERECTION**

A. Erect stairs level and plumb, free from distortion or defects detrimental to appearance or performance.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Verify alignment with adjacent construction. Coordinate related work.

D. Do not field cut or alter members.

E. Field bolt and weld to match standard of shop bolting and welding. Hide bolts and screws whenever possible. Where not hidden, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

END OF SECTION

SECTION 05 53 00

GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grating, floor plates, and seats.

1.2 REFERENCES

A. **ASTM Standards**:

A36 Structural Steel.

D1187 Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

B. **FS Standards**:

TT-P-636 Paint, Coating, Alkyd, Wood and Ferrous Metal.

1.3 SUBMITTALS

A. Before ordering or fabrication of grating, floor plates, or seats, submit Shop Drawings of all pieces with positioning diagram for approval, Section 01 33 00.

1.4 STRUCTURAL REQUIREMENTS

A. Unless otherwise noted, fabricate gratings and floor plates to support uniform live load of 100 pounds per square foot with deflection not to exceed L/240 of span, minimum or a concentrated load of 400 pounds.

B. Maximum weight of grating and floor plate units 100 pounds unless indicated otherwise.

PART 2 PRODUCTS

2.1 MATERIALS

A. Grates: Aluminum, galvanized steel, or fiberglass grating as indicated. Furnish grating of the type, dimensions, and weights required.

B. Floor Plates: Floor plates fabricated from ASTM A36 steel with checkered pattern of the dimensions and thickness indicated.

C. Seats: Seats for all grating and floor plates as indicated. Fabricate seats for steel grating, fiberglass grating, or steel floor plates from steel sections or as indicated. Fabricate seats for aluminum grating from aluminum sections or as indicated.

2.2 FABRICATION

A. Band all grating.

B. Cut grating so that grating pattern matches adjacent sections.

C. Fabricate grating, floor plates, and seats so that adequate clearance is maintained.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Install gratings, floor plates, and seats as indicated.

B. Coat all aluminum surfaces in contact with concrete with ASTM D1187 bituminous coating FS TT-P-636 zinc chromate primer.

C. Block all seats during the placing of concrete so that clearances are maintained.

END OF SECTION

SECTION 05 56 00
METAL CASTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Castings for grates, frames and covers for Manholes, catch basins, tree wells, monument boxes, water meters, etc.

1.2 REFERENCES

A. **ASTM Standards**:

A27 Steel Castings, Carbon, for General Application.

A48 Gray Iron Castings.

A148 Steel Castings, High-Strength, for Structural Purposes.

B22 Bronze Castings For Bridges and Turntables.

B584 Copper Alloy Sand Castings For General Applications.

D1187 Asphalt-Base Emulsion for Use as Protective Coatings for Metal.

E10 Brinell Hardness of Metallic Materials.

1.3 SUBMITTALS

A. Shop Drawings, Section 01 33 00.

B. Manufacturer's affidavit certifying materials comply with Part 2 requirements. (X-ray certification mandatory).

1.4 QUALITY ASSURANCE

A. Make castings true to pattern in form and dimension and free from defects that would affect the service value of the casting.

B. Repair minor defects that do not impair the strength of a casting.

C. Reject castings that show injurious defects revealed by X-ray or machining operations.

1.5 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver and handle castings and gratings to prevent warping, rusting and damage.

B. Store all items on flexible surface and protect items from adverse environmental conditions.

PART 2 PRODUCTS

2.1 STEEL CASTINGS

A. High Strength Steel Castings For Structural Purposes: ASTM A148, Grade 80-50, except that the steel shall contain not less than 0.60 percent of manganese and not less than 0.20 percent silicon.

B. Mild-to-Medium Carbon Steel Castings For General Applications, ASTM A27: Grade 65-35 with a minimum Brinell hardness number of 130 when tested in accordance with ASTM E10.

2.2 GRAY IRON CASTINGS

A. All castings not specifically classified below shall conform to the requirements of ASTM A48, Class 30:

1. Grate, frame, cover castings sets for utilities, ASTM A48, Class 35.
2. Railings, railing posts and wheel guards; ASTM A48, Class 40.
3. Rockers, rocker plate bearings and bearing plates for bridges; ASTM A48, Class 50.

2.3 BRONZE CASTINGS

A. Expansion and Bearing Plates: Alloy C, ASTM B22.

B. Ornamental Tablets, Railings, Miscellaneous Ornaments and Fixtures: Alloy 1B, ASTM B584.

PART 3 EXECUTION

3.1 PREPARATION

A. Fit bearing surfaces of flush fitting machined castings together firmly without rocking. ENGINEER reserves the right to reject rocking sets.

B. Ensure castings are boldly filleted at angles and the arises are sharp and true. Unless indicated otherwise all letters shall be heavily raised and spaced to secure a uniform and balanced effect over the entire area of the panel.

C. Before castings are removed from the foundry, ensure they are cleaned and the parting lines, gates, and risers are ground flush.

D. Ensure sets are coated in quality ASTM D1187 asphalt paint unless galvanized or bronze sets are specified or required.

3.2 INSTALLATION

A. Furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of castings.

B. Adjust Street Fixtures elevation; Section 33 05 14.

C. Install countersunk flat head screw security bolts flush with top of grate.

3.3 CLEANING

A. Clean all castings free of grease, dirt, burrs, etc.

END OF SECTION

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

SECTION 06 61 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rough carpentry work not specified as part of other sections that is generally not exposed, except as otherwise indicated, and includes but is not limited to:

1. All wood framing and sheathing.
2. Furring.
3. Blocking for roofing system and related metal flashings.
4. Blocking for roof mounted items.
5. Wood posts and beams.
6. Wood grounds, nailers, blocking, and sleepers.
7. Subflooring and underlayment.
8. Preservative wood treatment where required.

1.2 REFERENCES

A. **ANSI Standards**:

A208.1 Mat-Formed Wood Particleboard.

B. **APA Standards**:

E304 Design/Construction Guide Residential and Commercial.

C. **ASTM Standards**:

D226 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

E84 Surface Burning Characteristics of Building Materials.

D. **AWPA Standards**:

M4 Care of Pressure Treated Wood Products.

LP-2 Wood Lumber, Timber, Plywood, Pressure Treated With Waterborne Preservatives for Above Ground Use.

E. **AWPB Standards**:

LP-22: Quality Control and Inspection Procedures for Soft Wood Lumber, Timber, Plywood, Pressure Treated With Waterborne Preservatives for Ground Contact Use.

F. **FS Standards**:

TT-W-571 Wood Preservative, Treating Practices.

G. **N.F.P.A. Standards**:

Manual for House Framing.

H. **NPA Standards**:

PS 1 Construction and Industrial Plywood.

PS 20 Softwood Lumber.

PS 51 Hardwood Lumber.

I. **UL Standards**:

790 Tests for Fire Resistance of Roof Covering Materials.

1.3 SUBMITTALS

A. Certificate of Pressure Treatment: Chemical solutions used, salt retention, and conformance. Include statement that moisture content of treated materials was reduced to maximum of 15 percent before shipment.

B. Certificate of Preservative and Fire-retardant Treatment: Plant certification that material complies with this specification and will not bleed through finished surfaces.

1.4 **QUALITY ASSURANCE**

A. Lumber Grading Rules and Species: PS1.

B. Plywood Grading Rules and Recommendations: PS 20, PS 51.

C. Factory-marking:

1. Type, grade, moisture content, inspection service and producing mill.
2. Marking may be omitted if certificate of inspection is provided for each shipment.

D. Underwriters' Laboratories, Inc.

E. Preservative and Pressure Treatment Standards: American Wood Preservers' Association.

1.5 **PRODUCT DATA**

A. Where dimensional lumber is required to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of American Lumber Standards Committee.

B. For woods requiring preservative treatment, submit manufacturer's treatment literature and instructions for use and certification by treating plant stating chemicals and process used, net amounts of preservative retained, compliance with applicable standard, and expected Service Life.

C. For woods requiring fire-retardant treatment, submit manufacturer's treatment literature and instructions for use and certification by treating plant that the treated woods comply with the applicable requirement and that the treating chemicals will not bleed out or affect finished surfaces.

1.6 **PRODUCT HANDLING AND STORAGE**

A. Keep wood covered, well ventilated, dry, and not in contact with earth when not being used.

B. Store wood to protect from warpage or delamination. Do not use woods damaged by improper protection.

C. Protect fire-retardant treated materials against high humidity and moisture during storage and erection.

D. Time delivery and installation to avoid delaying progress of other work.

E. Handle treated lumber and plywood and treat penetration damage per AWPA M4.

PART 2 PRODUCTS

2.1 **LUMBER MATERIALS**

A. Factory mark each piece of lumber with type, grade, mill and grading agency.

B. Provide dimensioned lumber; PS 20.

C. Provide dressed lumber, S4S, unless otherwise indicated.

D. Provide seasoned lumber with 19 percent maximum moisture at time of dressing and shipment for sizes two (2) inches or less unless indicated otherwise.

E. For light bearing walls and framing use construction grade Hemlock-fir North or better.

F. For interior nonbearing partition walls use stud grade Hemlock-fir North or better unless indicated otherwise.

G. For structural framing use No. 2 grade Douglas-fir or Larch or any species or grade meeting the following requirements:

1. F_b: 1,250 psi minimum.
2. E: 1,700,000 psi minimum.

2.2 **PLYWOOD OR PARTICLEBOARD MATERIALS**

A. Factory mark each sheet of plywood or particleboard with the appropriate trademark and grade.

B. Use plywood for subflooring, roofing, bracing, or other concealed areas that is APA performance rated, complying with the requirements indicated for grade designation, span rating, exposure durability classification, edge detail, and thickness.

C. Subflooring: Tongue and groove exterior rated sheathing thickness and span as indicated.

D. Wall sheathing: C-D exterior rated; thickness as indicated:

1. 5 ply minimum, for use behind any veneer.
2. 4 ply minimum, for all other uses.

E. For roof sheathing use C-D exterior rated plywood, thickness and span as indicated.

F. Provide mat-formed particleboard, Grade 1-M-1, complying with ANSI A208.1, in thickness indicated.

2.3 ACCESSORIES

A. Nails, Spikes, and Staples: Galvanized for exterior, high humidity locations, and treated wood, cement coated for other interior locations, Size and type to suit application.

B. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; Section 05 05 23. Size and type to suit application; galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations.

C. Fasteners:

1. Toggle bolt type for anchorage to hollow masonry.
2. Expansion shield and lag bolt type for anchorage to grouted masonry or concrete.
3. Bolts or power activated type for anchorage to steel.

D. Building Paper: 30 pound density asphalt saturated felt, non-perforated, ASTM D226.

E. Metal Framing Devices: Provide metal framing devices indicated.

F. Sound Board: Cellulose fiber board, specifically produced for sound deadening properties, thickness as indicated.

2.4 WOOD TREATMENT MATERIALS

A. Preservative Treatment: Where lumber or plywood is indicated as PT or "Treated", comply with applicable standard C2 (lumber) and C9 (plywood) of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark Requirements.

B. Pressure treat above ground items with water-borne preservatives complying with AWPB LP-2. After treatment, kiln dry to a maximum moisture content of 15 percent. Treat indicated items and the following:

1. Wood cants, nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor retarders, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing members less than 18 inches above grade.
4. Any wood framing members or elements exposed to weather.

C. Pressure-treat wood in contact with ground or fresh water with water-borne preservatives for gound contact use complying with AWPB LP-22.

D. If cut after treatment, coat cut surface with heavy brush coat of same chemical used for treatment and to comply with AWPA M4.

E. Complete fabrication of items that require treatment before the treatment step where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

F. Fire Retardant Treatment: Where "FR-S" lumber or plywood is indicated, provide materials that comply with AWPA standards for pressure impregnation with fire-retardant chemicals, and ASTM E84, and show no increase in flame spread and significant progressive combustion upon continuation of test for additional 20 minutes:

1. Where treated items are exposed to exterior or to high humidities or are to have a transparent finish in the form of stain or sealer, provide materials which show no change in fire-hazard classification when subjected to standard rain test (UL 790).

2. Use fire-retardant treatment which will not bleed through or adversely affect type of finish indicated and which does not require brush treatment of field-made end cuts to maintain fire-hazard classification.

3. Kiln-dry treated items to maximum moisture content of 19 percent.

G. Inspect each piece of treated lumber or plywood after drying and discard all defective pieces.

2.5 **SOURCE QUALITY CONTROL**

A. Shop pressure treat wood materials requiring UL fire rating or pressure impregnated preservatives to FS TT-W-571, Table 3.

B. Provide fire resistant treated materials with UL approved identification on each piece.

C. Deliver fire retardant treated materials cut to required sizes to minimize field cutting.

PART 3 EXECUTION

3.1 **SITE TREATMENT OF WOOD MATERIALS**

A. Brush or spray two (2) coats of preservative treatment for wood in contact with cementitious materials, roofing, metal flashings, and within 18 inches of the ground.

B. Apply preservative treatment per manufacturer's instructions.

C. Treat site-sawn ends. Allow preservative to cure before placing members.

D. Preservative treat items indicated as "PT", and fire retardant treated items indicated as "FR-S".

E. Prime paint surfaces in contact with cementitious materials with an exterior wood paint primer.

3.2 **INSTALLATION - GENERAL**

A. Discard units of material with defects that might impair quality of work, and units that are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads and fill holes in exposed carpentry work.

D. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

E. Refer to Uniform Building Code Table 25Q nailing requirements unless indicated otherwise.

3.3 **WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS**

A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Do not countersink bolts and nuts unless otherwise shown. Where possible, anchor to form work before concrete placement.

C. Provide permanent ground of dressed, preservative treated, key-bevelled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.4 **STUD FRAMING**

A. General: Provide stud framing, size and spacing indicated. Provide single bottom plate and double-top plates two (2) inches thick by width of studs; except single top plate may be used for non-load bearing partitions. Nail or anchor plates to supporting construction.

B. Construct corners and intersection with not less than three (3) studs. Provide miscellaneous blocking and framing indicated and as required for support of facing materials, fixtures, and specialty items and trim.

C. Provide continuous horizontal blocking row at mid-height of single-story partitions over eight (8) feet high and at midpoint of multi-story partitions using two (2) inches thick members of same width as wall or partitions.

D. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

E. For nonbearing partitions provide double-jamb studs and headers not less than four (4) inches deep for openings three (3) feet and less in width, and not less than six (6) inches deep for wider openings.

F. For load bearings partitions provide double-jamb studs for openings six (6) feet and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated, or if not, provide as recommended by N.F.P.A. "Manual for House Framing".

G. Plywood Sheathing: Four (4) feet wide panels vertical or horizontal. Fasten to framing as indicated. Block all edges with 2 x 4 minimum, flat.

3.5 **FLOOR JOIST FRAMING**

A. General: Provide framing of sizes and spacing indicated. Install with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or three (3) inches on masonry. Attach to wood bearing members by toe nailing or metal connectors; frame to wood supporting members with wood ledgers indicated, or if not with metal connectors. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds four (4) feet. Provide solid blocking (two (2) inches thick by depth of joist) at end of joists unless nailed to header or end member. Do not cut, bore, notch, or drill holes in any joists without ENGINEER's approval.

B. Lap members framing from opposite sides of beams, girders, or partitions not less than four (4) inches or securely tie opposing members together. Provide solid blocking (2 inches thick by depth of joist) over supports.

C. Under jamb studs at openings provide solid blocking between joist.

D. Under non-load bearing partitions provide double joists separated by solid blocking equal to depth of studs above.

E. Provide triple-joists separated as above under partitions receiving ceramic tile and similar heavy finishes or fixtures unless otherwise shown.

F. Provide bridging between joists where nominal depth-to-thickness ratio exceeds four (4), at intervals of eight (8) feet. Use bevel cuts 1" x 4" or 2" x 3" wood bracing, double-crossed, and nailed both ends to joists, or use solid wood bridging two (2) inches thick by depth of joist, end nailed to joist, or use steel cross bridging of equivalent strength.

G. Stair Framing: Provide stair framing members of size, space, and configuration indicated, or if not otherwise indicated, as required to support a minimum uniform live load of 100 psf and minimum concentrated load of 300 pounds applied to an area of four (4) square inches at center of tread. Fabricate stair framing members to provide exact fit with treads and risers with no change in dimensions between landings.

3.6 **PLYWOOD INSTALLATION**

A. General: Comply with APA E 304 for types of plywood products and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Subflooring: Glue-nail to framing.
2. Plywood Backing Panels: Nail to supports.

C. Particleboard Underlayment: Install in compliance with the recommendations of the NPA for the type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush. Glue-nail underlayment to subflooring.

D. Sound Board: Glue and nail per manufacturer's instructions.

END OF SECTION

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 19 00
WATER REPELLANT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Penetrating sealer over concrete and masonry.

1.2 REFERENCES

A. **ASTM Standards**:

C67 Sampling and Testing Brick, and Structural Clay Tile.

C140 Sampling and Testing Concrete Masonry Units.

C642 Specific Gravity, Absorption, and Voids in Hardened Concrete.

C672 Standard Test Method for Sealing Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

B. **DOT Standards**:

NCHRP 244 Series IV Concrete Sealers for Protection of Bridge Structures, National Cooperative highway Research Program, Report 244, Dec 1981.

1.3 SUBMITTALS

A. Manufacturer's recommended installation procedures.

B. Performance criteria data sheet showing compliance.

PART 2 PRODUCTS

2.1 PENETRATING COMPOUND

A. Material: Unless indicated elsewhere, CONTRACTOR’s choice:

1. Organo-silane,
2. Organo-siloxane,
3. Silocanate,
4. Potassium silicate.
5. Styrene acrylic silane co-polymer

B. Performance Criteria:

1. Water Absorption Reduction: 75 percent minimum, ASTM C67, ASTM C140, or ASTM C642.
2. Scaling Resistance (weight loss): Two (2) percent maximum, ASTM C672, when subject to 500 cycles of freeze-thaw.
3. Chloride Ion Reduction: 75 percent minimum, NCHRP 244 series IV.
4. Moisture Vapor Permeability: 100 percent minimum, NCHRP 244 series IV.
5. Maximum Drying Time: 1-1/2 hours.

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not use water repellant on surfaces that are to receive hardeners. Refer to Section 03 35 00.

B. Cure new concrete for 28 days before sealer application.

C. Remove curing compound before applying sealer. Do not expose large aggregate.

D. Make surfaces dry and free of laitance, dirt, dust, paint, grease, oil, rust, and other contaminants.

3.2 **APPLICATION**

A. Apply coating continuously and uniformly. Keep surface wet for 30 to 45 minutes.

END OF SECTION

SECTION 07 21 00
INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiber fill, rigid, batt, spray, or granular insulation for:

1. Insulation under slabs on grade.
2. Foundation wall insulation (and supporting backfill).
3. Block/board cavity wall insulation.
4. Loose cavity wall insulation.
5. Concealed and exposed board type building insulation.
6. Blanket type building insulation.
7. Loose fill building insulation.

1.2 REFERENCES

A. **ASTM Standards**:

C209 Insulation Board (Cellulosic Fiber), Structural and Decorative.

C516 Vermiculite Loose Fill Insulation.

C549 Perlite Loose-Fill Insulation.

C665 Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufacturer Housing.

C764 Mineral Fiber Loose-Fill Insulation.

D2842 Water Absorption of Rigid Cellular Plastics.

E84 Surface Burning Characteristics of Building Materials.

B. **FS Standards**:

HH-I-530 Insulation Board, Thermal, Unfaced Polyurethane or Polyisocyanurate.

HH-I-558 Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering Thermal (Mineral Fiber, Industrial Type).

HH-I-1030 Insulation, Thermal (Mineral Fiber, for Pneumatic or Poured Application).

1.3 SUBMITTALS

A. Manufacturer's product installation instructions.

B. Product data.

PART 2 PRODUCTS

2.1 MOLDED BEAD POLYSTYRENE INSULATION

A. Thermal resistance "R" per inch of 3.7 aged in service value; minimum compressive strength of 10 psi; water absorption by volume, ASTM D2842, 2.5 percent maximum, Square edges; board size of manufacturer's standard size by thickness indicated.

2.2 EXTRUDED CELLULAR POLYSTYRENE INSULATION

A. Thermal resistance "R" per inch of 5.56 aged in service value; minimum compressive strength of 30 psi; water absorption by volume, ASTM D2842, 0.3 percent, Square edges; board size of manufacturer's standard dimensions by thickness indicated.

2.3 EXPANDED CELLULAR URETHANE INSULATION

A. Thermal resistance "R" per inch of 5.56 aged in service value; minimum compressive strength of 25 psi; water absorption by volume, ASTM D2842, three (3) percent; factory applied skin of aluminum foil both faces, Square edges board size of manufacturer's standard sizes by thickness indicated; FS HH-I-530.

2.4 **CLOSED CELL POLYISOCYANURATE INSULATION**

A. Thermal resistance "R" per inch of 5.56 aged in service value; minimum compressive strength of 25 psi; water absorption by volume, ASTM C209, less than 1-1/2 percent; factory applied skin of aluminum foil on both faces, square edges; board size of manufacturer's standard dimensions by thickness indicate.

2.5 **GLASS FIBER REINFORCED POLYISOCYANURATE FOAM INSULATION**

A. Plastic core faced on exposed side with 0.019 inch aluminum sheet laminated over foil and faced on reverse side with reflective foil, thickness or R-Value as indicated. Provide interlocking PVC strips of proper size for mounting boards and covering joints.

2.6 **FIBER GLASS BATT INSULATION**

A. Preformed glass fiber batt or roll friction fit type without membrane.

2.7 **FIBER FILL INSULATION**

A. Mineral wool modulated for pour or bulk for pneumatic placement; "R" value as indicated; FS HH-I-1030.

2.8 **MINERAL FIBER INSULATION**

A. A maximum thermal conductivity "K" value of 0.26, and when tested, ASTM E84 a flame spread of 25 or less, a fuel contribution of 15 or less, smoke developed rating of 20 or less, ASTM C764. Where exposed, color shall be white with a minimum light reflectance of 70 percent.

2.9 **GRANULAR INSULATION**

A. Water repellent; fire resistant; flame/fuel/smoke contribution of 0/0/0, ASTM E84.

1. Vermiculite type, ASTM C516.
2. Perlite type, ASTM C549.

2.10 **MINERAL FIRE-PROOFING AND SAFING**

A. Noncombustible, four (4) pounds per cubic foot density, mineral fiber, ASTM C665 or FS HH-I-558.

2.11 **ADHESIVE MATERIALS**

A. Gun grade, mastic type, compatible with insulation and substrate, or type recommended by insulation manufacturer for application.

2.12 **ACCESSORIES**

A. Vapor and Air Retarder: Translucent polyethylene film for above grade application; six (6) mil thick.

B. Nails or Staples: Steel wire; galvanized; type and size to suit application, at least 1/2 inch longer than thickness of insulation.

C. Tape: Bright aluminum self-adhering; two (2) inches wide.

D. Rigid Insulation Fasteners: Impale clip type of wood or galvanized steel; of type to be mechanically fastened to surface to receive insulation; length to suit insulation thickness; capable of securely and rigidly fastening insulation in place.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Verify substrate and adjacent materials and insulation board are dry and ready to receive insulation and adhesive.

B. Verify substrate surface is flat, free of honeycomb, fins, irregularities, or materials that will impair adhesive bond.

C. Verify insulation boards are unbroken, free of damage, with face membrane undamaged.

D. Verify mechanical and electrical services within walls have been installed and tested.

3.2 INSTALLATION - FIBER FILL INSULATION

A. Install by pneumatic or pouring placement methods through access holes as required.

B. Place fiber fill insulation per manufacturer's instructions.

C. Place insulation tightly in stud, joist, rafters, spaces and tight to and behind mechanical and electrical services within the plan of insulation.

D. Completely fill intended spaces. Leave no gaps and voids.

3.3 INSTALLATION - RIGID INSULATION

A. Foundation Perimeter:

1. Adhere a six (6) inches wide strip of polyethylene sheet over joints with double beads of adhesive each side of joint. Tape seal joints between sheets. Extend sheet full height of joint.

2. Install boards on foundation wall perimeter, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.

3. Extend boards over expansion joints, unbonded to foundation 12 inches either side of joint.

B. Exterior Walls:

1. Apply adhesive in three (3) continuous beads per board length. Daub adhesive tight to protrusions.

2. Install boards on wall surface perimeter, vertically. Place membrane surface of insulation against adhesive.

3. Place boards in a method to maximize contact bedding. Stagger side joints. Butt edges and ends tight to adjacent board and to protrusions.

4. Place 24 inches wide polyethylene sheet at perimeter of wall openings from adhesive vapor and air retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor and air retarder.

C. Cavity Walls:

1. Secure impale fasteners to substrate at a frequency of six (6) per insulated board.

2. Apply adhesive in three (3) continuous beads per board length. Daub adhesive tight to protrusions to ensure continuity of vapor and air retarder.

3. Install boards horizontally between wall reinforcement.

D. Under Concrete Slabs:

1. Place insulation under slabs on grade after base for slab has been compacted.

2. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.4 INSTALLATION - BATT INSULATION

A. Install batt insulation and vapor retarder per manufacturer's instructions.

B. Install batt insulation without gaps or voids.

C. Trim insulation neatly to fit spaces. Use batts free of damage.

D. Fit insulation tight in spaces airtight to exterior side of mechanical and electrical services within the plane of insulation.

E. Protect all insulation materials during storage and insulation from moisture, tears or other damage. All damaged material shall be replaced at no additional cost to OWNER.

3.5 INSTALLATION - SPRAY ON INSULATION

A. Surfaces to receive spray-on insulation shall be free of dirt, grease, oil, loose paint, excessive rust scale, or other foreign material that could prevent adequate adhesion. Application shall not proceed until unsatisfactory conditions are corrected. Ambient temperature shall be between 40 and 155 deg F

B. Application: Mix, apply, and finish spray-on insulation per manufacturer's specifications and instructions for a monolithic blanket of uniform texture. Thickness shall be as indicated.

C. Mineral Fire-proofing and Safing: Following manufacturer's recommendations, install mineral fire-proofing and safing in all openings in floors and walls to seal completely, without voids, around pipe, conduit, duct, and other penetrations.

3.6 **INSTALLATION - GRANULAR INSULATION**

A. Place granular insulation in walls per manufacturer's instructions. Verify holes and openings have been sealed to prevent loss of insulation.

B. Place after masonry materials have sufficiently dried and attained optimum moisture content, and after vertical cores have been grouted.

C. Place as masonry is erected.

D. Ensure spaces are completely free of mortar and debris to allow free flow of insulation.

E. Completely fill spaces. Place in lifts and rod to eliminate air pockets. Do not exceed four (4) feet pouring height. Place before covering cores and bond beams or lintels.

F. Place temporary signs in rooms that face insulated walls warning workers to use caution to prevent loss of insulation if cutting into walls.

3.7 **CLEANING**

A. Section 01 74 13.

B. Remove from site all containers, wrappings, and scrap insulation materials. Leave floors broom clean.

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 91 00
PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing prepared surfaces that are to be coated in accordance with paint manufacturer's recommendations.

B. Paint all surfaces unless it is indicated they are not to be painted.

1.2 REFERENCES

A. SSPC Standards:

SP1 Solvent Cleaning.

SP6 Commercial Blast Cleaning.

1.3 SAMPLES

A. Before proceeding with paint application, prepare eight (8) inches x 10 inches sample(s) of all paint systems on identical substrate materials on which the system will be applied.

B. Identify each sample as to surface preparation, paint system, color, product name and number, and manufacturer.

C. Colors to be selected by ENGINEER before commencement of work.

D. Submit manufacturer's coating product data sheet for each coating type to be applied, before initiating surface preparation.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in original, unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.
2. Federal specification number, applicable.
3. Manufacturer's stock number and date of manufacture.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instruction.
8. Color name and number.

B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 deg F in well ventilated area or as recommended by manufacturer.

C. Take precautionary measures to prevent fire hazards and spontaneous combustion of paint material. Provide temporary fire extinguishers.

1.5 JOB CONDITIONS

A. Abrasive blast cleaning shall not be performed if humidity is greater than 85 percent, and if surface temperature is less than five (5) deg F above the dew point of ambient air.

B. Do not apply finishes when temperature exceeds manufacturer's maximum and minimum temperature allowable, nor in dust, smoke laden atmosphere, damp or humid weather.

C. Provide adequate continuous ventilation.

D. Adequately protect other surfaces from paint and damage. Repair damage.

E. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

F. Place cotton waste, cloths and material which may constitute a fire hazard in closed metal containers and remove daily from site.

G. Remove electrical plates, surface hardware, fittings and fasteners, before painting operations. Carefully store, clean and replace on completion of work in each area. Do not use solvent to clean hardware that has permanent lacquer finish.

H. Post "Wet Paint" signs in freshly painted areas to reduce the potential for damage to the surfaces or damage to people passing the area.

1.6 **OPERATING PARTS AND LABELS**

A. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting. Unless otherwise indicated, protect by drop clothes or maskings.

B. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Varnish, Stain, Enamel, Lacquer and Fillers: Type and brand as indicated.

B. Paint Accessory Materials: Linseed oil, shellac, turpentine and other materials not specifically indicated.

C. Paints: Ready-mix except field catalyzed coatings.

D. Do not provide paints containing lead unless indicated otherwise.

PART 3 EXECUTION

3.1 **INSPECTION**

A. ENGINEER shall examine surfaces before surface preparation and before application of each succeeding coating. Correct any condition that may potentially affect proper surface cleaning or coating application.

B. Correct defects and deficiencies in surfaces that may adversely affect work of this section before applying any paint.

3.2 **PREPARATION OF SURFACES**

A. General: Perform preparation and cleaning procedures per paint manufacturer's instruction and as herein specified, for each particular substrate condition. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

B. Mildew: Remove mildew by scrubbing with approved chemical solution such as tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry completely.

C. Aluminum Surfaces: Remove surface contamination from aluminum surfaces by steam, high pressure water or solvent washing. Coat surfaces with wash primer.

D. Asphalt or Bituminous Surfaces: Remove dirt, oil, grease and sand to provide adhesion key. Apply compatible sealer or primer.

E. Cloth Surfaces: Remove dirt, grease and oil before applying paint system.

F. Copper Surfaces: Remove contamination from copper surfaces by steam, high pressure water or solvent washing. Coat surfaces with wash primer.

G. Copper Surfaces - Oxidized: Remove contamination from copper surfaces required to be oxidized. Apply oxidizing solution. Rub on repeatedly for correct effect. Once attained, rinse surface well with clear water, allow to dry, and paint.

H. Wallboard: Remove contamination from gypsum wallboard surfaces and prime to show defects, if any. Remove surface dust and dirt with clean water and sand with medium grit sandpaper. Fill hairline cracks, small holes and imperfections on plaster surfaces with patching plaster. Smooth off to match adjacent surfaces. Wash and neutralize high alkali surfaces where they occur.

I. Galvanized Surfaces: Remove surface contamination and oils from galvanized surfaces with solvent. Apply coat of wash primer.

J. Concrete, Concrete Block:

1. New Concrete: Do not start surface preparation until concrete has cured 30 days. Remove contamination, sandblast or acid etch with 100 percent water soluble acid and rinse new concrete surfaces with clear water. Allow to thoroughly dry.

2. Remove dirt, loose mortar, scale, powder and other foreign matter from concrete and concrete block surfaces which are to be painted or to receive a clear seal. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to thoroughly dry.

3. Remove stains from concrete and concrete block surfaces caused by weathering of corroding metals with a solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.

4. Test for moisture before painting.

K. Steel Surfaces:

1. Remove grease, dirt and dust from steel and iron surfaces by solvent cleaning (SSPC-SP1). Remove rust and mill scale by wire brushing, sandblasting (SSPC-SP6) or other satisfactory method indicated. Ensure steel surfaces are satisfactory before paint finishing.

2. Sand and scrape shop primed steel surfaces to remove all loose primer and rust. Feather out edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces including shop primed steels.

L. Wood:

1. Wipe off dust and grit from miscellaneous wood items and millwork before priming. Sand wood to required smoothness. Spot coat knots, pitch streaks and sappy sections with sealer. Fill nail holes and cracks after primer has dried and sand between coats. Back prime interior and exterior woodwork.

2. Remove dust, grit and foreign matter from exterior wood siding which is to receive paint finish. Seal knots, pitch streak and sappy sections. Fill nail holes with filler after prime coat has been applied.

3. Before finishing glue-laminated beams, wash down surfaces with solvent and remove grease and dirt.

3.3 **PREPARATION OF MATERIAL**

A. Mix and thin paint materials per manufacturer's product data sheets.

B. Store materials not in actual use in tightly sealed containers free from foreign particles.

C. Discard paints which have formed a film in the container or exceeded the manufacturer's recommended pot life.

D. Multiple component coatings shall be prepared using all the contents of the container for each component. Partial batches will not be permitted.

3.4 **APPLICATION**

A. Apply each coat at proper consistency and per manufacturer's recommendations.

B. Make each coat of paint slightly darker than preceding coat unless otherwise approved.

C. Sand lightly between coats as required to achieve specified finish.

D. Do not apply finishes on surfaces that are damp or wet.

E. Ensure that edges, corners, welds, and other protrusions receive a dry film thickness equivalent to the flat surfaces.

F. Where clear finishes are required on wood ensure tint fillers match wood. Work fillers well into the grain before set. Wipe excess from the surface.

G. Backprime exterior woodwork which is to receive paint finish, with exterior primer paint.

H. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoat paint.

I. Backprime interior and exterior woodwork, which is to receive stain or varnish finish, with gloss varnish reduced 25 percent with mineral spirits.

J. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.

K. Prime top and bottom edges of wood doors with gloss varnish when they are to receive a stain or clear finish.

3.5 MECHANICAL AND ELECTRICAL EQUIPMENT

A. Coordinate with mechanical and electrical sections with respect to painting and finishing requirements, color coding, identification banding of equipment, ducting, piping and conduit.

B. Remove grills, covers and access panels for mechanical and electrical systems from location and paint separately.

C. Finish paint primed equipment to color selected.

D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports, except where items are plated or covered with a prefinished coating.

E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.

F. Treat and paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grills and louvers with one coat of flat black paint, to limits of sight line. Paint dampers exposed immediately behind louvers, grills, convector and baseboard cabinets to match face panels.

G. Paint exposed conduit and electrical equipment occurring in finished areas. Color and texture to match adjacent surfaces.

H. Paint sides and edges of plywood backboard for electrical equipment before installing backboards and mounting equipment.

I. Color Coding:

Table 1 – Color Coding of Mechanical/Electrical Equipment

Utility	Color
Natural Gas	Yellow
Sanitary Sewer	Brown
Storm Drain	Green
Potable Water	Blue
Telephone	Orange
Electrical Power	Red
Danger and Fire	Red

J. Paint color band and identify flow arrows, naming, numbering, etc.

3.6 CLEANING

A. Section 01 74 13.

B. As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered.

C. During progress of work keep premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

D. Upon completion of work leave premises neat and clean.

3.7 FIELD QUALITY ASSURANCE

A. Minimum Coating Thickness: Maintain minimum thickness recommended by manufacturer.

B. Appearance: Cloudiness, spotting, show through of subsurface, laps, brush marks and other surface imperfections will not be acceptable.

C. Rework: Areas not acceptable will be refinished to the required standards.

D. Holiday Testing: Metal surfaces shall be holiday tested for pinholes and missed areas in the coating. Recoat holiday areas.

E. Drying Time: Do not exceed drying time between coats.

3.8 EXTRA STOCK

A. Furnish not less than 1 gallon of each color.

B. Tightly seal and clearly label all containers.

END OF SECTION

SECTION 09 96 23
GRAFFITI RESISTANT COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of clear, breathable, multi-polymer, water-based, penetrating, non-sacrificial graffiti coating for concrete surfaces, masonry surfaces, metals, and natural stones.

B. Includes companion cleaner.

1.2 REFERENCES

A. **ASTM Standards**:

D1475 Density of Paint, Varnish, Lacquer, and Related Products.

D1653 Water Vapor Permeability of Organic Coating Films.

D2369 Volatile Content of Coatings.

D3278 Flash Point of Liquids by Setaflash Closed-Cup Apparatus.

1.3 SUBMITTALS

A. Manufacturer's recommended installation procedures.

B. Performance criteria data sheet showing material compliance.

1.4 QUALITY ASSURANCE

A. Applicator: Minimum of five (5) years experience in application of similar systems and products on projects of similar size and scope.

B. Manufacturer: Minimum five (5) years experience in manufacturing the proposed graffiti resistant coating.

PART 2 PRODUCTS

2.1 MATERIALS

A. Multi-polymer, water-resistant, non-sacrificial formulation that does not alter appearance of substrate:

1. Color: Clear.
2. Water-Vapor Transmission: 33 perms minimum, ASTM D1653.
3. Flash Point: 150 deg F maximum, ASTM D3278.
4. Freeze Point: Minus 50 deg F minimum.
5. Density: Six (6) pound per gallon minimum, ASTM D1475.
6. Solids by Weight: Six (6) percent minimum, ASTM D2369.
7. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

2.2 CLEANER

A. Composition of solvent cleaner:

1. Flash Point: 140 deg F minimum, ASTM D3278.
2. Freeze Point: 10 deg F minimum.
3. Density: Nine (9) pounds per gallon minimum, ASTM D1475.
4. Solids by Weight: 25 percent minimum, ASTM D2369.
5. Volatile Organic Compounds (VOC): Comply with local, state, and federal requirements.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Do not use graffiti resistant coatings on surfaces that are to receive hardeners until after hardener application. Refer to Section 03 35 00.

B. Test and clean substrate per coating manufacturer's recommendations. Surfaces are to be free of sand, dust, dirt, oil, grease, chemical films, and other contaminats and loose materials.

C. Make sure concrete surfaces are cured a minimum of seven (7) days before beginning application.

D. If surface paint is flaking or cracked, completely remove loose paint before application.

3.2 APPLICATION

A. Do not apply coating over existing graffiti treatment unless prior coat is of same coating material.

B. Apply coating continuously and uniformly.

C. Control environment for proper coating drying.

3.3 GRAFFITI REMOVAL

A. Use water in combination with graffiti cleaner.

END OF SECTION

SECTION 09 97 14
COATINGS FOR STEEL BRIDGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Washing, scraping, brushing, and sand blasting bridge metal surfaces before finishing.

B. Applying finish on steel products or assemblies.

1.2 REFERENCES

A. **AASHTO Standards**:

M67 Foliage Green Bridge Paint.

M68 Black Paint for Bridges or Timber Structures.

M69 Aluminum Paint.

M70 White and Tinted Ready-Mixed Paint.

M72 Red Lead Ready-Mixed Paint.

B. **SSPC Standards**:

SP1 Solvent Cleaning.

SP6 Commercial Blast Cleaning.

SP10 Near White Blast Cleaning.

1.3 WEATHER LIMITATIONS

A. Apply coating only when all of the following conditions are met:

1. Air temperature is above 50 deg F
2. Surface temperature of the material is between 40 deg F and 100 deg F and at least five (5) deg F above dew point.
3. Surface to be painted is clean and dry.

B. Cover coat materials in damp or cold weather until dry or until weather conditions improve to permit open exposure.

PART 2 PRODUCTS

2.1 PAINT

A. Red lead paint conforming to AASHTO M72 for all shop priming of steel items.

B. When finish coat of paint is specified to be aluminum, black or graphite paint, colored green, brown or dark gray, use a red lead paint as specified for the shop coat, tinted light brown as required, with lamp black in an amount not to exceed 1/4 pound per gallon for the first field coat.

C. When finish coat is white or gray, use a first field coat conforming to the specification for white and tinted ready-mixed paint (lead and zinc base), AASHTO M70 in lieu of red lead paint.

D. Paint for finish coat as indicated and conforming to one of the following AASHTO specifications:

1. Foliage green bridge paint, M 67.
2. Black bridge paint, M 68.
3. Aluminum paint (paste-mixing vehicle), M 69.
4. White and tinted ready-mixed paint (lead and zinc base), M 70.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Unless indicated otherwise, thoroughly clean all metal surfaces to be painted according to SSPC-SP1 solvent cleaning. Unless cleaning is to be done by blast cleaning, neutralize all weld areas with a proper chemical before cleaning is started, and thoroughly rinse with water after cleaning.

B. For blast cleaning two methods are provided. Either of these methods may be used unless indicated otherwise:

1. SSPC-SP6.
2. SSPC-SP10.

3.2 PAINT APPLICATION

A. Do not shop prime areas where field welding is required, bolted connections are to be made, or on steel that is to be encased in concrete.

B. Paint may be applied with hand brushes or by spraying, except apply aluminum paint by spraying. By either method, apply coating of paint smoothly and uniformly so that no excess paint collects at any point. If work done by spraying is not satisfactory, hand brushing shall be required.

C. When brushes are used, manipulate paint under brush to produce smooth, uniform, even coating in close contact with the metal or with previously applied paint, and work into all corners and crevices.

D. When using spraying equipment apply paint in a fine, even spray without addition of any thinner. In cool weather, warm paint to reduce the viscosity for use.

E. Paint when applied with spray equipment shall be immediately followed by brushing when necessary to secure uniform coverage and to eliminate wrinkling, blistering and air holes.

F. If operations have damaged the paint or painting is unsatisfactory, prepare the surface as indicated above and repaint.

3.3 PROTECTION

A. Protect adjacent structures, pedestrians, vehicular, and other traffic upon, underneath, or near the area to be painted and all portions of the structure against damage or disfigurement by splatters, splashes, and over spraying of paint.

END OF SECTION

SECTION 09 97 15

COATINGS FOR STEEL WATER STORAGE TANK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing exterior and interior of steel water storage tanks.

B. Refinishing existing steel tanks.

1.2 REFERENCES

A. **AWWA Standards**:

D102 Painting Steel Water-Storage Tanks.

B. **NSF Standards**:

61 Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

A. Product: Submit:

1. Mixing instructions.
2. The quality and type of thinner recommended.
3. Percent solids by volume for liquid materials.
4. Spreading rate in square feet per gallon at 1 mil dry film thickness.
5. Net weight per U.S. gallon.
6. Recommended drying time between coats and before immersion.
7. Pot life after mixing.
8. Safety precautions.

B. Test Report: Indicate:

1. The film thickness gage used.
2. Locations where tests were made.
3. Dry film thickness at each location
4. Name of person making the test
5. Name of CONTRACTOR personnel witnessing the test.
6. Name of OWNER personnel witnessing the test.

1.4 WEATHER

A. Apply coatings only when all of the following conditions are met:

1. Air temperature is above 50 deg F
2. Steel surface temperature is between 40 deg F and 100 deg F and at least five (5) deg F above dew point.
3. Surface to be painted is clean and dry.

B. Cover painted materials in damp or cold weather until dry or until weather conditions improve to permit open exposure.

PART 2 PRODUCTS

2.1 CLEANING PRODUCTS

A. Solvent solution for cleaning oil, grease and dirt before surface preparation.

B. Abrasive sand or grit for blast cleaning to produce profile recommended by paint manufacturer.

2.2 **EXTERIOR COATING PRODUCTS**

A. General: The following exterior coating systems for steel tanks refer to AWWA D102. Unless indicated otherwise provide System No. 1.

B. Outside Paint System No. 1: Alkyd, alkyd, alkyd.

C. Outside Paint System No. 2: Vinyl, vinyl, vinyl.

D. Outside Paint System No. 3: Alkyd, alkyd, silicone-alkyd.

E. Outside Paint System No. 4: Alkyd, alkyd, alkyd, alkyd.

F. Outside Paint System No. 5: Zinc, chlorinated-rubber, chlorinated-rubber.

2.3 **INTERIOR COATING PRODUCTS**

A. General: Comply with NSF Standard 61. The following interior coating systems refer to AWWA D102. Unless indicated otherwise provide System No. 1.

B. Inside Paint System No. 1: Epoxy, epoxy, epoxy.

C. Inside Paint System No. 2: Zinc Chromate-vinyl butyral wash, vinyl, vinyl.

D. Inside Paint System No. 3: Chlorinated rubber, chlorinated rubber, chlorinated rubber.

E. Inside Paint System No. 4: Vinyl, vinyl resin, vinyl resin, vinyl resin.

F. Inside Paint System No. 5: Coal tar, coal tar.

G. Inside Paint System No. 6: Coal tar, coal tar, coal tar.

H. Inside Paint System No. 7: Zinc.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Clean all surfaces to be finished according to AWWA D102.

B. After blasting, remove all sand, dust and grit with vacuum cleaner, compressed air (clean and dry), or a clean brush.

C. Prime coat cleaned surfaces within eight (8) hours of preparation.

3.2 **PRIME COAT APPLICATION**

A. Apply prime coat using a method recommended by coating manufacturer. Allow to dry for manufacturer's recommended drying time before applying subsequent coats.

B. Apply a stripe coat of primer to all edges, angles, welds, and bolted connection on interior of tank by hand brushing.

C. Apply evenly so there are no runs or thin areas.

D. Repair all runs and sags before application of stripe or finish coats.

3.3 **FINISH COAT APPLICATION**

A. Dry Film Thickness: Refer to AWWA D102.

B. Apply finish coats using the method recommended by coating manufacturer and apply evenly to eliminate runs or thin areas.

C. Appearance: Cloudiness, spotting, show through of subsurface, laps, brush marks and other surface imperfections shall not be acceptable.

D. Rework areas not acceptable shall be refinished to the required standards.

E. Do not immerse coating until full cure of coating has been achieved and cure is approved by coating manufacturer.

3.4 **TESTING**

A. Wet and dry film thickness, each 100 square feet.

B. Holiday test metal surfaces for pin holes and missed areas in the coating. Recoat holiday areas.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13 34 19
METAL BUILDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish all structural design data, fabrication, and erection of a metal building, including all primary and secondary structural framing members, connection bolts, covering, skylights, access hatches, windows, doors, flashing, fasteners, closures, sealer, insulation, and other miscellaneous items.

1.2 DESIGN CODES

A. All structural steel members shall be designed for those sections of the following listed codes as considered to be applicable by the building manufacturer and as related to design requirements and allowable stress.

1. AISC: Specification for the Design, Fabrication and Erection of Structural Steel for Building.
2. MBMA: Recommended Design Practices Manual.
3. SDI: Steel Door Institute.
4. Publications:
   a. Underwriters Laboratories (UL): Building Materials Directory.
   b. State of Utah: Utah Energy Code.

1.3 REFERENCES

A. **ANSI Standards**:

B18.6.4 Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series).

B. **ASTM Standards**:

A325 High-Strength Bolts for Structural Steel Joints.

A441 High-Strength Low-Alloy Structure Magnesium Vanadium Steel.

A446 Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.

A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

A525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

A529 Structural Steel with 42 ksi (290 MPa) Minimum Yield Point (1/2 In. (13-mm) Maximum Thickness).

A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

A572 High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.

C167 Thickness and Density of Blanket or Batt Thermal Insulations.

C177 Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

D1494 Diffuse Light Transmission Factor of Reinforced Plastic Panels.

D3220 Reinforced Thermoplastic Polyester Molding and Extrusion Materials.

E84 Surface Burning Characteristics of Building Materials.

E96 Water Vapor Transmission of Materials.

B. **AWS Standards**:

D1.1 Structural Welding Code.

C. **FS Standards**:

FF-H-106 Hardware, Builders': Locks and Door Trim.

D. **SSPC Standards**:

SP6 Commercial Blast Cleaning.

1.4 **DEFINITIONS**

A. **Clear Span Buildings**: A building of the single-gable, rigid frame type with clear span primary transverse rigid frames.

B. **Modular Frame Buildings**: A building of the single-gable, rigid frame type with the primary transverse frames supported by intermediate columns.

C. **Shed Roof Buildings**: A building of the single slope, rigid frame type with the primary transverse frames being clear span or supported by intermediate columns.

1.5 **BUILDING NOMENCLATURE**

A. Measure the building "Width" and "Length" in accordance with the manufacturer's method.

B. Measure the building "Eave Height" from the bottom of the base plate of the rigid frame columns to the intersection of lines representing the inside of the wall covering and the inside of the roof covering.

C. "Slope Roof" as indicated with a minimum of 1/8 inch of rise for each 12 inches of horizontal run or as indicated.

D. The "Bay Spacing" between intermediate frame center lines as indicated.

1.6 **WIND UPLIFT RATINGS**

A. Furnish, when required, a roof deck system having a UL wind uplift rating of Class 30, Class 60, or Class 90 per Guide No. TGKX in Underwriters' Laboratories, Inc. "Building Materials Directory".

1.7 **DESIGN REQUIREMENTS**

A. Apply roof live loads to the horizontal roof projection or as indicated and in accordance with local Laws and Regulations.

B. Apply a snow load on a horizontal projected area for determining maximum load conditions. Snow loads shall be in conformance with local Laws and Regulations.

C. Use the design wind pressure indicated, applied to the primary framing and to the wall components per MBMA's recommended design practices manual. Wind and seismic loading shall conform to local Laws and Regulations.

D. Use wind or seismic conditions to control design, whichever is largest.

E. Design Load Combination: Determine maximum load combinations as follows:

1. LL = live load; DL = dead load; WL = wind load
2. **30 psf LL and over**:
   - DL + LL, DL = WL, DL + 1/2 LL + WL or DL + 1/2 WL +LL
3. **LL less than 30 psf**:
   - DL + LL and DL + WL

1.8 **SUBMITTALS**

A. Erection Drawings: Submit complete erection drawings to ENGINEER showing anchor bolt settings, sidewall, endwall, and roof framing, transverse cross-sections, covering and flashing details, and accessory installation details to clearly indicate the proper assembly of all building parts.

B. Certificate: Signed by a licensed design professional stating that the building design meets the requirements of this section and is in accordance with Accepted Engineering Practices.

PART 2 PRODUCTS

2.1 **MANUFACTURED UNITS**

A. Structural Framing:

1. Shop fabricate all framing members for bolted field assembly. Indicated on Shop Drawings all field cutting or drilling when required.

2. Primary structural framing includes the transverse rigid frame, wing unit rafter beams and columns, canopy beams, intermediate columns, end bearings frames, endwall columns, and wind bracing.

3. Secondary structural framing includes the purlins, girts, eave struts, flange bracing, sill support, clips, and other miscellaneous structural parts.

4. Use hot rolled steel sheet, plate, and strip in the fabrication of welded assemblies conforming to ASTM A529, A 572, A 441, or A 570, Grade E with a 50 ksi yield as applicable. Use hot roll sheet and strip in the fabrication of cold-formed members conforming to ASTM A570, Grade E except for the following:

a. For thicknesses .050" to .097" use a minimum yield strength of 55,000 psi and a minimum tensile strength of 67,500 psi.

b. For thicknesses .098" to .130" use a minimum yield strength of 55,000 psi and a minimum tensile strength of 65,000 psi.

c. For thicknesses .131" to .229" use a minimum yield strength of 50,000 psi and a minimum tensile strength of 62,500 psi.

d. Use smooth round bars for diagonal rod bracing conforming to the requirements of ASTM A572, Grades 60 or 65.

5. Use structural tubing for columns and other structural uses conforming to ASTM A500, Grade B (42,000 psi yield).

6. Manufacture cold-formed sections by precision roll or brake forming with all dimensions true, and free of fluting or buckling.

7. Weld all shop connections, AWS D1.1. Weld all flange to web connections using continuous submerged arc partial penetration fillet welds on one side of the web. Make all other welds by either the gas metal, submerged or shielded arc process. Make welds in flange plates full penetration.

8. Make all field connections per manufacturer's specifications.

9. Mark all framing members with an easily visible identifying mark, either stamped, penciled, or painted.

B. Wind Bracing: Use diagonal rod bracing in both roof and sidewall, wind columns, or manufacturer's standard method. Use double roof purlins interconnected by diaphragms between the rigid frames at all points of attachment of diagonal roof bracing. Fixed base corner columns or other suitable designed bracing may be used in lieu of sidewall rod bracing. Wind bracing in the roof or sidewall need not be furnished where it can be shown that the diaphragm strength of the roof or wall covering is adequate to resist the longitudinal wind forces.

C. Flange Bracing: Brace laterally the inside flange of all rigid frames so that the allowable compressive stress is adequate for any combination of loading.

D. Sill Support: Provide a continuous member to which the base of the wall covering may be attached.

E. Framed Openings: Design the structural framing members for all openings for the specified design loads.

F. Painting: Clean by rotary abrasive blasting to an SSPC-SP6 commercial blast grade all primary structural framing members which are not galvanized. Following cleaning, apply 1 shop coat of iron-oxide zinc-chromate primer.

2.2 **ROOF AND WALL COVERING**

A. General: Unless indicated otherwise, provide roof coverings to resist the design loads.

B. Panel Materials:

1. Insulate all wall and roof covering units to provide a maximum "U" factor as specified by the Utah Energy Code unless indicated otherwise. Use rigid urethane polystyrene, cellular glass or fiberglass for insulation, all with a suitable vapor retarder.

2. Provide roof and wall panel units consisting of galvanized steel facings and conforming to ASTM A446, G-90 coating class and the required grade and yield stress as required by the design load. Use galvanized coated steel of commercial quality with a nominal coating weight of 1.25 ounces per square foot. Aluminum-zinc alloy coating of the same quality and 0.5 ounces per square foot is also acceptable.

C. Fasteners:

1. Self-tapping sheet metal screws conforming to ANSI B18.6.4 with Type "A" threads. Where required for weather tightness use screws equipped with metal and neoprene washers. Use screws and washers that are carbon steel plated with 0.0003 inch thick cadmium. Coat all exposed fasteners and washers after plating with zinc phosphate and with one prime coat and two finish coats of baked silicone polyester. Match the color of the finish

with the wall and roof panels. Type ASTM A325 stainless steel fasteners plated with 0.00015 inch thick cadmium and aluminum washers may be substituted for the above.

2. Use standard wall fasteners that are nylon headed, cadmium plated, carbon steel, Type "AB" screws. Color-match wall panels and nylon screw heads.

3. Use structural blind rivets that are pull type fasteners having an aluminum body and an aluminum mandrel. Install to securely clinch the joined surfaces together.

D. Sealant and Closures:

1. Use a sealant for sidelaps, endlaps, and flashings that is a gray pressure-sensitive tape blended from butyl and EPDM rubbers, with not less than 50 percent butyl and suitable inert fillers and pigments. Use only sealants that are non-asphaltic, non-shrinking, non-drying, and non-toxic with superior adhesion to metals, plastics, and painted surfaces at temperatures from -10 deg F to +140 deg F and will not flow at 200 deg F For standing seam roof panels use the manufacturer's standard sealant.

2. Seal side joints of tongue and groove units with a non-skinning liquid butyl sealant, applied in the female joint of the interior face.

3. Use standard closures that are closed cell foam EPDM closures matching the panel profile and installed along the eave, rake, and at accessories to be weather-tight.

E. Flashing, Closures, and Trims:

1. Furnish all flashing and trim at the rake, corners, and eaves, at framed openings, to provide weather-tightness and a finished appearance.

2. Use only galvanized steel for flashing, metal closures, trim, and other miscellaneous uses, conforming to ASTM A525, coating Class G-90, 26 gage or heavier.

3. Provide a formed panel matching the slope and profile of adjoining roof panels along the building ridge on (1:12) buildings.

F. Color Finish:

1. Unless indicated otherwise color coat exposed surface of all galvanized steel roof and wall panels, flashing, trim, gutters, downspouts, ventilators, louvers, and other exterior galvanized steel surfaces. Use a color coating system utilizing a silicone polyester (colors) or polyester (white).

2. Unless indicated otherwise color coat all interior wall coverings and the interior face of units with a polyester finish.

3. Finish the interior side of all panels with a 0.5 mil, stone white polyester coating.

2.3 **ACCESSORIES**

A. Metal Swing Doors:

1. Use only door leaves that are 1-3/4 inches thick, full flush, fabricated from 20 gage, galvanized, mill bonderized steel with a core consisting of either one piece, full size, impregnated Kraft paper honeycomb with a minimum crush strength of 45 psi, or foamed-in-place polyurethane. Hang each door leaf using three 4-1/2 inches x 4-1/2 inches galvanized steel interlocking template butt hinges.

2. Use only door frames that are constructed from 16 gage galvanized steel of a rabbeted design with field applied, continuous weather stripping.

3. Use thresholds of extruded aluminum and provide a positive weatherseal.

4. Equip doors with cylindrical lock sets conforming to FS FF-H-106, Series 160, Type A, Series 161, Type A; or Security Lock Type A. When not specified use a Security Lock Type A with two (2) sets of keys.

5. Use door leaves and frames that are made with embossed steel faces, bonderized, and prime painted. Apply a finish coat of enamel to all doors and frames.

B. Aluminum Horizontal Slide Windows:

1. Extruded aluminum alloy sections meeting the requirements of AAMA.

2. Install clear flat drawn window glass as required to qualify for the high wind zone requirements of the AAMA. Embed glass in mastic and securely retained by extruded vinyl spines.

3. Use only screen cloth that is full or half length made of aluminum frames wired with aluminum cloth.

4. Use hardware that is made of corrosion resistant materials.

5. Use weather stripping that is of the finest quality woven pile together with vinyl extrusions.

6. Equip all windows with integral head and sill flashing with jamb fins specially designed to match the wall panel profile and ensure complete weather-tightness.

7. Install windows so only minor amounts of caulking or sealant are visible from exterior.

C. Skylight Panels:

1. Type I, structural (general purpose) fiber reinforced polyester skylight panels conforming to ASTM D3220.

2. Use skylights that have a profile matching the type of panel and arc 1/16 inches thick, weight eight (8) ounces per square foot with a minimum acrylic content of 15 percent. Use white skylights with a granitized surface finish and minimum ASTM D1494 light transmission of 66 percent.

3. Use insulated skylights consisting of white plastic panels to which a three (3) inches deep pan is factory bonded to create an insulating air space. The pan shall be clear acrylic and consist of two (2) pans to give a nominal length skylight to fit two (2) adjacent purlin spaces. Light transmission shall be a minimum of 66 percent.

D. Eave Gutters and Downspouts: Use only eave gutters that are formed to a true profile free of objectionable waviness and imperfections from 26 gage galvanized steel. Match the face of the gutter to the profile of the rake trim. Provide positive counters flashing. Fasten sections securely and seal at end laps. Support outside face of gutter with heavy gage galvanized steel supports.

E. Insulation:

1. Fiberglass blanketing insulation manufactured per ASTM C167, and C177. (k value is not to exceed 0.31 BTU/hr/sq.ft./inch thick/deg F)

2. Furnish all facings with 1 or two (2) inch tabs without adhesive as required:

a. Vinyl sheet facing: Nominal 0.004 inch thick with a permeability rating of 1. to 1.5 grains/hr./sq. ft. tested by ASTM E96, Method A, workable at five (5) deg F and above, and available in white; colors may change.

b. Vinyl-Scrim-Foil: Linen textured with a permeability rating of less than 0.1 grains/hr./sq.ft. tested by ASTM E96, workable at 30 deg F and above with a white finish.

c. Foil-Scrim-Kraft: Foil-surfaced with a permeability rating of less than 0.1 grains/hr./sq.ft. tested by ASTM E96, workable at -10 deg F and above with a regular aluminum finish. Kraft paper shall be free of any chemical treatments which could cause deterioration of metal panels under any environmental condition.

3. Use a composites insulation with a UL approved flame spread rating of 25 or less tested per ASTM E84 (tunnel test) with rolled and stapled side joints.

F. Ventilators: Gravity type fabricated from galvanized steel and conforming to one of the following:

1. Continuous, furnished in 10'-0" lengths. Provide splice plates and end caps to make up the specified length. Continuous ventilators shall have dampers that provide an adjustable opening at the throat and are of the manually operated screw type or pull chain type: or

2. Circular with interior baffles and exterior wind band designed to provide maximum air flow. Optional dampers shall be a spring-loaded butterfly type operated by a fused pull chain.

3. Furnish all ventilators with birdscreens.

G. Louvers: Fabricated from galvanized steel overlapping blades providing maximum weather-tightness while allowing free air flow. Louvers shall be either fixed type with integral birdscreen, adjustable, operated by pull chain, or gravity type indicated.

H. Access Hatches: Provide steel access hatches on roof as indicated to allow accessibility for removing equipment. Fit hatches with approved locking devices located on the inside of building.

2.4 **BUILDING ANCHORAGE**

A. Design building anchor bolts and related anchorage to resist column reactions resulting from specified loads as applied in the specified loading combinations.

PART 3 EXECUTION

3.1 FRAMING ERECTION

A. Do no erection work on the building before review of Shop Drawings.

B. Erect framing, AISC and MBMA specifications.

C. Provide temporary bracing for erection and wind loads to maintain structure plumb and in alignment until completion of erection.

D. Set column base plates per manufacturer's specifications.

E. Do not field cut or alter structural members without approval.

F. After erection prime welds, abrasions, and surfaces not shop primed. Use a primer consistent with shop coat.

3.2 WALL AND ROOFING SYSTEMS

A. Before beginning panel installation, align structural framing true, plumb, and square. Accurately locate all accessory openings.

B. Install roof panel continuous from ridge to eave for buildings 60 feet wide or less. Where endlaps are required, lap a minimum of three (3) inches at a roof purlin.

C. Install wall panels continuous from 1-3/4 inches below the column base to the roof line. Where the required length would exceed 32 feet, Splice at a girt. Square cut all panels at the roof line.

D. Before securing, seal all laps of roof panels with a continuous ribbon of tape sealer.

E. Secure roof and wall panels to intermediate framing members with sheet metal screws at a maximum spacing of 12 inches; 24 inches at endlaps roof panels. On standing seam roof panels attach with manufacturer's standard method.

F. Stitch sidelaps of roof panels through the high rib with sheet metal screws at a maximum 20 inches spacing.

G. Install insulated wall units continuous from 1-3/4 inches below the column base to roof line. Where panel length exceeds 24 feet, splice at a girt. Flash the splice for complete weather-tightness.

H. Predrill panels and fasten to the sill support and to the eave or rake framing with sheet metal screws. Attach at intermediate framing with structural blind rivets or acceptable alternate.

I. Exercise care to ensure that panels are erected true and square and that the module is accurately maintained. Adjust for squareness of module when indented side joint in the interior face does not deviate more than 1/8 inch from parallel.

J. Following complete erection of wall panels, place a 1 inch wide adhesive-backed accent tape at each interior joint.

3.3 TOLERANCES

A. Framing Members: 1/4 inch from level, 1/8 inch from plumb.

B. Siding and Roofing: 1/8 inch from true position.

3.4 INSTALLATION OF ACCESSORIES

A. Install door frames, doors, overhead doors, windows and glass, and other accessories per manufacturer's instructions.

B. Seal wall and roof accessories watertight and weather-tight with sealant.

3.5 GUTTER AND DOWNSPOUT ERECTION

A. Rigidly support and secure components. Join lengths with formed seals sealed watertight. Flash and seal gutters to downspouts.

B. Apply bituminous paint on surfaces in contact with cementitious materials.

C. Slope gutters minimum 1/8 inch per foot.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 05 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for mechanical systems.

B. General requirements for submittals, labeling, and servicing mechanical systems.

C. Locating equipment and test run mechanical systems.

1.2 SUBMITTALS

A. General: Submittals must indicate proper arrangements to suit installation and maintenance requirements such as but not limited to motor location, access door openings, filter removal, piping connections. Clearly mark equipment submittal sheets indicating equipment symbol and exact selection of proposed equipment.

B. Shop Drawings: Submit complete, bound, indexed, loose leaf binder large enough for all items, including:

1. Equipment schedule items.
2. Vibration elimination devices.
3. Valves.
4. Insulation.
5. Registers and grilles.
6. Automatic temperature controls.
7. Certificates of guarantee.

C. Pipe Tests: If requested, submit a report of tests performed by pipe manufacturer and the date each test was completed.

1.3 LABELING

A. Identify all critical items of equipment with permanently etched, laminated plastic labels indicating function or relationship of each piece of equipment to system involved. Secure all labels in place in a clearly visible location with appropriate self-tapping screws.

B. Mark pipe continuously to identify such information as nominal size, pressure rating, industry standards designation number, etc.

1.4 SERVICE

A. Provide emergency service for mechanical systems.

B. In the event of a system Failure, OWNER shall be able to telephone a single request for complete service call by using a number furnished under the contract. The service organization shall dispatch in the time specified by the ENGINEER a person to the site who shall be able to analyze the systems and locate the malfunction. If work should be required out of the normal trade definition, it shall be the responsibility of this service organization to contact the CONTRACTOR or any other specialty involved, and take the responsibility of completing the repairs and putting the system into operation.

C. Service shall be provided by a service business, established and experienced in this work. Complete information in regard to this service organization, showing the personnel, equipment, location, experience, etc., shall be submitted for review along with other items of the system.

D. This service shall be provided starting at the date of Substantial Completion, and for the duration of the CONTRACTOR's guarantee period.

1.5 SUBSTITUTIONS

A. Section 01 25 00.

B. Resolve any conflict arising from use of substituted equipment.

C. Pay all costs required to make equipment comply with intent of Contract Documents. All approvals shall be obtained in writing.

1.6 **COORDINATION**

A. Section 01 31 13.

B. Plan all work to proceed with a minimum of interference with other trades.

C. Inform affected trades of all openings for mechanical work.

D. Furnish all special frames and sleeves as indicated in other Sections.

1.7 **PRODUCT HANDLING**

A. Section 01 65 00.

B. Deliver all materials to the job bearing manufacturer's name and trade name and UL label in every case where a standard has been established for that particular material.

C. Store product in original containers, protect from elements, and make readily accessible for inspection until ready for installation.

1.8 **PROJECT CONDITIONS**

A. Notify ENGINEER if a discrepancy occurs between the equipment supplied and the intent or function of the equipment, catalog numbers, discontinued products, Drawings, Specifications, etc.

B. Failure to report any conflict does not relieve CONTRACTOR from meeting the intent of the Contract Documents nor shall it change the contract cost.

C. Perform all required digging, cutting, incidental work, and make required repairs.

D. Do not cut into any structural element without ENGINEER’s knowledge.

PART 2 PRODUCTS

2.1 **EQUIPMENT**

A. Where two (2) or more units of the same class of new equipment are required, provide units of single manufacturer.

B. Use standard products of the manufacturer unless indicated otherwise.

PART 3 EXECUTION

3.1 **ROUGH IN REQUIREMENTS**

A. Refer to architectural, structural, mechanical, civil and electrical Drawings.

B. Verify that equipment dimensions meet space requirements with sufficient clearances as may be required by equipment used and as indicated.

C. Check building and equipment dimensions for exact placement of sleeves, conduit and equipment.

D. Determine requirements and dimensions relating to manufacturer's Shop Drawings.

E. Make changes required due to lack of coordination at no additional cost to OWNER.

3.2 **ACCESSIBILITY FOR MAINTENANCE**

A. Coordinate location of equipment such as valves, dampers, fixtures, motors, fans, controls, etc. to allow accessibility for maintenance.

B. Ensure access for service or maintenance for proper operation and function.

C. To facilitate function, coordinate mechanical work of all other trades to avoid concealing equipment.

D. Refer any critical location or assembly conflicts to ENGINEER.

3.3 **TEST RUN**

A. Perform preliminary operation of all mechanical systems in cooperation with all trades involved.

B. Arrange time of test run.

C. Make operating test by a team consisting of manufacturer's representative, CONTRACTOR's representative and ENGINEER.

D. Complete test run in one (1) working day including possible different date identification and recheck of significant items under different working conditions.

END OF SECTION

SECTION 22 11 13

FACILITY WATER DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of building water piping, drain piping, and related work.

B. Installation of pipe hangers, sleeves, supports, brackets, and related items.

C. Testing of piping systems and correction of any problems found to exist.

1.2 REFERENCES

A. ASME Standards:

B31.1: Power Piping.

1.3 PIPING SYSTEM LAYOUTS

A. Piping system Drawings are diagrammatic and are intended to show approximate location of equipment and piping. Verify dimensions, whether in figures or scaled, in the field. CONTRACTOR is responsible for the installation of complete and workable systems whether completely detailed on the plans or not.

B. Ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. ENGINEER reserves the right to make minor changes in location of piping and equipment up to the time of installation without additional cost to OWNER.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Install work per applicable provisions of codes, rules, regulations, statutes, and ordinances of authorities having jurisdiction.

PART 2 PRODUCTS

2.1 PIPE

A. Provide size, type, and class of pipe for various uses as follows:

1. Steel pipe lined and coated, Section 33 05 09.
2. Ductile iron pipe, Section 33 05 05.
3. Copper pipe, Section 33 05 03.
4. PVC pipe, Section 33 05 07.
5. ABS pipe, Section 33 05 01.
6. PP pipe, Section 33 05 11.

B. Do not substitute different pipe unless approved in writing before Substitutions. To request Substitution, refer to Section 01 25 00.

2.2 PIPE HANGERS AND SUPPORTS

A. Properly support, suspend, or anchor all piping and fittings to prevent sagging, overstressing, or longitudinal movement, and to prevent thrust or loads on or against other equipment.

B. Support horizontal piping on adjustable split steel ring or clevis hangers. The following schedule shows minimum spacing:

1. Steel and Copper:
   a. 1-1/4" and smaller 6'-0" on center
   b. 1-1/2" to 3" 8'-0" on center
   c. 4" and larger 12'-0" on center

2. PVC, CPVC, and ABS:

a. 1" and smaller 4'-0" on center

b. 1-1/4" to 2" 5'-0" on center

c. 2-1/2" to 4" 6'-0" on center

d. 5" and larger 8'-0" on center

C. Support insulated piping with pipe saddles and hangers that fit on outside of insulation. Do not compress or damage pipe insulation with hangers or supports.

D. Provide all rigid hangers with a means of vertical adjustment after erection.

E. Use copper or copper plated hangers for supporting uninsulated copper pipe.

F. Use one of the following means of supporting horizontal piping from a wall.

1. Steel J-Hook for pipe located close to wall, up to three (3) inches pipe.

2. For hanger suspension with 750 lbs. maximum loading, use light welded steel bracket with hole for one rod, 3/4 inch diameter.

3. For pipe-roll stand support use welded-steel bracket.

G. For vertical piping supports for all pipe except copper:

1. Support vertical piping with wrought steel riser clamps. Make adequate provision for expansion, contraction, and lateral stability.

2. Use steel extension pipe clamps for vertical pipe supports. Refer to manufacturer's rated maximum loading for each size pipe. Bolt clamp securely to pipe rest, clamp end extension on building structure.

3. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp end extension from inserts.

H. For uninsulated vertical copper tubing lines, furnish copper tube straps.

I. Use beam clamps that are of malleable iron for 3/8 inch hanger rods; forged steel beam clamp for hanger rod up to 1-1/2 inches.

2.3 **INSERTS**

A. Furnish and set inserts in concrete forms; provide reinforcing rods for pipe sizes over three (3) inches or equivalent.

B. Furnish concrete inserts as follows: Black, malleable iron, universal type for threaded connections with lateral adjustment.

2.4 **SHIELDS**

A. Provide shields to protect insulation in all areas.

B. Provide approved galvanized form shields to protect insulation at areas of contact with hangers and supports.

C. Furnish low compressive insulation protector shields. Size per shield manufacturer's recommendations.

2.5 **SLEEVES**

A. Where pipes pass through floors, footings, foundations, walls, or ceilings, furnish and install pipe sleeves. Sleeves for concealed piping shall be of galvanized iron, and for exposed piping on I.P.S. black steel pipe installed so as to be completely covered by escutcheons. Extend sleeves through floors 1/2 inch above finish floor.

2.6 **ESCUTCHEONS**

A. Fit pipe passing through walls, floors, or ceilings with escutcheons with set screws.

B. Use prime painted escutcheons where surface is to receive a paint finish; otherwise, use escutcheons that are nickel or chromium plated.

C. Where piping is insulated, use escutcheon outside the insulation.

2.7 **JOINTS**

A. For screwed pipe make ends with sharp, clean tapered threads using pipe compound on male thread only. Do not use mill cut threads. Ream cut pipe to full inside diameter.

B. Welding may be done by either arc or acetylene process, ASME B31.1.

C. For solder joints use fittings specifically made for soldering. Clean all burrs and roughen pipe to clean. Solder complete around joint.

D. For grooved pipe jointing systems use mechanical pipe couplings and fittings.

E. For no-hub cast iron pipe use double screw joint neoprene coupler.

2.8 **UNIONS**

A. Furnish and install unions necessary for installation and necessary to permit removal of equipment.

B. For unions in steel pipe 1-1/2 inches and smaller use malleable iron ground joint unions with brass to iron seat, galvanized or black as required.

C. For larger unions in steel pipe use standard weight, cast iron flange unions with 1/16 inch thick gaskets, galvanized or black as required.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Before installation of piping, verify that it will not interfere with clearances required for the erection and finish of structural members, architectural members, electrical, sprinkler, or mechanical items.

B. Hang or support piping materials from roof support system whenever possible.

C. Do not cut any structural members for installation of piping.

3.2 **INSERTS**

A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over four (4) inches in diameter.

C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.3 **SLEEVES**

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping passes through floor, ceiling, or wall, close-off space between pipe and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

3.4 **PIPE HANGERS AND SUPPORTS**

A. Support all piping and make adequate provisions for expansion, contraction, slope, and anchorage.

B. The use of pipe hooks, chains, or perforated metal for pipe support will not be permitted.

C. Suspend all piping in the building as indicated.

D. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.

E. Place a hanger within 1 foot of each horizontal elbow.

F. Use hangers that are vertically adjustable 1-1/2 inches minimum after piping is erected.

G. Support horizontal soil pipe near each hub, with five (5) feet maximum spacing between hangers.

H. Support vertical piping at every other floor. Support vertical soil pipe at each floor and at hub.

I. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

J. Where practical, support riser piping independently of connected horizontal piping.

3.5 PIPING INSTALLATION

A. Cut piping accurately for fabrication to measurements established at the construction site and work into place without springing or forcing.

B. Remove burrs and cutting slag from pipe by reaming or other approved cleaning methods.

C. Make changes in direction with proper fittings.

D. Arrange piping so as not to interfere with the removal of other equipment, ducts, or devices. Do not block doors, windows, or access openings. Provide unions in the piping at connections to all equipment. Unions must be accessible.

E. Make connections of dissimilar metals (such as copper and steel) with insulating couplings suitable for at least 175 psig working pressure at 250 deg F

F. Cap or plug open ends of pipes and equipment with PVC caps or expanding neoprene plugs to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste, or similar materials are not acceptable.

G. Install all piping systems so they can easily be drained. Provide hose bibs at low point of water lines.

H. Slope all soil and waste lines within the building at 1/4 inch per foot fall in the direction of flow unless indicated otherwise.

3.6 PRIMING AND COATING

A. Prime coat exposed steel hangers and supports and hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces.

B. Color Code, Section 09 91 00.

3.7 DISINFECTION AND TESTING

A. Disinfect culinary water piping, Section 33 13 00.

B. Performance testing culinary water piping, Section 33 08 00.

C. Repair defects that develop under tests promptly and repeat tests. No caulking of screwed joints, cracks, or holes will be permitted. Replace pipe or fitting or both with new material when repairing leaks in screwed joints.

D. Repair leaks in copper tubing by melting out joint, thoroughly cleaning both tubing and fitting, and resoldering.

END OF SECTION

SECTION 22 11 23
WATER PUMP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Base mounted, in-line vertical, in-line circular, positive displacement pumps, materials for water and waste water.

1.2 SUBMITTALS

A. Before Installation: Drawings, specifications, dimensions, make, style, speed, size, type, horsepower, full load amps, head-capacity curves, efficiency curves, net positive suction head (NPSH) curves, specific materials used, design features and weights.

B. After operation of system: Pump test start up certificate from pump manufacturer.

PART 2 PRODUCTS

2.1 FABRICATION - GENERAL

A. Statically and dynamically balance rotating parts.

B. Except for submerged pumps or unless otherwise directed, tap pumps at the suction and discharge for pressure gages.

C. Construction: Permit complete servicing without breaking piping or motor connections.

D. Speed: 1750 rpm.

E. Connections: Flanged and bolted.

2.2 BASE MOUNTED PUMP

A. Type: Centrifugal, single or multi stage, direct connected.

B. Casing: Cast iron, split volute, single or double suction, rated for greater of 150 psi or 1.25 times actual working discharge pressure, renewable bronze wearing rings, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze, or stainless steel shaft sleeves.

E. Bearings: Oil lubricated roller or ball bearings with oil reservoirs. Provide oil seal and integral dirt and water seal at each end of reservoir.

F. Drive: Flexible coupling with coupling guard.

G. Seals: Packing gland with minimum four (4) rings teflon impregnated packing and gland lantern rings.

H. Baseplate: High grade, heat treated cast iron or reinforced heavy steel with integral drain rim grout base.

2.3 IN-LINE PUMP

A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.

B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual discharge working pressure, suction and discharge gage port, air vent, wear rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft and secured with locknut.

D. Shaft: Stainless or carbon steel with bronze or stainless steel sleeve through seal chamber.

E. Seals: Packing gland with minimum four (4) rings teflon impregnated packing and gland lantern rings.

2.4 IN-LINE CIRCULATOR

A. Casing: Bronze cast iron rated for 125 psi working pressure.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two (2) oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

2.5 **SEWAGE PUMP (NON-SUBMERSIBLE)**

A. Type: Vertical centrifugal, direct connected, simplex or duplex.

B. Casing: Cast iron volute with radial clearance around impeller.

C. Impeller: Bronze or cast iron, nonclogging, semi-open, keyed to the stainless steel shaft.

D. Support: Cast iron pedestal registered and dowelled with inspection openings on cast iron sub-coverplate, bolted to steel coverplate with gas tight gaskets.

E. Bearings: Forced grease lubricated bronze sleeve every six (6) feet and force grease lubricated ball thrust above.

F. Packing boxes extra deep and grooved with heavy-duty packing arrangement with bronze lantern ring for water seal attachment.

G. Drive: Flexible coupling.

H. Controls Duplex: Alternator to alternate operation of pump on average load, cut-in second pump on rising level or pump Failure, separate high level alarm.

2.6 **SUBMERSIBLE PUMP**

A. Section 22 13 33.

2.7 **POSITIVE DISPLACEMENT PUMP**

A. Type: Single stage, rotary gear:

1. Cast iron casing hardened shaft with stainless steel sleeves and mechanical seal,
2. Self-lubricating bronze bearings,
3. Inlet and outlet connections, and,
4. Integral bypass type adjustable relief valve.

B. Drive: Flexible coupling with coupling guard.

C. Base: Cast iron common mounting for pump and motor with drop rim and drain tapping.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Secure pumps to floor or base as indicated and per manufacturer's recommendations.

B. Provide drains for bases and stuffing boxes piped to and discharging into floor drains.

C. Provide air cock and drain connection on horizontal pump casings.

D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes four (4) inches and over.

3.2 **PUMP TESTING AND START-UP**

A. Test the pump for flow, speed, vibration, and amperage draw. Factory representative shall certify that the installation is correct and the pumps are functioning properly.

END OF SECTION

SECTION 22 13 33
SUBMERSIBLE PUMP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submersible pump with controls and components.

B. Coordinate installation with work of separate trades.

1.2 DESIGN REQUIREMENTS

A. Statically and dynamically balance rotating parts.

B. Pumps to operate under continuous submergence at a minimum depth of 35 feet without loss of watertight integrity.

C. Capable of handling storm water, sanitary sewerage, and wastewater.

D. Pump to operate at 1750 rpm unless indicated otherwise.

E. Design to permit complete servicing without breaking piping or motor connections.

F. Motor temperature rise to conform to latest NEMA standards for submersible pumps.

1.3 SUBMITTALS

A. Substitutions: Section 01 25 00.

B. Shop Drawings: Section 01 33 00 for pumps, electrical connections and controls.

C. Pump Curves: Certified pump performance characteristics with pump and system operating point plotted. Include net positive suction head (NPSH) curve.

D. Motor and Cable Insulation Test: For moisture content or insulation defects.

E. Pump manufacturer's certificate that installation is correct and the pump(s) function properly relative to flow, speed, vibration and amperage draw.

1.4 HANDLING AND STORAGE

A. Protect against damage and dirt during shipping and storage.

PART 2 PRODUCTS

2.1 MAJOR PUMP COMPONENTS

A. Gray case iron, Class 30 casing, with smooth surfaces devoid of blow holes and other irregularities.

B. Stainless steel exposed bolts and nuts, Section 05 05 23.

C. Waterproof exterior. Manufacturer select exterior spray with PVC epoxy primer chloric rubber paint finish.

2.2 DISCHARGE CONNECTION ELBOW

A. Installed in the wet well.

B. Make connection of pump to discharge connection elbow automatic when pump is lowered into place in a simple downward motion.

C. Provide sliding guide bracket and guide bar(s) as part of the discharge connection elbow.

D. Guarantee sealing of the discharge interface.

2.3 MATING SURFACES

A. Seal all mating surfaces. Do not use secondary sealing compounds, gaskets, grease, or other devices.

2.4 CABLE ENTRY

A. Watertight and submersible seal for cable entry into pump.

B. Isolate cable entry junction chamber and motor from each other so foreign material entering through the pump top (if any) shall not have access to the motor.

C. Do not use epoxies, silicones, or other secondary sealing systems.

2.5 **PUMP MOTOR**

A. Squirrel-cage, induction, shell type design, housed in an air-filled, watertight chamber, NEMA design B type with stator winding and stator leads insulated against moisture and temperatures less than 311 deg F

B. Design for continuous duty, capable of sustaining a minimum of 10 starts per hour.

C. Capable of continuous operation at totally, partially or non-submerged conditions.

2.6 **JUNCTION CHAMBER**

A. Junction chamber to contain the terminal board.

B. Connection Between Cable and Stator Leads: Perfectly leak-proof.

2.7 **COOLING SYSTEM**

A. Provide an adequately designed cooling system for the pump(s).

B. Provide provision for external cooling and flushing.

2.8 **THERMAL SENSORS**

A. Use thermal sensors to monitor stator temperatures that are wired to the control panel.

2.9 **PUMP SHAFT SEAL**

A. Carbon steel shaft completely isolated from the pumped liquid by a mechanical rotating shaft seal system. Seals require neither maintenance nor adjustment, which can be easily inspected and replaced.

B. Do not use a pressure differential consisting of a single or double spring action between upper and lower sealing units to offset external pressure and to effect shaft sealing.

C. Use oil as seal lubricant. Provide drain and inspection plug, with a positive anti-leak seal that is easily accessible from the outside.

2.10 **SHAFT BEARINGS**

A. Permanently lubricated bearings capable of five (5) years continuous operation.

B. Use bearings capable of operating for short periods of time with the discharge valve closed.

2.11 **IMPELLER**

A. Dynamically balanced, double shrouded, nonclogging design having a long thrulet without acute turns capable of handling solids, fibrous materials, heavy sludge and other similar materials.

B. Fit the impeller and the shaft by sliding and using a key to lock.

2.12 **VOLUTE**

A. Designed with smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller.

B. Install a wear ring system to provide efficient sealing between the volute and impeller.

2.13 **PUMP MOTOR CABLE**

A. Use pump motor cable suitable for submersible pump application. Conform cable sizing to NEC specifications for pump motors.

B. Seal pump cable end with a high quality protective covering to make it impervious to moisture or water seepage before electrical installation.

C. Provide 1 foot extra length of cable for each 50 feet of depth.

D. Provide 10 feet of extra cable beyond surface plate.

E. Provide corrosion resistant shield where cable passes pump volute.

2.14 **ACCESS FRAME, GUIDES AND DOOR**

A. Provide access frame to the discharge connection elbows complete with hinges and flush locking mechanism, upper guide holder and level sensor(s) cable holder. Provide frame with sliding nut rails to attach the accessories required. Lower guide bar holder(s) shall be integral with the discharge connection elbow.

B. Provide guide bars of the size necessary to lift and lower the pump(s) without bending, binding, or vibration. Do not support any portion of the weight of the pump of the guide bars.

C. Provide surface plate with adequate rigidity to support the system, but with sufficient openings to allow free access to cable, vent and water.

D. Access doors of skid proof design.

E. All components galvanized or zinc coated, Section 05 05 10.

2.15 **CONDUIT SYSTEMS**

A. Section 26 05 33.

B. Do not use flexible conduit.

2.16 **CONTROL PANEL**

A. Solid state logic circuitry operational in temperature range of -40 deg F and +120 deg F and waterproof, designed for outdoor use, lockable and containing line voltage pump power circuit and lower voltage pilot control circuit or approved equivalent. The pilot control circuit takes power from the same terminal board. Perform the following functions:

1. Start and stop pumps at required water levels.
2. Alternate the sequence of starting via manual or automatic selection.
3. Start progressively more pumps if water level in sump continues to rise.
4. Instant disconnect from power source in the event of major electrical fault.

B. Equip the panel with all protective devices for motors as disconnects, relays, hand-auto-off switches designed for three phase 480/277 volt power system to control the pumps via the operation of the liquid sensors.

C. On/off pump running lights in the control panel for each pump.

D. Adjustable thermostat heater.

2.17 **STRAINER**

A. Strainer with net inlet area three (3) times (if not indicated) the net inlet area of impeller.

2.18 **TIMERS**

A. Provide timers such that the operating time of each pump can be continuously monitored. Fit each timer with a reset capability to restart timing cycle.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Check impeller, motor rating, and electrical connections for compliance with manufacturer's recommendations.

B. Secure pumps as indicated and per the manufacturer's recommendations.

3.2 **PUMP TESTING AND START-UP - FIELD**

A. Qualified millwright to check, align, and certify pumps before start-up.

B. Before submergence, run the pump dry to establish correct rotation and mechanical integrity.

C. Run the pump for a minimum of 30 minutes submerged, under six (6) feet of water minimum. Retest motor and cable insulation.

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

E. System Testing: Run a complete operating test of the pumps and associated equipment after installed in the field:

1. Dry Test: Turn on the power to all equipment. With the pump station dry, activate the number 1 pump liquid level sensor. Then activate the number two (2) pump and the number three (3) pump liquid level sensors, etc. Check the "pumps running" lights on the control panel to see that they are operating properly. Deactivate all sensors. Pump systems should turn off and the number 1 pump should switch to become the lag pump with the

number two (2) pump becoming the lead pump, etc. Repeat the above process to verify that the pumps have transferred the lead.

2. Wet Test: Provide a source of water adequate for this test. Conduct this test identically to the Dry Test. All equipment must pass these tests. Repair or replace any equipment failing to operate properly at no additional cost to OWNER.

F. Start-up: Instruct OWNER's personnel, Section 01 78 23.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for electrical systems.

B. Requirements for submittals, quality assurance, product handling and coordination.

1.2 REFERENCES

A. NFPA Standards:

70 National Electrical Code.

1.3 ELECTRICAL SYSTEM LAYOUTS

A. Drawings are diagrammatic, intended to indicate general scope and locations of work to be installed.

B. Furnish as if called for in detail by the Contract Documents all items of labor and material or equipment incidental to or necessary for the complete installation and proper operation of electrical work.

1.4 SUBMITTALS

A. Section 01 33 00.

B. Electrical installation certificate from electrical inspection authority having jurisdiction.

C. Wiring Layout: Before installation of the electrical work, submit a complete wiring layout, showing arrangement of all circuits, conduits, and control equipment, size of conduit, conductors, wiring diagrams and connections of all equipment necessary for full understanding and record of the installation.

1.5 QUALITY ASSURANCE

A. Section 01 43 00

B. Workmanship to be neat with good appearance, NFPA 70.

1.6 SUBSTITUTIONS

A. Section 01 25 00.

B. Resolve any conflict arising from use of substituted equipment.

C. Pay all costs required to make equipment comply with intent of Contract Documents. All approvals shall be obtained in writing.

1.7 COORDINATION

A. Section 01 31 13.

B. Plan all work to proceed with a minimum of interference with other trades.

C. Inform affected trades of all openings for electrical work.

D. Furnish all special frames and sleeves as indicated in other Sections.

1.8 PRODUCT HANDLING

A. Section 01 65 00.

B. Deliver all materials to the job bearing manufacturer's name and trade name and UL label in every case where a standard has been established for that particular material.

C. Store product in original containers, protect from elements, and make readily accessible for inspection until ready for installation.

1.9 PROJECT CONDITIONS

A. Notify ENGINEER if a discrepancy occurs between the equipment supplied and the intent or function of the equipment, catalog numbers, discontinued products, drawings, specifications, etc.

B. Failure to report any conflict does not relieve CONTRACTOR from meeting the intent of the contract documents nor shall it change the contract cost.

C. Perform all required digging, cutting, incidental work, and make required repairs.

D. Do not cut into any structural element without ENGINEER's knowledge.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 26 05 13
CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of wires or cables required for power distribution, service, feeders, and branch circuits.

1.2 REFERENCES

A. NFPA Standards:

70 National Electrical Code.

1.3 SUBMITTALS

A. Field Test Data: Megohmmeter test data for circuits under 600 volts.

PART 2 PRODUCTS

2.1 MATERIALS

A. Building Conductors: Copper, 600 volt insulation, THW.

B. Branch Circuit Conductors and All Conductors #3 AWG and Smaller: Copper, with TW, THHN, or THWN insulation #10 AWG and smaller, and THW larger than #10 AWG, where ambient temperature conditions exceed 140 deg. F:

1. Size all conductors; NFPA 70.
2. Minimum size to be #12 AWG.
3. Stranded conductors for #8 AWG and larger.
4. For outlets to fixtures, and in fixture channels (in dry areas); THHN insulated conductor.
5. In damp locations, under slabs, on exterior provide THWN.

C. Fire Alarm System Conductors: Cross-linked thermosetting polyethylene (RW90 X-link) type insulating.

D. Provide permanent plastic name-tag indicating load feed.

E. Use type XHHW conductors for water pumping and regulator stations.

F. Cable Supports: OZ cable supports for vertical risers, type as required by application.

2.2 COLOR AND CODING OF CONDUCTORS

A. 120/208 volt and 277/480 volt as follows

Table 1 – Color Coding of Conductors

120/208 volt	277/480 volt
A Phase – Black	A Phase – Brown
B Phase – Red	B Phase – Orange
C Phase – Blue	C Phase – Yellow
Neutral – White	Neutral – Grey
Ground – Green	Ground – Green Stripe

PART 3 EXECUTION

3.1 INSTALLATION

A. NFPA 70.

B. Make conductor length for parallel feeders identical.

C. Lace or clip groups of feeder conductors at distribution center, pull-boxes, and wireway. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.

D. Provide copper grounding conductors and straps.

E. Install wire and cable in code conforming raceway.

F. Use non-detrimental wire pulling lubricant for pulling No. 4 AWG and larger wire.

G. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.

H. Color code conductors to designate neutral conductor and phase.

I. Furnish necessary reels, reel jacks, and other pulling aids required to prevent damage to wires and cable.

J. Splicing:

1. Install wires and cables continuous without splices from sources of supply to distribution equipment and from source of supply to motor, lighting, or power outlet.

2. Do not use pull boxes for making splices.

3. Do not install splices in conduits.

K. Use of cable with more conductors then specified; CONTRACTOR's option. When done, tape off and labeled extra conductors as spares.

3.2 CONDUCTOR CONNECTIONS

A. Use approved pressure type solderless connectors and lugs for service entrance, feeder, equipment connections and terminal posts.

B. Use connectors of a type compatible to conductors, locations, and load.

C. Make neutral connection and taps individually in order to prevent the possibility of an "open-neutral".

D. Make branch circuit connections with UL approved solderless connectors. Do not depend solely upon a single insulating material to secure connection as well as to insulate it.

E. After first either silverplating the bars or applying suitable non-oxidizing agents, bolt buss bar connections with adequate nonferrous bolts, washers, and lockwashers.

F. Insulate joints and taps with patented or molded plastic insulators. Use tapes compatible with conductor jackets, temperature, and other conditions.

3.3 SPECIAL WIRING

A. Special Systems: Furnish and install equipment, materials, labor, services, and accessories required for completion of any special systems of an electrical nature, but not classified otherwise herein, that may be indicated. Applicable portions of NFPA 70 also apply.

3.4 HAZARDOUS AREAS

A. Comply with NFPA 70 when installing wiring, fixtures, and equipment in locations classified as "Hazardous Locations".

3.5 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW

A. Before energization, test cable and wire for continuity of circuit and for short circuits. Megger all circuit of 100 amp and greater rating.

B. Correct malfunctions.

C. Submit record of mega ohm meter readings to ENGINEER.

3.6 IDENTIFICATION OF FEEDERS

A. Affix a marker stamped or embossed on each cable at each entry to and exit for each manhole, pullhole, pullbox, cable tray switchgear and switch, identifying circuit; i.e. "MCCI", "PANEL L" "NO 1" etc.

B. Identification letters to be 1/8 inch size minimum.

C. Markers to be rigid, noncorrosive, attached to feeder cables with feeder identification.

D. Nylon straps to be used to tie the markers.

END OF SECTION

SECTION 26 05 33
RACEWAY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical transport systems consisting of flexible or rigid conduits, couplings, supports, nonmetallic ducts, wireways and gutter.

1.2 REFERENCES

A. **ANSI Standards**:

C80.1 Rigid Steel Conduit - Zinc-Coated.

C80.3 Electrical Metallic Tubing - Zinc-Coated.

B. **FS Standards**:

W-F-406 Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.

WW-C-566 Conduit, Metal, Flexible.

C. **NEMA Standards**:

TC6 PVC and ABS Plastic Utilities Duct for Underground Installation.

TC9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

D. **NFPA Standards**:

70 National Electric Code.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4 inch.

B. Rigid Metal Conduit (RMC): ANSI C80.1.

C. Intermediate Metal Conduit (IMC): ANSI C80.1.

D. Rigid and Intermediate Steel Conduit Fittings: Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at conduit termination, use OZ type B bushings on conduits 1-1/4 inch and larger.

E. Electrical Metallic Tubing (EMT): ANSI C80.3.

F. EMT Fittings: Provide insulated throat non-indenter type malleable steel fittings; concrete tight where required by application. Install OZ type B bushings on conduits 1-1/4 inches and larger.

G. Flexible Metal Conduit (FMC): Zinc-coated steel, FS WW-C-566.

H. Flexible Metal Conduit Fittings: Type 1, Class 1, Style A, FS W-F-406.

I. Liquid-Tight Flexible Metal Conduit: Single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible PVC (polyvinyl chloride).

J. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G.

K. Expansion Fittings: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS

A. General: 3/4 inch minimum trade size.

B. Underground PVC Plastic Utilities Duct: NEMA TC6, Type I for encased burial in concrete, Type II for direct burial.

C. Duct Fittings: NEMA TC9, match to duct type and material.

2.3 **CONDUIT, TUBING, AND DUCT ACCESSORIES**

A. Types and sizes, and materials, complying with manufacturer's published product information, that mates and matches conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 **LOCKNUTS, BUSHINGS, CONNECTORS, COUPLINGS, AND SUPPORTS**

A. General: Provide malleable bushings, except that plastic bushings may be used in lieu of phenolic-lined malleable bushings where "insulating bushings" are required.

B. Provide "double-locknut" system (two (2) locknuts) throughout, each being tightened wrench tight as to effectively bond outlet box or cabinet to conduit.

C. Sealing Bushing: OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

D. Provide insulated-through type ground bushing of the malleable type.

E. Provide connectors or couplings that are proper for the conduit they are used with. Make watertight when required.

F. Provide cadmium plated or galvanized fittings.

G. Provide fittings with die-cut threads unless approved otherwise.

H. EMT connectors used with #4 and larger cable shall have throat liners of suitable plastic insulation.

2.5 **INTERIOR OUTLET BOXES**

A. Section 26 05 34.

2.6 **SCHEDULE OF LOCATIONS**

A. Galvanized steel conduit in concrete.

B. Electrical metallic tubing in other locations.

C. For underground conduit use rigid, threaded, galvanized steel conduit, or solvent welded PVC conduit.

D. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid tight connectors. Motor connection size is 1/2 inch minimum.

E. Provide flexible conduit for fixture and control wiring with sufficient length of flexible conduit to avoid transmission of vibration.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavate. Section 31 23 16.

3.2 **INSTALLATION**

A. Install conduit concealed in all areas, excluding mechanical and electrical rooms, connections to motors, and connections to surface cabinets.

B. For exposed runs attach surface-mounted conduit with clamps.

C. Coordinate installation of conduit in masonry work.

D. Unless indicated otherwise, do not install conduit larger than 2-1/2 inches in concrete slabs. Provide a minimum concrete cover around conduits of two (2) inches.

E. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt and moisture.

F. Clean out conduit before installation of conductor.

G. Alter conduit routing to avoid structural obstructions, minimizing crossovers.

H. Fill end of conduit with fiberglass where conduits leave heated area and enters unheated area.

I. Provide flashing and pitchpockets, making watertight joints where conduits pass through roof or waterproofing membranes.

J. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended buildings.

K. Route all exposed conduits parallel or perpendicular to building lines.

L. Make interconnections between difference types of raceways with manufactured fittings approved by UL.

M. Size raceways; NFPA 70 tables. Do not reduce from any sized indicated.

N. Do not exceed sizes permitted in slabs or walls.

O. Do not exceed number of bends allowed in conduit by NFPA 70.

P. Make joints wrench tight or otherwise with minimum resistance to the flow of fault currents.

Q. Use furred spaces and chases to an advantage in concealing conduits.

R. Make field bends only where needed and then carefully to minimize wire pulling tensions and for best appearance in exposed runs.

S. Test conduit runs with lignum vitale ball (mandrel) of 85 percent of conduit diameter.

T. Cut conduit with hacksaw or other approved pipe cutting tool and ream ends to clean out all burrs before connecting.

U. Keep conduits at least six (6) inches away from steam or hot water pipes, breaching, and boilers, but in no case permit conductors to reach higher than rated temperatures. Avoid traps in runs and slope conduit to drain.

V. Fasten raceways securely in place. Firmly fasten conduit within three (3) feet of each outlet, junction box, cabinet, or fitting. Support metallic conduit, rigid (heavy wall) and EMT at least every 10 feet. Support rigid nonmetallic conduit in strict accordance with NFPA 70. Use raceway fasteners designed for the purpose.

3.3 **SPECIAL CONDUIT FITTINGS**

A. Use special conduit fittings as required or indicated. Use UL approved fittings suitable for location and usage made.

B. At expansion joints use special fittings if cast in concrete slabs.

C. Building Expansion Joints: Where surface conduits, raceways, panels, or light fixtures, span building expansion joints, make satisfactory arrangements to provide the movement provided for in building structure plus or minus nominal joint width.

3.4 **PULL BOXES, WIREWAYS, AND GUTTERS**

A. Furnish as indicated, plus any such items required to assemble conduits and other raceways. Provide Section 26 05 34 pull boxes as dictated by wire pulling requirements. Unless indicated otherwise face into secondary or unfinished rooms.

B. Construction: Code gage galvanized sheet steel and sized strictly in conformance with NFPA 70 requirements.

C. Finish: Free of burrs, sharp edges, unreamed holes, and sharp-pointed screw or bolts.

D. Coating: When mounted direct to concrete or masonry walls that are below grade or where there will be sweating or other moisture present on wall surface, coat backs of boxes with a heavy coat of black asphalt paint before mounting.

E. Protection: Adequate provisions for preventing damage to conductors either during pulling in or from weights and tensions when in place.

F. Weatherproof, rain-tight, or special type when indicated or when required by NFPA 70.

3.5 **ANCHORS, FASTENERS, AND MISCELLANEOUS SUPPORTS**

A. Use compatible anchors in roof or ceiling slabs of concrete from which a load is suspended and anchors used to fasten heavy equipment without lead in their construction.

B. Make exposed conduit fastenings with one-piece, malleable conduit clamps. Two hole, galvanized sheet metal pipe straps may be used on all concealed installations.

C. Use companion bases or backs with conduit clamps when conduit is exposed to weather or continuous moisture.

D. Use ring type hangers on individual runs of conduit three (3) inches and larger if suspended, complete with threaded rods. Use adjustable turnbuckles when specified or otherwise as an option.

E. Support multiple runs of suspended conduits from trapeze style hangers suspended with rigid threaded steel rods and with suitable conduit clamps or straps of the same make as cross channels used.

F. Mount multiple runs of conduit on ceiling or wall surfaces.

G. Do not hang or support electrical equipment and materials from roof decks.

3.6 COLOR CODING, EXPOSED CONDUIT

A. Provide color bands 1 inch wide for conduits up to two (2) inches in diameter and one-half the conduit diameter for large conduits applied at panel and pull-box locations within each room and 500 feet on centers within an area.

B. Color Banding:

Table 1 – Color Banding

Unit	Color Band
120/208 Volt	Gray
347/600 Volt	Sand
Fire Alarm	Red
Telephone	Blue
Intercommunication and Sound	Yellow
Clocks	Green
Television	Rust
Low Voltage Switching	Black

C. Nonmetallic Pressure Piping Label: When applicable, engraved plastic laminate, label permanently affixed to main electrical meter panel reading "THIS STRUCTURE HAS A NONMETALLIC PRESSURE PIPING SERVICE".

END OF SECTION

SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Junction boxes, pull boxes, fittings.

1.2 REFERENCES

A. NEMA Standards:

OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. NFPA Standards:

70 National Electric Code.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70 as applicable for installation of electrical boxes and fittings.

B. Comply with NEMA OS 1 and NEMA OS 2 as applicable for outlet boxes, device boxes, covers and box supports.

C. Provide electrical boxes and fittings which have been UL-listed and labeled.

PART 2 PRODUCTS

2.1 INTERIOR OUTLET BOXES

A. One piece, galvanized flat rolled sheet steel, cast iron or cast aluminum outlet wiring boxes, of types shapes and sizes, including box depths, to suit each respective location and installation. If of aluminum, essentially "copper free". Do not use on conduits of dissimilar metals, except with ENGINEER’s knowledge.

B. Construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices.

C. Minimum depth 1-1/4 inches or 2-1/8 inches depth for boxes with three (3) or more conduit entries.

D. Use in combination with factory or field bends when indicated or advised. Complete outlet bodies with mounting brackets, hangers, extension rings, fixture studs, cable clamps, metal straps, gaskets, cover, hubs, reducers, and other accessories.

2.2 WEATHERPROOF OUTLET BOX

A. Corrosion-resistant cast-metal of types, shapes and sizes (including depth) required.

B. Threaded conduit ends, cast-metal face plates with spring hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES

A. Building Structure Type: Code-gage sheet steel with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with galvanized steel Section 05 05 23 nuts, bolts, screws and washers.

B. Buried Type: Unless shown otherwise on drawings, plastic body and cover, or pre-cast concrete with screw-on cast iron covers; of types, shapes and sizes to suit each respective location and installation; equipped with stainless steel nuts, bolts, screws and washers, Section 05 05 23.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of electrical boxes and fittings with wire, cable and raceway installation work.

B. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 INSTALLATION

A. Install where indicated, complying with manufacturer's written instruction, applicable requirements of NFPA 70 and NEMA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install coverplates for all boxes; weatherproof outlets for interior and exterior locations exposed to weather or moisture.

C. Install boxes and fittings to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.

D. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10 inches of conduit between them.

END OF SECTION

SECTION 26 09 26
PANELBOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical distribution panelboards.

B. Connections between fixtures, equipment and panelboards.

1.2 REFERENCES

C. **NEMA Standards**:

1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

250 Enclosures for Electrical Equipment (1000 Volt Maximum).

B. **NFPA Standards**:

70 National Electric Code.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of panelboard required.

B. Shop Drawings. Submit showing accurately scaled layouts of enclosures and required individual panelboard devices. Show circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.

1.4 QUALITY ASSURANCE

A. Construct panelboards to NEMA 1 and NEMA 250 Standards and provide UL labels.

B. Comply with NFPA 70 pertaining to installation of wiring and equipment in hazardous locations.

C. Make all grounding tight and secure throughout.

PART 2 PRODUCTS

2.1 PANELBOARD - GENERAL

A. Provide panelboards of the same make and key alike with a master key arrangement.

B. Use dead front panelboards with one-piece cabinets constructed from code gage steel. Cabinets shall have knockouts and minimum gutter space of four (4) inches on all sides.

C. Provide branches with automatic circuit breakers, thermal-magnetic type, unless indicated otherwise. Multi-pole breakers shall automatically open all poles when an overload occurs in any pole. Branch circuit breakers used for switching duty shall be UL listed as SWD type. Ground fault circuit interrupter protection as required by NFPA 70 shall be provided by ground fault circuit interrupting breakers. Circuit breakers shall have positive trip indication as well as clear "off" and "on" indication.

D. Use factory assembled panelboards with amp rating units indicated. Provide spare units and blank spaces as indicated. Main circuit breaker or lugs only as indicated.

E. Affix large, permanent individual numbers to each breaker on panelboard face in a uniform position. Number starting at the top, with odd numbers used in sequence down left hand side and even numbers used in sequence down right hand side.

F. Use fronts manufactured with code gage steel, finished with rust inhibiting primer and baked enamel finish and manufacturer's standard color. Provide doors with flush tumbler type locks. Provide a circuit directory frame and card with a clear plastic covering inside the door.

G. Furnish locking clips for "off" position only, with "on" trip free travel and installed in all circuits so indicated.

H. Label panel with black phenolic or acceptable alternate engraved nameplate with 1/4 inch high lettering on the interior of each panelboard; including panel name and voltage. Provide red nameplate on emergency system panels.

I. For outside locations use a NEMA 4R cabinet.

2.2 **PANELBOARD - 480 VOLT**

A. Voltage: 277/480 volts, three (3) phase, four (4) wire, S/N, equipped with automatic circuit breaker.

B. Circuit Breakers: Minimum interrupting capacity of 14,000 amps at 277 volts. Use breakers that are UL rated for use as switches.

C. Locking Clips: Five (5) minimum per panel.

2.3 **PANELBOARD - 208 VOLT**

A. Voltage: 120/208 volts, three (3) phase, four (4) wire, S/N, equipped with automatic circuit breakers.

B. Circuit Breakers: Minimum interrupting capacity of 10,000 amps at 120 volts.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Provide mounting brackets, bus bar drillings and filler pieces for unused spaces.

B. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit.

C. Install per NFPA 70, NEMA, manufacturer's instructions and authorities having jurisdiction.

END OF SECTION

SECTION 26 13 13
CIRCUIT BREAKER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of motor circuit breaker and circuit disconnects.

1.2 REFERENCES

A. NEMA Standards:

250 Enclosures for Electrical Equipment (1000 Volts Maximum).

KS Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).

B. NFPA Standards:

70 National Electric Code.

1.3 SUBMITTAL

A. Product Data: Submit manufacturer's data including specifications, installation and general recommendations, for each type of motor and circuit disconnect switch required.

B. Shop Drawings: Submit dimensioned drawings of electrical motor and circuit disconnect switches which have a rating of 100 amperes and larger.

1.4 QUALITY ASSURANCE

A. Conform to:

1. NFPA 70.
2. Local and state codes and to authority having jurisdiction.

B. Provide switches that are UL listed and labeled. Comply with NEMA KS 1 and NFPA 70.

PART 2 PRODUCTS

2.1 GENERAL

A. Motor and circuit disconnects shall have a UL label.

B. Single Phase Disconnect Switches: Two (2) pole switch.

2.2 GENERAL DUTY SWITCHES

A. Sheet steel enclosed switches, fusible or nonfusible as indicated of types, sizes and electrical characteristics indicated.

B. Rated 240 volts, 60 hertz.

C. Spring assisted, quick-make, quick-break mechanisms.

D. Provide single phase or three phase with solid neutral as required by application.

E. Equip with padlock handle in OFF position.

F. Provide NEMA enclosures as required by application.

G. Provide fusible switches with Class R rejection fuse clip kits.

2.3 MAINTENANCE STOCK, FUSES

A. Provide as required of classes, types, and ratings for electrical requirements for service indicated.

B. Furnish additional fuses amounting to 1 unit for every 10 installed units, but not less than five (5) units of each, for both power and circuit fuses.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motor and circuit disconnect within sight of controller position.

B. Coordinate motor and circuit disconnect installation work with electrical race way and cable work.

END OF SECTION

SECTION 26 29 13
MOTOR CONTROLLER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of motor starters for electric motor driven equipment.

B. Types of motor starters include:

1. AC fraction horsepower manual starters.
2. AC line voltage manual starters.
3. AC non-reversing magnetic starters.
4. AC combination non-reversing magnetic starters.

1.2 REFERENCES

A. **NEMA Standards**:

250 Enclosures for Electrical Equipment (1000 Volts Maximum).

B. **NFPA Standards**:

70 National Electric Code.

C. **UL Standards**:

508 Electrical Industrial Control Equipment.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data on motor starters.

B. Shop Drawings: Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts.

C. Motor Voltage/Current Report: After installation is complete including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, and thermal heater size installed for each motor.

1.4 QUALITY ASSURANCE

A. Comply with NEMA, UL 508, and NFPA 70 standards as applicable to wiring methods, construction and installation of motor starters.

B. Provide units which have been UL-listed and labeled.

PART 2 PRODUCTS

2.1 MOTOR STARTER - GENERAL

A. Provide motor starters and ancillary components of types, sizes, ratings and electrical characteristics indicated.

B. Materials, design and construction is manufacturer's option unless indicated.

C. Thermal Overload Units: Sized to actual running full load current, not to motor plate current. Size heaters for mechanical equipment after air and water balancing have been completed.

2.2 AC FRACTIONAL HP MANUAL STARTER

A. Single-phase, 1 and 2 pole, 300 volt AC maximum unless indicated.

B. Equip with 1 piece thermal overload relay with field adjustment capability of plus or minus 10 percent of nominal overload heater rating; for protection of AC motors of 1 HP and less. (For manually controlled motors in excess of 1 HP, refer to motor line voltage manual starter.)

C. Motor Protection Switches: Quick-make, quick-break trip free toggle mechanism, green pilot lights, with lock-off toggle operated handle. Mount surface units in NEMA 1 enclosures, unless indicated. Provide NEMA 3R

enclosure in exterior or damp location. Provide flush mounted units with coverplate to match wiring device coverplates.

2.3 **AC LINE VOLTAGE MANUAL STARTER**

A. 2 or 3 pole, 600 volt AC maximum unless indicated.

B. Equip with pushbutton operator, low voltage protection feature and green pilot light.

C. Motor Protection Switches: Trip free mechanism such that contacts will open under load and remain open until thermal element has cooled, and unit is reset. Mount surface units in NEMA 1 enclosure unless indicated. In exterior or damp location provide NEMA 3R enclosure. Provide flush mounted units with coverplate to match wiring device coverplates.

2.4 **AC NON-REVERSING MAGNETIC STARTER**

A. 2 or 3 pole, 600 volts maximum, with thermal overload position in all phases and inherent under voltage release.

B. Molded case automatic air circuit breakers.

C. Contactor with three (3) overload relays.

D. 120 volt holding coil.

E. Pilot light in cover, green resistor type.

F. Reset button, and Hand-Off-Automatic switch in cover, field convertible to Off/Auto or Start/Stop push button.

G. Two (2) sets of normally open, auxiliary contacts in addition to standard auxiliary holding contact supplied with each contactor.

H. 120 volt control transformer of sufficient capacity to handle operating coil and associated controls.

I. Surface mounted starters in NEMA Type 1 enclosure unless indicated. In exterior or damp locations provide NEMA 3R enclosure.

2.5 **AC COMBINATION NON-REVERSING MAGNETIC STARTER**

A. Molded case automatic air circuit breakers with rotary operating handle and lock off facility.

B. Restrict opening of switch enclosure by the use of a defeater screw unless switch is in the "off" position.

C. Contacts with three (3) overload delays.

D. 120 volt holding coils.

E. Pilot light in cover, green resistor type.

F. Reset button, and Hand-Off-Automatic switch in cover, field convertible to Off-Auto or Start-Stop push button.

G. Two (2) sets of normally open, auxiliary contacts in addition to standard auxiliary holding contact supplied with each contactor.

H. 120 volt control transformer of sufficient capacity to handle operating coil and associated controls.

2.6 **MAINTENANCE STOCK, FUSES**

A. Provide as required of classes, types, and ratings for electrical requirements for service indicated.

B. Furnish additional fuses amounting to 1 unit for every 10 installed units, but not less than five (5) units of each, for both power and circuit fuses.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Install NEMA size motor protection switches. For units not using NEMA rating, use equivalent NEMA size.

B. In finished areas mount motor protection switches flush and install suitable cover-plates.

C. Install heaters correlated with full load current of motor provided.

D. Install fuses in fusible circuit breaker, if any. Mount chart inside each starter indicating heater type, size, and ampere rating.

END OF SECTION

SECTION 26 56 19
ROADWAY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Materials and procedures for installing roadway lighting system.

B. Testing, painting, restoration, salvage.

1.2 REFERENCES
A. **APWA (Utah) Standards**:

Plan 710 Riser.

Plan 730 Collar for street light pole.

Plan 731 Junction box.

Plan 732 Trench for buried electrical conduit.

Plan 733 Joint use trench.

Plan 736 Street light pole terminal.

Plan 737 Street light meter pedestal,

Plan 741 Direct burial street light pole.

Plan 742 Direct burial street light pole.

Plan 743 Concrete base for street light pole.

B. **ASTM Standards**:

B3 Soft or Annealed Copper Wire.

B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

D2301 Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

C. **NEMA Standards**:

250 Enclosures for Electrical Equipment (1000 Volts Maximum).

D. **NFPA Standards**:

70 National Electric Code.

E. **SSPC Standards**:

25 BCS Zinc Oxide Alkyld, Linseed Oil Primer for.

1.3 SUBMITTALS
A. Shop Drawings and Product Data: Complete, bound, indexed, large enough for all items included. When requested, supplement the following list by such other data as may be required, including detailed scale drawings and wiring diagrams of any special equipment and of any proposed deviation from the Contract Documents:

1. Performance data for luminaires, including lighting contours on the roadway surface and average maintained level of light in foot-candles.
2. Shop Drawings for luminaires showing pertinent physical characteristics, type of light source, and wattage.
3. Shop Drawings of ornamental poles.
4. Luminaire supports.
5. Pole bases.
6. Wiring schematic.
7. Fixture mounting height.
8. Drawing showing location of poles and underground power conduit.

B. Warranties and instruction sheets.

C. Testing results of this section article 3.9.

1.4 **MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS**

A. Notify ENGINEER before performing any work on existing systems.

B. Allow 20 feet minimum overhead clearance across thoroughfares and 12 feet minimum clearance above sidewalk areas. Do not run temporary conductor on top of the ground or across any sidewalk area unless protected in an electrical raceway and barricaded.

C. Maintain existing electrical systems or approved temporary replacements, in effective operation for the benefit of the traveling public during the progress of the Work, except when shutdown is permitted to allow for alteration or removal of the systems. Do not interfere with the regular lighting schedule.

PART 2 PRODUCTS

2.1 **EXISTING MATERIALS**

A. Where existing systems are to be modified, incorporate existing material in revised system, salvage, or abandon.

2.2 **CONDUCTORS**

A. Materials:

1. Solid or stranded copper of size indicated conforming to ASTM B3 and ASTM B8.
2. Insulation; RHH-RHW-USE grade cross link polyethylene compound.
3. Color and coding of 120/240 volt, Section 26 05 13.

B. Splicing: Compatible with cable insulation and water seal for underground use. Comply with UL code.

C. Conduit: Section 26 05 33.

2.3 **POLES AND LUMINAIRE SUPPORTS**

A. Height, type, configuration, and base detail required.

2.4 **JUNCTION BOXES**

A. Buried type; Section 26 05 34 and as follows:

1. In sidewalk and paved surfaces, provide precast reinforced concrete boxes as shown in the Drawings or APWA Plan 731.
2. In landscaped surfaces, provide plastic or concrete boxes.

B. Cover Stencil: "Street Lighting". Where box contains street lighting voltage greater than 600 volts, stencil "High Voltage".

2.5 **INSULATING TAPE**

A. Type 1 vinyl chloride, ASTM D2301.

2.6 **LUMINAIRE**

A. Luminaire Assembly: Standard Highway Luminaire (Cobra Head) shoe box design:

1. Die-cast aluminum housing with high temperature wiring.
2. Reflectors, sockets, mounting cradles, and clamps properly fitted to the housing.
3. Luminaire weight and projected area within design loading limits.
4. Replaceable air filter and IES distribution type as indicated.

B. Mounting adjustment:

1. Ten degrees above horizontal for the reflector and refractor.
2. Five degrees adjustment from vertical on the bracket arm.

C. Lamps: Metal halide, 250 or 400 watts as indicated:

1. Clear uncoated, pulse start.
2. Apparent color temperature of 3800 K.

3. Rated-life of not less than 20,000 hours (400 Watt) or 10,000 hours (250 Watt) when used on a 10 hour per start duty cycle.

D. Ballast: Replaceable prewired with minimum primary power factor of 90 percent with normal secondary load with sufficient open circuit voltage to start lamps at minus 20 deg F. Ballast shall provide regulation with five (5) percent variation in lamp watts with a 10 percent variation in primary voltage.

E. Bonding and Grounding: Copper wire strap No. 6 AWG minimum.

F. Paint: None.

2.7 **CONTROL EQUIPMENT**

A. General: Failure of any electrical component will energize the lighting circuit.

B. Photo-electric Control: At least one (1) and five (5) foot candles sensitivity.

C. Control Relay Contacts Rating: Switch on at 3,000 watts minimum.

D. Remote Control Relays: Normally open.

E. Relays: Either mechanical armature type or mercury tube type, single or double pole, or as indicated:

1. Mechanical armature type: An operating coil (120 volts), a laminated core, a laminated armature, terminals, and silver alloy contacts.

2. Mercury tube type: An operating coil, hermetically sealed mercury tubes and terminals. Contacts shall be made either mercury to mercury or between mercury and alloy resistant to arcing and mercury amalgamation.

F. Enclosure: NEMA 250 Type 4 with dead front panel, keyed padlock

G. Paint: Waterproof.

2.8 **POLYSULFIDE BASE, SINGLE COMPONENT SEALANT**

A. Chemical curing, capable of being continuously immersed in water, withstand movement up to 20 percent of joint width, and satisfactorily applied throughout a temperature range to 40 to 80 deg F, Shore A hardness of 15 minimum and 50 maximum, non-staining and non-bleeding; color as selected by ENGINEER.

2.9 **CONCRETE AND GROUT**

A. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

B. Grout: Cement, Section 03 61 00.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavate; Section 31 23 16 and backfill; Section 33 05 20.

C. Do not disturb roadway surface, sidewalk, curb, gutter, or other obstructions outside of Work site.

D. Do not block or restrict pedestrian traffic, vehicle traffic, drainage, or utilities.

E. Barricade all Excavations in traveled ways.

F. Compact excavated Trench material; Section 33 05 20 to the requirements of the adjacent areas.

G. After backfilling Excavations, maintain smooth and well-drained surfaces until permanent repairs are completed.

H. Legally dispose of all excess or waste material.

3.2 **INSTALLATION - POLE**

A. Install poles plumb.

B. Locations:

1. 18 inches clear from pull box.

2. Not in pedestrian access way.

3. Unless specified otherwise:

a. 5 feet from new tree.

b. 10 feet from existing tree, driveway, or hydrant.

c. Center of park strip or 24 inches clear from top back of curb in park strips wider than 4-feet.

C. Wood pole direct burial:

Pole Length Above Ground	Depth of Burial
8 to 20 feet	60 inches minimum
21 to 30 feet	84 inches minimum

D. Steel Pole Direct Burial: As shown in the Drawings or APWA Plan 742.

E. Steel Pole with Screw-in base: As shown in the Drawings or APWA Plan 741.

F. Steel Pole with Concrete Base: As shown in the Drawings or APWA Plan 743.

G. Pole Base Covers: In landscaped areas install as shown in the drawings or APWA Plan 730

H. Signal pole foundation, Section 34 41 13.

3.3 **INSTALLATION - CONDUIT**

A. Risers on Poles: As shown in the Drawings or APWA Plan 710.

B. Pole Light Terminals: As shown in the Drawings or APWA Plan 736.

C. In structural applications, use rigid steel conduit in areas subject to vehicular load, on the surface of structures, inside of structures and foundations, between structures, and the adjacent pull boxes located next to structures.

D. In buried utility applications, install conduit as shown in the Drawings or APWA Plan 732 Sheet 1 or Sheet 2 as applicable. Place conduit as follows.

Location	Depth of Burial, inches
In front of curb faces	36 to 60
Back of the back of curb	24 to 36
Railroad tracks	36 to 60
Primary power cables	40 minimum

E. In joint use trenches install conduit as shown in the Drawings or APWA Plan 733. Adjust as appropriate.

F. Use sizes of conduit indicated or use larger sizes for any run at no additional cost to OWNER. No expanding or reducing fittings permitted.

G. Make field cuts square and true so ends come together for full circumference. Paint threads on all rigid steel conduit with rust preventive paint before couplings are made. Repair damaged coating on galvanized steel conduit.

H. Cap all conduit ends with standard pipe caps until wiring is installed. When caps are removed from metallic conduit, provide threaded ends and approved conduit bushings.

I. Clean all existing underground conduit to be incorporated into new system with a mandrel and blow out with compressed air. Where existing rigid steel conduit systems are to be modified or extended, install rigid steel conduit.

J. Make changes in direction by bending the conduit to a radius which will meet code or, preferable, using standard bends or elbows.

K. Install a No. 12 AWG pull wire or equivalent strength cord in all conduits which are to receive future conductors. Leave at least two (2) feet of pull wire extending beyond each end of the conduit run and secure.

L. Center conduit ends within the bolt circle of traffic signal poles or pedestals.

M. Pack conduit ends with sealant after conductors are installed.

N. Cap all conduit terminated without a pull box and identify its location by monumenting.

3.4 **INSTALLATION - CONDUCTOR**

A. Install wiring per the appropriate articles of NFPA 70. Artfully arrange wiring within cabinets, junction boxes, etc.

B. Splice only at junction boxes, transformer leads, in pole bases, or at control equipment. Splice conductors as per manufacturer's recommendations and codes. Provide a fused connector between the line and the ballast, accessible at the hand holes located in the poles.

C. Provide conduit to separate low-voltage conductors from high-voltage conductors in the same raceway (i.e., poles).

D. Splice insulation shall consist of layers of vinyl chloride electrical insulating tape applied to a thickness equal to and well lapped over the original insulation to provide uninterrupted underwater operation.

E. Leave two (2) feet of slack at each pole. Leave 18 inches of slack above top of pull box grade.

F. Mark termination of each conductor. Where circuit and phase are clearly indicated by conductor insulation, bands need not be used, otherwise use bands.

3.5 INSTALLATION - GROUNDING

A. Effectively ground metallic cable sheaths, metal conduit, nonmetallic conduit grounding wire, ballast and transformer cases, service equipment, anchor bolts, metal poles, and pedestals, and make mechanically and electrically secure to form a continuous system. Use a copper wire strap for bonding and grounding jumpers of the same cross-sectional area as No. 6 AWG for all lighting systems.

B. Ground one side of the secondary circuit of series-multiple and step-down transformers. Ground metal conduit, service equipment, and neutral conductor at service point as required by NEC and electricity company with grounding conductor No. 6 AWG or larger.

C. In all nonmetallic (PVC) type conduit, provide a No. 8 AWG bare copper wire continuously and ground at each junction box.

D. At each multiple service point, unless otherwise indicated, furnish a ground electrode. Use copper coated ground electrodes of steel or iron in one-piece lengths at least 3/4 inch in diameter. Do not use electrodes of nonferrous materials less than 1/2 inch in diameter.

E. Bond metal poles by means of a No. 8 AWG bonding wire attached from a grounding bushing to a foundation bolt or to a 3/16 inch or larger brass or bronze bolt installed in the lower portion of the pole.

F. On wood poles, ground all equipment mounted less than eight (8) feet above the ground surface.

G. Ground metallic conduit or bonding conductor system at intervals less than 500 feet to one of the following:

1. 1-inch galvanized pipe driven eight (8) feet deep.
2. ½-inch copper rod driven eight (8) feet deep.
3. Metal water main with the approval of the water company. Clean water main thoroughly before connection.

H. Use galvanized grounding bushings and bonding jumpers for bonding metallic conduit in a concrete pull box. Use lock nuts for bonding metallic conduit in steel pull boxes, one inside and one outside of the box.

I. Pull Boxes: Install ¾-inch x 10 feet copper clad ground rods at each pull box, six (6) inches above bottom. Ground all metal parts, neutral and ground wire with #6 B.C. Use exothermic weld or hammerlock connection.

3.6 INSTALLATION – STREET LIGHT METER PEDESTAL

A. Install street light meter pedestals as shown in the Drawings or APWA Plan 737.

3.7 INSTALLATION - JUNCTION AND PULL BOX

A. Install at locations indicated, and at additional points when conduit runs are more than 200 feet. Without additional cost to OWNER and at CONTRACTOR's convenience add such additional boxes as may be desired to facilitate the work.

B. Rest bottom of pull box firmly on 12 inches thick bed of 1-inch crushed rock extending a minimum of six (6) inches beyond the outside edge of box.

C. Establish grade of top of boxes as for foundations.

D. Place long side of box parallel to curb unless indicated.

E. Use box extensions if ballasts or transformers are installed in box.

F. Do not install boxes in Driveway aprons.

3.8 INSTALLATION - LUMINAIRE AND BALLAST

A. Immediately before installation, clean all light control surfaces, refractors, and reflectors to provide the maximum lumen output possible. Clean per luminaire manufacturer's recommendations.

B. Mount at height indicated.

C. Adjust luminaires individually to give the optimum light distribution.

3.9 **PAINTING**

A. Apply coatings, Section 09 91 00.

B. Recoat all painted equipment when relocated.

C. Use two (2) coats of paint on relocated and new work.

3.10 **FIELD QUALITY CONTROL**

A. Conduct and record date and time of following tests:

1. Continuity of each circuit.

2. Grounds in each circuit.

3. Megger test at 500 volts DC on each completed lighting circuit. The insulation resistance to ground shall be 10 megohms minimum.

4. Voltage and current on each circuit.

B. Functional Test:

1. Perform a functional test. Demonstrate each part of the system functions as specified or intended.

2. A functional test for each new or modified electrical system will consist of not less than five (5) days of continuous, satisfactory operation. If unsatisfactory performance of the system develops, correct the condition, and repeat the test until the five (5) days continuous satisfactory operation is obtained.

3. Do not start functional tests or turn-ons on Friday, or on the day preceding a legal holiday.

4. Shutdowns caused by factors beyond CONTRACTOR's control will not constitute discontinuity of the functional test.

C. Replace or correct any material revealed by these tests to be faulty.

D. Provide equipment, personnel, cable connections, and electrical energy for testing. Certify that each circuit has been completely tested and testing procedures are satisfied.

3.11 **SALVAGE**

A. Terminate all conduit abandoned in place at least five (5) inches below finished grade.

B. Exercise care in removing equipment to be reused or salvaged so that it will remain in the condition existing before its removal.

3.12 **RESTORATION**

A. Replace damaged equipment, concrete work or other fixtures or features disturbed or damaged by the installation.

B. Restore paved surfaces, Section 33 05 25.

C. Finish landscaped surfaces to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

END OF SECTION

DIVISION 31

EARTH WORK

SECTION 31 05 10

BOUNDARY MARKERS AND SURVEY MONUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing boundary markers and survey monuments.

1.2 REFERENCES

A. **APWA (Utah) Standards**

Plan 271 Corner and boundary markers.

Plan 272 Monument cap and base,

Plan 273 Frame and cover for monument.

Plan 274 Survey monument placement under pavements.

Plan 275 Covercollar for survey monuments.

1.3 PERFORMANCE REQUIREMENTS

A. Identify the land surveyor who set the marker plates and reference marks.

B. For vertical control datum use Mean Sea Level datum adjusted by United States Coast and Geodetic Survey for the location of survey.

C. Vertical Accuracy: 3rd order.

D. Make all individual tape measurements to the nearest 0.01 of a foot, with tape corrections for temperature, sag, suspension, etc. noted on all field notes requiring such measurements.

E. Horizontal Accuracy:

1. 1:10,000 minimum for urban areas.
2. 1:20,000 minimum for metropolitan areas.

1.4 SUBMITTALS

A. Survey notes and drawings showing:

1. All monuments found, set, reset, or replaced, describing their kind, size, and location and giving other data relating thereto.
2. Lines of survey, concrete structures containing reference marks, types of marks installed, distances and angles from monument referenced.
3. Witness monuments, basis of bearings, bearings, length of lines to monuments or corners witnessed and scale of drawing.
4. Errors of closure and method of adjustment.
5. Memorandum of oaths and certificates.
6. Narrative describing purpose of survey.
7. Any other data necessary for the interpretation of various items and locations for points, lines, and areas shown.

B. Copies of plats filed with the County Recorder.

1.5 QUALITY ASSURANCE

A. Use a land surveyor who complies with Utah licensing law and who is acceptable to OWNER to supervise setting or resetting of monuments and boundary markers.

B. Make surveys in conformance with accepted practice of land surveying and comply with all pertinent Laws and Regulations of land survey regulatory agencies and authority having jurisdiction.

PART 2 PRODUCTS

2.1 **MONUMENT**

A. **Cap and Base:** As shown in the Drawings or APWA Plan 272.

1. Cap: Brass or bronze or as indicated.

2. Base: Minimum three (3) feet long, precast or cast-in-place concrete. Make exposed surface of finished monument posts uniform, even texture, and free of holes, cracks, and chipped edges.

B. **Frame and Cover:** Asphalt coated, heavy duty, cast iron, Section 05 56 00. See Drawings requirements or APWA Plan 273.

2.2 **LOT LINE WITNESS MARKER**

A. Brass surveyor's tag or brass nail set in a lead filled hole in concrete.

2.4 **CORNER MARKERS**

A. **Rebar Corner:** No. 5 rebar, at least 18 inches long with the top filled with a nonferrous survey cap and stamped with land surveyor’s registration number. See Drawings requirements or APWA Plan 271.

B. **Pipe Corner:** As shown in the Drawings or APWA Plan 271.

1. One (1) inch internal diameter galvanized steel pipe at least 18 inches long, or two (2) inches internal diameter galvanized steel pipe at least 36 inches long.

2. Fit pipe with concrete or mortar plug, tagged with surveyor's license number.

3. Fix tag in concrete or mortar plug with a one (1) inch minimum long bent brass brad.

2.4 **FIELD NOTE PAPER**

A. Twenty (20) pound bond paper minimum with format of documents acceptable to OWNER.

2.5 **CONCRETE**

A. Cast-in-place: Class 4000, Section 03 30 04, or

B. Precast: Class 5000, Section 03 40 00.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 **SURVEY CONTROL**

A. **Horizontal Control:** Set base horizontal ground control upon a minimum of two (2) United States Coast and Geodetic Survey triangulation stations or equivalent, and tie to the Lambert Conformal Conic Projection for establishment of the State Plane Coordinate System with local datum adjustment within the Project area.

B. **Bearing Base:** Refer all directional measurements to one "bearing base". Actual measurements may be equated to bearings and linear measurements shown on any record (i.e., plat, official map, description, or approved field notes of lines resurveyed that are shown on such records used in the survey).

3.3 **INSTALLATION**

A. **Tie to Existing Monuments:** Tie into a monument which has State Plane Coordinates if the monument is within 1/2 mile of the proposed survey site or at a selected location.

B. **Corner Markers:**

1. Site Boundary: Install pipe corner markers.

2. Lot Boundary: Install rebar corner markers for lot corners. Do not use rebar where pipe corner markers are installed as a boundary marker and a corner marker.

C. **Lot Line Witness Marker:** Witness lot lines by installing ½-inch surveyor tags in sidewalk. If sidewalk does not exist, install tags in curb or mass concrete.

D. **Monuments:**

1. Locate monument cap and base so reference point falls within 1 inch diameter circle in the center of marker plate. Install marker plate in survey monument base before the concrete has acquired its initial set.

E. **Placement Under Roadway Pavements:**

1. Concrete Pavements: As shown in the Drawings or APWA Plan 274.

2. Bituminous Pavements: As shown in the Drawings or APWA Plan 275. Set top of frames and covers ¼-inch lower than Pavement surface. Place monument caps at least 4 inches below cover.

3. Install so frame and cover have no contact with monument cap or base.

F. **Reference Marks:** Section 01 71 34.

3.4 **DAMAGED MONUMENTS**

A. Replace survey control monuments that are disturbed or destroyed by CONTRACTOR.

B. If OWNER allows replacement of lost or destroyed survey control monuments, use a licensed land surveyor to re-establish control monuments based upon original survey control.

END OF SECTION

SECTION 31 05 13
COMMON FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common fill material.

1.2 REFERENCES

A. **ASTM Standards**:

C136 Sieve Analysis of Fine and Coarse Aggregates.

D448 Classification for Sizes of Aggregate for Road and Bridge Construction.

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2487 Classification of Soils for Engineering Purposes.

D2844 Resistance R-Value and Expansion Pressure of Compacted Soils.

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F1647Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 SUBMITTALS

A. **General**. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material before delivery to site.

B. **Topsoil**. Submit certification from topsoil Supplier assuring topsoil product meets requirements in this Section.

C. **Borrow, granular borrow, granular backfill borrow, recycled fill, sand, gravel.** Before delivering material to site, identify:

1. Name of Supplier and source.
2. Gradation, classification and CBR.
3. Percent composition of reclaimed bitumionous concrete or Portland cement concrete included in the mix.

D. **Slag, pumice, scoria**. Identify name of supplier, source, and density.

1.4 QUALITY ASSURANCE

A. Use a laboratory that complies with ASTM D3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 ACCEPTANCE

A. **General**:

1. Acceptance is by Lot. One (1) lot is one (1) day productionl
2. Dispute resolution, Section 01 35 10.

B. **Roadway Backfill**: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 BORROW

A. Classifications A-1-a through A-4, ASTM D3282.

2.2 **GRANULAR BORROW**

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D3282.

B. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.3 **GRANULAR BACKFILL BORROW**

A. Classification A-1, ASTM D3282.

B. Well graded.

C. Particle size, two (2) inch maximum.

D. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.4 **RECYCLED FILL**

A. Material: Pulverized Portland cement concrete, pulverized bitumionous concrete pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet requirements of this section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 **NATIVE**

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate proctor density data (see Section 31 23 26).

2.6 **CLAY**

A. Classification CL, CL-ML, or ML, ASTM D2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious materials.

C. Homogeneous, relatively uniform.

2.7 **SAND**

A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

Sieve	Percent Passing by Weight
3/8	100
100	1 – 10

2.8 **GRAVEL**

A. Material: Rock, stone, or other high quality mineral particle or combination.

Sewer Rock.

Nominal Size	ASTM Size No.
3.5 to 1.5”	1
2.5 to 1.5”	2
2 to 1”	3
1.5 to 3/4”	4
1 to 1/2"	5

Pea Gravel.

Nominal Size	ASTM Size No.
3/4 to 3/8”	6
1/2 to No. 4	7
3/8 to No. 8	8
No. 4 to No. 16	9
No. 4 (screenings)	10

2.9 **TOPSOIL**

A. Chemical Characteristics:

1. Acidity and alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO_3N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.
3. Composition, ASTM D2487:

Material	**Percent**
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30
Organic matter	2 - 5

Humus determined by ASTM F1647. Peat may be used as an organic amendment to meet the humus requirements.

2.10 **SLAG, PUMICE, SCORIA**

A. Chemically inert, porous, durable, free draining.

Table 1 – Gradation and Density

Criteria		**Slag**	**Pumice**	**Scoria**
Gradation, US Sieve	3”	100	100	100
	1 1/2"	80 – 100	80 – 100	80 – 100
	3/4"	20 – 100	--	--
	3/8”	0 – 20	0 – 20	40 – 100
	No. 4	0 – 10	0 – 10	10 – 70
	No. 16	--	0 – 65	0 – 40
	No. 50	--	0 – 40	0 – 25
	No. 200	0 – 3	0 – 3	0 – 15
Density, pound per cubic foot		85 – 100	75 – 80	60 – 75

NOTES:
(a) Gradations are based upon percent of material passing sieve by weight, ASTM C136.
(b) Density measured as in-place target.

2.11 **SOURCE QUALITY CONTROL**

A. Verify gradation, ASTM C136.

B. Select samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 31 05 15
CEMENT TREATED FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Controlled low-strength material (CLSM) requirements.

1.2 REFERENCES

A. **ASTM Standards**:

C25 Chemical Analysis of Limestone, Quicklime, and Hydrated Lime.

C33 Concrete Aggregates.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C51 Terms Relating to Lime and Limestone (As Used by the Industry).

C110 Physical Testing of Quicklime, Hydrated Lime, and Limestone.

C150 Portland Cement.

C260 Air-Entraining Admixtures for Concrete.

C494 Chemical Admixtures for Concrete.

C595 Blended Hydraulic Cement.

C618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 SUBMITTALS

A. Material analysis.

B. Mix design.

1.4 QUALITY ASSURANCE

A. Use a laboratory that complies with ASTM D3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 ACCEPTANCE

A. **General**:

1. Acceptance is by lot. One (1) lot is one (1) day production.

2. If non-complying fill material has been installed and no bid or negotiated price for the material is specified, apply pay adjustment against cost of work requiring CLSM as part of its installation. Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

B. **Lime or Asphalt Cement Treated Backfill**: Data sheet.

C. **Cement Treated Flowable Fill**:

1. Sublot Size:

a. Trench backfill, 100 cubic yards.

b. Roadway backfill, 250 cubic yards

2. Strength: At ENGINEER's discretion and ASTM C39, a lot with deficient sub-lot strength may be accepted on a pay reduction basis (Section 01 35 10), or accepted at 50 percent pay if a sub-lot is in Reject, or the lot shall be removed and replaced.

Pay Factor	**PSI Below 28 day Compressive Strength**
1.00	Less than 60
0.75	60 to 120
Reject	greater than 120

1.6 **SAFETY**

A. Protect persons and property from lime or quicklime handling.

PART 2 PRODUCTS

2.1 **CEMENT TREATED FLOWABLE FILL**

A. Cement:

1. Types I or II, ASTM C150.
2. Types IP or IS, ASTM C595.

B. Aggregate: Non-plastic sand, ASTM C33.

C. Water: Non-detrimental.

D. Admixtures: As needed for strength and flowability.

1. Pozzolan (fly ash), ASTM C618.
   a. Class C or Class F.
   b. Loss on ignition plus or minus three (3) percent.
2. Air: Four (4) percent to 35 percent, , ASTM C173.

E. Strength: 60 psi maximum in 28 days, ASTM D4832.

2.2 **LEAN CONCRETE**

A. Physical Characteristics:

1. Cement: Type II, ASTM C150.
2. Slump: One (1) to four (4) inches.
3. Strength: 750 psi plus or minus 100 psi in seven (7) days.

B. Aggregate: Non-plastic, crushed, Section 03 30 04. Submit substitute gradations for acceptance before beginning construction. Do not substitute gradations without approval.

2.3 **LIME TREATED FILL**

A. Aggregate: Non-plastic Aggregate base course, Section 32 11 23; or Common fill, Section 31 05 13.

B. Water: Non-detrimental.

C. Lime: Dry hydrated lime or quicklime, ASTM C25, ASTM C51, and ASTM C110:

1. Minimum Chemical Composition:
   a. Hydrated Lime ($Ca(OH)_2$): 85 percent of chemical.
   b. Quicklime (CaO): 90 percent of chemical.
2. Gradation: ASTM C136. Percent passing by weight.

Table 1 - Hydrated Lime and Quicklime		
Sieve	**Hydrated Lime ($Ca(OH)_2$)**	**Quicklime (CaO)**
No. 4	100	100
No. 30	95 – 100	–
No. 100	–	0 – 20
No. 200	75 – 100	–
NOTES (a) Hydrated Lime: Washed sample for 15 minutes plus or minus 1 minute, ASTM C110. (b) Quicklime: Dry sieve only.		

2.4 **ASPHALT TREATED FILL**

A. Cement:

1. Medium-setting emulsified asphalt, Section 32 12 09.
2. Medium-cure cutback asphalt, Section 23 12 09.

B. Aggregate:

1. Non-plastic aggregate base course, Section 32 11 23.
2. Common fill, Section 31 05 13.
3. RAP, Section 32 12 16.18.

C. Water: Non-detrimental.

PART 3 EXECUTION

3.1 **FIELD QUALITY CONTROL**

A. Cement Treated Fill (Flowable Fill):

1. Mold three (3) test cylinder, ASTM D4832. Test cylinders at 28 days.
2. If a cylinder test shows improper sampling, molding, handling, curing, or testing, discard the cylinder. Use remaining cylinders to determine average strength.

END OF SECTION

SECTION 31 05 16
LIGHTWEIGHT CELLULAR CONCRETE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, procedures, and testing for lightweight cellular concrete fill.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM Standards

1. C 495: Compressive Strength of Lightweight Insulating Concrete.
2. C 796: Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.

1.4 SUBMITTALS

A. Lightweight cellular concrete fill CONTRACTOR qualifications for review. Include the following:

1. CONTRACTOR name and Utah CONTRACTOR's License number.
2. Letter from the foam agent manufacturer qualifying the lightweight cellular concrete fill CONTRACTOR to satisfactorily prepare and place lightweight cellular concrete fill.
3. List of projects demonstrating at least three (3) years of experience with the placement of lightweight cellular concrete in similar applications.
4. List of projects where lightweight cellular concrete fill was successfully placed by the proposed project foreman.

B. Mix Design with mix proportions and test results for approval. Include at least the following:

1. Cement type and source.
2. Fly ash type and source if used.
3. Water source.
4. Foaming agent information.
5. Type and dosage of admixtures if used, including letter stating compatibility from the foaming agent manufacturer.
6. Test results demonstrating the adequacy of the mix design:
   a. Include weight and calculate density of specimens tested per ASTM C 495.
   b. Compressive strength according to ASTM C 495 except report compressive strength to the nearest 1 psi.

C. ASTM C 495 certification of the laboratory where compressive strength testing will occur, for information.

D. Work Plan for review. Include at least the following:

1. Planned construction schedule and sequence.
2. Placement procedures as recommended by the foaming agent manufacturer.
3. Type of equipment to be used.
4. Maximum single lift thickness as recommended by the foam manufacturer and details on construction of fill placement along slopes.

E. Cold weather protection plan for review as needed:

1. Placement plan to address curing of lightweight cellular concrete, to reduce the risk of freezing of uncured materials, prior to placement of subsequent lifts.
2. Refer to this Section, Paragraph 3.1 B.

1.5 **ACCEPTANCE**

A. Prepare one set of four (4) test specimens according to ASTM C 796 for the lightweight cellular concrete fill per each 300 cubic yards placed, but no fewer than one set per each day of placement.

1. Obtain samples for test specimens at the point of placement.
2. Verify density meets cast density in Table 3 at point of placement.
3. Use 3 x 6 inch cylinders for the test specimens.
4. Lightly tap the sides and/or bottom of the cylinders to remove air pockets after filling approximately half of each cylinder and then again once each cylinder is full.
5. Do not rod lightweight cellular concrete fill samples.

B. Test compressive strength at an AASHTO accredited laboratory in accordance with ASTM C 495; report compressive strength to the nearest 1 psi.

C. ENGINEER may accept material at a reduced price when the lightweight cellular concrete fill is below the specified 28-day compressive strength or above the specified cast density.

1. Apply the lowest applicable pay factor in Table 1 or Table 2 to the quantity of lightweight cellular concrete fill represented by the non-conforming test results.

Table 1 -Price Reduction for 28-Day Compressive Strength	
PSI Below Specified Strength	**Pay Factor**
1 to 5	0.9
6 to 10	0.7
More than 10	Reject*
Notes ENGINEER may accept a "reject" lot based on an engineering analysis that demonstrates that the compressive strength is adequate to serve the design purpose. ENGINEER applies a 0.5 pay factor if a reject lot is allowed to remain in-place.	

Table 2 - Price Reduction for 28-Day Compressive Strength	
Above Specified Cast Density	**Pay Factor**
4 to 10%	1.0*
11 to 20%	0.7*
More than 20%	Reject*
Notes Increases in density may have significant impact to the design intent. Any lot with a cast density test 4 percent or more above the specified cast density will require an engineering analysis to determine if the density is adequate to serve the design purpose. ENGINEER applies pay factors as specified if the lot is allowed to remain in-place. ENGINEER applies a 0.5 pay factor if a reject lot is allowed to remain in-place.	

PART 2 PRODUCTS

2.1 CLASSES

A. Meet requirements of Table 3 for Lightweight Cellular Concrete Fill class shown.

Table 3
Lightweight Cellular Concrete Fill Classes

Class	Maximum Cast Density* (pcf)	Minimum 28-day Compressive Strength According to ASTM C 495 (psi)
II	30	40
III	36	80
IV	42	120
V	50	160
VI	80	300

Notes
Weigh cylinders before compressive strength testing and include weight and calculated density in the testing report.

2.2 MATERIALS

A. Portland Cement. Refer to Section 03055.

B. Fly ash. Refer to Section 03055.

C. Foaming agent

1. As recommended by manufacturer
2. Conforming to ASTM C 796.

D. Potable Water

E. Admixtures

1. Only as allowed by foam manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare subgrade area for lightweight cellular concrete fill to be free of loose material and to be of uniform moisture.

1. Complete clearing, grubbing, stripping, and stockpiling topsoil before placing material.
2. Do not place lightweight cellular concrete in standing water.
3. Perform other subgrade preparation.

B. Place lightweight cellular concrete fill when ambient temperature is forecast to stay above 32 degrees F for a period of 12 hours immediately after placement.

1. Do not place lightweight cellular concrete on frozen ground.
2. For subsequent lifts that are not in contact with the ground, ENGINEER may authorize an appropriate cold weather protection plan if the ambient air temperature is forecast to stay above 28 degrees (F) for the first 12 hours after placement.

3.2 **PLACEMENT**

A. Mix foaming agent with cement and water on site as recommended by foam manufacturer.

B. Place lightweight cellular concrete fill in lifts no thicker than 3 ft, or according to foam manufacturer if their recommended maximum lift thickness is less than 3 ft.

1. Bench into existing embankment if placed adjacent to existing materials.

2. Do not place lightweight cellular concrete in standing water.

C. Allow each lift to cure at least 12 hours before placing subsequent lifts.

1. Remove any crumbling or flaking material or material that is otherwise compromised from the previously poured surface.

3.3 **PROTECTION**

A. Protect lightweight cellular concrete fill material from conditions which may cause degradation or otherwise impact its properties and performance, including precipitation, inclement weather, and excessive moisture absorption.

B. Do not operate heavy construction equipment or place soil backfill on the lightweight cellular concrete fill until the specified 28-day compressive strength has been attained.

C. Place and compact a minimum loose thickness of 6 inches over the lightweight cellular concrete before operating any earthwork equipment over the area.

1. Protect the edges of lightweight cellular concrete from damage due to earthwork or other operations.

END OF SECTION

SECTION 31 05 19
GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geotextile fabrics.

1.2 REFERENCES

A. ASTM Standards:

D146 Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.

D276 Identification of Fibers in Textiles.

D882 Tensile Properties of Thin Plastic Sheeting.

D3786 Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

D4354 Sampling of Geotextiles for Testing.

D4355 Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon - Arc Type Apparatus).

D4491 Water Permeability of Geotextiles by Permittivity.

D4533 Trapezoid Tearing Strength of Geotextiles.

D4632 Breaking Load and Elongation of Geotextiles (Grab Method).

D4751 Determining Apparent Opening Size for a Geotextile.

D4759 Determining Specification Conformance of Geosynthetics.

D4833 Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

D4873 Identification, Storage, and Handling of Geotextiles.

E96 Water Vapor Transmission of Materials.

E154 Testing Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces.

1.3 DEFINITIONS

A. **MARV**: Acronym for minimum average roll value. A statistical value of a particular test property embracing 95 percent confidence level of all possible values of that property. For a normally distributed set of data, it is approximately the mean value plus and minus two standard deviations.

B. **Permitivity**: - of geotextiles, the volumetric flow rate of water per unit cross sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile.

1.4 SUBMITTALS

A. Submit before use:

1. Sample of geotextile.
2. Manufacturer's certificate that each fabric complies with requirements of this section.

1.5 DELIVERY STORAGE AND HANDLING

A. Label fabric, ASTM D4873.

B. Deliver geotextile dry, in a wrapping that protects it from the elements during shipping and storage. Keep fabric dry.

C. Protect geotextile from ultraviolet light and temperature greater than 140 deg F until application.

1.6 QUALITY ASSURANCE

A. Provide manufacturer’s on-site technical supervision and assistance.

PART 2 PRODUCTS

2.1 GEOTEXTILE - GENERAL

A. **Stated values in this section are for non-critical, non-severe applications.**

B. Fabric consists of synthetic fibers at least 85 percent by weight of polyolefins, polyesters or polyamides.

C. Resistant to chemical attack, rot and mildew.

D. No tears or defects that adversely alter fabric's physical properties.

E. All numerical values represent minimum average roll values in the weaker principal direction.

2.2 STABILIZATION-SEPARATION GEOTEXTILES

A. Woven or non-woven fabric. Meet the following properties and survivability ratings.

Table 1 – Stabilization-Separation Geotextile

	Standard	MARV			
		Moderate		High	
		Woven	Non Woven	Woven	Non Woven
Grab tensile strength, lbs.	D4632	180	115	270	180
Grab elongation, percent	D4632	<50	>50	<50	>50
Trapezoid tear, lbs.	D4533	70	40	100	75
Puncture resistance, lbs.	D4833	70	40	100	60
Apparent opening size (AOS), US sieve, minimum.	D 4751	30	60	30	60

Construction Survivability

Subgrade, CBR	1		1 – 2		> 2	
Tire pressure, psi	<50	>50	<50	>50	<50	>50
6 inches cover thickness	NR	NR	H	H	M	M
12 inches cover thickness	NR	NR	H	M	M	M
18 inches cover thickness	H	M	M	M	M	M

NOTES
(a) H = High; M = Medium; NR = Not Recommended

2.3 SILT FENCE GEOTEXTILE

A. Use woven fabric. Meet standard or high performance properties:

Table 2 – Silt Fence Geotextile

	Standard	MARV	
		Standard	High
Grab tensile strength, lbs.	D4632	90	120
Grab elongation, percent	D4632	< 40	< 40
Flux, gal/min/ft^2	D4491	15	90
Apparent opening size (AOS), US sieve, minimum.	D4751	20	30
Ultraviolet degradation, percent	D4355	70	90

NOTES
(a) Percent of grab elongation retained determined after ultraviolet light and water, ASTM D4355 for 500 hours.
(b) No deviation from any requirement due to presence of seams.

B. High performance fence to have tape yarns in one principle direction only.

C. Add stabilizers or inhibitors to make filaments resistant to sunlight or heat deterioration.

D. Finish edges to prevent outer yarn from pulling away from the fabric.

E. Sheets of fabric may be sewn or bonded together. Provide minimum width recommended by manufacturer.

F. Manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

2.4 EROSION CONTROL GEOTEXTILES

A. Class A erosion control applications are those where the geotextile is used under conditions where installation stresses are greatest (more severe than Class B), i.e., stone placement height should be no more than five (5) feet and stone weights should not exceed 250 pounds.

B. Class B erosion control applications for geotextiles are used under conditions where installation stresses are more severe than Class C, i.e., stone placement height should be less than three (3) feet and stone weights should not exceed 250 pounds.

C. Class C erosion control applications are those where the geotextile is used in structures or under conditions where the geotextile is protected by a sand cushion or by "zero drop height" placement of stone.

D. Use woven or non-woven fabric.

Table 3 – Erosion Control Geotextile

	Standard	MARV		
		Class A	Class B	Class C
Grab tensile strength, lbs.	D4632	300	200	100
Grab elongation, percent, min.	D4632	15	50	50
Puncture resistance, lbs.	D4833	100	60	30
Trapezoid tear, lb.	D4533	80	50	40
Flux, gal/min/ft^2	D4491	25	25	25
Apparent opening size (AOS), US sieve, minimum	D4751	60	60	60
Ultraviolet degradation, percent	D4355	70	70	70
Permittivity, sec.$^{-1}$	D4491	0.1	0.1	0.1

NOTES

(a) Percent of grab elongation strength retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.

(b) Permittivity number reflects typical not minimum values for this test method only. The k value of the geotextile shall be greater than the k value of the soil.

2.5 ROADWAY PAVEMENT GEOTEXTILES

A. Sheet Fabric: Non-woven. Heat bonded only on one side to assist in preventing bleed through of tack coat and sticking of fibers to wheels of lay-down equipment.

Table 4 – Roadway Paving Geotextile			
	Standard	MARV	
		Standard duty	Heavy Duty
Grab tensile strength, lbs.	D4632	80	120
Grab elongation, percent	D4632	50	50
Asphalt retention, gal/yd^2	--	0.2	0.3
Melting point, deg F	D276	300	300
Ultraviolet degradation, percent	D4355	70	70
Apparent opening size (AOS), US sieve, minimum	D4751	60	60
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.			

B. Crack Patch Fabric: Needle-punched non-woven coated with an Asphalt Binder and a rubberized asphalt adhesive.

Table 5 – Crack Patching Geotextile		
	Standard	MARV
Strip tensile, lbs/in.	D882	50
Puncture resistance, lb	E154	200
Permeance, perms	E69 Method B	0.10 (max)
Pliability	D146	No crack in fabric or rubberized asphalt
NOTES (a) Strip tensile uses 12 inch/minute test speed and 1 inch initial distance between grips. (b) Pliability uses 180 degree bend on 1/4 inch mandrel at –25 deg F		

2.6 **DRAINAGE GEOTEXTILES**

A. Class A drainage applications are for fabrics where installation stresses are more severe than Class B, i.e. very coarse sharp angular aggregate is used, a heavy degree of compaction (greater than or equal to 95 percent relative to a standard proctor density, Section 31 23 26) is specified, or depth of trench is greater than 10 feet deep.

B. Class B drainage applications are those where fabric is used with smooth graded surfaces having no sharp angular projections, no sharp angular aggregate, compaction requirements are light, (less than 95 percent standard proctor, Section 31 23 26), and trenches are less than 10 feet deep.

C. Use non-woven fabric.

Table 6 – Drainage Geotextile			
	Standard	MARV	
		Class A	Class B
Grab tensile strength, lbs.	D4632	200	100
Grab elongation, percent, minimum	D4632	50	50
Puncture strength, lbs.	D4833	60	30
Trapezoid tear, lbs.	D4533	50	40
Flux, gal/min/ft^2	D4491	25	25
Apparent opening size (AOS), US sieve, minimum.	D4751	60	60
Permittivity, sec.$^{-1}$ (b)	D4491	0.1	0.1
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours. (b) Permittivity number reflects typical not minimum values for this test method only. The k value of the geotextile shall be greater than the k value of the soil.			

2.7 **WEED BARRIER GEOTEXTILE**

A. Use non-woven fabric.

Table 7 – Weed Barrier Geotextile		
	Standard	MARV
		Standard
Grab tensile strength, lbs.	D4632	90
Grab elongation, percent, minimum	D4632	50
Puncture strength, lbs.	D4833	25
Trapezoid tear, lbs.	D4533	30
Apparent opening size (AOS), US sieve, minimum.	D4751	50
Ultraviolet degradation, percent	D4355	70
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.		

2.8 **POSTS**

A. Minimum length, four (4) feet.

B. Steel: Round, U shaped, T shaped, or C shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening wire.

C. Wood:

1. Soft wood posts at least three (3) inches in diameter, or nominal 2 x 4 inches and straight to provide a fence without noticeable misalignment.
2. Hard wood post providing a minimum cross sectional area of 2.25 square inches.

D. Fasteners for Wood Posts:

1. Wire staples No. 17 gage minimum with a crown at least 3/4 inches wide and legs at least 1/2 inch long.
2. Nails 14 gage minimum, 1 inch long with 3/4 inch button heads.

2.9 **SOURCE QUALITY CONTROL**

A. Sampling practices, ASTM D4354.

B. Conformance verification, ASTM D4759.

PART 3 EXECUTION

3.1 STABILIZING POOR LOAD BEARING SOILS

A. Remove all organic material larger than 1 inch in diameter from the subgrade and grade to elevations required for overlaying backfill.

B. Compact subgrade to the extent allowed by substrate condition.

C. Roll fabric onto subgrade so subgrade remains smooth. Do not dag.

D. Fold or overlap geotextile in direction of drainage.

Table 8 - Geotextile Overlap

Soil CBR Rating	Overlap Required	
	Unsewn, inches	Sewn, inches
Less than 1	--	4
1 - 2	36	4
2 - 3	30	3
3 - 5	24	--
Greater than 5	18	--

NOTES

(a) Sewn seams both factory and field seams shall conform to 90 percent of the grab tensile strength requirements.

E. Place granular material on top of fabric and spread carefully to insure no puncture. Minimum backfill lift on fabric, six (6) inches.

F. Cover fabric with 12 inches of sand before placing rock larger than four (4) inches diameter on fabric.

G. Avoid sudden stops or turning motions by equipment operating on aggregate placed over the fabric.

H. Compact backfill soils over fabric to 95 percent or greater relative to a standard proctor density, Section 31 23 26.

I. Repair any puncture by covering with new fabric using the same overlap dimensions indicated in Table above.

3.2 SILT FENCE

A. Beginning work means acceptance of existing conditions.

B. The quantity of temporary silt fences may be increased, decreased, or eliminated entirely at CONTRACTOR's discretion at no additional cost to OWNER. Maintain the silt fence until the Work is accepted or until the fence and silt accumulations are removed.

C. Clear area of any debris and obstructions that may damage geotextile.

D. Place post in all low points.

E. Install posts a maximum of eight (8) feet apart with at least 18 inches in the ground. If not possible to achieve depth, secure posts to prevent overturning.

F. Attach filter fabric by wire, cord, pockets, staples, nails, or other effective means:

1. When using a wire support fence, provide at least six (6) horizontal wires with a minimum of 12 gage wire. Space vertical wires six (6) inches maximum. Secure geotextile to the up slope side of the post. Extend wire into the Trench a minimum of two (2) inches and extend a maximum of 36 inches above the ground surface.

G. Install fabric so six (6) to eight (8) inches of fabric is left at the bottom to be buried. Splice together only at support posts with a minimum overlap of 18 inches. Extend buried portion six (6) inches deep and the rest upstream of the fabric fence.

H. Sediment Removal: Remove sediment before deposit reaches 1/2 of the height of the silt fence, or extend height of silt fence. After removal of sediment, dress landscape.

I. Schedule of Locations: Typical locations include the toe of fill slopes, the downhill side of fill slopes, the downhill side of large cut areas, and at natural drainage areas. Limit geotextile materials to handle an area equivalent to 1,000 square feet per 10 feet of fence. Use caution should site slope be steeper than 1:1, and water flow rates exceed 1 cubic foot per second per 10 feet of fence face.

3.3 **EROSION CONTROL**

A. Install fabric in locations shown on the Drawings.

B. Unless specified elsewhere, overlap geotextile at least 2 feet (2) at all longitudinal and transverse joints, or the geotextile shall be sewn.

C. If overlapped, place geotextile so upstream sheet overlaps downstream sheet.

D. For placement on slopes, overlap the next downhill strip.

E. Anchor the geotextile by using key trenches or aprons at the crest and toe of the slope.

F. Pins, usually 18 inches in length, may be helpful in securing geotextile during installation.

G. Repair: Place patch over damaged area and extend three (3) feet beyond the perimeter of any tear or damage.

3.4 **ROADWAY PAVING FABRICS**

A. Preparing Bituminous Concrete Surface:

1. Brush road surface clean of debris, dust and gravel. Remove all water from surface and allow to dry.
2. Patch holes and level uneven areas with bituminous concrete.
3. Fill cracks between 1/8 inch to 1/2 inch with asphalt cement. Allow cement to cure before geotextile placement.
4. Clean cracks larger than 1/2 inch to a depth of 3 inches and fill with bituminous concrete. Where pavement is severely cracked, rutted, deformed or distressed, secure approval for providing an bituminous concrete leveling course before geotextile placement.

B. Tacking Bituminous Surface for Pavement Fabric: Use tack asphalt recommended by fabric manufacturer. Apply tack as follows:

1. Dry pavement surface; 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace, reduce the application rate to no less than 0.20 gallons per square yard.
2. Heavy duty fabrics; 0.30 to 0.40 gallons per square yard.
3. Provide a tack width equal to geotextile width plus six (6) inches.
4. Apply tack only as far in advance of geotextile installation as is appropriate to insure a tacky surface at the time of geotextile placement.
5. Allow tack time to cure with no moisture remaining before placing the geotextile and overlay.
6. Clean excess tack material from the road surface.

C. Fabric Placement:

1. Place fabric into the asphalt tack with a minimum amount of wrinkling or folding. Slit and lay flat wrinkles or folds in excess of 1 inch.
2. Shingle lap all transverse joints and slit folds or wrinkles in the direction of the paving operation.
3. Maximize geotextile contact with the pavement surface by brooming or pneumatic rolling.
4. Additional hand placed asphalt tack may be required at laps and repairs.

D. Protection and Repair:

1. Do not allow traffic except necessary construction equipment and emergency vehicles to drive on the fabric.
2. Turn paver and other vehicles gradually and keep turning to a minimum to avoid movement and damage to the geotextile. Do not permit abrupt starts and stops.
3. Remove and replace damaged geotextile with the same type of geotextile, and shingle lap the overlaps in the direction of paving. Restrict overlaps to a maximum of six (6) inches.

3.5 **SUBSURFACE DRAINAGE**

A. Excavate trench to size and depth indicated.

B. Cut fabric to width required and place in trench. Prevent damage to geotextile.

C. Overlap geotextile 12 inches or the full width of the trench, whichever is less at the top of trench.

D. Overlap successive pieces of geotextile a minimum of 12 inches in the direction of flow.

E. Place fill to hold fabric in place.

F. Repair any damage to geotextile by placing patches extending three (3) feet in all directions beyond the damaged area.

3.6 **WEED BARRIER**

A. Preparation:

1. Remove sharp objects, large stones and undesirable vegetation.

2. If placing geotextile over existing bed, cut an "X" over each plant and push geotextile under plant base. If placing over new bed, roll geotextile over soil and cut an "X" for each plant hole. Fold excess geotextile under and cover with specified landscaping materials.

B. Surface Cover: Provide at least four (4) inches of cover on all areas on the geotextile unless otherwise specified by ENGINEER. If using large landscape rock, increase thickness of cover material over geotextile to three (3) times the diameter of the largest rock material. Do not leave any portion of geotextile exposed to direct sunlight.

C. Repair: Repair immediately. Clear the damaged area plus an additional three (3) feet and apply geotextile patch.

D. Maintenance: Maintain surfaces and supply additional landscape materials where necessary, including areas affected by erosion.

3.7 **FIELD QUALITY CONTROL**

A. Reject fabric at the time of installation, if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, handling or storage.

END OF SECTION

SECTION 31 05 21
GEOGRIDS AND GEOCOMPOSITES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geogrid and geocomposite reinforcement in embankments, over subgrades, in granular bases, and in roadway pavements.

1.2 REFERENCES

A. **AASHTO Standards:**

R50 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures

T289 Determining pH of Soil for Use in Corrosion Testing.

B. **ASTM Standards**:

D276 Melting Point Minimum.

D4354 Sampling of Geotextiles for Testing.

D4355 Resistance to Loss of Load Capacity under UV light and Weathering.

D4759 Determining Specification Conformance of Geosynthetics.

D4873 Identification, Storage, and Handling of Geotextiles.

D6637 Determining Tensile Properties of Geogrid.

D7737 Load Transfer Capability.

D7748 Flexural Rigidity of Geogrids, Geotextiles and Related Products.

C. **ASCE Publications:**

1. Giroud, J.P., and Han, J. (2004). "Design Method for Geogrid-Reinforced Unpaved Roads. Part I – Development of Design Method." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 775-786.

2. Giroud, J.P., and Han, J. (2004). "Design Method for Geogrid-Reinforced Unpaved Roads. Part II – Calibration and Applications." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 787-797.

D. **EPA Standards:**

9090 - Compatibility Test for Wastes and Membrane.

E. **FHWA Standards**:

NHI-09-087 Corrosion/Degradation of Soil Reinforcement for MSE Walls and Reinforced Soil Slopes.

NHI-10-024 Design and Construction of MSE Walls and Reinforced Soil Slopes – Volume I.

NHI-10-025 Design and Construction of MSE Walls and Reinforced Soil Slopes – Volume II.

F. **GRI Standards**:

GG9Torsional Behavior of Bidirectional Geogrids When Subjected to In-Plane Rotation

1.3 DEFINITIONS

A. **BCG**: Acronym for base course geogrid.

B. **Geocomposite**: Fabric composed of a geogrid and either a geotextile or a tack film.

C. **LAG**: Acronym for large aggregate geogrid.

D. **MARV**: Acronym for minimum average roll value (defined in Section 31 05 19).

E. **MSE**: Acronym for mechanically stabilized earth.

F. **SAG**: Acronym for small aggregate geogrid.

1.4 SUBMITTALS

A. Submit the following at least one (1) week prior to product placement.

1. Geogrid product data and sample.
2. Geocomposite product data and sample.
3. Manufacturer's warranty.
4. Installer's warranty.
5. Tack coat grade.
6. Information requested by ENGINEER.

B. If a bituminous surface is placed concurrent with the reinforcement, check temperature requirements and minimum thicknesses. Submit daily report to ENGINEER. Report the following.

1. Tack temperature (minimum 4 times per day).
2. Tack application rate (minimum 4 times per day).
3. Bituminous concrete temperatures (minimum 4 times per day).
4. Bituminous concrete thickness (minimum 4 times per day using depth probe after initial breakdown rolling).
5. Average tack application rate based on yield calculation using applicator weights and measured surface area

1.5 **DELIVERY STORAGE AND HANDLING**

A. Label, handle and store product, ASTM D4873.

B. Prevent mud, wet concrete, epoxy or other deleterious materials from coming in contact with and affixing to in-place geogrid and geocomposite materials.

C. Protect product as recommended by the manufacturer. This may include protection from ultraviolet light, moisture, high or low temperatures, or roll orientation during storage.

D. Cover product within 14 days of deployment.

1.6 **QUALITY ASSURANCE**

A. **Pre-Placement Conference**: Arrange a conference at least 48 hours prior to installation of geogrid or geocomposite. Attendees are ENGINEER, Inspector, Supplier, and installer. Discuss installation and inspection procedures and the following.

1. Location.
2. Overlap.
3. Tensioning (if required).
4. Construction equipment and installation practices.
5. Critical items that can affect design criteria or warranty.

B. **Supplier or Manufacturer**:

1. For embankment installations and mechanically stabilized earth (MSE) structures provide at least two (2) days of on-site supervision and technical assistance.
2. For roadway projects, provide one (1) day's on-site assistance.

1.7 **ACCEPTANCE**

A. **Pavement Subgrade**: Geogrid equivalence for subgrade stabilization should be determined based on the Giroud-Han method (this section article 1.2).

B. **Roadway Structures**: Geogrids utilized as part of the pavement structure should be reviewed based on the AASHTO R50.

C. **MSE Structures**: If CONTRACTOR requests substituting a rectangular or square geogrid for a triangular geogrid, CONTRACTOR must show the structural benefit and stability of a rectangular or square geogrid is equivalent to or better than the triangular geogrid. As a minimum the following conditions must be met.

1. For large aggregate geogrids (LAG) the aperture pitch is between 1.7 and 2.2 inches.
2. For small aggregate geogrids (SAG) the aperture pitch is between 0.5 and 0.9 inches.

1.8 **WARRANTY**

A. Manufacturer or Supplier: Warrant product to meet the specifications.

B. Installer: Warrant workmanship for two (2) years.

PART 2 PRODUCTS

2.1 GEOGRIDS AND GEOCOMPOSITES - GENERAL

A. Synthetic fiber at least 85 percent by weight of polypropylene, polyethylene, polyester, polyvinyl alcohol, fiberglass, modified polymer, or polyamide.

B. Resistant to chemical attack, rot and mildew, EPA 9090.

C. No tears or defects that will adversely alter properties of product.

2.2 GEOGRID FOR EMBANKMENTS

A. For environments tested in accordance with AASHTO T289, (FHWA-NKI-09-85):

1. Polypropylene (PP) can be used where pH is 3 or greater. Do not use when pH is below 3.

2. High denisty polyethylene (HDPE) can be used where pH is 3 ot 9. Do not use when pH is below 3 or above 9.

3. Were pH is 3 to 9, high molecular weight (Mn) and low carboxyl end group concentration (CEG) polyester products can be used. Do not use when pH is below 3 or above 9.

Table 1 – Embankment Geogrid

Property	Standard	MARV		
		Type	Type 2	Type 3
Ultimate strength, lb/ft	D6637	1500	4000	9000
Long term allowable design strength, lb/ft	(a)	450	1700	3600
Resistance to UV degradation, percent minimum	D4355	95	95	95
Resistance to long term degradation, percent minimum	EPA 9090	100	100	100

NOTES

(a) Long term allowable design strength is calculated by dividing the ultimate tensile strength by the product of the reduction factors for creep, installation damage and degradation for the design period. Values used for these reduction factors must be based on testing outlined by FHWA-NHI-09-087.

2.3 GEOGRID FOR ROADWAY SUBGRADE OR BASE COURSE

A. Base course geogrid (BCG) is used for gradations of aggregate where the median of the aggregate size (D50) is between 0.75-inches and 1.25-inches.

B. Large aggregate geogrid (LAG) is used where (D50) is greater than 1.25-inches.

C. Small aggregate geogrid (SAG) is used where (D50) is less than 0.75-inches.

Table 2 – Subgrade and Base Course Geogrid							
Property	**Standard**	**MARV**					
		BCG		**LAG**		**SAG**	
Rib shape		□	△	□	△	□	△
UV resistance at 500 hours, percent	D4355	70	70	70	70	70	70
Chemical resistance, percent	EPA 9090	100	100	100	100	100	100
Junction efficiency, percent	D7737	90	90	90	90	90	90
Ribs per junction	Observed	4	6	6	6	6	6
Aperture pitch, in.	Measured	1.0–1.3 (a)	1.6 (b)	2.4 (b)	2.4 (b)	1.3 (b)	1.3 (b)
Radial stiffness at 0.5% strain , lb/ft (c)	D6637	--	15,400	23,900	23,900	13,700	13,700
Isotropic stiffness ratio (d)	D6637	--	0.6	0.6	0.6	0.6	0.6
Torsional rigidity at 20 kg.cm, m-N/deg	GG9	6.5	--	--	--	--	--
Flexural rigidity (mg-cm)	D7748	750,000	--	--	--	--	--
Tensile strength at 2% strain (lb/ft)	D6637	400 x 600	--	--	--	--	--
Ultimate tensile strength (lb/ft)	D6637	1300 x 1900	--	--	--	--	--

NOTES

(a) Machine and cross machine direction

(b) Determined by measuring the spacing between sets of parallel ribs in any direction.

(c) ASTM D6637 Method B with a 2 aperture gage length tested in all "rib" and "mid-rib" directions. The radial stiffness is computed as the minimum measured modulus at 0.5 percent strain for each direction.

(d) Minimum measured radial stiffness at 0.5 percent strain divided by the maximum measured radial stiffness at 0.5 percent strain.

2.4 GEOGRID AND GEOCOMPOSITE FOR ROADWAY PAVEMENT

A. Placement is between bituminous pavement layers. Do not use with less than 2-inches of bituminous concrete cover.

B. Polyester geocomposite (PGC) is composed of a high modulus polyester geogrid bonded to a lightweight non-woven fabric.

C. Fiberglass geogrid (FG) is composed of a fiberglass geogrid coated with an elastomeric polymer.

D. Fiberglass geocomposite with a tack film (FGT) is composed of a fiberglass geogrid coated with an elastomeric polymer and bonded to a 100% polymer tack film.

Table 3 – Roadway Pavement Geogrids and Geocomposites				
Property	**Standard**	**MARV**		
		PGC	**FG**	**FGT**
Opening size, in.	Measured	0.5-1.0	0.5-1.0	0.5-1.0
Ultimate tensile strength, lb/ft	D6637	3425 x 3425	6720 x 6720	6720 x 6720
Minimum tensile strength at 2% strain, lb/ft	D6637	--	4704 x 4704	4704 x 4704
Tensile strength at 3% strain, lb/ft	D6637	825 x 825	6720 x 6720	6720 x 6720
Melting point (geogrid), deg F	D276	490	430	430
Softening point (geotextile), deg F	–	220	--	--
Softening point (tack film), deg F	--	--	--	285
Adhesive Backing	--	--	Pressure Sensitive	Pressure Sensitive

2.5 **CLAMPS, TAPE, RUBBER PADS**

A. Recommended by Supplier.

2.6 **TACK COAT**

A. Recommended by geocomposite Supplier.

2.7 **SOURCE QUALITY CONTROL**

A. Sample geogrids and geocomposites using ASTM D4354 standard practices.

B. Verify specification conformance, ASTM D4759.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Instruct workers about protecting product of this Section.

B. Repair damage to subgrade surface before installation.

C. Round edges of excavation and grade changes.

3.2 **GEOGRID REINFORCEMENT FOR GRANULAR BASE**

A. Deploy each geogrid panel per manufacturer's recommendations.

B. Install panels so overlapping panel is upgrade of the underlying panel. Ties or stakes can be used to maintain overlaps. Overlap as follows.

Soil CBR Rating	**Recommended Overlap**
2 +	1.0 foot
1 – 2	2.0 feet
less than 1	3.0 feet

C. Do not bend or fold panels past 90 degrees without a minimum of 6 inches of material between bent or folded layers.

D. At least six (6) inches of fill cover is required if tracked vehicles are operated over geogrid.

E. Wheeled traffic may operate over polypropylene products if subgrade supports equipment without deforming. Repair any damage.

3.3 GEOGRID REINFORCEMENT FOR ROADWAY PAVEMENTS

A. Preparation:

1. Clean surface of bituminous concrete base course.
2. Seal cracks wider than 1/8 inch, Section 32 01 17. Repair larger cracks, potholes, depressions, and irregularities.
3. Place bituminous concrete leveling course if required.

B. Spray on tack coat uniformly at 0.08 - 010 gal-yd^2.

C. Place geogrid per manufactures recommendations.

D. Overlap geogrid in a shingle fashion on tack coat in the direction of overlay placement. Overlap geogrid edges and ends six (6) inches minimum, unless required otherwise by Supplier.

3.4 SOIL REINFORCEMENT

A. Compact embankment subgrade.

B. Place geogrids or geocomposites in embankments at the locations and elevations shown on the plans or as recommended by Supplier.

C. Do not bend or fold panels past 90 degrees without a minimum of 6 inches of material between bent or folded layers.

D. Unless specified elsewhere, compact the fill to 95 percent or greater relative to a modified proctor density.

END OF SECTION

SECTION 31 11 00
SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of trees, stumps, roots, and tree debris.

B. Clearing site of plant life, root systems and shrubs.

C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 REFERENCES

A. **NAA Standards**:

Pruning Standards for Shade Trees.

B. **Utah Shade Tree Pruning Standards**.

1.3 QUALITY ASSURANCE

A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 SITE CONDITIONS

A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 PROTECTION

A. Protect roots and branches of trees to remain.

B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least three (3) feet high.

C. When setting posts, avoid damaging tree roots.

D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.

E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 STUMP TREATMENT SOLUTION

A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 EXAMINATION

A. The drawings do not purport to show all trees and shrubs existing on site.

B. Verify with ENGINEER which plantings are to be removed or to remain.

C. Tree root inspection:

1. Assist ENGINEER by removing and replacing existing surface improvements.

2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using contract Modification prices.

3.2 PREPARATION

A. Locate utilities. Preserve utilities that are to remain in service, Section 31 23 16.

B. Review work procedures with ENGINEER.

C. Schedule work carefully with consideration for property owners and general public.

D. Before starting, arrange for disconnection of all utility services that are to be removed or which interfere with work.

3.3 **SITE CLEARING**

A. Remove all vegetation outside of excavation, fill slope lines, and limits of slope rounding.

B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 **TREE REMOVAL**

A. Remove branches, limbs, and debris.

B. Remove stumps and roots to 18 inches below proposed grade.

C. For stumps larger than six (6) inches caliper remove and treat as follows:

1. Remove chips and debris from around remaining stump.

2. Apply stump treatment solution in accordance with manufacturer's recommendations.

3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.

4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation and disposal of excavated materials.

B. Protection of existing facilities such as utilities, vegetation, structures affected by excavation, etc.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 245 Subgrade stabilization.

1.3 PAYMENT PROCEDURES

A. No Contract Time extension shall be granted, and no additional compensation shall be made if buried utilities or structures that conflict with the Work have not been found by Keyholing.

B. Perform Incidental Excavation at no additional cost to OWNER.

1.4 DEFINITIONS

A. **Authorized Over Excavation**: Upper limit of excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.

B. **Classified Excavation**: The excavation of specified materials.

C. **Incidental Excavation**: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of excavation, slough, or over-break.

D. **Unclassified Excavation**: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or rock fragments will not be sufficient cause to change classification of surrounding materials.

E. **Keyholing**: The process of making a small, precisely controlled hole for “day-lighting”, or uncovering and exposing underground utilities, to locate or inspect them.

1.5 STORAGE AND HANDLING

A. Stockpile excavated material to cause minimum inconvenience to public and provide for emergency services as necessary.

B. Provide free access to existing fire hydrants, water valves, gas valves, and meters.

C. Provide free flow of storm water in all gutters, conduits, and natural water courses.

D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.

E. Promptly remove other material from site.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

C. Stabilization fill, aggregate base course or common fill with maximum rectilinear particle size of two (2) inches.

D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Photograph existing surfaces where work will take place to document conditions before excavation, Section 01 78 39.

B. Use white paint and mark the proposed excavation.

C. Call the one-call center and wait the required amount of time. Colors of one call center marks indicate the following:

White	Proposed excavation
Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials.
Orange	Communications, alarm, signal, cables or conduits.
Blue	Potable water.
Purple	Reclaimed water, irrigation and slurry lines.
Green	Sewer and storm drain lines.
Pink	Temporary survey markings.

D. Implement traffic control plan requirements, Section 01 55 26.

E. For temporary controls, refer to Section 01 57 00.

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.

B. Utilities:

1. Keyhole, expose or otherwise locate utilities as necessary to give utility agency at least one (1) day notice to protect, preserve, or relocate a utility that may interfere with or may be damaged by excavation work. Preserve utilities that remain in service.

2. Where utilities or structures conflict with design grades, report conflict to appropriate utility company and ENGINEER 14 days before initiating work within the conflict area.

C. Support and protect from damage any existing facility and structure that exists in, passes through, or passes under the site.

D. Protect existing landscape sprinkler systems. When sprinkler system disturbance is required, interrupt and repair system so operation of system is maintained, Section 02 41 13.

E. Carefully remove soil around tree roots so ENGINEER can assess stability and health of tree.

3.3 GENERAL EXCAVATION REQUIREMENTS

A. Excavate topsoil from areas to be relandscaped or regraded and other marked areas.

B. Excavate site to line and grade indicated. Legally dispose of excavated material.

C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.

D. Where soil has been softened or eroded by flooding or hardened by drying, rework all damaged areas or replace with approved material at no additional cost to OWNER.

E. Notify ENGINEER of unexpected subsurface conditions.

F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by excavation work.

G. Protect excavation walls as required. If conditions permit, slope excavation sides to maintain a safe and clean working area. Remove loose materials.

H. Where ENGINEER deems subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.4 TOPSOIL

A. Excavate topsoil only to depth that will preserve topsoil quality.

B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.5 SHORING

A. Slope, shore, sheet, brace or otherwise support excavations over four (4) feet deep, Section 31 41 00.

B. When soil conditions are unstable, excavations shallower than four (4) feet deep must also be sloped, supported, or shored.

3.6 DEWATERING

A. Keep excavation free from surface and ground water.

B. If ground water is in the intended construction operations, dewater excavations.

C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State, or local agency having jurisdiction.

D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.

E. Pay for damages and costs resulting from dewatering operations.

3.7 ROADWAY EXCAVATION

A. In advance of setting line and grade stakes, clear and grub area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts.

B. Roadway excavation is Unclassified Excavation. It includes Portland cement concrete or bituminous concrete pavement removal and removal of any aggregate base or sub-base material to line and grade established by Drawings or ENGINEER.

C. Roadway Subgrade Stabilization. As shown in the Drawings or APWA Plan 245.

3.8 STRUCTURAL AND LANDSCAPE EXCAVATION

A. Provide shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.

B. For piling work, coordinate special requirements for piling. Protect excavation walls.

C. If conditions permit, slope excavation sides as excavation progress. Maintain a safe and clean working area.

D. Support excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.9 TRENCH EXCAVATION

A. Grade bottom of trenches to provide uniform bearing surface.

B. If necessary, make bell holes and depressions required for laying and joining pipe or box.

C. Limit width of trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.

D. In roadways and regardless of trench depth, limit length of open trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect trenches overnight.

3.10 STABILIZATION EXCAVATION

A. Perform stabilization excavation as Incidental Excavation.

3.11 AUTHORIZED OVER EXCAVATION

A. Over excavation must be permitted by ENGINEER to be classified as authorized over excavation. Volume will be determined by the method of average-end-areas in the original position.

3.12 TOLERANCE

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 17
ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for Rock removal and use of explosives to assist in Rock removal.

1.2 REFERENCES

A. **NFPA Standards**:

495 Manufacture, Transportation, Storage, and Use of Explosive Materials.

1.3 DEFINITIONS

A. **Rock**: Solid mineral material that cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting.

1.4 SUBMITTALS

A. Submit proposed method of blasting, delay pattern, explosive types, type of blasting mat cover, and intended Rock recovery method.

B. Submit photographs of existing site conditions and facilities in vicinity of Work before blasting. Refer to construction photographic requirements, Section 01 78 39.

1.5 QUALITY ASSURANCE

A. Seismic Survey Firm: Company specializing in seismic surveys with two (2) years documented experience.

B. Explosive Firm: Company specializing in explosives for disintegration of Rock with 2 years documented experience.

PART 2 PRODUCTS

2.1 EXPLOSIVES

A. Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.

2.2 DELAY DEVICES

A. Type recommended by explosives firm.

2.3 BLASTING MAT MATERIALS

A. Type recommended by explosives firm.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify site conditions and note irregularities affecting work of this Section.

B. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

C. Locate and preserve utilities, Section 31 23 16.

D. Beginning work of this Section constitutes acceptance of existing conditions.

E. Comply with NFPA 495.

3.2 STORAGE OF BLASTING MATERIALS

A. Securely store all explosives in compliance with Laws and Regulations.

B. Mark all storage places clearly.

C. Where no local Laws or Regulations apply, provide storage not closer than 1,000 feet from any road, building, camping area or place of human occupancy.

3.3 ROCK REMOVAL - NONEXPLOSIVE METHOD

A. Cut away Rock at excavation bottom to form level bearing.

B. Remove shaled layers to provide sound and unshattered base for foundations.

C. Remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.

D. Correct unauthorized Rock removal at no additional cost to OWNER.

3.4 ROCK REMOVAL - EXPLOSIVE METHOD

A. Provide a qualified explosives expert to act as an advisor and consultant during drilling and blasting operations.

B. Advise owners of adjacent buildings or structures and utility companies in writing before setting up seismographs. Describe blasting and seismic operations.

C. Obtain and pay for a seismic survey before Rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties and utilities.

D. Provide seismograph monitoring during progress of blasting operations.

E. Disintegrate and remove Rock from excavation operations.

END OF SECTION

SECTION 31 23 23
BACKFILLING FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural backfill materials.

B. Structural backfilling requirements.

1.2 REFERENCES

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.4 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this Section.

C. If requested, submit a written quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.5 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.6 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.7 ACCEPTANCE

A. **General**: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. **Material**: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. **Lift thickness**: One test per Lot.

D. **Compaction**: One test per Lot. Verify compaction using nuclear tests, ASTM D2922. Density and lot sizes as follows:

Table 1 – Density and Lot Sizes			
Structure Type	**Density**	**Proctor**	**Lot Size**
Strip Footings	95	Standard	Subgrade: 200 linear feet
	98	Modified	Aggregate base course: 200 linear feet per lift.
Structure Footing excluding strip footings	95	Standard	Subgrade: 225 square feet.
	98	Modified	Aggregate base course: Each 225 square feet per lift
Embankments	95	Standard	Fill: 625 square feet per lift
Interior Slab on Grade	98	Modified	Aggregate base course: 625 square feet
Side of Foundation Walls and Retaining Walls	95	Standard	Exterior:
	98	Modified	Interior
Miscellaneous small structures (e.g. Manholes, drainage boxes, etc.)	95	Standard	Subgrade: Each footprint area Fill: Each lift
	98	Modified	Aggregate base course: Each lift
NOTES (a) Standard proctor, ASTM D698. (b) Modified proctor, ASTM D1557.			

E. **Flowable Fill Strength**: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. **Grade, Cross Slope**: Measured at random locations.

1.8 **WARRANTY**

A. Repair settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.
B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.

2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.

3. Ground surface is not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, pavings, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **SUBGRADE**

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's inspection of subgrade surface preparations.

C. If Subgrade is not readily compactable get ENGINEER’s permission to stabilize the subgrade.

3.5 **FOUNDATIONS AND SLABS ON GRADE**

A. Lift thickness before compaction is eight (8) inches.

B. Do not backfill against walls until concrete has obtained 14 days strength. Backfill against foundation walls simultaneously on each side.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Where flowable fill is used, use fill that flows easily and vibration for compaction is not required.

3.6 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.7 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or ninety eight (98) percent minimum relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.8 **CLEANING**

A. Remove stockpiles from site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 31 23 26
COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Compaction of granular fill materials.

1.2 REFERENCES

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS

A. **A-1 Soil**: Defined in ASTM D3282.

B. **Modified Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D1557 using procedure A, B or C as applicable.

C. **Relative Density (or Relative Compaction):** The ratio of field dry density to the maximum laboratory density expressed as a percentage.

D. **Standard Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE

A. Use a soil and rock laboratory that complies with ASTM D3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION

A. Moisten or dewater backfill material to obtain optimum moisture for compaction.

B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.

C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

3.2 FIELD QUALITY CONTROL

A. **Testing**: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for

1. Changes in source of materials or proportions requested by CONTRACTOR, or
2. Failure of materials to meet specification requirements, or
3. Other testing services needed or required by CONTRACTOR.

B. **Optimum Soil Density**: Use ASTM D2216 and the following industry standards.

1. For A-1 Soils: Method C of ASTM D1557 (Modified Proctor)
2. For All Other Soils: Method C of ASTM D698 (Standard Proctor).

C. **Field Density**:

1. Use ASTM D3017 and test method C of ASTM D2922 for shallow depth nuclear testing.
2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

3.3 **REPORT**

A. For each material tested, document the following:

1. Vertical and horizontal location of the test.
2. Optimum laboratory moisture content.
3. Field moisture content.
4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion control and slope protection facilities including blankets or mulches.

B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

A. Submit before using:

1. Sample of blanket or geotextile materials.
2. Mulch formula.
3. Grass mixture listing.
4. Plant list.
5. Geotextile manufacturer's certification.

B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.

B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.

C. Deliver blanket in original wrapping showing name of manufacturer and product weight.

D. Deliver plant materials immediately before placement.

E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced before planting.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap: Rock, Section 31 37 00.

B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.

C. Geotextiles: Section 31 05 19.

D. Erosion Control Vegetation Mats: Permanent three dimensional mats that allow for revegetation where high water flows are expected.

E. Fiber Mulches: Straw, hay, wood or paper free from weeds and foreign matter detrimental to plant life.

F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.

G. Topsoil and Fertilizer: Section 31 05 13 and Section 32 92 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove foreign materials, roots, rocks, debris.

B. Grade to eliminate rough spots, ponding areas.

C. Grade soil to drain perimeter water away from protected areas.

D. Temporary controls, Section 01 57 00 as applicable.

3.2 **SLOPE PROTECTION BLANKET**

A. Cover seeded slopes where grade is greater than one (1) vertical to three (3) horizontal with blanket. Roll down over slopes carefully and loosely without stretching or pulling.

B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.

C. Toe-wrap fabric at bottom of slope.

D. Staple loosely the outside edges and overlaps.

E. In ditches, lay matting in upstream direction. Overlap and staple ends six (6) inches with upstream section on top.

F. If natural drainage water traverses protected or controlled area; construct a channel or riprap Section 31 37 00.

G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.

H. Present alternative methods of protection for approval before starting any work.

3.3 **GEOTEXTILE**

A. Placement, Section 31 05 19.

3.4 **MULCHES**

A. Apply mulches at the rate necessary.

B. When installed with a tackifier, apply at the rate recommended by the tackifier supplier.

3.5 **SURFACE COVER**

A. Grass, Section 32 92 00.

B. Ground cover, Section 32 93 13.

3.6 **MAINTENANCE**

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.

B. Protect and repair geotextiles, Section 31 05 19.

C. Keep surface of soil damp only as necessary for seed germination.

D. Apply water slowly so surface of soil will not puddle and crust.

E. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

F. Re-fertilize 60 days after planting.

G. Remove weeds that are over three (3) inches high.

END OF SECTION

SECTION 31 31 19
VEGETATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of soil treatment to remove weed and vegetation.

1.2 SUBMITTALS

A. Submit certificate identifying composition of non-selective control herbicide.

PART 2 PRODUCTS

2.1 HERBICIDE

A. Water soluble herbicide for non-selective control of annual and perennial weeds.

PART 3 EXECUTION

3.1 MIXING

A. Mix herbicide solution in strict accordance with manufacturer's instructions and applicable Laws and Regulations.

3.2 APPLICATION

A. Execute all work in an orderly and careful manner with due consideration for surrounding plantings that are to remain.

B. Apply herbicide solution with a shield applicator. Do not allow solution to mist, drip, drift, or splash onto desirable vegetation.

C. Apply solution according to manufacturer's recommendations seven (7) days before preparation of surface to receive additional cover material. Do not add cover material until ENGINEER reviews spraying results.

D. Do not spray under windy or adverse weather conditions.

E. Replace portions of surrounding vegetation damaged or killed through this operation.

END OF SECTION

SECTION 31 36 00
GABIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gabion for slope or bank protection and erosion control in open channels.

1.2 REFERENCES

A. ASTM Standards:

A313 Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire.

A641 Zinc-Coated (Galvanized) Carbon Steel Wire.

A764 Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs.

1.3 SUBMITTALS

A. Manufacturer's product data showing gabion wire twist or welded pattern, components to be used, erection and component tolerances, overall layout, typical construction details, and construction procedures.

B. Design criteria recommended by manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer of gabion structure to train and instruct construction personnel regarding installation of gabion.

B. Do not allow any gabion structure to deform during backfill operation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Gabions: Uniform hexagonal wire mesh woven in two (2) or 3-1/2 twist pattern with openings fabricated in such a manner as to be non-raveling and designed to provide required flexibility and strength. Wire mesh shall have deformability sufficient to permit a minimum mesh elongation equivalent to 10 percent of the unstretched length of the mesh test section without reducing the gage or tensile strength of the individual wire strands to values less than those for similar wire, one (1) gage smaller in diameter.

B. Wire: Galvanized steel, Class 3, ASTM A641:

1. Fabric: US gage 11 after galvanization.
2. Selvedges: US gage 9.
3. Binding and Connecting: US gage 13-1/2.
4. Tensile Strength: 60,000 - 75,000 (psi).
5. Elongation: 12 percent maximum.

C. Polyvinyl Chloride Coated Galvanized Wire:

1. Wire Mesh Fabric: Same diameter as galvanized with an approximate overall diameter of 0.12785 inch (galvanized wire core plus PVC coating).
2. Selvedges: Same diameter as galvanized except, galvanized wire code to be US gage 10 (0.1338 inch with an approximate overall diameter of 0.15545 inch (galvanized wire core plus PVC coating)).
3. Binding and Connecting: Same diameter as galvanized with an approximate overall diameter of 0.10825 inch (galvanized wire core plus PVC coating).

D. Fasteners: Resistant to a force of at least 900 pounds while still remaining in a locked and closed position:

1. Stainless steel, ASTM A313 for PVC coated gabions.
2. Galvanized, ASTM A764, Finish I, Class I, Type 3 with the same weight of coating as specified in ASTM A641.

E. Stone: Hard, durable, graded from four (4) inches to eight (8) inches diameter.

PART 3 EXECUTION

3.1 GABION ASSEMBLY

A. Assemble base, lid, ends and sides into a single woven unit. If not woven then connect these members so that strength and flexibility at the connecting point is at least equal to that of the mesh.

B. Where length of gabion exceeds 1-1/2 times its horizontal width, divide gabion basket with diaphragms, of the same mesh and gage as the body of the gabion, into equal cells whose length does not exceed horizontal width. Secure diaphragms in position on the gabion bottom so no field tying is required.

C. Tie all untied edges with binding wire. Loop wire tightly around every other mesh opening along seams such that every other mesh opening along seams are single and double loop alternating.

3.2 PLACEMENT

A. Place empty gabions into positions indicated. Tie each unit to the adjoining unit along the vertical reinforced edges and the top selvedges.

B. Tie front and back of base of empty gabions to top of previously filled gabions.

C. Stretch gabions to achieve better alignment and finish.

D. Position fasteners at two (2) per foot of selvedge.

3.3 GABION FILLING

A. Backfilling Gabion Structures 24 inches High or Greater:

1. Backfill each unit in 12 inches thick lifts.

2. At the completion of the first backfill lift, tie one connecting wire in each direction to opposite face of each gabion cell. Loop and twist lock all connecting wires around two (2) mesh openings.

3. At the completion of the second backfill lift, tie two (2) connecting wires as above.

4. Continue above backfilling procedure until gabion structures are filled.

5. Tie gabion structure lid to the rest of the basket.

B. Backfilling Gabion Structures 18 inches High or Less:

1. Backfill each unit in lifts 1/2 the thickness of the gabion structure.

2. At the completion of the first backfill lift, tie two (2) connecting wires in each direction. Complete wire tying and backfill operation as above.

END OF SECTION

SECTION 31 37 00
RIPRAP OR ROCK LINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placement of loose riprap, hand-placed riprap, or grouted riprap.

1.2 REFERENCES

A. ASTM Standards:

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 SUBMITTALS

A. Submit before use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

PART 2 PRODUCTS

2.1 AGGREGATE

A. Durable, angular, hard stone free from seams and cracks.

B. Graded in size to produce a reasonably dense mass.

C. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.

D. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.

E. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.

F. At least 95 percent of the stones shall have at least two (2) fractured or clean angular faces.

2.2 ACCESSORIES

A. Portland cement grout, Section 03 61 00.

B. Geotextile fabric, Section 31 05 19.

C. Grout, Section 04 05 16.

2.3 SOURCE QUALITY CONTROL

A. Aggregate: Wear not greater than 40 percent when tested, ASTM C535.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval before backfilling.

B. Install required geotextile in accordance with Section 31 05 19.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

3.4 **GROUTED RIPRAP**

A. After placement and wetting the stones, sweep sand or fine gravel into the interstices to fill to within four (4) inches of the outer surface of the riprap.

C. Fill the remaining volume of the interstices flush with a well-mixed grout.

D. Keep grout wet by sprinkling or covering with wet material for at least three (3) days. Protect grout from stream water or any other disturbance during this cure period.

E. Do not place grout in freezing weather.

END OF SECTION

SECTION 31 41 00
SHORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shoring for open Excavations requiring a Protective System.

B. Underpinning to stabilize adjacent structure.

1.2 PRICE - MEASUREMENT AND PAYMENT

A. **In Trenching Shoring**:

1. A two (2) Protective System is required if each Side of the Trench is to be shored. The use of a Trench Box shall be classified as one Protective System.

2. Payment covers cost of Protective System to a depth of three (3) feet below Excavation elevations indicated. Allowance for extra cost may be made, based upon the actual cost to CONTRACTOR of constructing, extending, or reconstructing any Protective System that may be necessary to carry excavation to required depth that is greater than three (3) feet below Excavation elevations indicated. Extra cost will be paid for by **Change Order**.

B. **Excavation in Lieu of Protective System**: If a Protective Systems is specified but the CONTRACTOR uses open excavation (without a protective system) and ENGINEER has knowledge of the alternate excavation operation, the CONTRACTOR will be paid in full for the Protective System specified, which includes extra excavation, extra backfill, backfill compaction, or other incidental work performed by CONTRACTOR in lieu of constructing the Shoring or underpinning.

1.3 DEFINITIONS

A. **Accepted Engineering Practices**: Those requirements or practices that are compatible with standards required by a duly licensed or recognized authority.

B. **Benching**: A method of protecting persons and property against cave-ins by excavating the Sides of an Excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

C. **Excavation**: Any man-made cut, cavity, or depression in an earth surface, including Trenches, formed by earth removal and producing unsupported earth conditions (Sides). If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a Trench.

E. **Protective System**: Any recognized method of protecting persons and property against cave-ins, collapse of adjacent structures, or material that may fall or roll from an Excavation Side into an Excavation. Protective systems include Support Systems, Sloping and Benching systems and Shield systems.

F. **Shield**: A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect persons and property within the structure without preventing a cave-in. Shields may be permanent structures or may be designed to be portable and moved along as work progresses. Portable Shields used in Trenches are usually referred to as "trench boxes" or "trench shields".

G. **Shoring**: A structure that supports the Sides of an Excavation and thereby protects persons and property from cave-ins.

H. **Side**: Vertical or inclined earth surface formed at the outer edges of an Excavation.

I. **Sloping**: A method of protecting persons and property against cave-ins by excavating to form Sides that are inclined away from the Excavation, the angle of incline being of such a degree for the conditions of exposure that a cave-in will not occur.

J. **Support System**: A structure that protects persons and property by providing support to an adjacent structure, underground installation, or the Sides of an Excavation.

K. **Trench**: A narrow Excavation made in the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15 feet.

L. **Trench Box**: See Shield.

M. **Unfractured Rock**: Rock that can be excavated with vertical Sides and remain intact while exposed. Fractured rock is considered equivalent to unfractured rock when the material on the Side or Sides of the Excavation is secured against cave-in or movement by rock bolts, netting, or other means approved by a licensed design professional.

1.4 **DESIGN OF PROTECTIVE SYSTEMS**

A. Design Support Systems, Shield systems, structural components of these systems, and Sloping and Benching systems to resist all loads that are intended to be imposed or transmitted to them.

B. Design a system for any hydrostatic pressure in the Sides of an Excavation.

1.5 **SUBMITTALS**

A. Submit a Protective System plan when requested.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. CONTRACTOR's choice.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Make safe or remove trees, surface encumbrances that are hazardous to Shoring operations.

B. Provide adequate ventilation of Excavations.

C. Control dust and groundwater.

3.2 **STABILITY OF ADJACENT STRUCTURES**

A. Support adjoining buildings, walls, sidewalks, pavements, or other structures endangered by excavation operations.

B. Excavation below level of base of footing of any structural foundation or wall shall not be permitted except as follows:

1. Underpinning or other Support Systems is provided to ensure stability of structure, or
2. Excavation is in Unfractured Rock, or
3. A licensed design professional determines in writing that such work will in no way pose a hazard to persons and property or the integrity of the structure.

3.3 **PROTECTION OF PERSONS AND PROPERTY**

A. Protect from cave-ins. Install a Support System, by Sloping, by Benching, by use of a Shield system, or by use of a combination of these methods.

B. Scale to remove loose material. Use rock bolting, wire mesh, installation of protective barricades, or provide equivalent protection.

C. Stairway, Ladder, Ramp: Comply with OSHA.

D. Protect against cave-ins from vibratory loads adjacent to excavation operations.

3.4 **INSPECTIONS**

A. Inspect Excavations daily for evidence of possible cave-ins, indications of Failure of Protective Systems, or other hazardous conditions.

B. Upon discovery of hazardous conditions, cease all work in Excavations until additional precautions have been taken to ensure persons and property safety.

3.5 **SHIELD SYSTEMS**

A. Minimize time when Sides of an Excavation remain unsupported.

B. Do not subject Shield systems to loads other than those considered in their design.

C. Remove persons and property from Excavation when portable Shields are being relocated.

3.6 **INSTALLATION AND REMOVAL OF SUPPORT SYSTEMS**

A. Do not overload Support Systems.

B. Install additional members to carry loads imposed upon the Support System when temporary removal of individual members is necessary.

C. When removing Support System, release member by member slowly to avoid Failure of the remaining members or cave-ins.

D. Coordinate backfilling to minimize time an unsupported Excavation remains open.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 01 05

INFORMATION, REGULATORY, AND WARNING SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Information, regulatory, and warning signs but not street name signs or construction signs.

1.2 REFERENCES

A. **ASTM Standards**:

B209: Aluminum and Aluminum - Alloy Sheet and Plate.

B. **FS Standards**:

L-P 380: Plastic Molding Material Methacrylate.

L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

C. **National Bureau of Standards**:

PS 1: Construction and Industrial Plywood.

D. **DOT Standards**:

MUTCD:Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. For definition purposes, the various types of signs are identified by a combination of letter and number. The letter represents the type of sign panel construction and the number represents the type of lettering and symbols to be used as follows:

1. Panel Type:
   a. Type A: Reflectorized sheeting on sheet aluminum.
   b. Type B: Reflectorized sheeting on plywood.
2. Letter Type:
   a. Type 1: Reflectorized demountable cutout letters, symbols, and borders with prismatic reflectors.
   b. Type 2: Opaque legend and borders.
   c. Type 3: Reflectorized permanently attached cutout letters, symbols, and borders or reflectorized screen processed letters, symbols, and borders.

1.4 SUBMITTALS

A. Submit Shop Drawings of support structures before fabrication.

B. Submit sample of each color of reflective sheeting including manufacturer's name and product number.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sign Blank:

1. Aluminum Sheet: 0.1 inch thick ASTM B209 alloy 6061-T6.
2. Aluminum Extrusion: 0.1 inch thick ASTM B209 alloy 6063-T5 and 6063-T6.
3. Softwood Plywood: PS 1 Group 1 with each panel bearing initials DFPA Grade - Trademark of the American Plywood Association; painted to ENGINEER's choice of color unless indicated.

B. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8 inch diameter mounting holes.

C. Fabricated Supports: Galvanized steel, Sections 05 05 10 and 05 12 00.

D. Sheeting:

1. Reflective: FS L-S-300 with 2,200 hours minimum durability.

2. Nonreflective: Nonchalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.

E. Prismatic Reflectors: Methyl methacrylate lens meeting FS L-P-380 requirements with aluminum frame.

F. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

G. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

2.2 **COLORS AND FORMAT**

A. Sign Colors and Format: MUTCD.

B. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 **INSTALLATION**

A. Do not remove a sign that is being replaced until the new sign is placed and uncovered. Provide temporary covering. Maintain covering until removal.

B. Unless indicated otherwise use clearance and locations shown in MUTCD. Install posts plumb and in proper alignment. Construct sign post foundations with concrete. Finish foundations flush with or below natural ground.

C. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

D. Construct overhead support structures where indicated with signs horizontal and perpendicular to roadway. Minimum allowable vertical clearance from high point of pavement is 16.5 feet.

3.3 **WORKMANSHIP**

A. Carefully fabricate and erect signs. Damage signs will be rejected.

B. Make all vertical joints and cuts flat and true.

C. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

D. Lay out and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

E. Wash all sign faces before final inspection, Section 01 74 13.

END OF SECTION

SECTION 32 01 06
STREET NAME SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for street name sign and components.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 292 Street name signpost.

B. **ASTM Standards**:

B 209 Aluminum and Aluminum-Alloy Sheet and Plate.

C. **FS Standards**:

L-S-300 Sheeting and Tape, Reflective: Nonexposed Lens.

PART 2 PRODUCTS

2.1 MATERIALS

A. Blanks:

1. Aluminum Sheet: 0.1-inch-thick ASTM B209 alloy 6061-T6, of the height indicated with length required to spell the street name (18, 24, 30, 36, 42, 48 inches).

2. Nonmetallic: Fiberglass reinforced composite bonded with a thermosetting polymer and the following properties:

   a. Tensile strength (transverse), 5,000 psi minimum.

   b. Tensile strength (longitudinal), 25,000 psi minimum.

   c. Lengths as required to spell the street name (18, 24, 30, 36, 42, 48 inches).

   d. Height as indicated.

B. Reflective Sheeting: Reflective per FS L-S-300 with 2,200 hours minimum durability.

C. Sign Lettering: White upper-case and lower-case letters, reverse silk screened on white with specified background color transparent ink.

D. Letter Composition: Spell out street name and give numerical coordinate on the right-hand side; include neighborhood logo, if applicable, on the left-hand side. Font as indicated.

E. Rail for Sign Blank: Tensile strength 40,000 psi minimum.

F. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube per Sections 05 12 00 and Section 05 05 10 requirements, with 3/8 inch diameter mounting holes.

G. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

H. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 **INSTALLATION**

A. Install posts as shown in the Drawings or APWA Plan 292.

B. Set posts two (2) feet deep and anchored in concrete.

C. Provide 10 feet high clearance from the ground level to the bottom of sign.

D. Install posts plumb so closest edge of sign is two (2) feet from vertical projection of the curb face at the point of curve (PC) of the intersection approach curb.

E. Restore all surfaces damaged during installation.

END OF SECTION

SECTION 32 01 07

RELOCATE POST MOUNTED SIGNS AND MAIL BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocate post mounted signs.

B. Relocate mail boxes to supports approved by USPS.

1.2 REFERENCES

A. **USPS Standards**:

Mailbox requirements.

1.3 DEFINITIONS

A. **Post Mounted Signs**: Street name signs and traffic control signs such as regulatory signs, warning signs, guide signs, detour and closure signs.

PART 2 PRODUCTS

2.1 CONCRETE

A. Cast-in-place: Class 3000 minimum, Section 03 30 04.

2.2 MAIL BOX SUPPORTS

A. Wood: Salt treated fir, hemlock or pine for post, shelf and brace. Grade: No. 2 or better.

B. Metal: Galvanized or dark epoxy painted steel post, shelf and brace with no defects.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavate, Section 31 23 16.

C. Reuse existing mail boxes, street signs and posts unless indicted otherwise.

3.2 EXISTING TRAFFIC CONTROL SIGNAGE

A. Maintain all existing traffic control and street signs in full view of the intended traffic.

B. Coordinate post mount sign relocations such that view of existing traffic control and street signs is maximized.

3.3 SIGN RELOCATION

A. Maintain existing signs until construction requires removal. Coordinate with ENGINEER 24 hours in advance of removal of any sign.

B. Relocate existing street signs indicated or ordered by ENGINEER.

C. Remove concrete from existing posts where posts are to be reused.

D. Protect new signs and posts until Project is accepted.

E. Reset post in concrete, eight (8) inches in diameter to depth indicated or ordered by ENGINEER.

F. Completely fill and compact hole left by removing sign post. Match adjacent surface.

3.4 MAIL BOX RELOCATION

A. Completely remove all designated mail box posts and footings.

B. Furnish and install new posts, shelf, and brace.

C. Relocate existing mail boxes indicated or ordered by ENGINEER.

D. Attach box firmly to shelf and post.

E. Repair any damage done to mail box during moving or replace if irreparable to ENGINEER's and mail box owner's satisfaction.

F. Compact soil around post and provide firm support.

G. Provide support for temporary mail box as required during construction at no extra cost to OWNER, with temporary mail box located in accordance with United States Postal Service requirements.

H. Restore original location of box to condition equivalent to adjacent area.

3.5 **PAVEMENT MARKINGS**

A. Section 32 17 23.

END OF SECTION

SECTION 32 01 10

RELOCATE FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reset existing fences and gates in new locations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nails, Spikes and Staples: Galvanized steel for exterior, high humidity locations, and treated wood. Size and type to suit applications.

B. Chain Link Fences and Gates: Section 32 31 13.

C. Wire Fences and Gates: Section 32 31 16.

D. Concrete: Class 3000 minimum, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate locating utilities, Section 01 31 13.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Completely remove all existing posts, footings, wires, gates, and other items used in fencing.

B. Remove concrete on posts. Reuse posts, wire, and gates from existing fence.

C. Replace any fencing materials and gates that are damaged, lost, or broken during fence and gate relocations. Provide new materials as required which meets Specifications, for fence and gates of the same type.

D. Set relocated fences and gates straight and true.

E. Fill in old post holes unless they become part of new construction.

F. Reset posts in concrete, eight (8) inches in diameter to depth indicated or two (2) feet minimum.

END OF SECTION

SECTION 32 01 13.50
FOG SEAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of a surface rejuvenator (hot liquid asphalt emulsion) over a pavement surface that has aged at least nine (9) months.

1.2 SUBMITTALS

A. Product data including manufacturer's literature and installation instructions.

B. Traffic control and notification plan.

C. Construction equipment list.

1.3 WEATHER

A. Apply sealer seal when air and roadbed temperatures in the shade are between 50 and 80 deg F The temperature restrictions may be waived only upon written authorization from ENGINEER.

B. Do not apply sealer during rain, fog, dust, or other unsuitable weather.

PART 2 PRODUCTS

2.1 ASPHALT BINDER MATERIALS

A. Select from the following:

1. Emulsified asphalt: grade SS-1h, Section 32 12 03.
2. Cationic emulsified asphalt: grade CSS-1h, Section 32 12 03.
3. Cationic quick set asphalt: grade CQS-1h, Section 32 12 03.
4. Cationic asphalt emulsion with gilsonite ore.

B. Rejuvenators:

1. Asphalt and maltene oil with polymer mix.
2. Maltene oil base.
3. Latex: Two (2) parts latex to 100 parts asphalt emulsion.

2.2 MIX DESIGN

A. Emulsified asphalt and water dilution ratios.

1. Ratio of 1:1 for most applications.
2. Ratio of 2:1 for use on hills where runoff may be of concern or on existing very rough surface texture pavements.

2.3 SAND

A. Section 31 05 13.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Standard bituminous spreader with triple coverage spray bar.

3.2 PREPARATION

A. Plane off or grind off existing painted lines, grease or oil patches, and spillage of any material that has adhered to pavement.

B. Remove all dust, dirt and debris.

C. Apply crack sealant, Section 32 01 17, if indicated.

D. Clean surface by water flush. Do not flush over cracks. Complete flush 24 hours prior to application of seal. Surface must be completely dry prior to application.

3.3 **APPLICATION**

A. Follow sealant manufacturer's recommendations in regard to fogging of substrate, priming of substrate, and dilution of sealer.

B. Application Rate: Use the following as a guide. If surface completely absorbs emulsion with ability to absorb more, increase application rate.

Table 1 - Application Rate

Dilution	Rate, Gal/sq.yd.	Temperature, deg F		
		Target	Minimum	Maximum
1:1	0.10 to 0.15	150	90	190
2:1	0.08 to 0.12			

C. Stop application if any spray bar nozzle is not working properly.

D. Blot areas with too much emulsion by spreading a light, uniform layer of sand.

3.4 **PROTECTION**

A. Protect all structures, including curb and gutter, sidewalks, guardrails and guide posts from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to City.

B. Do not discharge bituminous material into borrow pits or gutters.

C. Prevent tracking of seal coats onto adjacent surfaces.

3.5 **OPENING TO TRAFFIC**

A. Keep traffic off surface until material is no longer tacky and will not track out. Material should set between 4 to 6 hours after application.

B. To allow traffic on surface prior to complete setting of the emulsion, CONTRACTOR may lightly sand surface at no additional expense to the OWNER.

C. CONTRACTOR is responsible for any claims for damage.

END OF SECTION

SECTION 32 01 13.61
SLURRY SEAL

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Stone and an asphalt binder slurry evenly mixed and spread as a seal coat for roadways and thoroughfares.

1.2 REFERENCES

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C117 Material Finer Than 0.075 mm Sieve in Aggregate.

C131 Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C136 Sieve Analysis of Fine and Coarse Aggregates.

D5 Penetration of Bituminous Materials.

D36 Softening Point of Bitumen (Ring-and-Ball Apparatus).

D242 Mineral Filler for Bituminous Paving Mixtures.

D1664 Coating and Stripping of Bitumen-Aggregate Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D3319 Accelerated Polishing of Aggregates Using the British Wheel.

D3628 Selection and Use of Emulsified Asphalts.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D3910 Design, Testing, and Construction of Slurry Seal.

D5821 Determining the percentage of Fractured Particles in Coarse Aggregate.

D6937 Density of Emulsified Asphalt.

1.3 SUBMITTALS

A. **Mix Design:** Provide the following. Allow ENGINEER 10 days to evaluate the submittal. Do not mix aggregate and emulsions designated for other public or private projects.

1. Date of mix design. If older than 180 days from date of submission recertify mix design.
2. Target Grading Curve for aggregate.
3. Percentages of emulsion, aggregate, water and additives in the mix.
4. Emulsion type and time target for opening up a thoroughfare to traffic.
5. Slurry application rate.
6. Aggregate physical properties (this section article 2.4). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from the date of submission.

B. **Before Placement**: Submit at least 48 hours before delivery.

1. Traffic control plan, Section 01 55 26.
2. List of the construction equipment to be used.
3. Certification from emulsion supplier stating emulsion meets requirements in this section.

C. **Reports**:

1. Provide daily reports to OWNER's representative including weight of material used, application rate, area covered. Indicate date, type, and project names.

2. Provide delivery tickets for each emulsion delivery. Include certification from manufacturer that emulsion meets specifications.

3. Submit oil quantities in CONTRACTOR's emulsion storage tankers prior to transfer, after transfer and at the end of each working day.

1.4 **QUALITY ASSURANCE**

A. Foreman of paving crew has completed at least three (3) projects of similar scope.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. Verify mixture delivered to site contains the same emulsion specified in the mix design

D. Do not change source of asphalt emulsion or aggregate without supporting changes in the mix design.

E. Reject product that does ot meet requirements.

1.5 **WEATHER**

A. Temperature:

1. Apply seal coat when air and pavement surface temperatures in the shade are 45 deg F and rising.

2. Cease application if air or pavement temperatures are below 55 deg F and falling or if the finished product will freeze before 24 hours.

B. Moisture and Wind:

1. Do not apply seal coat to a wet surface (no visible standing water or high sheen), during rain, if humidity prolongs curing, or in unsuitable windy weather.

2. Cease work if weather or other conditions prolong opening pavement surface to traffic.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least three (3) days before applying seal coat.

B. Indicate application time and when new surface can be used. If necessary, include a map showing closed-off areas.

C. Provide phone numbers of at least two (2) individuals who represent the CONTRACTOR who can be reached at any time during the work.

D. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

E. Should work not occur on specified day, issue an updated notice advising when work will be performed.

1.7 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring compling material as part of its installation, Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

4. Opening surface treatment to traffic does not constitute acceptance.

5. Observation of CONTRACTOR’s field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Asphalt Binder**:

1. Lot size is total contracted product placement. Sub-lot size is one (1) day production.

2. Of all sub-lot samples collected, randomly select one sub-lot and test it for the physical properties in this section The lot is acceptable if tests on this sub-lot sample meets requirements. If the sample does not meet requirements, continue testing other samples for a sample that complies.

3. Pay Reduction: At ENGINEER's discretion, a lot with a defieient sub-lot test may be accepted if pay for the lot is reduced using one of the following applicable pay factors, or lot may be accepted at 50 percent pay if lot is in Reject

Pay Factor	Number of Non-complying Tests
1.00	0
0.95	1
0.90	2
0.85	3
Reject	4

C. **Aggregate**: Lot size is one (1) day's production with 300 tons sub-lots. Collect Samples randomly before mixing. Test gradation, ASTM C 136. Test thickness. Lot will be acceptable if:

1. Average gradation of each sieve for the Lot is within the Target Grading Band for that sieve, and
2. Number of Samples in the Lot with any sieve measurement outside of the Target Grading Band does not exceed two (2), and
3. Material on 200 sieve does not exceed allowable.
4. Price Adjustment: Aggregate gradation defects may be accepted if 2.5 percent price reduction is applied against lot for each condition not met. Maximum price reduction for a lot is five (5) percent.

D. **Placement**:

1. Mat Appearance:
   a. No runoff onto concrete curbs, gutter pans, and shoulders.
   b. No streaking, drag marks or squeegee marks.
   c. No light spots.
   d. No de-bonding.
   e. Straight longitudinal edges with proper joints.
2. Price Adjustment: Not applicable. Correct deficiencies at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

A. Crack Pouring Asphalt: Rubberized asphalt or asphalt rubber hot pour, Section 32 01 17.

B. Tack Coat: SS-1 or CSS-1, Section 32 12 13.13. Use a tack coat that is compatible with seal coat application.

C. Emulsified Asphalt: Unless specified elsewhere provide CQS-1h quick traffic type, ASTM D3628 with a two (2) hour return to traffic quickset. Provide the following properties.

Table 1 – Physical Properties				
	Standard	Target	Min	Max
Tests on Emulsion				
Viscosity at 25 deg C, second	D 244	32	15	90
Sieve test, percent		0.01	--	0.30
Settlement, 5 day, percent		3.5	--	5
Storage stability, 1 day, percent		0.6	--	1
Residue by distillation, percent		64.2	60	--
Tests on Residue from Evaporation				
Penetration at 25^{O} C, 0.1 mm	D 5	51	40	90
Softening point, deg. C.	D 36	60	57	--
Kinematic viscosity, cSt/sec	D 2170	--	650	--
Saybolt furol viscosity at 77^{O} F., seconds		--	--	50
Polymer solids based on mass of residual asphalt, percent	--	3 to 6	3	--
NOTES (a) Polymer is a solid synthetic rubber or latex material. (b) Cement mixing test waived. (c) Polymer solids are to be milled or blended into the asphalt or emulsifier solution before the emulsification process.				

2.2 **AGGREGATE**

A. **Material**: Stone, slag, or other high quality particle or combination clean and free from organic matter or other detrimental substances with the following properties.

Table 2 – Aggregate Properties				
		Standard	Min	Max
Angularity (fractured faces), percent		D 5821	80	--
Wear (hardness or toughness), percent		C 131	--	35
Soundness (weight loss in 5 cycles), percent		C 88	--	10
Clay content (sand equivalent), percent	SS Type I	D 2419	45	--
	SS Type II	D 2419	55	--
	SS Type III	D 2419	60	--
Polishing, BPN		D 3319	28	--
Water absorption, percent		--	--	1.25
NOTES (a) Angularity of aggregate retained on No. 4 sieve with at least one (1) mechanically fractured face or clean angular face. Provide 100 percent (maximum) for thoroughfares with a Road Class III (Section 32 12 05). (b) Wear of aggregate retained on No. 12 sieve after 500 revolutions. (c) Soundness for combined coarse and fine aggregate measured using five (5) cycles Na_2SO_4. (d) Clay content before additives.				

1. Material passing any sieve and retained on the next consecutive sieve is 45 percent maximum.

2. Target Grading Curve must lie within one (1) of the following Master Grading Bands. Field Samples shall not vary from the Target Grading Curve by more than the Target Tolerance.

Table 3 – Master Grading Band and Target Tolerance Limits					
Sieve	Standard	Master Grading Band Limits Percent Passing			Target Tolerance
		SS Type I	SS Type II	SS Type III	
3/8 in.	C136	--	100	100	--
No. 4		100	90 - 100	70 - 90	+/- 5
No. 8		90 - 100	65 - 90	45 - 70	+/- 5
No. 16		65 - 90	45 - 70	28 - 50	+/- 5
No. 30		40 - 65	30 - 50	19 - 34	+/- 5
No. 50		25 - 42	18 - 30	12 - 28	+/- 4
No. 100		15 - 30	10 - 21	7 - 18	+/- 3
No. 200	C117	10 - 20	6 - 15	5 - 15	+/- 2
NOTES (a) Target tolerance is the allowable variation from the Target Grading Curve. (b) Portion retained on the No. 4 sieve clean and free of clay coatings. (c) Portion passing No. 200 sieve includes mineral filler.					

2.3 **ADDITIVES**

A. Use water that is clean, non-detrimental, and free from salts and contaminant.

B. Mineral Filler: ASTM D242.

C. Portland cement, hydrated lime, limestone dust, fly ash, or aluminum sulfate to regulate setting time and improve workability.

D. Limestone dust, fly ash, and rock dust to alter aggregate gradation.

2.4 **MIX DESIGN**

A. Asphalt Binder: Select type and grade of emulsified asphalt, ASTM D3628.

B. Proportioning: Use the consistency test of ASTM D3910 to determine optimum ratio of aggregate, filler, water, and emulsion.

C. Set and Cure Time: Select to meet opening to traffic requirements.

D. Stripping: More than 90 percent of bituminous-coated particles retain asphalt coating, ASTM D1664.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Paver: Use a continuous-flow mixing unit:

1. Capable of applying at least 15,000 square yards of material per day.

2. Capable of accurately delivering a predetermined portion of aggregate, water, and asphalt emulsion to the mixing chamber.

3. Prevent loss of slurry from the distributor by using a mechanical type squeegee distributor equipped with flexible material in contact with the pavement surface.

4. Has a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the mix design application rate.

3.2 **PREPARATION**

A. **Meter Calibration**: On a test strip at least 500 feet long, determine the correct meter settings on the mixing equipment. The settings are to produce a product that complies with the following:

1. Set time 30 minutes maximum. Initial set occurs when blotting the surface of the material yields only water (no emulsion).

2. No distress when exposed to traffic two (2) hours after placement.

B. **Surface Repair**: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.

2. Providing tack coat on highly absorbent, polished, oxidized, or raveled bituminous pavement or on brick or on Portland cement concrete surfaces.

3. Crack filling and crack sealing, Section 32 01 17.

4. Pushing or shoving pavement to be repaired as follows.

a. Mill damaged area at least three (3) inches below required surface elevation. Section 32 01 16.71

b. Install and compact PG64-22, DM-3/4, 50 blow bituminous concrete in lifts not less than three (3) inches after compaction. See additional requirements in Section 33 05 25.

C. **Masking**: Mask-off Street Fixtures, end of streets, intersections.

D. **Traffic Control**:

1. Implement traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without flaggers if work requires maintaining two-way vehicular traffic.

2. Grind off existing pavement markings and lane stripes. If existing markings and stripes are to be reestablished, use reflective tabs to mark existing locations before applying seal coat. Unless specified otherwise, cost is included in the work of this section.

E. **Cleaning**:

1. Remove loose material that may cause drag marks.

2. Remove mud spots, sand, dust, oil, vegetation, and other objectionable material.

3. Do not flush water, or apply pressurized water over cracked pavement unless ENGINEER allows its' use and a sufficient time is allowed for drying.

3.3 PROTECTION

A. Trees, Plant, Ground Cover:

1. Protect trees, plants, and other ground cover from damage.

2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage to no additional cost to OWNER.

B. Protect structures, curb, gutter, sidewalks, guard rails, guide posts, etc. from physical damage.

3.4 APPLICATION

A. General:

1. Machine meter settings must match mix design. Water and additives may be adjusted (per mix design) for better consistency or set time.

2. Wait at least two (2) hours if an adjacent pass has broken and started to cure.

3. The seal coat, when cured shall present a uniform, skid-resistant appearance with all cracks filled.

4. Do not apply lane marking tape or paint for traffic control until layout and placement has been verified with ENGINEER.

B. In the Spreader Box:

1. Do not exceed four (4) minutes total mixing time.

2. No additional water.

3. No lumping, balling or unmixed aggregate.

4. No segregation of the emulsion and aggregate fines from the coarse aggregate.

5. No breaking of emulsion.

6. No overloading. Carry a sufficient amount of slurry in all parts of the spreader box for complete coverage.

C. Spreading:

1. Dampen surface immediately before application of surface treatment (prevents premature breaking and improves bonding). All surfaces are to be uniformly damp with no free water standing on the surface or in cracks.
2. Keep material delivery at a constant rate even if forward speed lay-down machine varies.
3. Do not reduce application rate along edges or around manhole covers.
4. Apply seal coat right to the edge of the pavement. Do not leave uncovered areas near curbs, Street Fixtures, or edges.
5. Make straight lines at all locations.
6. Place seal coat out to right-of-way line on side streets and intersections.
7. Use hand squeegees to spread mix in areas that cannot be reached with distribution spray bar.
   a. Provide complete and uniform coverage.
   b. Avoid unsightly appearance from hand work.
8. If coarse aggregate settles to bottom of mix, remove slurry from pavement.

D. Joints:

1. Make transverse joints straight-cut butt type, not over-lap type.
2. Place longitudinal joints on lane lines. Limit overlap to three (3) inches maximum.
3. Tolerance for joint match is 1/4 inch difference in elevation when measured with a 10 feet long straight edge over the joint.
4. Stop and correct paving operation if longitudinal or transverse joints have uncovered areas or unsightly appearance.

E. Lines

1. Make straight lines along lip of gutter, shoulders end of streets, and in street intersections. No runoff on these areas will be permitted.
2. Vary edge lines no more than one (1) inch per 100 feet.

3.5 **TOLERANCES**

A. Thickness: Measured in pounds per square yard. Standard application rate applies unless specified elsewhere.

Slurry	Standard	Heavy
SS Type I	8 to 12	10 to 13
SS Type II	12 to 16	15 to 18
SS Type III	15 to 18	22 to 25

3.6 **FIELD QUALITY CONTROL**

A. Emulsion density testing, ASTM D6937. If testing shows material non-compliance, remove installed product and halt operations until new material is delivered and is known to be in compliance.

B. If an ASTM C136 sieve analysis shows aggregate gradation non-compliance, either remove the material or blend in other aggregates to bring it into compliance. This may require a new mix design. Screening may be required at the stockpile to remove any defective material.

C. Measure the total amounts of material installed, and verify it meets the application rate. Make all emulsion deliveries in the presence of OWNER's representative.

3.7 **AFTER APPLICATION**

A. Raise reflective tabs that were covered over by application.

B. Clean Street Fixtures.

C. Leave no streaks caused by oversized aggregate particles or buildup on squeegees.

D. Leave no holes, bare spots, or cracks. The seal coat shall be uniform and skid-resistant when cured.

E. Do not apply permanent pavement markings or stripe material until layout and method of payment has been determined by ENGINEER and final application of seal coat has been in-place at least 10 days, or as permitted by ENGINEER. Layout must be verified by ENGINEER prior to application.

3.8 **REPAIR**

A. Remove delaminated or non-compliant product found after installation and apply acceptable product.

B. Remove spatter, mar and overcoat from curb, gutter, sidewalk, guard rails, guide posts, etc.

C. Remove overcoat from Street Fixtures.

D. Make edge and end lines straight. Provide good appearance.

E. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement.

F. Repair collateral damage caused by construction.

3.9 **OPENING TO TRAFFIC**

A. Cure time depends on type of asphalt, mixture characteristics and weather. Keep traffic off of treated surface until seal coat does not track-out.

END OF SECTION

SECTION 32 01 13.64
CHIP SEAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphalt binder and cover aggregate evenly spread as a uniform, skid-resistant seal coat on roadways and thoroughfares.

B. Application of a slurry seal over a chip seal (cape seal) if specified.

1.2 REFERENCES

A. **ASTM Standards**:

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C117 Amount of Material Finer Than 0.075 mm Sieve in Aggregate.

C131 Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C136 Sieve Analysis of Fine and Coarse Aggregates.

C142 Clay Lumps and Friable Particles in Aggregates.

D5 Penetration of Bituminous Materials

D36 Softening Point of Bitumen (Ring and Ball Apparatues).

D242 Mineral Filler for Bituminous Paving Mixtures.

D1664 Coating and Stripping of Bitumen-Aggregate Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

D2419 Sand Equivalent Vlue of Soils and Fine Aggregate

D3319 Accelerated Polishing of Aggregates Using the British Wheel.

D3628 Selection and Use of Emulsified Asphalts.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D3910 Design, Testing, and Construction of Slurry Seal.

D4791 Flat or Elongated Particles in Coarse Aggregate.

D5821 Determining the percentage of Fractured Particles in Coarse Aggregate.

1.3 SUBMITTALS

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal. Do not mix aggregate and emulsions designated for other public or private projects.

1. Date of mix design. If older than 60 days from date of submission, recertify mix design.
2. Type and grade of asphalt binder to be used (if not specified).
3. Target Grading Curve for aggregate.
4. Asphalt and aggregate compatibility.
5. Asphalt additives.
6. Asphalt and aggregate application rates.
7. Aggregate physical properties (this section article 2.3). The information is for suitability of source and not for project control. Test results shall not be older than 455 days from the date of submission.

B. **Before Placement**: Submit 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.
2. List of construction equipment to be used.

3. Certification from emulsion supplier stating emulsion meets requirements in this section.

C. **After Installation:** Submit the asphalt bill of lading. Identify weight of asphalt, weight of emulsified asphalt (after water has been added).

D. **Reports**: If requested by ENGINEER, submit source and field quality control testing reports performed by CONTRACTOR and Suppliers.

1.4 **QUALITY ASSURANCE**

A. Foreman of CONTRACTOR's crew has completed at least three (3) projects of similar scope.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. Do not change source of asphalt emulsion or aggregate without supporting changes in the mix design.

D. Reject product that does not meet requirements.

1.5 **WEATHER**

A. Temperature:

1. Apply seal coat when air and pavement surface temperatures in the shade are 70 deg F and rising.

2. Allow four (4) weeks of warm weather cure time. This generally limits performance of work from May 15 to August 31.

3. Do not apply seal coat if pavement surface is above 120 deg F

B. Moisture and Wind: Do not apply seal coat during rain, if humidity prolongs curing, or in unsuitable windy weather.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least three (3) days before applying seal coat.

B. Indicate application time and when new surface can be used. If necessary, include a map showing closed-off areas.

C. Provide phone numbers of at least two (2) individuals who represent the CONTRACTOR who can be reached at any time during the work.

D. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

E. Should work not occur on specified day, issue an updated notice advising when work will be performed.

1.7 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring seal coat as part of its installation. Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

4. Opening chip seal surface to traffic does not constitute acceptance.

5. Observation of CONTRACTOR’s field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Asphalt Binder**:

1. Lot size is total contracted product placement. Sub-lot size is one (1) day production.

2. Of all sub-lot samples collected, randomly select one sub-lot and test it for the physical properties in this section. The Lot is acceptable if tests on this sub-lot sample meets requirements. If the sample does not meet requirements, continue testing other samples for a sample that complies.

3. Pay Reduction: At ENGINEER's discretion, a lot with deficient sub-lot tests may be accepted if pay for lot is reduced using one of the following applicable pay factors, or lot may be accepted at 50 percent pay if lot is in Reject.

Pay Factor	Number of Non-complying Tests
1.00	0
0.95	1
0.90	2
0.85	3
Reject	4

C. **Aggregate**: Verify suitability of aggregate source

1. Lot size is one (1) day production with 500 tons sub-lots. Collect samples randomly from the hauling equipment. Test gradation, ASTM C 136. Lot will be acceptable if:

a. Average gradation of each sieve for lot is within the Target Grading Band for that sieve, and

b. Number of samples in lot with any sieve measurement outside of the Target Grading Band does not exceed two (2), and

c. Material on 200 sieve gradation does not exceed allowable.

2. Price Adjustment: Aggregate gradation defect may be accepted if 2.5 percent pay factor is applied against lot for each condition not met. If a lot has multiple defective sub-lots, maximum cumulative pay factor for a lot is five (5) percent.

D. **Placement**:

1. Asphalt Binder:

a. No runoff onto concrete curbs, gutter pans, shoulders, etc.

b. No streaking, drilling, bare spots.

c. No light spots.

d. Uniform with no ridging.

2. Aggregate:

a. Asphalt See-through: Not more than 15 percent black (asphalt) can be seen through the newly laid and compacted rock chip after sweeping.

b. Embedment: After rolling and evaporation, random sampling reveals large particles are embedded in the asphalt binder on their flat side to a depth of 50 percent to 70 percent.

3. Pay Adjustment: Not applicable. Correct deficiencies at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 BINDER

A. Crack Pouring Asphalt: Rubberized asphalt or asphalt rubber hot pour, Section 32 01 17.

B. Emulsified Asphalt: Cationic or anionic emulsion, Section 32 12 03. Use any of the following additives to match aggregate particle charge, weather conditions, and mix design:

1. Anti-strip: To change or neutralize particle charges.

2. Enhancer: To promote greater film thickness on the aggregate.

3. High Float Agent: To improve temperature susceptibility of the asphalt and impart a gel structure to the asphalt.

4. Polymer: To reduce stripping, improve coating, decrease temperature susceptibility and increase stability of mix.

5. Rejuvenator: To adjust penetration of base asphalt or soften reclaimed asphalt.

2.2 COVER AGGREGATE

A. Material: 100 percent crushed stone, slag or other high quality particle or combination. Clean and free from organic matter or other detrimental substances with the following properties.

Table 1 – Physical Properties			
	Standard	**Min**	**Max**
Dry-unit weight (rodded), lb/ft^3	C 29	--	100
Wear (hardness or toughness), percent	C 131		30
Angularity (2 fractured or angular faces), percent	D 5821	60	--
Soundness (weight loss), percent	C 88	--	12
Polishing, BPN	D 3319	30	--
Flats or elongates (1:3 ratio), percent	D 4791	--	10
Friable particles, percent	C 142	--	3
NOTES (a) Wear of aggregate retained on No. 8 sieve. (b) Soundness for combined coarse and fine aggregate measured using five (5) cycles Na_2SO_4.			

B. Gradation: Analysed on a dry weight and percent passing basis and graded as follows.

Table 2 – Master Grading Band				
Sieve	**Standard**	**Grade A**	**Grade B**	**Grade C**
1/2 in.	C 136	100	–	100
3/8 in.		85 – 100	–	70 – 90
No. 4		0 – 20	–	0 – 5
No. 8		0 – 5	85 – 100	0 – 3
No. 16		–	10 – 25	–
No. 50		–	0 – 5	–
No. 200	C 117	0 – 1	0 – 2	0 – 2
NOTES (a) Portion retained on No. 4 sieve clean and free of clay coatings. (b) Material passing any sieve and retained on the next consecutive sieve is 45 percent maximum. (c) Portion passing No. 200 sieve includes mineral filler, ASTM C117.				

2.3 **MIX DESIGN**

A. Select type and grade of emulsified asphalt, ASTM D3628.

B. Determine asphalt application rate based upon achieving an aggregate embedment of 50 to 70 percent.

Note: It is difficult to get adequate embedment of 3/8 inch aggregate with an asphalt application rate of 0.30 gallons per square yard.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Distributor Truck: Use triple overpass distributor bar setting. Apply asphalt binder uniformly (no drilling).

B. Aggregate Spreader: Variable width up to 20 feet in a single pass. Distribution varies no more than one (1) pound per yard.

C. Rollers: Rubber tire pneumatic with a gross load adjustable to apply 200 to 250 pounds per inch of rolling width.

3.2 **PREPARATION**

A. Equipment Calibration:

1. Do not begin or continue application without ENGINEER's knowledge of the calibration process and equipment settings.

2. Do not deviate from calibration settings without ENGINEER's knowledge.

B. Surface Repair: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.

2. Providing tack coat on highly absorbent, polished, oxidized, or raveled bituminous pavement or on brick or Portland cement concrete surfaces.

3. Crack filling and crack sealing, Section 32 01 17.

4. Pushing or shoving pavement to be repaired as follows.

a. Mill damaged area at least three (3) inches below required surface elevation. Section 32 01 16.71

b. Install and compact PG 64-22, DM-3/4, 50 blow bituminous concrete in lifts not less than three (3) inches after compaction. See additional requirements in Section 33 05 25.

C. Masking: Mask-off Street Fixtures, end of streets, intersections.

D. Traffic Control:

1. Implement traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without flaggers if work requires maintaining two-way vehicular traffic.

2. Grind off existing pavement markings and lane stripes. If existing markings and stripes are to be reestablished, use reflective tabs to mark existing locations before applying seal coat. Unless specified otherwise, cost is included in the work of this section.

E. Cleaning:

1. Remove loose material, mud spots, sand, dust, oil, vegetation, and other objectionable material.

2. Do not flush water or apply pressurized water over cracked pavement unless ENGINEER allows its' use and a sufficient time is allowed for drying.

3.3 **PROTECTION**

A. Trees Plants, Ground Cover;

1. Protect trees, plants and other ground cover from damage.

2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect structures, curb, gutter, sidewalks guard rails, guide posts, etc. from physical damage.

3.4 **APPLICATION**

A. General: Wait at least seven (7) days before placing chip seal on new bituminous surfaces

B. Asphalt Emulsion: Keep viscosity between 50 and 100 centistokes, ASTM D2170 during application

1. Make straight lines along lip of gutter and shoulders, end of streets and in street intersections. No runoff onto these areas will be permitted.

2. Leave no holes, bare spots, or cracks.

3. Vary edge lines no more than one (1) inch per 100 feet.

4. Protect curb, gutter, and sidewalk from spatter, mar, or overcoat.

C. Chips: Apply aggregate within +1 to –2 pounds per square yard of mix design:

1. For polymer and latex modified emulsions, apply chips immediately.

2. For other emulsions, maintain a distance of not more than 100 feet between distributor and chip spreader.

3. Use a damp chip but not saturated. (Note. If water can be seen running out of the haul truck, the chips are too wet).

4. Spread larger aggregate first.

5. Hand broom cover material if necessary to distribute the aggregate uniformly over Pavement surface.

D. Blotting: If bleeding occurs, apply a blend of 25 to 50 percent hydrated lime with sand (blotting material). Use sand to cool chips.

3.5 **ROLLING**

A. Use a rubber tire roller to seat aggregate. Apply at least two (2) complete rolling coverage.

B. Complete rolling before the bituminous material cools or hardens.

C. Keep traffic off at least four (4) hours or until moisture leaves remaining chips. Sweep surface before allowing uncontrolled traffic on chips.

3.6 **FOG SEAL**

A. If a fog seal is specified, see Section 32 01 13.50.

B. Apply within 24 hours of placing chips. Keep viscosity between 50 and 100 centistokes during application, ASTM D2170.

3.7 **CAPE SEAL**

A. If a cape seal is specified, remove loose chips (by sweeping), fog the chip seal surface with water, and apply slurry seal, Section 32 01 13.61 within 48 hours of chip seal application.

3.8 **FIELD QUALITY CONTROL**

A. Emulsion density testing, ASTM D6937. If testing shows material non-compliance, halt operations, remove installed product and install new material known to be in compliance.

B. Measure the total amounts of material installed, and verify it meets the application rate.

3.9 **AFTER APPLICATION**

A. Raise reflective tabs that were covered over by application.

B. Clean Street Fixtures.

C. Do not apply permanent pavement markings or stripe material until layout and method of payment has been determined by ENGINEER and final application of seal coat has been in-place at least 14 days, or as permitted otherwise by ENGINEER. Layout must be verified by ENGINEER prior to application.

3.10 **REPAIR**

A. Remove non-compliant product found after installation and apply acceptable product.

B. Remove spatter, mar and overcoat from curb, gutter, sidewalk, guard rails, guide posts, etc.

C. Remove overcoat from Street Fixtures.

D. Make edge and end lines straight. Provide a good appearance.

E. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying Pavement.

F. Repair collateral damage caused by construction.

END OF SECTION

SECTION 32 01 13.69
MICRO-SURFACE SEAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stone and an asphalt binder slurry evenly mixed and spread in variably thick cross-sections as a seal coat for roadways and thoroughfares.

1.2 REFERENCES

A. ASTM Standards:

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C117 Amount of Material Finer Than 0.075 mm Sieve in Aggregate.

C131 Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C136 Sieve Analysis of Fine and Coarse Aggregates.

C142 Clay Lumps and Friable Particles in Aggregates.

D5 Penetration of Bituminous Materials.

D36 Softening Point of Bitumen (Ring-and-Ball Apparatus).

D242 Mineral Filler for Bituminous Paving Mixtures.

D244 Emulsified Asphalts.

D1664 Coating and Stripping of Bitumen-Aggregate Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D3319 Accelerated Polishing of Aggregates Using the British Wheel.

D3628 Selection and Use of Emulsified Asphalts.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D3910 Design, Testing, and Construction of Slurry Seal.

D4791 Flat or Elongated Particles in Coarse Aggregate.

D5821 Determining the percentage of Fractured Particles in Coarse Aggregate.

1.3 SUBMITTALS

A. **Mix design**. Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Target Grading Curve for aggregate.
3. Percentages of emulsion, aggregate, water and additives in the mix.
4. Emulsion type and time target for opening up a thoroughfare to traffic.
5. Results of asphalt stripping test and wet track abrasion test.
6. Type and minimum amount of polymer solids to be incorporated in the asphalt emulsion by the Supplier. (in general, three (3) percent based on asphalt weight is considered minimum).
7. Identity of additives added to the emulsion mix or to any of the component materials for control of the quick traffic properties.
8. Slurry application rate.

9. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **Before Placement**: Submit at least 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.

2. List of the construction equipment to be used.

3. Aggregate hardness, soundness and polishing test results (this section article 2.2). Aggregate analysis to be no more than 180 days old.

4. Meter settings for micro-surfacing machine. Previously determined settings for the meters may be submitted providing such determinations are no more than 180 days old and the materials used in such determinations match those specified herein.

5. Test results of five (5) day settlement test, ASTM D244 on emulsions stockpiled longer than 36 hours by CONTRACTOR. This submittal may be waived, providing the CONTRACTOR's storage unit has continuous mixing capability, or the emulsion has had additional emulsion blended into it before use.

6. Certificate by emulsion supplier identifying:

a. the mix design for which the emulsion is formulated.

b. the emulsion meets requirements of this section article 2.1.

c. the type of polymer modifier added to the emulsion.

d. the amount of polymer modifier added to the emulsion.

7. Asphalt Bill of Lading: Identify weight of asphalt, weight of emulsified asphalt (after water has been added and that Asphalt Binder complies with Section 32 12 03 requirements).

C. **Reports**: If requested by ENGINEER, submit report of source and field quality control testing performed by CONTRACTOR and Suppliers.

1.4 **QUALITY ASSURANCE**

A. Foreman of CONTRACTOR's crew has completed at least three (3) projects of similar scope.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. Verify asphalt emulsion delivered to site is the same emulsin specified in the mix design.

D. Do not change source of asphalt emulsion or aggregate without supporting changes in the mix design.

E. Reject product that does not meet requirements.

1.5 **WEATHER**

A. Temperature:

1. Apply seal coat when air and pavement surface temperatures in the shade are 45 deg F and rising.

2. Do not apply seal coat if air or pavement surface is below 55 deg F and falling or if the finished product will freeze before 24 hours.

B. Moisture and Wind: Do not apply seal coat to a wet surface, (no visible standing water or high sheen), during rain, if humidity prolongs curing, or in unsuitable windy weather.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least three (3) days before applying new seal coat.

B. Indicate application time and when new surface can be used. If necessary, include a map showing closed-off areas.

C. Provide phone numbers of at least two (2) individuals who represent the CONTRACTOR who can be reached at any time during the work.

D. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

E. Should work not occur on specified day, issue an updated notice advising when work will be performed.

1.7 **ACCEPTANCE**

A. General:

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring seal coat material as part of its installation. Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

4. Opening new seal coat to traffic does not constitute acceptance.

5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Mix Design**: Use the following as a guide in evaluating the mix design.

1. Residual Asphalt: 5.5 to 10.5 percent by dry weight of aggregate.

2. Mineral Filler: 0 to 3 percent by dry weight of aggregate.

3. Polymer Based Modifier: Less tha 3 percent solids based on bitumen weight content.

4. Sand Equivalency: Control of set time.

C. **Asphalt Binder**:

1. Lot size is total contracted material placement. Sub-lot size is one (1) day production.

2. Of all sub-lot samples collected, randomly select one sub-lot and test it for the physical properties in this section. The lot is acceptable if tests on this sub-lot sample meets requirements. If the sample does not meet requirements, continue testing other samples for a sample that complies.

3. Pay Reduction: At ENGINEER's discretion, a lot with a deficient sub-lot tests may be accepted if pay for the lot is reduced using one of the following applicable pay factors, or lot may be accepted at 50 percent pay if lot is in Reject.

Pay Factor	**Number of Non-complying Tests**
1.00	0
0.95	1
0.90	2
0.85	3
Reject	4

D. **Aggregate**:

1. Lot size is one (1) day production with 500 tons sub-lots.

2. Collect samples randomly from mixing equipment and test gradation, ASTM C136. Lot will be acceptable if:

a. Average gradation of each sieve for the lot is within Target Grading Band for that sieve, and

b. Number of Samples in lot with any sieve measurement outside of Target Grading Band does not exceed two (2), and

c. No sample varies from Target Grading Band by more than target tolerance on any one (1) sieve.

3. Price Adjustment: Aggregate gradation defects may be accepted if a 2.5 percent price reduction is applied against the Lot for each condition not met. Maximum price reduction for the Lot is five (5) percent.

E. **Mat Appearance**: Correct deficiencies at no cost to OWNER.

1. No runoff onto concrete curbs, gutter pans, and shoulders.

2. No streaking, drag marks or squeegee marks.

3. No light spots.

4. No de-bonding.

5. Straight longitudinal edges with proper joints.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

A. Crack Pouring Asphalt: Rubberized asphalt or asphalt rubber hot pour, Section 32 01 17.

B. Tack Coat: SS-1 or CSS-1, Section 32 12 13.13. Use a tack coat that is compatible with seal coat application.

C. Emulsified asphalt: CSS-1h quick-traffic type, ASTM D3628 with a two (2) hour return to traffic quickset. The use of polymer solids is CONTRACTOR's choice.

Table 1 – Asphalt Binder Properties

	Standard	Target	Min	Max
Tests on emulsion				
Viscosity at 25 deg C, SSF	D244	32	15	90
Sieve test, percent	D244	0.01	--	0.30
Settlement, 5 day, percent	D244	3.5	--	5
Storage stability, 1 day, percent	D244	0.6	--	1
Residue by distillation	D244	64.2	62	--
Tests on residue from evaporation				
Penetration at 25 deg C, 0.1mm	D140	51	40	90
Softening point, deg C	D36	60	57	--
Kinematic viscosity, cSt/sec	D2170	--	650	--
Saybolt furol viscosity at 77 deg F, cSt/sec	D2170	--	--	50
Polymer solids based on mass of residual asphalt, percent	--	3 to 6	3	--

NOTES

(a) Cement mixing test waived.

(b) Polymer solids are to be milled or blended into the asphalt or emulsifier solution before the emulsification process.

2.2 AGGREGATE

A. **Material**:

1. Clean and free from organic matter or other detrimental substances.

2. Stone, slag or other high quality particle or combination, 100 percent crushed with the following physical properties.

Table 2 – Aggregate Properties				
		Standard	Max	Min
Angularity (fractured faces), percent		D5821	80	--
Wear (hardness or toughness), percent		C131	--	30
Soundness (weight loss in 5 cycles), percent	Na_2SO_4	C88	--	15
	Mg_2SO_4	C88	--	25
Clay content (sand equivalent), percent		D2419	65	--
Polishing, BPN		D3319	35	--
NOTES (a) Angularity of aggregate retained on No. 4 sieve with at least one (1) mechanically fractured face or clean angular face. (b) Wear of aggregate retained on No. 8 sieve. (c) Soundness for combined coarse and fine aggregate. (d) Clay content before additives.				

B. **Gradation**: Analyzed by ASTM C136 on a dry weight and percent passing basis:

1. Material passing any sieve and retained on the next consecutive sieve is 45 percent maximum.
2. For heavy-duty surface applications use 100 percent crushed material.
3. Target Grading Curve must lie within one of the following Master Grading Bands. Field Samples shall not vary from the Target Grading Curve by more than the target tolerance.

Table 3 – Master Grading Band and Target Tolerance Limits			
Sieve	Master Grading Band		Target Tolerance
	Type II	Type III	
1/2 in.	–	100	–
3/8 in.	100	>85	+/- 5
No. 4	70 – 90	60 – 87	+/- 5
No. 8	45 – 70	40 – 60	+/- 5
No. 16	28 – 50	28 – 45	+/- 5
No. 30	19 – 34	19 – 34	+/- 5
No. 50	12 – 25	12 – 25	+/- 4
No. 100	7 – 18	7 – 18	+/- 3
No. 200	5 – 15	4 – 8	+/- 2
NOTES (a) Target tolerances is the allowable variation from the Target Grading Curve. (b) Portion retained on No. 4 sieve. • clean and free of clay coatings • more than 80 percent of the particles by weight, with at least 1 mechanically fractured face or clean angular face. (c) Portion passing No. 200 sieve includes mineral filler, ASTM C117.			

2.3 ADDITIVES

A. Use water that is clean, non-detrimental, free from salts and contaminant.

B. Mineral filler, ASTM D242.

C. Portland cement, hydrated lime, limestone dust, fly ash, or aluminum sulfate to regulate setting time and improve workability.

D. Limestone dust, fly ash, and rock dust to alter aggregate gradation.

2.4 **MIX DESIGN**

A. Proportioning: Using procedures for mix design developed by the International Slurry Surfacing Association, determine the proportions of aggregate, mineral filler (minimum and maximum), water (minimum and maximum), polymer modified asphalt emulsion, and additives in the mix.

B. Set and Cure Time: Select to meet opening to traffic requirements.

C. Striping: More than 90 percent of bituminous-coated particles retain asphalt coating, ASTM D1664.

D. Wet Track Abrasion: ASTM D3910.

1. 50 grams per square foot maximum in a one (1) hour soak, and
2. 75 grams per square foot maximum in a six (6) day soak.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Mixing Equipment: Use a storage and mixing device capable of accurately proportioning and delivering aggregate, emulsified asphalt, mineral filler, additive, and water on a continuous flow basis to a spreader box. Mixing equipment must perform as follows.

1. Capable of applying at least 15,000 square yards per day.
2. Equipped with proportioning devices based upon either volume or weight control.
3. Its' mixer is to be a multi-blade, multi-shaft unit:
   a. Autonomous if lay-downs are longer than 600 feet.
   b. Truck mounted is permitted for lay-downs less than 600 feet.

B. Spreader:

1. Equipped with a spreader box that has a front seal so no loss of mixture occurs at road contact and an adjustable rear seal to act as a final strike-off device.
2. Equipped with a secondary strike-off device to improve surface texture.

C. Rut Filling Box: Wide enough to bridge ruts.

3.2 **PREPARATION**

A. **Meter Calibration**: On a test strip at least 500 feet long, determine the correct meter settings on the mixing equipment. Settings are to produce a product that complies with the following:

1. Thirty (30) minutes maximum initial set time. Initial set occurs when blotting of the seal coat yields only water (no emulsion).
2. No distress when exposed to traffic two (2) hours after placement.

B. **Surface Repair**: Method of payment to be determined by ENGINEER if any of the following are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
2. Providing tack coat on highly absorbent, polished, oxidized, or raveled bituminous pavement or on brick or portlnd cement concrete surfaces.
3. Crack filling and crack sealing, Section 32 01 17.
4. Pushing or shoving pavement to be repaired as follows.
   a. Mill damaged area at least three (3) inches below required surface elevation, Section 32 01 16.71.
   b. Install and compact PG64-22, DM-3/4, 50 blow bituminous concrete in lifts not less than three (3) inches after compaction. See additional requirements in Section 33 05 25.

C. **Masking**: Mask-off Street Fixtures, end of street, and intersections.

D. **Traffic Control**:

1. Implement traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without flaggers if work requires maintaining two-way vehicular traffic.

2. Grind off existing pavement markings and lane stripes. If existing markings and stripes are to be reestablished, use reflective tabs to mark existing locations before applying seal coat. Unless specified otherwise, cost of this work is included in the work of this section.

E. **Cleaning**:

1. Remove loose material, mud spots, sand, dust, oil, vegetation, and other objectionable material.

2. Do not flush water, or apply pressurized water over cracked pavement unless ENGINEER allows its' use and a sufficient time is allowed for drying.

3.3 **PROTECTION**

A. Trees, Plants, Ground Cover.

1. Protect trees, plants, and other ground cover from damage.

2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect structures, curb, gutter, sidewalk, guard rails, guide posts, etc. from physical damage.

3.4 **SPOT LEVELING**

A. Where rut deformation is less than 1/2 inch apply only amount of seal coat needed to level the surface (scratch course).

B. Where rut deformation exceeds 1/2 inch:

1. Mill high spots.

2. Use a rut-filling box.

3. Use multiple placements when ruts depth exceed 1-1/2 inches. For every inch of seal coat add 1/8th to 1/4 of an inch of material as a crown (allows for compaction under traffic).

4. Allow three (3) days cure time under traffic.

3.5 **APPLICATION**

A. **General**:

1. Machine meter settings must match mix design.

2. Pre-wet existing pavement surface to prevent premature breaking or to improve bonding.

3. Wait at least two (2) hours if an adjacent pass has broken and started to cure.

4. When cured, the seal coat shall present a uniform, skid-resistant appearance with all cracks filled.

B. **Additives**: During application, water and additives may be increased or decreased (per mix design) for better consistency or set time.

C. **In the Spreader Box**:

1. No spreading of material remaining in box when mixer is shut off.

2. No additional water added to the box.

3. No lumping, balling or unmixed aggregate.

4. No segregation of the emulsion and aggregate fines from the coarse aggregate.

5. No breaking of emulsion.

6. No overloading. Carry a sufficient amount of seal coat in all parts of the spreader for complete coverage.

D. **Spreading**:

1. Dampen surface immediately before seal coat application. All surfaces are to be uniformly damp with no free water standing on the surface or in cracks when seal coat is applied.

2. If coarse aggregate settles to bottom of mix, remove seal coat from pavement.

3. Butt joint adjacent lanes at edges and provide complete sealing at joint.

4. In areas where spreader box cannot be used, apply seal coat by hand.

E. **Joints**:

1. Make transverse joints straight-cut butt type, not over-lap type.

2. Place longitudinal joints on lane lines. Limit overlap to three (3) inches maximum.

3. Tolerance for joint match is 1/4 inch difference in elevation when measured with a 10 feet long straight edge over the joint.

4. Stop and correct paving operation if longitudinal or transverse joints have uncovered areas or unsightly appearance.

F. **Lines**:

1. Make straight lines along lip of gutter and shoulders. No runoff on these areas will be permitted. Remove if happens.

2. Vary edge lines no more than two (2) inches per 100 feet.

3.6 **TOLERANCES**

A. Type II aggregate thickness = **16 to 18 pounds per square yard**.

B. Type III aggregate thickness = **20 to 25 pounds per square yard**.

3.7 **FIELD QUALITY CONTROL**

A. If an ASTM C136 sieve analysis shows aggregate gradation non-compliant, either remove the material or blend in other aggregates to bring it into compliance. This may require a new mix design. Screening may be required at the stockpile to remove any defective materials.

B. Measure total amounts of material installed, and verify it meets the application rate.

3.8 **AFTER APPLICATION**

A. Raise reflective tabs that were covered over by application.

B. Clean Street Fixtures.

C. Do not apply pavement markings or stripe materials until layout and method of payment has been determined by ENGINEER and final application of seal coat has been in-place at least 14 days, or as permitted by ENGINEER. Layout must be verified by ENGINEER prior to marking applications.

D. If coarse aggregate settles to the bottom of the mix, remove and replace the application. When cured, the application shall be uniform and skid-resistant.

3.9 **REPAIR**

A. Remove spatter, mar, and overcoat from curb and gutter, sidewalk, guard rails and guide posts, etc.

B. Remove overcoat from Street Fixtures.

C. Make edge and end lines straight. Provide a good appearance.

D. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement.

E. Repair collateral damage caused by construction.

3.10 **OPENING TO TRAFFIC**

A. Cure time depends on type of asphalt, mixture characteristics, and weather. Keep traffic off of surface until seal coat material does not track-out.

END OF SECTION

SECTION 32 01 16.71

COLD MILLING BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Lower surface elevation of bituminous concrete Pavement by milling.

B. If grinding is required to smouth-out surface bumps or depressions refer to Section 32 01 26.

1.2 PAYMENT PROCEDURES

A. No payment for leveling course to correct over milling or for additional milling to correct shallow milling.

1.3 REFERENCES

A. **APWA (Utah) Standards:**

Plan 253 Bituminous concrete pavement overlay.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Arborist's certification.

C. Pre-milling profilographs for full width mills.

D. Redline drawings showing discovered existing utilities.

1.5 QUALITY ASSURANCE

A. Provide a person capable of calculating grades and cross-slopes in degrees and percentages. Cross slopes vary when the crown line is not parallel to pavement edge line.

1.6 SITE CONDITIONS

A. Existing Street Fixtures may have been paved over making them hidden (or buried). Locate and protect them. Failure to find them may result in damage to milling equipment. Repair damaged CONTRACTOR machinery and Street Fixtures at no cost to OWNER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Detector: Able to find Street Fixtures (utility frames and covers, valve boxes, etc.) that are buried under pavement surface.

B. Milling Machine:

1. Equipped to prevent air pollution.
2. Equipped with a system to control depth and slope of mill cut.

C. Cleaning equipment able to pick up millings and waste water.

3.2 PREPARATION

A. Notify neighborhood at least 48 hours before day and time of milling.

B. Coordinate utility locations, Section 01 31 13. Preserve all active utilities.

C. Implement traffic control plan requirements in Section 01 55 26.

D. Mark areas in the field that are to be milled. Mark existing utilities on redline drawings.

E. Use a detector to find hidden (or buried) Street Fixtures.

3.3 **PROTECTION**

A. Install Invert Covers, Section 01 71 13.

B. Lower utility frames, covers, and other Street Fixtures.

C. Trees may require pruning, Section 32 01 93. Avoid or minimize damage to tree branches. Provide certified arborist observation of tree branch cuts larger than four (4) inches diameter. Notify ENGINEER of such tree branch cut or damage.

D. CONTRACTOR is liable for any property damage due to loose material on pavement surface, vertical pavement cuts, drop-offs, etc.

E. Protect plant and animal habitat. Follow federal, state or local work permit requirements.

3.4 **MILLING**

A. If not indicated elsewhere meet cross slopes and depth of milling shown on APWA Plan 253.

B. Meet profile grade required or indicated by ENGINEER.

C. Do not disfigure adjacent work or existing surface improvements by accidentally cutting into them. Make appropriate repairs.

D. If milling exposes smooth underlying pavement surface, mill the smooth surface to make it rough.

E. Mill off additional material if standing water has a potential to accumulate or if surface has been damaged by water since beginning of milling operation.

F. Where vehicles or pedestrians must pass over milled edges provide safe temporary ramps suitable to speed of user vehicles (or suitable for wheel chair user needs).

G. Unless stipulated elsewhere, all residues from the milling process become property and responsibility of CONTRACTOR. Waste millings legally. Do not discharge millings into storm drains, ditches, or waters of the State.

H. If work equipment is removed from the milling site and milled surface awaits further work, provide appropriate traffic control and cleaning.

I. Notify ENGINEER when milling exposes weak or unstable surfaces. Verify extent of exposure by proof rolling at no additional cost to OWNER.

3.5 **TOLERANCES**

A. Milling Depth: As indicated plus or minus 10 percent not uniformly high or uniformly low.

B. Striation Texture: Uniform, discontinuous, longitudinal, 3/16 inch deep maximum, 3/4 inch center to center.

C. Smoothness:

1. On Longitudinal Grade: Plus or minus 5/16 inch in 25 feet.
2. At Longitudinal Grade Breaks: Plus or minus 1/4 inch in 10 feet.

D. Cross Slope:

1. In the Parking Lane: Two (2) percent target, five (5) percent maximum.
2. In the Travel Lane: Two (2) percent target, 1.5 percent minimum.

3.6 **FIELD QUALITY CONTROL**

A. Edge Mill: Verify cross slopes. Advise ENGINEER if a two (2) percent maximum break-over angle on an edge mill indicated on APWA Plan 253 cannot be achieved.

B. Full Width Mill:

1. Verify cross slopes. Advise ENGINEER if a four (4) percent maximum break-over angle on a full width mill indicated on APWA Plan 253 cannot be achieved.

2. On thoroughfares exceeding 25 mph use laser profiling to determine depth of milling along the proposed crown line or other breakover point.

3. Verify cut depth calculations with ENGINEER before milling.

3.7 **CLEANING**

A. Unless indicated elsewhere, all residues from the milling process become property and responsibility of CONTRACTOR. Waste millings legally. Do not discharge millings into storm drains, ditches, or waters of the State. Legally dispose of milled material.

END OF SECTION

SECTION 32 01 16.74

IN-PLACE HOT REUSED BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seamless repair of bituminous concrete pavement by applying evenly distributed heat over the pavement surface, then mixing and compacting the heated pavement in-place.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 254 Patch repair – in place hot reused bituminous paving.

1.3 SUBMITTALS

A. Manufacturer's product data, equipment and material specifications.

B. Traffic control plan, Section 01 55 26.

1.4 PERFORMANCE REQUIREMENTS

A. Use a method that does not burn the pavement surface or burn off any existing bituminous pavement volatiles.

PART 2 PRODUCTS

2.1 MATERIAL

A. Rejuvenating agent, bituminous concrete mix, and reclaimed RAP or ROSP aggregate.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Mark areas in the field that are to be repaired. Mark existing utilities on redline drawings.

C. Use a detector to find hidden (or buried) Street Fixtures.

3.2 REPAIRS

A. Apply heat to areas to be repaired:

1. Do not exceed a surface temperature of 350 deg F
2. Minimum surface temperature is as indicated in Section 32 12 16.13.

B. Follow APWA Plan 254 requirements. Mechanically scarify and thoroughly mix the repair area. Provide beveled sides.

C. Add and thoroughly mix additional bituminous material and rejuvenating agent as required to fill depressions, Potholes, or to match grade of adjacent pavement surfaces.

D. Screed and level the repair area in preparation for compaction and allow the material to become integral with edges of repair area.

E. Compact surface with a steel drum roller. Match the grade of the adjacent pavement after compaction. No longitudinal surface bumps allowed.

F. Cool repaired area to 150 deg F before opening to vehicular traffic.

G. Reapply heat and rework area in the case where bumps and depressions are present in finished surface.

H. Sweep up and dispose of excess material and debris.

I. Repair any damage at no additional cost to OWNER.

END OF SECTION

SECTION 32 01 17

SEALING CRACKS IN BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Filling and sealing cracks in bituminous concrete pavements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 265 Crack sealing. B. **ASTM Standards**:

D 36 Softening Point of Bitumen (Ring-and Ball Apparatus)

D 977 Emulsified Asphalt. D 2397 Cationic Emulsified Asphalt. D 6690 Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

D 5078 Crack Filler for Asphalt Concrete and Portland Cement Concrete Pavements.

D 5329 Sealants and Fillers, Hot-Applied for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.

D 8260 Hot-Applied Asphalt Aggregate-Filled Mastic.

1.3 DEFINITIONS

A. **Crack Sealing**: The placement of specialized crack sealing materials in or above cracks to prevent the intrusion of incompressibles and water into the crack. The crack receives unique crack configuration prepartion.

B. **Wide Crack Sealing**: The placement of specialized mastic materials in or above cracks greater tha 1 ½" to prevent the intrusion of incompressibles and water into the crack, adding structure and stability.

1.4 SUBMITTALS

A. Product Data sheets.

B. Demonstrate compliance with D 5078, D 8260, or D 6690 (Type I, II, III, or IV) as specified in project documents.

1.5 QUALITY ASSURANCE

A. Do not use crack repair product that has been over-heated or suffered prolonged heating according to manufacturer's recommendations, ravels, or can be pulled out by hand after placement.

B. Do not mix different manufacturer's brands or different types of crack repair material.

C. Do not allow crack repair product temperature at the point of placement to drop below the manufacturer's recommended application temperature during installation.

D. When loading product into product tank allow material to reach manufacturer's recommended application temperature prior to application.

E. Rework Defective Work.

1.6 NOTICE

A. Send written notice to residents and businesses within affected area at least three (3) days before preparation and application of Crack Sealing material.

B. Indicate date, time, and location of affected area and when it must be cleared of vehicles. Provide notice of when pavement surface can be used following application.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Send a new notice, at least one (1) day in advance, identifying the new starting date should work not occur on the specified day.

1.7 **ACCEPTANCE**

A. Visually inspect areas for adhesion Failure, damage to crack repair product, missed cracks, foreign objects in the product, or other problems that indicate work is not acceptable.

PART 2 PRODUCTS

2.1 **SEALER MATERIAL**

A. Follow Table 1.

Table 1 – Fillers and Sealers

Material Type	Standard	Application
Hot-applied		
Rubberized Asphalt	D 5078 D 6690	Sealing
Low Modulus Rubberized Asphalt	D 6690 (Type IV)	Sealing
Hot Applied Mastic	D 8260	Sealing
Chemically Cured		
Silicone	(a)	Sealing

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Sealant Heating Equipment: Indirect heating using double boiler or circulating hot oil heat transfer for heating product. Do not use direct heat transfer units (tar pots). Unit must have means of constant agitation.

B. Compressed Air Lance or Hot Air Lance: Provide clean, oil-free compressed air at a minimum volume of 90 cubic feet per minute at a pressure of 120 pounds per square inch.

C. Router: Use equipment sufficiently maneuverable to follow meandering cracks and that provides a uniform and controlled routing depth. Maintain bits that are sharp enough to create a clean cut.

3.2 **PREPARATION**

A. Allow at least one week for repaired cracks to cure and harden before placing thin overlays (chip seal, slurry seal, micro-surface, etc.).

B. Routing should be considered in areas with increased thermal movement or when a high performance product is desired.

C. Blow cracks clean. Remove foreign matter, loosened particles, and weeds.

D. Use a hot air lance when surfaces are wet or when air temperature is less than 40 deg F. Do not use on saturated pavements or burn the surrounding Pavement. Seal cracks immediately before cool down.

E. If a thin overlay is to be applied within six (6) months, remove crack overfill by squeegee.

3.3 **CRACK SEALING AND WIDE-CRACK SEALING**

A. Refer to APWA Plan 265, unless otherwise indicated.

B. Reapply material to any crack segment where material shrinkage or insufficient material was applied in a previous pass or application.

3.4 **PROTECTION**

A. Use non-abrasive deblotting product if traffic or construction activities are likely to cause pull out. Replace pull out at no additional cost to OWNER.

B. Repair vehicles or other property damaged by crack repair operation.

3.5 **LIMITATIONS**

A. Cracks that are less than 1/8” in width are not recommended for crack sealing, consider a surface preservation treatment.

B. Cracks that are over 1 ½” in width are not recommended for crack sealing, consider hot-applied mastic repair.

END OF SECTION

SECTION 32 01 19
PATCHING RIGID PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Full depth removal and replacement of Portland cement concrete roadway pavement panels.

1.2 REFERENCES
A. **APWA (Utah) Standards**:

Plan 256 Concrete pavement patch.

Plan 261 Concrete pavement joints.

B. **ASTM Standards:**

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcing.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 SUBMITTALS
A. Joint filler board data sheet.

B. Joint sealer data sheet.

C. Bond breaker data sheet.

D. Traffic control plan, Section 01 55 26.

E. Concrete mix design.

1.4 ACCEPTANCE
A. Concrete compressive strength.

B. Profile and cross-section tolerance.

PART 2 PRODUCTS

2.1 REINFORCEMENT
A. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, ASTM A615:

1. Dowel Bar: Smooth.
2. Tie Bar: Deformed.
3. Mat: Deformed.

B. Dowel Bar End Cap: Non-metallic that allows 1/4 inch longitudinal movement of bar.

2.2 CONCRETE
A. Class 4000 cast-in-place, Section 03 30 04.

B. Slump range per mix design.

2.3 ACCESSORIES
A. Bond Breaker: Paraffin wax, lithium grease, or other semi-solid, inert lubricant.

B. Expansion Joint Filler: F1 sheet 1/2 inch thick, Section 32 13 73.

C. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round, Section 32 13 73.

D. Contraction Joint Sealer: HAS1 or HAS4 hot applied, Section 32 13 73.

E. Curing and Sealing Compound: Membrane type, ASTM C1315. Type II Class A or B (white pigmented).

F. Tackifier: Epoxy gel Type II, Section Section 03 61 00 for attaching plastic concrete to existing hard concrete or for securing dowel and deformed tie bars in drilled holes.

G. Water Repellant: Penetrating compound, Section 07 19 00.

2.4 **SOURCE QUALITY CONTROL**

A. Use concrete accelerating admixtures in cold weather only when approved in the mix design. Use of admixtures will not relax cold weather placement requirements.

B. Use set retarding admixtures during hot weather only when approved by ENGINEER.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Make full depth saw cuts around the perimeter of the rectangular section to be removed. Do not over cut.

C. Make full depth re-cuts along any edge that is damaged during repairs, including failures on the underneath of the slab caused by insufficient saw-cut depths.

D. Remove panels without damaging remaining panels. Use chains and lift pins.

E. Repair foundation materials, grade, and compact.

F. Repair concrete damaged by removal operations

3.2 **LAYOUT**

A. Panels:

1. Follow APWA Plan 256 requirements.
2. Determine extent and dimensions of removal from Drawings, or acceptable to ENGINEER.
3. Form any side that does not have an adjacent panel. Form to match existing panels providing a vertical edge.

B. Joints:

1. Follow APWA Plan 261 requirements.
2. Tackifier required on vertical surface of cold joints, both transverse and horizontal. Do not apply bond breaker to cold joints
3. Keep existing pavement joint layout when scoring
4. Saw new concrete joint on same line if repairs straddle an existing joint line.

3.3 **BAR PLACEMENT**

A. Drill holes for bars using a rigid drill frame. Prevent bits from wandering.

B. Drill holes at mid-depth of the slab. Do not damage remaining pavement section. Remove contaminants from holes.

C. Deformed Bar: For drilled holes that receive deformed bars, place adhesive at far end of each hole. Fit retention ring to bar to prevent adhesive grout from flowing out of hole.

D. Dowel Bar: For drilled holes that receive smooth dowel bars, place grease at far end of drilled bar hole.bar before insertion. Grease and place an expansion end cap on protruding end of dowel bars.

E. Repair any bar coating damage with appropriate repair material.

F. Repack loose bars prior to placing concrete mix.

G. Before placing concrete in the work area:

1. Allow firm set of adhesive grout around bar.
2. Coat dowel bar extension with bond breaker.

3.4 **CONCRETE PLACEMENT**

A. Section 03 30 10.

B. Make sure base course is uniformly damp at time of placement.

C. Prevent segregation of concrete mix.

D. Consolidate concrete along face of existing panels and under reinforcement. Keep vibrators away from joint assemblies and reinforcement. Do not dislocate reinforcement, dowels, and tie bars during consolidation.

3.5 **FINISH**

A. Section 03 35 00.

B. Profile and cross-section tolerance is ± 1/8 inch.

C. Do not tool joints that are to be saw-cut and sealed.

D. Texture surface to match existing.

3.6 **CURING**

A. ASTM C1315. Apply total coverage in two (2) directions after texturing.

B. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.7 **PROTECTION AND REPAIR**

A. General: Protection and repair expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10:

1. Do not open to traffic until 4000 psi concrete strength is reached.

2. Protect concrete pavement surface against damage and marking. Place barricades at the proper locations to prevent traffic from using the pavement.

C. Repair:

1. Remove and replace any concrete slab replacement that exhibit cracking, shrinkage, or failure caused by traffic.

2. Correct patch profiles in excess of 1/8 inch **higher** or **lower** than the existing pavement profile through surface grinding or removal and replacement. Apply water repellant over surface grindings.

END OF SECTION

SECTION 32 01 20

DOWEL BAR RETROFIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dowel bar assemblies across existing transverse joints and cracks in concrete roadway pavement slabs eight (8) inches thick or thicker.

B. Concrete patch.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 262 Dowel bar retrofit.

B. **ASTM Standards**:

A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing.

C882 Bond Strength of Epoxy Resin Systems Used With Concrete By Slant Shear.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 SUBMITTALS

A. Sample of dowel bar and end cap.

B. Data sheets for:

1. Joint filler board.
2. Joint sealer.
3. Bond breaking compound on dowel bar.
4. Dowel bar expoxy or galvanizing coating.

C. Concrete mix design.

1.4 ACCEPTANCE

A. Concrete compressive strength, APWA Section 03 30 10.

B. Field quality control by CONTRACTOR, this section article 3.2

PART 2 PRODUCTS

2.1 DOWEL BAR ASSEMBLIES

A. Dowel Bars:

1. Smooth, grade 60 ksi galvanized or epoxy coated steel, ASTM A615. Bars must be free from burrs or other deformations detrimental to free movement of the bars in the concrete. Bars must be sawn by manufacturer, not sheared.

2. White pigmented bond breaking curing compound or other semi-solid, insert lubricant applied at the manufacturing facility. DO NOT apply bond breaker whie the dowel bar assembly is in the reservoir

B. Chair Device: Non-metallic designed to press securely against the reservoir bottom and sides providing 1/2 inch clearance between reservoir bottom and bottom of bar.

C. End caps: Non-metallic that allow 1/4 inch bar movement required at both ends of bar.

2.2 CONCRETE PATCH

A. 3/8 inch aggregate maximum.

B. 3000 psi in 3 hours and 5000 psi in 24 hourse, ASTM C109.

C. Shrinkage maximum in 4 days 0.13 percent, ASTM C157.

D. Bond strength of 1,000 psi in 24 hours, ASTM C882.

2.3 **ACCESSORIES**

A. Joint Products: Section 32 13 73.

B. Curing and Sealing Compound: Membrane type, ASTM C1315.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Jackhammers: Less than nominal 30 pound class to prevent spalling.

B. Saws: Capable of cutting a minimum of three (3) slots simultaneously if more than 100 bars are to be placed in the Work. Less than 00, a walk behind saw may be used providing a template is used to ensure the slot locations are within the specified tolerances.

3.2 **PREPARATION**

A. Before the start of major operations, provide a test section consisting of at least 24 complete dowel bar retrofits.

B. In the presence of the ENGINEER and 24 hours after completing the test section randomly check dowel positioning by coring. Drill two cores, one on each end of a dowel bar to expose both ends and allow measurement for proper alignment. If the dowels are located incorrectly or air voids exist around the dowel bars, additional cores will be taken under ENGINEER's direction to determine severity.

C. CONTRACTOR will perform and patch all testing at no additional cost to OWNER.

D. Backfill all core locations using the acceptable dowel bar retrofit patching material.

3.3 **INSTALLATION**

A. Preparation: See APWA Plan 262 requirements.

B. Reservoir:

1. Saw, remove concrete, then sand blast. Remove dust, concrete slurry, and debris.
2. Skewed joints or cracks may require slots longer than the length shown in the plan. Increase length at no additional cost ot OWNER.
3. If work is delayed for any reason reclean patching areas as necessary.
4. Apply CAS-5 silicone joint sealer to crack and joint in the reservoir walls and bottom.

C. Bars:

1. Place bars on chairs in middle of slab.
2. 1/2 inch clearance from bottom of reservoir.
3. Maximum allowable skew is 0.375 inches per 12 inches (3 percent) in horizontal and vertical planes.

D. Filler Board: Place in vertical plane of the transverse joint or crack. Fit tightly at reservoir bottom, sides and circumference of bar.

E. Concrete: Install and consolidate. Finish and apply curing and sealing compound.

F. After cure: Remove joint filler board across width of reservoir to a depth of two (2) inches. Seal joint with HAS-4 sheet, one component elastomerit type joint sealer.

3.4 **PROTECTION AND REPAIR**

A. General: All expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10. Protect down stream habitat from saw-cutting slurry.

C. Repair: Replace any non-functioning or damaged dowel bar retrofit.

END OF SECTION

SECTION 32 01 26
GRINDING PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Smooth-out surface bumps or depressions in bituminous or Portland cement concrete Pavement by grinding.

B. If milling is required to lower a bituminous pavement surface refer to Section 32 01 16.71.

1.2 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

1.3 QUALITY ASSURANCE

A Worker Experience: Provide a person capable of calculating grades and cross-slopes in degrees and percentages.

1.4 SITE CONDITIONS

A. Existing Street Fixtures may have been paved over making them hidden (or buried). Locate and protect them. Failure to find them may result in damage to grinding equipment. Repair damaged machinery and Street Fixtures at no cost to OWNER.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Detector: Able to find Street Fixtures (utility frames and covers, valve boxes, etc.) that are buried under Pavement surface.

B. Roadway Grinding Machine: Self propelled:

1. Cutting head 36 inches wide minimum.
2. 50 to 60 diamond blades per foot of head.
3. Equipped to prevent air pollution.
4. Equipped with a system to control depth and slope of grind cut.

C. Water truck, waste truck and cleaning equipment able to pick up grindings and waste water.

3.2 PREPARATION

A. Notify neighborhood at least 48 hours before day and time of grinding.

B. Preserve all active utilities. Coordinate utility locations, Section 01 31 13.

C. Implement traffic control plan requirements, Section 01 55 26.

D. Mark areas in the field that are to receive grinding.

E. Use a detector to find hidden (or buried) Street Fixtures.

F. Mark hidden and existing utilites on redline Drawings.

3.3 PROTECTION

A. Install Invert Covers, Section 01 71 13.

B. CONTRACTOR is liable for any property damage due to loose material on pavement surface, vertical pavement cuts, drop-offs, etc.

C. Protect transverse or longitudinal joints.

D. Avoid or minimize damage to tree branches. Provide certified arborist observation of tree branch cuts larger than four (4) inches diameter. Notify ENGINEER of such tree branch cut or damage.

E. Protect plant and animal habitat. Follow federal, state or local work permit requirements.

3.4 GRINDING

A. Grind until pavement on both sides of transverse joints and cracks is in the same plane and meets the same tolerance. Provide a smooth uniform finish texture.

B. Perform grinding in a longitudinal direction. Skid resistance of final ground surface must be comparable to adjacent sections not requiring corrective work.

C. Do not grind structures. Protect adjacent concrete flat work.

D. Surface treatment of grind areas as follows:

1. Bituminous Surface: Tack coat, Section 32 12 13.13.
2. Concrete Surface: Water repellant, Section 07 19 00.

E. If work equipment is removed from the grinding site and grinding surface awaits further work, provide appropriate traffic control and cleaning.

3.5 TOLERANCES

A. Roadway Striation Texture: Uniform, continuous, longitudinal:

1. Groove width between 0.09 and 0.15 inches wide.
2. Peaks of ridges between grooves approximately 1/16 inch higher than the bottom of the grooves
3. Width of peak ridges from 0.06 to 0.13 inches

B. Smoothness: Required tolerances are indicated in Section 32 01 31.

1. No dent (or lip) at start or finish in longitudinal direction.

C. Cross Slope:

1. Uniform with no depressions or misalignment of slope greater than 1/4 inch in 10 feet between grade breaks (roadway crown line excepted).
2. 1/8 inch maximum dent (or lip) transverse to the direction of pedestrian or vehicle travel. Potential for standing water not allowed.

D. Taper lane grinding into shoulder (parking lane) area. Target is two (2) percent with a maximum allowable slope of five (5) percent.

3.6 CLEANING

A. All residues from the grinding process become property and responsibility of CONTRACTOR. Waste grindings legally. Do not discharge grindings into storm drains, ditches, or waters of the State.

END OF SECTION

SECTION 32 01 29

CONCRETE PAVING RAISING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raise Portland cement concrete pavement and flat work to grade by jacking.

1.2 REFERENCES

A. **ASTM Standards**:

C150 Portland Cement.

C618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C1107 Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D1621 Compressive Properties of Rigid Cellular Plastics.

D1622 Apparent Density of Rigid Cellular Plastics.

D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D1621 Compressive Properties of Rigid Cellular Plastics.

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Plan for containing grout in the jacking process.

C. Data sheet for polyurethane or shrinkage resistant grout.

D. Procedure to be used in verifying injection fluid usage.

E. Injection sequence for raising roadway pavement panels.

F. Verify elevation of roadway pavement panel raising.

1.4 QUALITY ASSURANCE

A. Provide a licensed professional land surveyor to verify elevation changes in the roadway pavement profile.

PART 2 PRODUCTS

2.1 POLYURETHANE

A. High density, water based formulation.

Table 1 – Physical Properties

	Standard	Min	Max
Density, lb/ ft^3	D1622	3.8	4.3
Tensile strength, psi	D790	100	--
Elongation, percent	--	5.1	--
Compressive strength at yield point, psi	D1621	90	--

NOTES
(a) Maximum time of set is 15 minutes.
(b) Use value of flexural strength or flexural yield as tensile strength.

2.2 PORTLAND CEMENT GROUT

A. Type I or II, ASTM C150 with silica sand and a shrinkage-compensating agent with plasticizing and water reducing agents.

2.3 **PORTLAND CEMENT DRY MIX**

A. Select from the following options. Obtain ENGINEER's approval for any deviation from the option selected:

1. **Option 1:**
   a. One volume Portland cement, type I or II, ASTM C1107.
   b. Three volumes pozzolan, ASTM C618, type F.
   c. Shrinkage compensating agent with plasticizing and water reducing agents.
   d. Adjust water to meet field conditions.
2. **Option 2:**
   a. One volume Portland cement, type I or II, ASTM C1107.
   b. One volume pozzolan, ASTM C618, type F.
   c. Two volumes clean sand.
   d. Shrinkage compensating agent with plasticizing and water reducing agents.
   e. Adjust water to meet field conditions.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Pumping injection unit.

B. Drills and injection tubes.

C. Laser levels or dial micrometers.

D. Dynamic cone penetrometer.

E. Concrete saw.

F. Generators and other equipment.

3.2 **PREPARATION**

A. Pay applicable license or royalty fees.

B. Implement traffic control plan requirements, Section 01 55 26.

C. Use professional land surveyor elevation measuring device to establish target profile grade for roadway panels.

3.3 **PROTECTION**

A. Protect down-stream fish habitat. Remove slurry deposits from surfaces.

B. Do not permit rain or sprinkler system water to wash away dust.

C. Contain injected material during the jacking process. If containment is lost, implement remediation procedures immediately.

D. Protect against displacement of adjacent surfaces

3.4 **ROADWAY PAVEMENT FOUNDATION STABILIZATION**

A. Discover voids and soil conditions with penetrometer.

B. Limit concrete drill holes to 5/8 inch diameter maximum.

C. By injection, fill voids until pavement until lift is initiated.

3.5 **JACKING**

A. Saw-cut between failed and non-failed slabs as necessary to prevent damage to non-failed slabs.

B. Drill injection holes where necessary. Provide injection sequence for raising roadway pavement panels or concrete flat work without cracking. ENGINEER may order removal and replacement of panels cracked by CONTRACTOR at CONTRACTOR's cost.

C. Inject grout at proper depth to evenly raise pavement and flat work level with adjacent surface.

D. Do not displace adjacent surfaces.

E. After jacking, grade must be plus or minus 1/8 inch of target.

F. Fill injection holes with at least four (4) inches of non-shrink grout.

G. Patch drill holes.

3.6 **REPAIR**

A. Repair construction damage at no additional cost to OWNER. Damages include but are not limited to the following.

1. Raised adjacent slabs or structures not scheduled for rising.
2. Material or work product that shrinks, deteriorates, or otherwise fails by the end of the correction period.

END OF SECTION

SECTION 32 01 31
PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Smoothness tolerances for placing flexible pavements, rigid pavements, and pavement patches.

B. Procedure for correcting defective smoothness.

1.2 REFERENCES

A. **ASTM Standards**:

E950 Measuring the Longitudinal profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

1.3 DEFINITIONS

A. **Must Grind**: Areas of roadway pavement not meeting localized roughness or profile deviation tolerance.

B. **Road Class**: Attribute of a public or private thoroughfare based upon equivalent single axel loads (ESAL).

Class I: (ESAL < 10^4 per year) Includes maintenance mixes, bike paths, parking lots, residential driveways, light traffic residential streets, light traffic rural farm roads.

Class II: (ESAL between 10^4 and10^6 per year). Includes heavy traffic residential streets, rural farm collector roads, non-industrial parking lots, urban low volume collector streets.

Class III: (ESAL > 10^6 per year). Includes high volume collectors, arterials, industrial parking lots (primary load from 3-axle or greater vehicles), climbing lanes, truck weigh stations.

C. **Wheel Path**: A continuous parallel line inside a travel lane 2.5 feet from the lane line or median line.

D. **IRI**: International Roughness Index.

E. **MRI**: Mean Roughness Index. An average of all profiles performed within a lot or sublot.

F. **Localized Roughness**: Profile deviations in a continuous 25 ft of pavement.

G. **Category 1 Pavements**: Newly constructed pavement surfaces where there is no curb and gutter or adjacent curb and gutter is placed as part of the contract.

H. **Category 2 Pavements**: Newly constructed pavement surfaces with total design overlays of 2 inches or less, or newly constructed pavement surfaces with existing adjacent curb and gutter.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Certifications for profilographs, profilers, and operators.

C. Summary report of smoothness profile testing.

1.5 QUALITY ASSURANCE

A. Provide testing equipment and a person capable of calculating grades and cross-slopes in degrees and percentages. Cross slopes vary when the crown line is not parallel to pavement edge line.

1.6 ACCEPTANCE

A. **General**:

1. Acceptance is by Lot.
2. Dispute resolution, Section 01 35 10.
3. Opening a profiled surface to traffic does not constitute acceptance.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Profile Roughness**:

1. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding lot. Treat partial segments longer than 250 feet as a lot.

2. Excluded from the lot are turn lanes, parking lanes, medians, Street Fixtures, intersection areas from 50 foot prior to stop bar to 50 foot past opposite stop bar, bridge decks, grades greater than eight (8) percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

C. **Localized Roughness**: Limit to areas less than 15 feet in length using IRI with a 250 mm filter.

D. **Profile Deviation**: Verify "Must Grind" bumps and depressions are removed from the lot surface. Lot is area of total placement. No area is excluded.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. **Profilometer**:

1. Capable of producing results required by ASTM E1364 and ASTM E1926.
2. Set profilometer readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

B. **Milling and Grinding Machines**:

1. Equipped to prevent air pollution.
2. Equipped with a system to control depth and slope of pavement cut.

C. Cleaning equipment able to pick up millings and waste water.

3.2 PREPARATION

A. **Traffic Control**: Implement traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.

B. **Surface Repair**: Method of payment to be determined by ENGINEER if preliminary profiling of existing pavement is required before placement of thin bonded overlay, micro-surfacing, slurry seal, chip seal, etc.

3.3 TOLERANCES

A. **Profile Roughness, Localized Roughness, and Profile Deviation**: Verify bumps and depressions meet tolerance. Trace all wheel paths in direction of travel. Begin traces 50 feet before edge of new pavement or patch and end traces 50 feet after edge of new pavement or patch. Areas (including the 50 feet end trace areas) exceeding localized roughness or profile deviation tolerance are "Must Grind" areas.

1. Category 1 Pavements.

Table 1 – Roughness and Deviation Tolerance
Category 1 Pavements

Speed mph	Road Class	Profile Roughness Index Inches / Mile				Profile Deviation Inches/25 feet Maximum
		MRI[(a)]		PI		
		Min	Max	Min	Max	
N/A	I	–	–	–	–	0.4
31 to 45	All Classes		120		190	N/A
>45	All Classes	–	90	–	175	N/A

NOTES
(a) MRI (International Roughness Index).
(b) Localized limits (25 foot base) – applies to Class I roads and areas excepted from PRI requirements under Article 1.6.B.2.

2. Category 2 Pavements

a. For all pavements, meet Localized Roughness and Profile Deviation requirements of Table 2.

b. For pavements with pre-construction profile information of the existing roadway, meet MRI Percent Improvement requirements of Table 2 using the following formula:

$$\frac{[MRI_o - MRI_f] \times 100}{MRI_o}$$

Where:

MRI_o = MRI of original roadway surface

MRI_f = MRI of final corrected roadway surface

Table 2 – Roughness and Deviation Tolerance
Category 2 Pavements

Speed mph	Road Class	MRI[(a)] Improvement (%)	Localized Roughness Improvement (%)	Profile Deviation Inches/25 feet Maximum[(b)]
N/A	I	N/A	10	0.4
31 to 45	All Classes	10	20	0.4
>45	All Classes	20	30	N/A

NOTES
(a) MRI (International Roughness Index).
(b) Localized limits (25 foot base) – applies to Class I roads and areas excepted from PRI requirements under Article 1.6.B.2.

3.4 **REPAIR**

A. **General**:

1. Do not begin repairs without ENGINEER's knowledge of such activity.
2. All repair expenses are at no additional cost to OWNER.

B. **Bituminous Concrete Repair**:

1. Smooth out profile irregularities by grinding. See Section 32 01 26.
2. Apply Section 32 12 03 cationic or anionic emulsion at 0.11 ± 0.01 gallons per square yard and a sand friction blotter over all grind areas.
3. If depressions cannot be corrected by grinding, do a cold mill and inlay repair per Section 32 01 16.71 or do a remove and replace patch repair per Section 33 05 25. **Raising depressions with a skin patch and feathered edges is NOT ACCEPTABLE**. Patch profile must meet this section's smoothness requirements.

C. **Portland Cement Concrete Repair**:

1. Smooth out profile irregularities by grinding. See Section 32 01 26.
2. Apply penetrating sealer over all grind areas. See Section 07 19 00.
3. If depressions cannot be corrected by grinding, remove concrete and provide a concrete pavement patch per Section 32 01 19. Patch profile must meet this section's smoothness requirements.

END OF SECTION

SECTION 32 01 34
WHITE TOP INLAY

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Portland cement concrete inlays in existing bituminous pavements.

1.2 **REFERENCES**

A. **ASTM Standards**:

C1116 Fiber-Reinforced Concrete and Shotcrete.

C1399 Obtaining Average Residual Strength of Fiber-Reinforced Concrete.

1.3 **DEFINITIONS**

A. **Inlay**: A volume with sides and a bottom located within an existing roadway pavement surface.

B. **Moderate Exposure Condition**: Exposure in a climate where freezing is expected but where concrete will not be continually exposed to moisture or free water for long periods before freezing and will not be exposed to deicing agents or other aggressive chemicals.

C. **Severe Exposure Condition**: Exposure to deicing chemicals or other aggressive agents or where the concrete may become highly saturated by continued contact with moisture or free water before freezing.

1.4 **SUBMITTALS**

A. Section 32 13 13.

1.5 **WEATHER**

A. Section 32 13 13.

1.6 **NOTICE**

A. Section 32 13 13.

1.7 **ACCEPTANCE**

A. Section 32 13 13.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Concrete: Fiber reinforced, 4000 psi minimum, ASTM C1116.

B. Aggregate: Maximum size one-third of white top thickness.

C. Fiber: Synthetic, with a minimum strength of 80 psi, ASTM C1399.

1. 3 pounds per cubic yard
2. 1.5 inches long.

D. Slump: Over four (4) inches requires ENGINEER's acceptance.

E. Air Content: Severe exposure unless specified otherwise.

Table 1 - Total Air Content, Percent			
Nominal Maximum Aggregate Size, (in.)	**Mild Exposure**	**Moderate Exposure**	**Severe Exposure**
1	3.0	4.5	6.0
3/4	3.5	5.0	6.0
1/2	4.0	5.5	7.0
3/8	4.5	6.0	7.5

PART 3 EXECUTION

3.1 PREPARATION

A. Mill bituminous surface to depth specified. Remove debris and loose particles. Pressure wash exposed surface. Allow surface to dry before proceeding.

B. Do not place concrete when the bituminous surface temperature is less than 35 deg F

C. Cool hot bituminous pavement surfaces to 100 deg F or less. Allow surface to dry before proceeding.

D. Do not allow traffic on pavement once final cleaning is performed.

3.2 FORMWORK

A. Section 03 11 00.

3.3 PLACEMENT

A. Section 03 30 10 and as follows.

1. Do not move concrete hoziontally with vibrator.
2. 1/8 inch in 10 feet tolerance
3. Uniform and sharp corners. Do not use excess mortar to build up slab edges or round slab corners.

3.4 FINISH

A. For Speed Less Than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.

B. For Speed 45 mph and Greater: 1/8 inch deep groove 80 degrees to the crown line and randomly spaced between 3/8 and 1-1/2 inches.

3.5 CURE

A. Section 03 39 00.

B. Apply at two (2) times the manufacturer's recommended rate Type II Class A or B (white pigmented) membrane forming compound. Apply total coverage in two (2) directions for total white coverage on all exposed surfaces after texturing.

C. Eliminate thermal shock by keeping ground and air temperature close to cure temperature.

3.6 JOINTS

A. General:

1. Construct joints at locations, depths and dimensions indicated or match alignment of joints in adjacent panels.
2. Minimum angle between any two intersecting joints is 90 degrees plus or minus 10 degrees.
3. Joints must intersect pavement free edges at a 90 degree angle and extend straight for a minimum of 1-foot from the free pavement edge.

B. Contraction Joints:

1. Single saw cut 1/8 inch wide, 1/3 slab depth.
2. Saw transverse joints first.
3. Saw only when concrete is hard enough to prevent raveling and finish sawing before conditions favor uncontrolled cracking.

4. The larger dimension of any panel shall not exceed 125 percent of the smaller dimension. If drawings do not indicate joints spacing, provide the following.

White Top thickness, (in.)	Approximate Spacing (ft.)
2	2 – 3
2.5	2.5 – 3.5
3	3 – 4
3.5	3.5 – 5.0
4	4 – 6

C. Isolation Joints: F1 sheet 1/2 inch thick, Section 32 13 73. Use this joint where pavement abuts building, manholes and other fixed objects.

D. Joint Sealing: Not required.

3.7 **PROTECTION AND REPAIRS**

A. General: All expenses are at no cost to OWNER.

B: Protection: Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C: Repair:

1. Remove and replace cracked panels.
2. Patch spall with Section 03 61 00 shrinkage resistant grout.
3. Remove graffiti.

3.8 **OPENING TO TRAFFIC**

A. Not sooner than 3,000 psi.

END OF SECTION

SECTION 32 01 90

MAINTENANCE OF PLANTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Landscape maintenance and replacement.

B. Guarantees.

1.2 ACCEPTANCE

A. Seeded areas will be accepted at end of maintenance period when seeded areas are established and have been mowed at least three (3) times.

B. All other areas will be accepted not **less than 60 days after planting** and successful growth.

1.3 GUARANTEE

A. Guarantee begins after Irrigation System and plant installation inspections and acceptance have been completed and continues for one (1) calendar year, or as specified elsewhere.

B. Replace plant materials found dead or not in a healthy growing conditions with plant materials of same size and species with a new guarantee commencing on date of replacement.

C. At end of guarantee period if landscaped surfaces have settled causing poor drainage conditions, correct grade deficiencies. Make corrections after receiving approval of corrective methods and schedules.

D. Perform corrective work at no additional cost to OWNER.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 GRASS MAINTENANCE

A. General: Maintain surfaces until work is accepted, but in any event for a period of not less than 60 days after planting. Supply additional topsoil where necessary, including areas affected by erosion or settlement.

B. Watering: Water to ensure uniform seed germination and to keep surface of soil damp. Apply water slowly so soil will not puddle and crust.

C. Fertilizing: Fertilize during seeding and two (2) weeks after seeding and sodding. Apply 16-0-0 fertilizer (NPK ratio) in fall season following manufacturer’s recommendations.

D. Mowing:

1. Mow times are 7:00 to 10:00 a.m. or 5:00 to 8:00 p.m. Height three (3) inches.

2. Clean cut with sharp blade. Do not cut more than 1/3 of blade at any one mowing. Remove clippings. After first mowing, water to moisten soil from three (3) inches to five (5) inches deep. Allow a minimum of five (5) days between mowings.

E. Grading: Roll when required to remove minor depressions or irregularities.

F. Weeding: When using herbicides, apply in accordance with manufacturer's recommendations. Remedy damage from improper use.

G. Protection and Repair: Protect planted areas with warning signs during maintenance period. Erect temporary fences, or barriers, to control pedestrians when necessary. Repair, reseed or resod areas showing rodent damage, erosion damage and other damage.

3.2 **TREES, PLANTS, AND GROUND COVER MAINTENANCE**

A. General: Care for planted areas. Maintain, water, weed, repair, and protect until work is accepted, but in any event for a period of not less than 60 days after planting. Supply additional topsoil where necessary, including areas affected by erosion or settlement.

B. Watering: After planting, keep ground continuously moist until healthy growth is established. Thereafter, thoroughly water once a day until work is accepted. Prevent erosion.

C. Weeding: Uproot and remove weeds completely. Do not allow growth and germination of weed seeds. Fill holes caused by weeding with topsoil and rake smooth.

D. Protection: Protect planted areas against traffic by erecting barricades and warning signs. Replant damaged planted areas.

E. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep wires tight. Repair or replace accessories when required.

F. Prune broken or dead branches. Replace sub-standard sized plants that required excessive pruning to American Nurseryman Standards.

3.3 **IRRIGATION SYSTEM MAINTENANCE**

A. Repair installed pressurized Irrigation Systems to operate properly.

B. Repair erosion or settlement around Street Fixtures and Irrigation System components.

C. Winterize system by October 15. Use compressed air at 100 psi only in pressurized systems. Do not put 100 psi air through drip circuits. Coordinate with ENGINEER.

D. Repair Irrigation System components broken by CONTRACTOR.

3.4 **REPLACEMENTS**

A. When any portion of surface becomes gullied or otherwise damaged and planting has failed to grow, repair and replant.

B. At conclusion of maintenance period, replant areas showing root growth failure, bare or thin spots, and eroded or settled areas with materials of like kind and size as specified for original planting.

C. Throughout the maintenance period, replace any unsatisfactory or dead plants within 10 days of written notice.

END OF SECTION

SECTION 32 01 91
TREE ROOT CUTTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cutting and removing tree roots.

B. Protecting surface improvements from future tree root growth.

1.2 PROJECT CONDITIONS

A. Provide written watering instructions to neighbors in property abutting the tree root cuts to advise them of the tree's watering requirements.

1.3 SUBMITTALS

A. Upon ENGINEER's request, submit a copy of arborist's ISA certificate and registration number on file with the State Division of Commercial Code.

1.4 QUALITY ASSURANCE

A. Provide an ISA certified arborist to observe tree root cutting.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 AVOIDING ROOT CUTS

A. When placing or replacing concrete sidewalk:

1. Adjust alignment to curve around, over or away from tree trunks. Do not proceed in this work until alignment has been reviewed by ENGINEER.
2. Adjust thickness and concrete contraction joints.

B. When replacing concrete curb and gutter:

1. Adjust thickness and concrete contraction score marks over tree roots.
2. Do not vary gutter invert from straight grade.

3.2 CUTTING TREE ROOTS

A. Never cut buttress roots [i.e. roots at the broadened base of the tree trunk] without written authorization of arborist. Avoid injury to trunk.

B. Keep root cutting at least four (4) feet away from tree trunk. Limit cutting to one side of tree unless authorized otherwise in writing by arborist.

C. Cut roots clean and straight (no ragged or torn edges). Use an axe, saw, or appropriate equipment that properly cuts roots. Do not make partial root cuts.

D. Do not injure roots to remain.

E. Cut roots back to root laterals.

3.3 BACKFILLING

A. Backfill all cut and exposed roots the same day of root cutting, or cover with wood chips, mulch and water until backfilling is accomplished.

B. Place soil below root cut.

C. To prevent vertical root growth, place an impermeable membrane over root cuts. Bend membrane edges to plane below cut root. Place backfill materials adjacent to and above impermeable membrane.

3.4 **PROTECTION**

A. After cutting roots of tree:

1. Immediately water tree after backfilling.

2. Apply a minimum of 1 inch of water over the entire area under the tree canopy and well beyond over a period of four (4) hours.

3. Restrict water runoff.

END OF SECTION

SECTION 32 01 93
PRUNING TREES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pruning branches of existing trees.

1.2 REFERENCES

A. **ANSI Standards**:

A300 Tree Care Operation - Tree, Shrub, and Other Woody Plants.

Z133.1 Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements.

B. **ISA Standards**:

Standards for Pruning.

C. **UCFC Standards**:

Shade Tree Pruning Standards

1.3 SUBMITTALS

A. Tree protection plan that identifies trees to be pruned and reasons for pruning.

B. Upon ENGINEER's request, submit a copy of arborist's ISA certificate and registration number on file with the State Division of Commercial Code.

1.4 QUALITY ASSURANCE

A. Provide an ISA certified arborist to observe tree pruning.

PART 2 PRODUCTS

2.1 PRUNING PAINT

A. Formulated for horticultural application to cut or damaged plant tissue.

2.2 DISINFECTANT

A. Chlorine based.

PART 3 EXECUTION

3.1 PREPARATION

A. Pruning work in any publicly owned right of way requires CONTRACTOR notifying adjacent property owner and giving them a brief description of why and how the work will be done. Notification needs to be given at least two (2) weeks before any work is done so property owner has a chance to respond if they choose to do so. The arborist selected to provide pruning service shall provide the notices. A written record of delivery dates of notices by address is required of the arborist.

B. Pruning trees on private property require tree owner approval. ENGINEER and CONTRACTOR shall jointly contact the owners for approval before performing any work.

3.2 TREE PRUNING

A. Adhere to safety requirements, ANSI A133.1.

B. Conform to ANSI A300 and the Utah Shade Tree Pruning Standards when pruning.

C. Conform to OSHA 1910.269 if there are power or communication lines within the area occupied by the tree's branches or adjacent to the tree.

D. Remove tree branches extending over the roadway to provide a clear height of:

1. 16 feet over the travel lane. The travel lane means the lane vehicles typically use for travel that is different than the parking lane which is adjacent to the the curb normally used for parking
2. 14 feet over the driveway approach.
3. 12 feet over finished grade.
4. 6 feet over street light.
5. 12 feet over signal light.

E. The contracted arborist may need to reduce the above referenced clearances based on tree size, species, or location.

F. Remove dead, diseased, damaged, broken, hanging, obstructing, crossing or weak branches.

G. Prune trees to make them shapely, symmetrical, and typical of the natural form of the species being pruned. Thin no more than 25 percent of the live canopy. Do not remove branches that would deform the appearance of the tree.

H. Cut deadwood back to existing callous growth. **Do not remove callous growth.**

I. Reduce length of limbs as ordered by ENGINEER.

J. Do not remove any live branch larger than six (6) inches in diameter unless authorized by ENGINEER.

K. Pre-cut branches to reduce weight of final cut. Select final cuts by location of branch bark ridge and branch collar.

L. No intermodal final cuts permitted unless authorized by ENGINEER.

M. The use of climbing spurs (gaffs) are prohibited.

N. Disinfect pruning equipment that comes in contact with diseased plant material. Remove disinfectant from equipment before proceeding with work.

O. Use the "Natural Target" or "Drop Crotch" pruning method when removing limbs.

P. Do not top, pollard, stub or dehorn any tree.

Q. Make all pruning cuts sufficiently close to the trunk or parent limbs without cutting into or removing the "branch collar" or the "branch bark ridge".

3.3 BRANCH DISPOSAL

A. Remove branches from site.

B. Remove all wood chips.

END OF SECTION

SECTION 32 05 10
BACKFILLING ROADWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roadway backfill materials.

B. Roadway backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 245 Subgrade stabilization.

B. ASTM Standards:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Embankment**: A raised earthen structure.

B. **Pavement**: A surface or covering, as of Portland cement concrete, bituminous concrete, brick, concrete paver, etc., specifically a paved street, sidewalk, curb, gutter, curb cut assembly, ramp, apron, Driveway, etc.

C. **Subgrade**: A surface of native earth or Rock leveled off as to receive backfill materials.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material.
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight, and aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this section.

C. If requested, submit a quality control Inspection and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural roadway section to required density.

D. Soil Cement: Do not spread soil cement mixture when air temperature is less than 40 deg F in the shade.

E. Drainage: Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of work area.

1.8 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per Lot.

D. Compaction: One test per Lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot size as follows:

Table 1 – Compaction Standard and Lot Sizes

Material	Proctor	Lot Size
Subgrade	Standard	1000 square yards
Common Fill	Standard	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift
Aggregate base course	Modified	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift Curb, Gutter, and Waterways: 200 linear feet per lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.

E. Flowable Fill Strength: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.9 **WARRANTY**

A. Repair incidental settlement or settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13: Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23: Untreated base course.

C. Cement treated fill, Section 31 05 15: Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE**

A. Stabilization separation fabric, Section 31 05 19: Woven, high MARV.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Areas to be backfilled are free of debris, snow, ice or water.
3. Bearing surfaces are not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **SUBGRADE**

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER’s permission to stabilize the Subgrade:

1. Excavation for Subgrade stabilization is incidental work. Section 31 23 16.
2. Place geotextile fabric per APWA Plan 245. Place acceptable fill in lifts over the geotextile, compact and wrap.

3.5 **EMBANKMENTS**

A. Place backfill material in lifts not exceeding equipment compaction capability.

B. Build shoulders to a grade higher than that of adjacent fills. Provide surface runoff at all times.

C. Commence compaction along edge of area to be compacted and gradually advance toward center.

D. Operate compaction equipment along lines parallel or concentric with the center-line of the embankment being constructed.

E. Do not damage subsurface structures or utilities.

3.6 **BASE COURSES**

A. Place backfill material in lifts not exceeding eight (8) inches before compaction.

B. Maintain moisture content in compaction operations.

C. Avoid segregation when spreading backfill. Keep surfaces free from pockets of coarse and fine aggregate.

D. Rework fills that do not conform to compaction requirements until requirements are met.

E. Protect cement treated fill against freezing and traffic for seven (7) days.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using handheld compaction equipment.
3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days. Maximum is 90 psi in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test roadway backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

B. Proof Rolling Test:

1. Before placing fill material for roadbed backfills, proof roll subgrade using gross weight of 18,000 pounds/tandem axle, with a tire pressure at least 90 psi.

2. All proof roll passes will traverse the subgrade parallel to the roadbed centerline. All subsequent passes will be offset 1/2 the vehicle width until the entire subgrade is tested.

3. ENGINEER will analyze, determine, designate and measure the areas, if any, requiring additional compaction or reconstruction.

4. Once subgrade passes the proof rolling test, protect the surface from construction operations and traffic damage. Repair all cuts, ruts, and breaks. Keep surface in a satisfactory condition until geotextile fabric or base course has been placed.

3.10 **CLEANING**

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Treated and untreated base course production and placement.

1.2 REFERENCES

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Agtgregates by Washing.

C136 Sieve Analysis of Fine and Coarse Aggregates.

D75 Sampling Aggregates.

D448 Sizes of Aggregate for Road and Bridge Construction.

D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3665 Random Sampling of Construction Materials.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 DEFINITIONS

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP**: Acronym for reclaimed asphalt pavement. See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 SUBMITTALS

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.

3. Target gradation for each sieve size,

4. Percent composition of reclaimed asphalt or concrete included in the mix.

5. Unit weight, CBR, relative density, and relative moisture content.

6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 **QUALITY ASSURANCE**

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 **ACCEPTANCE**

A. **General:**

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.

3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.

4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

5. Dispute resolution, Section 01 35 10.

B. **Gradation**: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors						
Criteria	**Pay Factor**	**Mean of Deviations of Acceptance Tests From the Target Grading Curve Expressed in Percentage Points**				
		1 Sample	**2 Samples**	**3 Sample**	**4 Sample**	**5 or More Samples**
1/2" and Larger Sieves	1.00 0.95 0.90 0.80 0.70	0 – 15 16 – 17 18 – 19 20 – 21 22 – 23	0.0 – 12.1 12.2 – 13.9 14.0 – 15.1 15.2 – 17.2 17.3 – 18.8	0.0 – 10.8 10.9 – 12.4 12.5 – 13.5 13.6 – 15.3 15.4 – 16.7	0.0 – 10.0 10.1 – 11.5 11.6 – 12.5 12.6 – 14.2 14.3 – 15.5	0.0 – 9.5 9.6 – 11. 11.1 – 11.9 12. – 13.5 13.6 – 14.7
3/8" Sieve	1.00 0.95 0.90 0.80 0.70	0 – 15 16 – 17 18 – 19 20 – 21 22 – 23	0.0 – 11.5 11.6 – 13.2 13.3 – 14.4 14.5 – 16.3 16.4 – 17.9	0.0 – 9.8 9.9 – 11.3 11.4 – 12.3 12.4 – 13.9 14.0 – 15.2	0.0 – 8.8 8.9 – 10.1 10.2 – 11 11.1 – 12.5 12.6 – 13.6	0.0 – 8.0 8.1 – 9.2 9.3 – 10.0 10.1 – 22.4 11.5 – 12.4
No. 4 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 14 15 – 17 18 19 – 20 21 – 22	0.0 – 10.5 10.6 – 12.1 12.2 – 13.1 13.2 – 14.9 15.0 – 16.3	0.0 – 8.8 8.9 – 10.1 10.2 – 11 11.1 – 12.5 12.6 – 13.6	0.0 – 7.8 7.9 – 9.0 9.1 – 9.8 9.9 – 11.1 11.2 – 12.1	0.0 – 7.0 7.1 – 8.0 8.1 – 8.7 8.8 – 10.0 10.1 – 10.8
No. 16 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 11 12 – 13 14 15 – 16 17	0.0 – 8.2 8.3 – 9.4 9.5 – 10.3 10.4 – 11.6 11.7 – 12.7	0.0 – 6.9 7.0 – 7.9 8.0 – 8.6 8.7 – 9.8 9.9 - 10.7	0.0 – 6.2 6.3 – 7.1 7.2 – 7.8 7.9 – 8.8 8.9 – 9.6	0.0 – 5.6 5.7 – 6.4 6.5 – 7.0 7.1 – 8.0 8.1 – 8.7
No. 200 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 4.5 4.6 – 5.2 5.3 – 5.6 5.7 – 6.4 6.5 – 7.0	0.0 – 3.4 3.5 – 3.9 4.0 – 4.3 4.4 – 4.9 4.9 – 5.3	0.0 – 2.9 3.0 – 3.3 3.4 – 3.6 3.7 – 4.1 4.2 – 4.5	0.0 – 2.5 2.6 – 2.9 3.0 – 3.1 3.2 – 3.6 3.7 – 3.9	0.0 – 2.3 2.4 – 2.6 2.7 – 2.9 3.0 – 3.3 3.5 – 3.6
NOTES (a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.						

C. **Relative Density**: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. **Field Density**: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 - Placement Type, Location, Sub-lot Size

Type	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with pavement placement).	1,000 square yards
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non-load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. **Material**: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties

	ASTMs	Aggregate Class		
		A	B	C
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D5821	50	–	–
Wear (toughness or hardness), max., percent	C131	50		
Fine aggregate				
Liquid Limit, max.	D4318	25		
Plastic Index, max.	D4318	0	0	6
Sand Equivalent, min., percent	D24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C29	75		
CBR, min., percent	D1883	70	55	--

NOTES

(a) Faces: Retained on No. 4 sieve.

(b) Wear: Retained on No. 12 sieve after 500 revolutions.

(c) Liquid limit and plastic index: Passing No. 40 sieve.

(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.

(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. **Gradation**: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Target Grading Curve must lie within the selected aggregate grade in table 4. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Master Grading Bands				
Sieve	Aggregate Grade			Target Tolerance
	Grade 1-1/2	Grade 1	Grade 3/4	
1-1/2"	100	–	–	(Pay factor 1.00 in Table 1)
1 "	–	100	–	
3/4 "	70 – 85	–	100	
1/2 "	–	79 – 91	–	
3/8 "	55 – 75	–	78 – 92	
No. 4	40 – 65	49 – 61	55 – 67	
No. 16	25 – 40	27 – 35	28 – 38	
No. 200	7 – 11	7 – 11	7 – 11	

NOTES
(a) It is assumed fine and course aggregate have same bulk specific gravity.
(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1" sieve in Grade 1 is not applicable.
(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

C. **Changing Source**: A new material properties report is required.

2.2 TREATED BASE COURSE

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:
   a. Sand equivalent and fractured face measured after asphalt residue is burned off.
   b. Plasticity and wear requirements apply to virgin aggregate portion only.
   c. Allowable asphalt content is controlled by allowable CBR.
2. Remove debris from crushed RAP aggregate by screening.
3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:
   a. Cement with its chemical components is allowed.
   b. Wear test and fractured face test not required.

2.3 SOURCE QUALITY CONTROL

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

C. Testing Protocol: Gradation, ASTM C136. Maximum density, ASTM D1557. Optimum moisture content, ASTM D2216.

PART 3 EXECUTION

3.1 SUB-BASE PREPARATION

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 **PLACEMENT**

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.
2. Maintain optimum moisture content plus or minus two (2) percent.
3. Use appropriate compaction equipment.
4. Do not place additional material on any unaccepted layer or on any frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 - Placement Type, Location, Aggregate Class

Type	Location	Aggregate Class		
		A	B	C
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement)	**X**		
II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	**X**	**X**	
III	Landscape (includes non-structural, non-load bearing areas.	**X**	**X**	**X**

NOTES:
(a) **X** indicates where placement is allowed.

C. Compaction:

1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 **FIELD QUALITY CONTROL**

A. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

B. Testing Protocol: Gradation, ASTM C136. Field density, ASTM D2922. Moisture content, ASTM D3017.

3.4 **REPAIR OR REMOVAL**

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 32 11 24

PULVERIZED PAVEMENT BASE COURSE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Full depth reclamation by pulverizing and mixing an existing asphalt pavement/base and/or imported aggregate with a hydraulic cement, pozzolan or chemical stabilizer in-place to produce a stabilized base course mix.

B. This specification is not intended for use with emulsion, foamed asphalt or other bituminous stabilizing agents.1.2 **REFERENCES**

A. **ASTM Standards**:

C 136 Sieve Analysis of Fine and Coarse Aggregates.

C 150 Portland Cement.

C 593 Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization.

C 595 Blended Hydraulic Cement.

C 618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.

C 977 Quicklime and Hydrated Lime for Soil Stabilization.

C 1157 Blended Hydraulic Cement (Performance).

D 558 Moisture-Density Relations of Soil-Cement Mixtures.

D 1633 Compressive Strength of Molded Soil-Cement Cylinders.

D 1883 California Bearing Ratio (CBR) of Laboratory-Compacted Soils.

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.Technical Documents.

B. NCHRP

144: Recommended Practice for Stabilization of Subgrade Soils and Base Materials.

C. Portland Cement Association.

1. Guide to Full-Depth Reclamation (FDR) with Cement.
2. Soul Cement Laboratory Handbook.

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. List of equipment to be used.

C. Mix design showing percentage and quantity of stabilizer and moisture needed..

1.4 WEATHER

A. Temperature: Do not pulverize when the soil, aggregate or subgrade is frozen, or when the ambient temperature is below 40 deg F or when freezing temperatures are anticipated within seven (7) days of the end of the full depth replacement process.

1. CONTRACTOR may request permission from ENGINEER to process in above conditions. Submit a cold weather plan detailing changes to mix design, construction practices, curing practices and testing practices to achieve design results. Obtain written approval of cold weather plan and permission to process from the ENGINEER before beginning pulverization efforts.

1.5 ACCEPTANCE

A. Acceptance practices may employ the following or may be based on Contractor QC results.

1. Gradation: Random measure, 2 times per day, minimum.
2. Depth: Random measure each 1,000 square yards.

3. Density: Nuclear gauge each 1.000 square yards.
4. Moisture Content: 2 times per day, minimum, and immediately after a precipitation event.
5. Quantity of stabilizer added matches submittal data.

B. **Placement**: Acceptance is by Lot. Lot size is total contracted product placement. Sub-lot size is one (1) day production.

1. Gradation: Random measure each sub-lot, at least 2-times.
2. Depth: Random measure each 1,000 square yards.
3. Density: Nuclear gage each 1,000 square yards or proof roll.
4. Moisture Content: Random measure each sub-lot, at least 2-times and after a precipitation event.
5. Stabilizer: Measure if quantity of stabilizer added matches submittal data.
6. Pay Adjustment: Not applicable. Correct placement deficiencies at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 TACK COAT CURING COMPOUND

A. Cationic or anionic emulsified asphalt, Section 32 12 03.

2.2 STABILIZER and ADDITIVES

A. Hydraulic Cements:

1. Type I or II, ASTM C 150
2. Type GU or MS, ASTM C 1157
3. Type IP or IS, ASTM C 595
4. Non-specification hydraulic cement may be used. Meet mix design requirements and demonstrate consistency of cement to be supplied for duration of the stabilization efforts.

B. Lime and Pozzolans.

1. Lime: Hydrated or Quicklime, ASTM C 977.
2. Pozzolans: Fly Ash, Class C or Class F, ASTM C 618;

C. Chemical Stabilizer: Use type allowed by ENGINEER

2.3 AGGREGATES

A. Imported Materials for Stabilization: Gravel, untreated base course, Recycled Asphalt Pavement (RAP), crushed Portland cement concrete or other Non-Plastic (PI=0) aggregate meeting gradation requirements of Article 2.4C-1.

2.4 MIX DESIGN

A. Pulverized Pavement Requirements:

1. Pulverize existing pavement to the following gradation, ASTM C 136.

Sieve	Percent Passing by Weight
3”	100
2”	>95
#4	<55
#200	<20

2. For pulverized in-place materials with PI>20, demonstrate ability to intimately mix stabilizer with the pulverized material that will produce a reasonably homogeneous and continuous stabilized matrix.

B. Mix Design Requirements (without stabilizer)

1. Submit target gradation using all common soil sieves and source acceptance testing demonstrating compliance with section 2.4C and following:

a. CBR (ASTM D 1883): 70%, minimum, with a 10 lb. surcharge.

b. Plastic Index (ASTM D 4318): 6, max.

C. Mix Design Requirements (with stabilizer):

1. Unless stabilizer content is otherwise specified or approved, follow mix design recommendations of NCHRP 144: Recommended Practice for Stabilization of Subgrade Soils and Base Materials.

2. Perform mix design on materials obtained from project. Do not use “Representative” materials not obtained from project site.

3. Unless otherwise specified, meet unconfined compressive strength per ASTM D 1633, method A, of 500 to 600 psi at seven (7) days, using samples vacuum saturated according to ASTM C 593.

4. If stabilizer content is specified, use the following minimum contents during application and processing. Interpolate as necessary.

Stabilizer Application Rate (lbs per SF)				
Depth (Inches)	**Specified Cement Content (%)**			
	3%	4%	5%	6%
4	1.4	1.8	2.3	2.7
6	2.0	2.7	3.4	4.1
8	2.7	3.6	4.5	5.4

D. Stabilizer Selection: Select and use aggregate stabilizers based on application and mix design results.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Pulverizing Machine: Capable of cutting to the required depth, pulverizing, and sizing the material.

B. Blending Machine: Capable of mixing stabilizer and pulverized material to a reasonably homogeneous and continuous stabilized matrix.

3.2 PREPARATION

A. Identify location of all buried utilities.

B. Notify neighborhood of day and time of operation.

C. Implement traffic control plan requirements in Section 01 55 26.

D. Install Invert Covers, Section 01 71 13.

E. Lower Street Fixtures.3.3 **CONSTRUCTION**

A. Pulverize asphalt pavement and untreated base course to depth specified by contract documents.

1. Control dust, Section 01 57 00.

2. If necessary for grade control, remove amount of pulverized material as shown on plans, or as directed by ENGINEER. If CONTRACTOR is directed to remove poor materials situated below the pulverized materials, push the pulverized material to the side, remove underlying material as directed, and push pulverized material back to original location.

3. If it is necessary to remove material below pulverized product to meet specified grade, **method of payment is determined by ENGINEER.**

4. Shape, grade, compact, finish.

a. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

B. If stabilizer is required, add stabilizer and pulverize again.

1. Prior to adding stabilizer, verify that the moisture content of the UNSTABILIZED material is between minus 1% and plus 4% of design moisture content.

2. For powdered stabilizers, add stabilizer in slurry format or use shroud to prevent dust clouds. Replace shroud with slurry form if placed stabilizer produces dust clouds prior to pulverization.

3. For slurried stabilizers, use a manifold for distribution with a minimum of 4 ports. Do not place slurried stabilizer wider than the width of pulverizing equipment. Surfaces wider than the pulverizing equipment shall be performed in a race-track or lap pattern.

a. Do not include water or other slurry dilutants in stabilizer quantity calculations.

4. Shape, grade, compact, finish. Complete all finishing operations within 4 hours of application of stabilizer.

a. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

5. Maintain optimum moisture content, minimum, of stabilized surface during and after compaction until curing practices are applied.

6. Curing.

a. Moist-cure stabilized material for 7 days with continuous water spray; or

b. Place asphalt tack coat at a minimum residual application rate of 0.06 gal/SY.

i. Apply in a manner that achieves >99% coverage.

ii. Apply daily within 2 hours of completing finishing operations.

7. Pre-crack treated surface between 24 and 48 hours after final compaction.

a. Roll treated surface with 2 to 3 passes (1 pass is down and back) of a 12-ton, minimum, vibratory roller at maximum amplitude and walking speed.

3.4 **FIELD QUALITY CONTROL**

A. Gradation:

1. Test gradation twice daily, and after visual changes in type of material being processed, i.e. change from granular to clay.

2. If #200 sieve material changes by more than 10% of total sample weight, revise mix design to accommodate.

B. Compaction:

1. Achieve Ninety-eight (98) percent or greater density with stabilizer relative to a standard proctor density (without stabilizer), Section 31 23 26. Use the following procedures:

2. Maintain moisture content between minus 1% and plus 4% of optimum moisture content, ASTM D 558. Test 1 time per every 2 hours of processing, minimum, and immediately after a precipitation event.

3. Determine in-place density with a nuclear density gauge, direct transmission procedure ASTM D 2922.

C. Submit summary of daily QC efforts and results to Engineer within 48 hours or prior to next day's processing efforts.

3.5 **Surfacing Placement**

A. Do not place surface course less than 72 hours after completion of finishing practices.

B. Sweep loose material from treated surface prior to placement of surface course.

3.6 **REPAIR**

A. Repair surface irregularities.

1. Scarify or add additional treated material as necessary to meet finishing requirements.

B. Seal cracks in cured stabilized material.

3.6 **OPENING TO TRAFFIC**

A. Completed portions of pulverized pavement can be opened to low-speed traffic and to construction equipment, provided the curing material or moist curing operations are not impaired and provided the pulverized material is sufficiently stable to withstand marring or permanent deformation.

B. Open to all traffic after the pulverized material has received a curing compound or a subsequent overlay surface, or is sufficiently stable to withstand marring or permanent deformation.

END OF SECTION

SECTION 32 12 03
ASPHALT BINDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. An asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate, non-fibrous organic modifiers.

B. Requirements for accepting non-complying Asphalt Binders.

1.2 REFERENCES

A. **ASTM Standards**:

D113 Ductility of Bituminous Materials.

D977 Emulsified Asphalt.

D2026 Cutback Asphalt (Slow-Curing Type).

D2027 Cutback Asphalt (Medium-Curing Type).

D2028 Cutback Asphalt (Rapid-Curing Type).

D2397 Cationic Emulsified Asphalt.

D3381 Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

D4552 Classifying Hot-Mix Recycling Agents.

D5710 Trinidad Lake Modified Asphalt.

D6373 Performance Graded Asphalt Binder.

B. UDOT Standards:

UDOT Section 02745 – Asphalt Binders.

UDOT Quality Management Plan 509 – Hot Mix Asphalt.

1.3 SUBMITTALS

A. Submit bill of lading for each shipment of Asphalt Binder from vendor. Identify the following:

1. Source of product (manufacturer);
2. Type and grade of asphalt, and
3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE

A. Reject Asphalt Binders that are not uniform in appearance and consistency or foams at hot mixing temperature.

B. Do not use storage containers contaminated with other types or grades of petroleum products.

C. Do not use petroleum product that does not comply with contract requirements.

1.5 ACCEPTANCE

A. **General**:

1. Acceptance is by Lot. One (1) Lot is one (1) day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation. Section 01 29 00
3. Dispute resolution, Section 01 35 10.

B. **Performance Graded Asphalt Binder (PGAB):** Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Meet limits published in Section 209 of UDOT's "Manual of Instruction, Part 8 Materials". Pay reductions are as follows:

a. If none of the critical properties are outside rejection limit a composite pay adjustment of 25 percent or less is allowed.

b. If one or more of the critical properties falls outside the rejection limit or if a composite pay adjustment is more than 25 percent, Asphalt Binder will be rejected.

C. **Asphalt Cement (AC) Binder**: Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Ductility: Meet this section's requirements, or

2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials":

a. Lot may be accepted using the published graphics. If pay adjustment exceeds 30 percent, reject Asphalt Binder, or

b. If allowed to remain after placement, pay adjustment will be 50 percent.

D. **Cut-back Binder**: Meet this section's requirements for ductility.

E. **Trinidad Lake Modified Asphalt**: Supplier's certificate for ASTM compliance.

F. **Emulsified Asphalt**: Supplier's certificate for ASTM compliance.

G. **Recycle Asphalt**: Identity of source (asphalt cement or tar products).

H. **Crack Patch**: Meet material requirements in Section 32 01 17.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

A. Petroleum asphalt that complies with ASTM D6373. Blending binder with polymers, crumb rubber, or natural bitumens is CONTRACTOR's choice.

2.2 ASPHALT CEMENT (AC)

A. Petroleum asphalt that complies with Table 2 of ASTM D3381 except as follows:

1. Replace ductility, ASTM D113, at 77 deg F (25 deg. C) with ductility at 39.2 deg F (4 deg. C). Use the following values.

- AC-5: greater than 25.
- AC-10: greater than 15.
- AC-20: greater than 5.

2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".

B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low-temperature copolymer consisting of two (2) percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

A. Petroleum asphalt that complies with ASTM D5710 (a blend of natural bitumens).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

A. Petroleum asphalt that complies with ASTM D2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

A. Petroleum asphalt that complies with ASTM D2027 (fluxed or blended with a kerosene type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

A. Petroleum that complies with ASTM D2028 asphalt (fluxed or blended with a naphtha solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted:

1. Anionic, ASTM D977 (breaks by evaporation).
2. Cationic, ASTM D2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

A. Petroleum asphalt that complies with ASTM D4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage:

1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP aggregate when less than 30 percent virgin aggregate is added.
2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to RAP.

2.9 WARM-MIX ASPHALT (WMA)

A. Performance grade Asphalt Binder or asphalt cement binder blended with a wax, foam, chemical, or organic additive.

2.10 HIGHLY MODIFIED BINDER

A. Performance Graded Asphalt Binder (PGAB): See ASTM D6373.

1. Highly-Modified Mix: Use PG 76-34 Highly Modified Binder with a minimum total asphalt binder content of 6.0%, by weight. Refer to UDOT Section 02745 and Quality Management Plan 509.

Table 1
PG76-34 High Mod

Original Binder		
Dynamic Shear Rheometer, AASHTO T-315	@76° C, G*, kPA	1.30 Min
	@76° C, phase angle, degrees	70.0 Max
Rotational Viscometer AASHTO T 316	@135° C, G*/sinδ, kPa	3 Max
Flash point, AASHTO T48	°C	260 Min
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@76° C, G*/sinδ, kPa	2.20 Min
Elastic Recovery, AASHTO T 301 mod (a)	%	90 Min
PAV Residue, 20 hours, 2.10 MPa, 100* C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@25° C, kPa	5,000 Max
Bending Beam Pheometer, AASHTO T 313	@-24° C, S, MPa	600 Max 150 Min
Direct Tension Test, AASHTO T 314	@-24° C, m-value	0.300 Min
	@-24° C, Failure Strain, %	(c)
	@-24° C, Failure Stress[(b)], MPa	(c)
Delta Tc from additional BBR test, ASTM D7643	@-30° C	-1.0 Min

Notes:
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.
(b) No allowances will be given for passing at colder grade.
(c) Report test results for DTT with acceptance testing, DTT not required for qc testing

PART 3 EXECUTION

3.1 INSTALLATION

A. Prime coat, Section 32 12 13.19.

B. Tack coat, Section 32 12 13.13.

C. Plant mix paving, Section 32 12 16.13.

D. Road mix paving, Section 32 12 16.19.

E. Slurry seal coating, Section 32 01 13.61.

F. Crack sealing, Section 32 01 17.

END OF SECTION

SECTION 32 12 05
BITUMINOUS CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Composition of a bituminous concrete mix.

B. Provisions for mix design of Highly-Modified Hot Mix Asphalt (HMHMA) using a high-performance asphalt mixture flexible pavement consisting of one or more layers of an asphalt mixture comprised of aggregate, asphalt binder, hydrated lime, an option to incorporate RAP and other additives.

C. For placement of a bituminous concrete mix, refer to Section 32 12 16.13.

1.2 REFERENCES

A. **AASHTO Standards**:

M323 Superpave Volumetric Mix Design, Single User Digital Publication

R18 Standard Recommended Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

R30 Mixture Conditioning of Hot-Mix Asphalt (HMA)

T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

B. Asphalt Institute Standards:

SP-2 SUPERPAVE Mix Design Series No. 2

C. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

C142 Clay Lumps and Friable Particles in Aggregates.

D75 Sampling Aggregates.

D140 Sampling Bituminous Materials.

D242 Mineral Filler for Bituminous Paving Mixtures.

D979 Sampling Bituminous Paving Mixtures.

D995 Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

D3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D4552 Classifying Hot-Mix Recycling Agents.

D4791 Flat or Elongated Particles in Coarse Aggregate.

T283 Effect of Moisture on Asphalt Concrete Paving Mixtures (Lottman Test).

D5444 Mechanical Size Analysis of Extracted Aggregate.

D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate.

D6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

D6373 Performance Graded Asphalt Binder.

1.3 **DEFINITIONS**

A. **Mix Designator:** An alphanumeric code that identifies binder grade, aggregate grade, and compaction level for a bituminous concrete mix. For example, in PG64-34, SP-1/2, 75Nd:

1. Binder grade (PG64-34): The alpha portion represents Performance Graded Asphalt Binder. The numberical portion represents the grade of the binder.

2. Aggregate gradation (SP-1/2): The alpha portion represents Superpave mix. The numerical portion represents the nominal maximum sieve size.aggregate gradation.

3. Compaction level (75Nd): This is the compaction level using Superpave mix design process.

B. **Bituminous Binder:** A graded bituminous cement composed of any of several viscous or solid mixtures of hydrocarbons and their nitrogen and sulfur derivatives, whose combined properties meet a defined standard.

1. Virgin Asphalt Binder: A refined or manufactured bituminous cement known as performance graded asphalt binder (PG or PGAB).

2. Recycled Asphalt Binder: A bituminous cement contained in recycled asphalt pavement known as performance graded asphalt binder (PG or PGAB).

C. **Binder Grades:**

1. Virgin Binder Grade: The grade of asphalt binder received from binder supplier and added to the mix.

2. RAP Binder Grade: The grade of recycled asphalt binder contained in recycled asphalt pavement.

3. Resultant Binder Grade: The resultant grade of binder in the mix based on blending of virgin binder and RAP binder grades.

4. Design Binder Grade: The required grade of binder for the pavement based on environmental conditions, also the virgin asphalt binder specified when using 15% or less RAP.

5. Highly-Modified Binder: Performance Grade Binder with higher amounts of polymer modifiers to be used in Highly Modified Hot Mix Asphalt (HMHMA).

D. **Mean of Deviations**: Defined in Section 32 11 23.

E. **Nominal Maximum Size**: One sieve size larger than first sieve size retaining more than 10 percent of the Sample. One hundred percent of the aggregate might be able to pass through the nominal maximum size sieve but not more than 10 percent will be retained on that sieve. The maximum size sieve will be one (1) sieve size larger than the nominal maximum size.

F. **RAP**: Acronym for reclaimed asphalt pavement. A granular product recovered from a bituminous pavement containing aggregate and an Asphalt Binder.

G. **Quality Control:** Sampling, testing and inspection efforts performed by the Contractor to control the mix production and placement operations. Locations, times, practices and personnel (other than Lab AMRL Accreditation and minimum requirements in Article 3.3) are the contractor's decision.

1. Requirements for Quality Control that may/will be used in acceptance decisions will be defined by the Owner in Section 32 12 05S - Project Specific Surfacing Requirements.

H. **Owner Verification Testing**: Sampling, testing and inspection efforts, and personnel/laboratory qualifications that are utilized by the Owner to verify compliance of the mix production and placement with specifications. Locations, times, practices and personnel are at the Owner's decision.

I. **Road Class**: Road Class as identified in Section 32 12 05S – Project Specific Surfacing Requirements, or as defined in section 32 01 31 Pavement Smoothness if not in 32 12 05S.

J. **Warm Mix Asphalt** (WMA) is defined as asphalt produced with a maximum production temperature (Fahrenheit):

1. PG58 > 270 degrees

2. PG64 > 280 degrees

3. PG70 > 290 degrees

4. PG76 > 300 degrees

K. Highly-Modified Hot Mix Asphalt (HMHMA): A bituminous concrete mix that incorporates Highly Modified Binder at higher binder contents and requires higher in-place density for extended performance.

1.4 **SUBMITTALS**

A. **General**:

1. Pre-approved Mix Design: Submit name and address of Supplier.
2. Allow ENGINEER 10 days to evaluate mixing equipment and mix design submittals.
3. Once a mix design is accepted, a new mix design submittal is required if the following occurs.
   a. Asphalt Binder grade is changed.
   b. Aggregate source is changed. When this occurs, submit a physical properties report on the proposed aggregates.

B. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM D3666. And follows Section 01 45 00 requirements.
2. Mix Production Equipment: Submit verification by an individual acceptable to ENGINEER, that plant equipment complies with requirements of ASTM D995.
3. Testing Report: If requested by ENGINEER, submit a report of source and field quality control testing performed by CONTRACTOR and Suppliers.
4. Testing Report: If identified by Section 32 12 05S – Project Specific Surfacing Requirements, submit Quality Control data to the Engineer within 3 working days after completion of each day of paving or prior to the start of the next paving day, whichever is sooner.
5. Plant Production Report: If identified by Section 32 12 05S – Project Specific Surfacing Requirements, submit daily plant production records to the Engineer within 1 working day after completion of each day of paving and prior to the start of the next paving day.
   a. Plant report must include weights of all individual aggregates, bitumens, water and other additives incorporated in mix, including RAP, lime, mineral filler, fiber or other additives.

C. **Mix Design:** Submit the following.

1. Valid mix design.
   a. Mix designs dated from the previous paving season (calendar year) are invalid unless accompanied by a letter from the Asphalt Supplier certifiying that the mix design is still valid for the current paving season.
   b. Mix designs dated prior to the previous paving season are invalid.
   c. Mix designs are invalid if aggregate source or binder grade are changed.
   d. Invalidated mix designs must be revalidated for volumetric properties (minimum 4 pucks, ± 0.2% from targets), or a replaced with a new mix design.
2. Virgin Binder source and grade, and Resultant Binder grade.
3. Optimum compaction temperature at the project site.
4. Theoretical maximum specific gravity.
5. Compaction density at design target air voids.
6. Target Grading Curve for aggregate.
7. Binder target percentage.
8. Dust to binder ratio.
9. Voids in the mineral aggregate (VMA).
10. Voids filled with Asphalt (Bituminous Binder), also known as VFA.
11. Hamburg Wheel Tracker results, if required
12. Percentages of 1) mineral filler, 2) anti-strip (if required), 3) reclaimed bituminous (asphalt) pavement (RAP), 4) recycle agent in the mix, and 5) virgin aggregate.

13. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than two (2) calendar years from the date of submission.

D. Warm Mix Asphalt (WMA) – Mix Design

1. WMA must be produced using an approved additive. Approved additives must be evaluated and published on the National Transportation Product Evaluation Program (NTPEP)

a. Chemical additive dosage shall be declared on the mix design. Production target dosage shall be a minimum and maximum percentage of weight of total binder (RAP + Virgin AC) per manufacturer recommendations.

b. Existing aspalt mix designs can be modified to WMA provided that all standard asphalt specifications continue to be met.

c. New volumetric mix design verifications shall be completed with the additive in the mix.

d. When adding a warm mix chemical to an existing approved mix design the contractor must provide documentation that the mix still meets APWA specifications.

e. The binder supplier shall confirm compatibility between their binder and the maximum dosage of additive to be used.

1.5 **MATERIALS QUALITY**

A. Do not change aggregate source or binder grade until ENGINEER accepts new grades and new or revalidated mix design.

B. HMA Mixing Plant: Capable of meeting ASTM D995 requirements or use UDOT Qualified Plant.

1.6 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) Lot is one (1) days' production.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.

3. If test results are not within this section's limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.

4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

B. **Mix Sampling and Testing**:

1. Sub-lot size is 500 tons or part thereof.

2. Sampling Protocol: ASTM D3665 and ASTM D979. Collect at least one (1) random Sample per sub-lot from behind paver and before compaction. For placements with a design thickness of 2 inches or less, samples may be taken at the plant. Any sample collected because of non-uniform appearance shall not be used in determining a pay factor for the Lot.

a. Sampling binder, ASTM D140. At owner's request, take 1 qt sample and provide to owner's representative.

3. Testing Protocol (Performed by Owner's Verification Testing Organization):

a. Project Less than 1000 tons – At Owner's discretion, mix samples will be compacted in the laboratory and tested for:

1) Binder content, ASTM D6307.

2) Aggregate gradation, ASTM D5444.

3) Maximum Specific Gravity (Rice), ASTM D2041

b. Project greater than 1000 tons - Mix samples will be compacted in the laboratory and tested for:

1) Air voids, ASTM D3203.

2) Voids in the mineral aggregate, AI MS 2.

3) Binder content, ASTM D6307.

4) Aggregate gradation, ASTM D5444.

5) Maximum Specific Gravity (Rice), ASTM D2041

4. Reporting: The Owner or the Owner's Verification Testing organization will provide the contractor with acceptance results within 3 working days after completion of each day of paving, or prior to the start of the next paving day, whichever is sooner.

C. Lot Acceptance: A Lot is acceptable if binder content and aggregate gradation test average deviations are within pay factor 1.00 limits in Table 1 and no sub-lot devation exceeds 0.85 pay factor limit.

D. Un-Accepted Lots (Contracts Issued by Someone Other Than The Ultimate Owner of The Pavement): Provide recommended corrective measures based on Engineering Analysis, described below, based on durability and serviceability relative to the specified product requirements, including expected performance compared to design life. The ultimate owner of the pavement or a representative of such will review and either approve corrective measures or provide basis for rejection.

E. Un-Accepted Lots (Contracts Issued by The Ultimate Owner of The Pavement): At the Engineer's discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have a sub-lot test deviation greater than pay factor 0.85 limits may be accepted with a pay factor in accordance with Table 1.

1. Lots with a pay factor lower than 0.85 or with a sub-lot with a test deviation greater than the pay factor 0.85 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 1 – Pay Factors

Criteria	Pay Factor	Range of Mean of Deviations of Tests Results in Percentage Points from Binder and Gradation Targets			
		500 Tons	1,000 Tons	1,500 Tons	≥ 2,000 Tons
Binder Content	1.00	0.0 – 0.46	0.0 – 0.41	0.0 – 0.38	0.0 – 0.35
	0.95	0.47 – 0.58	0.42 – 0.52	0.39 – 0.58	0.36 – 0.52
	0.90	0.59 – 0.64	0.53 – 0.56	0.59 – 0.64	0.53 – 0.56
	0.85	0.65 – 0.69	0.57 – 0.61	0.65 – 0.69	0.57 – 0.61
Nominal Sieve	1.00	0.0 – 6.3	0.0 – 5.6	0.0 – 5.3	0.0 – 5.0
	0.95	6.4 – 7.9	5.7 – 7.0	5.4 – 7.9	5.1 – 7.0
	0.90	8.0 – 8.7	7.1 – 7.7	8.0 – 8.7	7.1 – 7.7
	0.85	8.8 – 9.5	7.8 – 8.4	8.8 – 9.5	7.8 – 8.4
No. 8 Sieve	1.00	0.0 – 4.8	0.0 – 4.3	0.0 – 4.0	0.0 – 3.8
	0.95	4.9 – 6.0	4.4 – 5.3	4.1 – 5.0	3.9 – 4.3
	0.90	6.1 – 6.6	5.4 – 5.8	5.1 – 5.6	4.4 – 4.8
	0.85	6.7 – 7.2	5.9 – 6.4	5.7 – 6.2	4.9 – 5.4
No. 50 Sieve	1.00	0.0 – 3.8	0.0 – 3.3	0.0 – 3.0	0.0 – 2.8
	0.95	3.9 – 5.0	3.4 – 4.3	3.1 – 4.0	2.9 – 3.3
	0.90	5.1 – 5.6	4.4 – 4.8	4.1 – 4.6	3.4 – 3.8
	0.85	5.7 – 6.2	4.9 – 5.4	4.7 – 5.2	3.9 – 4.4
No. 200 Sieve	1.00	0.0 – 2.0	0.0 – 1.8	0.0 – 1.8	0.0 – 1.8
	0.95	2.1 – 2.4	1.9 – 2.2	1.9 – 2.2	1.9 – 2.2
	0.90	2.5 – 2.7	2.3 – 2.4	2.3 – 2.4	2.3 – 2.4
	0.85	2.8 – 3.0	2.5 – 2.6	2.5 – 2.6	2.5 – 2.6

NOTES
(a) Test binder content using a burn-off oven, ASTM D6307.
(b) Determine aggregate gradation by extraction, ASTM D5444.

F. Engineering Analysis:

1. Submit an Engineering Analysis, performed and stamped by a Utah Registered Professional Engineer or Mix Supplier QC Manager with commensurate experience in materials and pavements performance, for approval within one week of receipt of test results or at least one working day (M-F) before performing any work that may prevent the evaluation, correction, or removal of the lot in question.

2. The engineering analysis shall include the following:

a. Reasons for disputing the acceptance or verification test results.

b. The Contractor's project quality control test results, including any split sample test results.

1) Test results must be from a UDOT qualified laboratory using UDOT qualified technicians, or results must be verified and certified (stamped) by a Utah Registered Professional Engineer.

2) Include all supporting test data and calculations for reported values.

c. Successful laboratory correlation information when required by material specification.

d. Statistical analysis or identification of potential outliers.

e. Procedures or issues leading to disputed acceptance test results.

f. Impact of results on pavement performance and recommended cost adjustment to impacted materials based on impact to pavement performance.

G. **Installation**: See Section 32 12 16.13 acceptance requirements.

PART 2 PRODUCTS

2.1 BINDER

A. Performance Graded Asphalt Binder (PGAB): See ASTM D6373.

1. Use the following minimum virgin mix binder grades unless otherwise specified.

Table 2 – Minimum Virgin Binder Grade

	Elevation	
Road Class	Above 4000 Feet	Below 4000 Feet
Class I & II	PG 58-28 (≤ 15% RAP) PG 64-34 (>15% RAP) (a)	PG 64-22 (≤ 15% RAP) PG 58-28 (>15% RAP)
Class III	PG 64-34 (a) (Up to 30% RAP)	PG 70-28 (≤ 15% RAP) PG 64-34 (>15% RAP)
a. Blending chart limitations for mixes exceeding 15% RAP must meet -28 for low end PG temperatures.		

2. Adjust virgin binder grade to accommodate RAP contents in excess of 15% as identified in Table 2. Do not use grades lower than xx-34. Use M323 Appendix X1 Blending chart to determine acceptable RAP content up to maximum allowed based on virgin binder grade selected or additives incorporated. Submit RAP binder grading and blending charts with mix design.

3. Use of Virgin Binder Grades exceeding the minimums, i.e. grades with ranges encompass greater temperature ranges than required for virgin binder, is acceptable.

4. Highly-Modified Hot Mix Asphalt; Use Highly Modified Asphalt Binder (PG 76-34) as per Section 32 12 03 Asphalt Binders.

2.2 AGGREGATE

A. Crushed stone, crushed gravel,slag, sand, or combination.

B. Use Table 3 to determine suitability of aggregate source.

Table 3 – Aggregate Physical Properties				
		Standard	Road Class	
			I & II	III
Coarse Aggregate				
Angularity, percent, minimum	One Fractured face	D5821	90	95
	Two Fractured faces		90	90
Wear (hardness or toughness), percent, maximum		C131	35	35
Flats or elongates (3:1 length to width), percent, maximum		D4791	--	20
Fine Aggregate				
Angularity (uncompacted void content), percent, minimum		T304	40	45
Sand equivalent, percent, minimum		D2419	45	60
Plastic limit, maximum		D4318	0	0
Blended Physical Properties				
Dry-rodded Unit Weight, lb/ft^3, minimum		C29	75	75
Weight Loss (Soundness), percent, maximum		C88	16	16
Friable particles, percent, maximum		C142	2	2

NOTES
(a) Coase aggregate is material retained on No. 4 sieve.
(b) Fine aggregate is material passing No. 4 sieve.
(c) Angularity is determined by weight.
(d) Wear of aggregate may have higher values if aggregate source is known to have higher values.
(e) Sand equivalent is waived for RAP aggregate but applies to the remainder of the aggregate blend.
(f) Plastic limit, passing No. 40 sieve. Aggregate is non-plastic even when filler material is added to the aggregate.
(g) Weight loss, using sodium sulfate.
(h) Friable particles are clay lumps, shale, wood, mica, coal passing the No. 4 sieve, and other deleterious materials.
(i) Road class as identified in project documents and as defined in Section 32 01 31

2.3 **ADDITIVES**

A. Mineral Filler: ASTM D242.

B. Recycle Agent: ASTM D4552.

C. Anti-strip Agent: Heat stable cement slurry, lime slurry, or chemical liquid.

D. RAP: Free of detrimental quantities of deleterious materials.

1. Use RAP Content as requirements of Table 2.
2. Determine RAP binder content by chemical extraction.

2.4 **MIX DESIGN.**

A. **Preparation**:

1. Get the Mix Designator and the Road Class from the OWNER, ENGINEER, or bid documents.
2. Use paragraph 1.4C to determine submittal requirements.

B. **Aggregate Gradation:** See Table 4. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 1. The target grading band limits are allowed to extend outside of the Master Grading Band limits.

Table 4 - Master Grading Bands - Superpave Mix Design		
Sieve	**Gradation Limits of Target Gradation**	
	SP-1/2	**SP-3/8**
3/4 inch	100	–
1/2 inch	90.0 – 100	100
3/8 inch	< 90.0	90.0 – 100
No. 4	–	< 90.0
No. 8	28.0 – 58.0	32.0 – 67.0
No. 200	2.0 – 10.0	2.0 – 10.0

NOTES

(a) Gradation is expressed in percent passing by weight per ASTM C136. Percentage of fines passing No. 200 sieve determined by washing per ASTM C117.

(b) The numerical portion of the grade designator (1/2, 3/8) represents the ***nominal maximum*** sieve size. Comparable ***maximum*** mix designs would be one sieve size larger, i.e. ½" nominal (superpave) maximum is comparable to ¾" maximum (Marshall).

C. Design Parameters: Determined by AI MS-2.

Table 5 - Mix Design Parameters	
Compaction Level (a)	Asphalt Institute SP-2
Road Class I/II	50Nd
Road Class III	75Nd
Design Air Void Target, percent (b)	3.5
Voids in Mineral Aggregate (VMA) relative to nominal sieve size grading and calculated using Gsb(dry), percent, minimum	ASTM D3203
Class II and III: SP-1/2	14.2
Class I: SP-3/8	15.2
RAP specific gravity for calculations	Gsb (dry) by chemical extraction
Dust to Binder Ratio, maximum	1.6
Tensile Strength Ratio (moisture sensitivity), minimum (a,c)	AASHTO T283
Road Class I (e)	80% or HWT
Rutting (Hamburg Rut Test) (a,d)	AASHTO T324
Road Class II	15 mm/10,000 passes
Road Class III	10 mm/20,000 passes

NOTES

(a) Road Class as identified in project documents and as defined in Section 32 01 31.

(b) Design Density Target: ASTM D2041. Percent of maximum theoretical specific gravity.

(c) Tensile Strength Ratio (moisture sensitivity): Use one cycle of Freeze-thaw conditioning. Compact test specimen to seven (7) percent plus or minus one (1) percent air voids. Applicable to Road Class I only.

(d) With testing performed at temperatures representing the specified binder grade in the Hamburg rut test, the average rut depth of two (2) mix design test samples is less than the amount shown for the respective Road Classes.

(e) Lottman not required if passing Hamburg Wheel Tracker

D. HMHMA Design Parameters: Determined by AI MS-2 and in accordance with Table 6.

Table 6 - Mix Design Parameters	
Compaction Level [a]	Asphalt Institute SP-2
All Road Classes	50Nd
Design Air Void Target, percent [b]	0.75 to 1.25
Voids in Mineral Aggregate (VMA) relative to nominal sieve size grading and calculated using Gsb(dry), percent, minimum	ASTM D3203
SP-1/2	15.0 to 17.0
SP-3/8	16.0 to 18.0
Voids Filled with Asphalt (VFA) @ N_{design}	90.0 to 95.0
RAP specific gravity for calculations	Gsb (dry) by chemical extraction
Dust to Binder Ratio, maximum	1.6
Draindown	AASHTO T305
All Road Classes	0.3 maximum
Rutting (Hamburg Rut Test) [a,c]	AASHTO T324
All Road Classes	10 mm/20,000 passes
NOTES (a) Road Class as identified in project documents and as defined in Section 32 01 31. (b) Design Density Target: ASTM D2041. Percent of maximum theoretical specific gravity. (c) With testing performed at temperatures representing the specified binder grade in the Hamburg rut test, the average rut depth of two (2) mix design test samples is less than the amount shown for the respective Road Classes.	

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Mixing Plant: ASTM D995. Provide.

1. Positive means to determine the moisture content of aggregate.
2. Positive means to sample all material components.
3. Sensors to measure the temperature of the mix at discharge.
4. Ability to maintain discharge temperature of mix.
5. Capability of maintaining plus or minus five (5) percent tolerance on component percentages in final mix.
6. **Ability to document control efforts.** 3.2 **INSTALLATION**

A. Pavement placement, Section 32 12 16.13.

B. Pavement restoration, Section 33 05 25

3.2 QUALITY CONTROL

Perform the following:

A. For all projects, test temperature of mix placed in the transport vehicle at the production plant.

1. Reject mixes exceeding the limits identified in the mix design.

B. For projects requiring testing, collect mix samples randomly from the plant (from truck or hot-drop) or the field (windrow or behind paver), ASTM D3665.

1. Sampling bituminous paving mixture, ASTM D979, minimum one sample per sub-lot.

C. If Quality Control is required by Section 32 12 05S – Project Specific Surfacing Requirements or project documents, submit Quality Control data to the Engineer. Submit data within 3 working days after completion of each day of paving or prior to the start of the next paving day, whichever is sooner.

D. For projects less than 500 tons, if identified as required by Section 32 12 05S – Project Specific Surfacing Requirements, provide one of the following:

1. Plant Report; or
2. Test results for binder content and combined gradation of mix

E. For projects between 500 and 1500 tons, provide the following:

1. Combined aggregate gradation in the mix, ASTM D5444.
2. Binder content in the mix, ASTM D6307.
3. Maximum Specific Gravity (Rice), ASTM D2041.

F. For projects greated than 1500 tons, provide the following:

1. Combined aggregate gradation in the mix, ASTM D5444.
2. Binder content in the mix, ASTM D6307.
3. Air voids, ASTM D3203.
4. Voids in the mineral aggregate, AI MS 2.
5. Maximum Specific Gravity (Rice), ASTM D2041.

G. Cease production when Air voids at Ndes averaged for each lot are not within Target Value ± 1.0 percent. Provide corrective measures in writing to the engineer to meet air void tolerances before resuming paving operations.

H. Warm Mix Testing: When rutting or moisture susceptibility tests are required on warm mix produced at temperatures below 275 deg F, condition the warm mix material before testing for two (2) hours at design mixing temperature plus or minus five (5) deg F per AASHTO R30 (short term aging). The material may be cooled to room temperature before conditioning.

END OF SECTION

SECTION 32 12 08
RUBBERIZED ASPHALT CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mixing aggregate, rubber, and Asphalt Binder to make a rubberized bituminous concrete mix.

1.2 REFERENCES

A. **ASTM Standards**.

D5 Penetration of Bituminous Materials.

D36 Softening of Bitumen (Ring-and-Ball Apparatus).

D75 Sampling Aggregates.

D92 Flash and Fire Points by Cleveland Open Cup Tester.

D140 Sampling Bituminous Materials.

D242 Mineral Filler for Bituminous Paving Mixtures.

D979 Sampling Bituminous Paving Mixtures.

D995 Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D2196 Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer.

D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

D3665 Random Sampling of Construction Materials.

D3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

D4867 Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.

D5329 Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.

D5444 Mechanical Size Analysis of Extracted Aggregate.

D6114 Asphalt Rubber Binder

D6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

D6373 Performance Graded Asphalt Binder.

D6927 Marshall Stability and Flow of Bituminous Mixtures.

1.3 DEFINITIONS

A. **Mix Designator**: An alphanumeric code that identifies components of a rubberized asphalt concrete mix. For example.

- *PG64-22, SP-1, 75Nd, TR*: PG64-22 is a Performance Greaded Asphalt Binder. SP-1 is the aggregate grade. 75Nd is the compaction level at Superpave mix design. TR means the mix has a Tire Rubber modifier.
- *PG64-22 DM-1/2, 50 blow. TR*: is a Performance Graded Asphalt Binder. DM-1/2 is the aggregate grade. 50 blow is the compaction level at Marshall mix design. TR means the mix has a Tire Rubber modifier.

1.4 SUBMITTALS

A. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM standards.
2. Mixing Equipment: Submit certification of plant equipment.

B. **Asphalt Rubber Binder Compliance**:

1. Submit the values obtained from the source quality control tests, along with the following information: percent, grade and source of the asphalt rubber binder used; and percent, gradation and source(s) of rubber used.

2. Provide a certificate from the asphalt rubber binder Supplier assuring that the rubber is derived from automotive, truck or other vehicle tire material.

C. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Industry standard used for mix design (i.e. Marshall or Superpave). If the industry standard will be modified or a different mix design procedure will be used, get ENGINEER's approval.

2. Date of mix design. If older than 365 days from date of submission, recertify mix design.

3. Target Grading Curve for aggregate.

4. Dust to binder ratio, tensile strength ratio (moisture sensitivity), and percentage of Asphalt Binder in the mix.

5. Percentages of mineral filler, anti-strip, and tire rubber in the mix.

6. Aggregate physical properties (this section article 2.3): The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from the date of submission.

D. **Testing Report**: If requested by ENGINEER, submit a report describing source and field quality control testing performed by CONTRACTOR and Suppliers.

1.5 **QUALITY ASSURANCE**

A. Use a laboratory that follows and complies with ASTM D3666 and follows Section 01 45 00 requirements.

B. Do not change aggregate source or rubberized Asphalt Binder source until ENGINEER accepts a new source and a new mix design.

1.6 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) Lot is one (1) day's production.

2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.

3. If test results are not within acceptable limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.

4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

5. Dispute resolution, Section 01 35 10.

B. **Rubberized Asphalt Concrete Mix**:

1. Sub-lot size is 500 tons or part thereof.

2. Sampling Protocol: ASTM D3665 and ASTM D979. Collect at least one random Sample per sub-lot from the following locations.

a. Behind paver before compaction, or

b. Where sub-lot exhibits non-uniform appearance.

3. Testing Protocol: Field samples will be compacted in the laboratory and tested for:

a. Air voids, ASTM D3203 or ASTM D6927.

b. Dust to binder ratio.

c. Asphalt content, ASTM D6307 and aggregate gradation, ASTM D5444.

C. **Pay Reduction**: Defective binder content or aggregate gradation defects may be accepted at reduced pay as indicated in Section 32 12 05 (Superpave design or Marshall design) as applicable.

D. **Installation**: Acceptance requirements are stipulated i n Section 32 12 16.13.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

A. Performance Graded Asphalt Binder (PGAB), ASTM D6373: Able to produce properties indicated in ASTM D6114 when interacted with ground recycled tire rubber.

2.2 GROUND RECYCLED TIRE RUBBER

A. Contains less than 0.75 percent moisture, is free flowing, contains no more than 0.01 percent ferrous metal particles by weight, and has not more than 0.5 percent fabric in hot-mix applications. The use of rubber from multiple sources is acceptable provided that the overall blend of rubber meets gradation requirements.

B. Gradation: Percent passing No. 8 mesh is 100 percent

C. Additives: Calcium carbonate or talc, up to four (4) percent by weight to prevent particles from sticking together.

2.3 AGGREGATE

A. Crushed stone, crushed gravel, slag, sand or combination with physical properties indicated for bituminous concrete mix (Marshal mix design or Superpave mix design). See Section 32 12 05.

2.4 ADDITIVES

A. Mineral Filler: ASTM D242.

B. Anti-strip Agent: Heat stable cement slurry or lime slurry.

C. Reclaimed Asphalt Pavement (RAP): NOT ALLOWED.

2.5 MIX DESIGN

A. Asphalt Rubber Binder: Type I, Type II, or Type III per ASTM D6114 with the following components.

Table 1 – Components of Asphalt Rubber Binder

Property	Standard	Binder Designation		
		Type I	Type II	Type III
Climate		Hot	Moderate	Cold
Base Asphalt Binder	D6373	PG70-22	PG64-22	PG58-28
Rubber added to base Asphalt Binder, percent, min.	--	15	15	15

B. Additives: Cement or lime slurry for tensile strength in the mix, CONTRACTOR's choice.

C. Aggregate Structure and Mix Properties: Refer to Section 32 12 05 for Superpave or Marshall aggregate structure and properties.

2.6 SOURCE QUALITY CONTROL

A. Collect Samples randomly, ASTM D3665. Do not change sampling points.

1. Sampling aggregates, ASTM D75. Collect sample before the drum mixer or after going through the drier.
2. Sampling asphalt rubber binder, ASTM D140.
3. Sampling bituminous pavement mixture, ASTM D979.

B. Do one (1) test of asphalt rubber binder every 20,000 gallons for the following properties.

1. Apparent viscosity, ASTM D2196 method A.
2. Penetration, ASTM D5.
3. Softening point ASTM D36.
4. Resilience, ASTM D5329.
5. Flash point, ASTM D92.
6. Penetration retention, ASTM D75.

C. **Test mix every production day** for the following:

1. Combined aggregate gradation in the mix, ASTM D5444.
2. Asphalt Binder content in the mix, ASTM D6307.
3. Tensile strength of the mix, ASTM D4867.
4. Temperature of mix placed in the transport vehicle.

D. Equipment: Certify at least every two (2) years through the services of a design professional licensed in the State of Utah, that plant equipment complies with requirements of ASTM D995.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Mixing Plant: ASTM D995. Provide.

1. Positive means to determine the moisture content of aggregate.
2. Positive means to sample all material components.
3. Sensors to measure the temperature of the mix at discharge.
4. Ability to maintain discharge temperature of mix.
5. Capability of maintaining component percentages of final mix within acceptable industry standards.

3.2 INSTALLATION

A. Pavement placement, Section 32 12 16.13.
B. Pavement restoration, Section 33 05 25

END OF SECTION

SECTION 32 12 13.13
TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of asphaltic material to existing bituminous concrete or Portland cement concrete surfaces before placing an bituminous concrete pavement.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03:

1. Identify water/asphalt dilution ratio.
2. Identify tack coat application rate.

B. Identify asphalt material recommended by fabric manufacturer.

1.3 WEATHER

A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg F Temperature restrictions may be waived only with ENGINEER's concurrence.

B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

1.4 NOTICE

A. Send written notice to residents or business owners 24 hours before applying coat.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following:

1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

PART 3 EXECUTION

3.1 PREPARATION

A. Select and advise ENGINEER of the type of tack material to be used.

B. Clean surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.

C. Provide safe pedestrian access across tack coat.

D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

3.2 APPLICATION

A. General:

1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
2. Apply tack only to area covered with bituminous concrete in the same day.

B. Application Rate: Typically as follows:

1. Emulsions, 0.05 to 0.15 gallons per square yard.
2. Cutback, CONTRACTOR's choice.

C. Tack for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows:

1. Dry pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce application rate to no less than 0.20 gallons per square yard.

2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

3.3 PROTECTION

A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.

B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.

B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.

C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION

SECTION 32 12 13.19
PRIME COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of liquid asphalt to aggregate base before placing bituminous concrete or Portland cement concrete pavement.

B. Placing sand on areas that are over-primed.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03.

1.3 WEATHER

A. Apply prime coat only when air and roadbed temperatures in the shade are greater than 40 deg F Temperature restrictions may be waived only with ENGINEER's knowledge.

B. Do not apply prime coat during rain, fog, dust, or other unsuitable weather.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following:

1. Slow Cure Cutback Asphalt: Grade SC-70, or SC-250, Section 32 12 03.
2. Medium Cure Cutback Asphalt: Grade MC-30, MC-70, or MC-250, Section 32 12 03.
3. Rapid Cure Cutback Asphalt: Grade RC-1, RC-2, or RC-250, Section 32 12 03.

2.2 SAND

A. Clean natural aggregate passing the No. 4 sieve and retained on the No. 200 Sieve.

PART 3 EXECUTION

3.1 PREPARATION

A. If aggregate base course to be primed contains an appreciable amount of loose material or is excessively dusty; moisten, blade, roll, and recompact to make the surface dense.

B. Do not start priming until all free surface moisture has disappeared.

C. Notify residents and business owners 24 hours before applying prime coat.

D. Provide pedestrian access across prime coat if required.

3.2 APPLICATION

A. If pavement surface is to be applied over loosely bonded surface, apply prime coat at 0.10 to 0.50 gallons per square yard to penetrate and seal. Do not flood surface.

B. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

C. Blot over-primed surface with a light, uniform layer of sand.

D. Prime under-primed areas with additional asphalt.

3.3 PROTECTION

A. Protect all structures, including curb, gutter, sidewalks, guardrails and guide posts from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to OWNER.

B. Do not discharge bituminous material into borrow pits or gutters.

C. Prevent tracking of prime coat onto adjacent surfaces.

3.4 **OPENING TO TRAFFIC AND MAINTENANCE**

A. Do not permit traffic to travel over freshly primed surface until prime coat has cured. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If one-way traffic is provided, control traffic by flagging or pilot car operation.

B. After prime coat application, leave work area undisturbed. If prime coat is tacky or tends to pick up under traffic after four (4) hours, blot excess prime coat with blotter sand. Prime coats can be opened to traffic after blotting.

C. Clean and maintain primed surfaces until surface pavement course is placed. Maintenance includes spreading any necessary additional blotter material, replacing all portions of prime coat that have been destroyed, and patching any break in primed surfaces.

END OF SECTION

SECTION 32 12 16.13

PLANT-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place a bituminous concrete pavement base course, leveling course, surface course, overlay course, or an inlay course.

B. Provisions for placement of Highly-Modified Hot Mix Asphalt (HMHMA) pavement base course, leveling course, surface course, overlay course, or an inlay course.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 761 Speed Bump.

Plan 762 Speed Table.

B. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

TP68 Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method.

T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

C. **ASTM Standards**:

D979 Sampling Bituminous Paving Mixtures.

D1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2725 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.

D2950 Density of Bituminous Concrete In Place by Nuclear Method.

D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

D3665 Random Sampling of Construction Materials.

D5361 Sampling Compacted Bituminous Mixtures for Laboratory Testing.

D6927 Marshall Stability and flow of Bituminous Mixtures.

1.3 DEFINITIONS

A. Lot: Defined in Section 01 35 10.

B. Must Grind: Defined in Section 32 01 31.

C. Road Class: Defined in Section 32 01 31

D. Sample: Defined in Section 01 35 10.

1.4 SUBMITTALS

A. Bituminous Concrete Mix Design, Section 32 12 05

B. Before Delivery: Submit 48 hours before delivery:

1. Materials Quality Data, this section Article 1.5
2. Traffic control plan, Section 01 55 26.
3. Manufacturer's certificate of compliance for paving geotextiles. (Refer to Section 31 05 19).
4. Certification of profilograph and profilograph operator.
5. Cold weather paving plan.

C. At Delivery: For each batch delivered to site provide a paper or electronic (e-ticket) delivery ticket with the following:

1. Date and project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Weight of mix delivered.

D. After Placement:

1. Quality Control Test Report: If required by Section 32 12 05S, submit density and thickness Quality Control data to the Engineer within 3 working days after completion of each day of paving or prior to the start of the next paving day, whichever is sooner.

2. After Placement: Before final payment submit summary report describing profile deviation and profile roughness. Section 32 01 31

1.5 **MATERIALS QUALITY**

A. Do not change aggregate source or binder grade until ENGINEER accepts new source and new mix design.

B. Perform Quality Control efforts identified in article 3.8.

C. Reject product and work that does not meet requirements of this Section.

D. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

E. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

F. For all equipment and hand tools used to mix, haul, and place the bituminous concrete, use a release agent that does not dissolve asphalt and is acceptable to ENGINEER.

1.6 **WEATHER**

A. Temperature:

1. April 15 to October 15: Place pavement when air temperature in the shade and the roadway surface temperature are above 50 deg F. The ENGINEER determines may provide written approval if it is acceptable to place outside of this temperature limit.

2. Before April 15 and After October 15: Provide a Cold Weather Paving Plan. ENGINEER must accept the plan before proceeding. Include the following details.

a. Haul details.
b. Placement details.
c. Compaction aids used in production.
d. Coordination procedure for acceptance testing.

B. Moisture: Do not place on frozen base, during adverse climatic conditions such as precipitation, or when roadway surface is wet or icy.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **OWNER VERIFICATION TESTING AND ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

4. Opening a paved surface to traffic does not constitute acceptance.

5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Mix Material**: Accepted as specified for bituminous concrete , Section 32 12 05, or rubberized asphalt concrete, Section 32 12 08.

C. **Mix Temperature at Site:**

1. Reject mixes in the transport material exceeding the limits identified in the mix design.

a. Use calibrated temperature probes for rejection of mix. Use temperature guns for quick approximate temperature readings only.

2. Dispose of cold mix in paver hopper as thin spread underlay.

D. **Grade, Cross Slope**: Perform minimum one grade and one cross-slope check per sub-lot.

E. Compaction: Options for acceptance are 1) core density, 2) non-destructive test density, or 3) control strip density with visual observation. Use core density unless specified elsewhere. A Lot is acceptable if density test averages are within pay factor 1.00 limits and no test is below Lowest Test limit. For remediated sublots, include remediated sub-lot tests in Lot evaluation.

1. Un-Accepted Lots: At the Engineer's discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have an individual test deviation greater than pay factor 0.80 allowed limits may be accepted with a pay factor in accordance with Table 1.

a. Lots with a mat pay factor lower than 0.80 or with a sub-lot with a test deviation greater than the pay factor 0.80 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 1 – Compaction Pay Factors

Pay Factor	Mat Density, in Percent Relative to ASTM D2041 (a)		Joint Density, in Percent Relative to ASTM D2041 (a) (d)	
	Average	Lowest Test	Average	Lowest Test
0.80	More than 98.0	–	More than 98.0	–
1.00	**93.0 to 98.0**	**90.0 or greater**	**91.0 to 98.0**	**89.0 or greater**
0.90	93.0 to 98.0	Less than 90.0	91.0 to 98.0	Less than 89.0
0.80	Less than 93.0	90.0 or greater	Less than 91.0	89.0 or greater
Eng. Analysis	Less than 93.0	Less than 90.0	Less than 91.0	Less than 89.0

Notes:
(a) For overlay design thicknesses of less than 2.0", mat density targets are reduced by 1% and no joint density cores are taken.
(b) Difference based on actual sublot mat density and sublot core density values.
(c) Report and calculate all density values to 0.1%.
(d) A paving Joint is defined as a longitudinal seam between two adjacent passes of asphalt placed during the project, and where the initial pass cools below 180 deg F prior to placement of the adjacent pass. Do not take Joint cores where the "Joint" is comprised of existing asphalt or concrete. Use 6" diameter cores for joint density determination.

2. Core Density: This method compares the average density of cores extracted from a pavement surface to maximum theoretical density. Contractor to take cores in the presence of and immediately deliver to the Engineer or Engineer's representative.

a. Mat Lot Size: One (1) day production.

b. Mat Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location. Samples are full depth or overlay depth in overlay construction.

1) Projects less than 500 Tons: Use 10 sublots and non-destructive tests. Coring may be used for dispute resolution.

2) Projects between 500 and 1000 Tons: Use 4 equal sublots.

3) Projects between 1000 and 1500 Tons: Use 6 equal sublots

4) Projects greater than 1500 Tons: Use 8 equal sublots.

c. Joint Sampling Protocol: Use ASTM D3665 to randomly select a total of three (3) longitudinal joint test locations for each joint. Samples are full depth or overlay depth in overlay construction.

1) Use 6” diameter cores, centered within 1 inch of center of joint.

2) Do not core projects smaller than 250 Tons.

d. Testing Protocol: ASTM D2726 for core density and ASTM D2041 (Rice) for maximum theoretical density.

3. **Non-Destructive Density Testing by Electronic Gage**:

a. Lot Size: One (1) day production, with sublots as defined in Article 1.8.E 2 Core Density.

b. Mat Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least two (2) surface test locations.

c. Testing Protocol: ASTM D2950 (nuclear gauge) or AASHTO TP68 (non-nuclear gauge) and ASTM D2041 (Rice) for maximum theoretical density. A non-destructive test is the average of two (2) test samples at each test location with a minimum 90 degree offset between test samples using mix correlated gauges. Use minimum 60 second count with Nuclear Gauge.

4. **Compaction Dispute Resolution**:

a. Submit an Engineering Analysis for approval within one week of receipt of test results or at least 24 hours before performing any work that may prevent the evaluation, correction, or removal of the lot in question.

b. Include information, engineering analysis, statistical analysis, and test results related to the dispute.

1). Reasons for disputing the acceptance or verification test results.

2). Secure two (2) supplementary cores 10-15 feet in opposing directions from the deficient acceptance test locations.

3). The Contractor’s project quality control test results, including any split sample test results.

a) Test results must be from a UDOT qualified laboratory using UDOT qualified technicians, or results must be verified and certified (stamped) by a Utah Registered Professional Engineer.

b) Include all supporting test data and calculations for reported values.

4). Successful laboratory correlation information when required by material specification.

5). Statistical analysis or identification of potential outliers.

6). Procedures or issues leading to disputed acceptance test results.

7). Provide recommended corrective measures or adjusted pay factor based on engineering evaluation based on durability and serviceability relative to the specified product requirements, including expected performance compared to design life.

F. **HMHMA Compaction**: Options for acceptance are 1) core density or 2) non-destructive test density. Use core density unless specified elsewhere. A Lot is acceptable if density test averages are within pay factor 1.00 limits and no test is below Lowest Test limit. For remediated sublots, include remediated sub-lot tests in Lot evaluation.

1. Un-Accepted Lots: At the Engineer’s discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have an individual test deviation greater than pay factor 0.90 allowed limits may be accepted with a pay factor in accordance with Table 1A.

a. Lots with a mat pay factor lower than 0.90 or with a sub-lot with a test deviation greater than the pay factor 0.90 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 1A – HMHMA Compaction Pay Factors				
Pay Factor	**Mat Density, in Percent Relative to ASTM D2041**		**Joint Density, in Percent Relative to ASTM D2041 [a]**	
	Average	**Lowest Test**	**Average**	**Lowest Test**
1.00	**96.0 to 99.0**	**94.0 or greater**	**94.0 to 99.0**	**92.0 or greater**
0.90	94.0 to 96.0	Less than 94.0	92.0 to 99.0	Less than 92.0
Eng. Analysis	Less than 94.0	Less than 94.0	Less than 92.0	Less than 92.0

Notes:
(a) A paving Joint is defined as a longitudinal seam between two adjacent passes of asphalt placed during the project, and where the initial pass cools below 180 deg F prior to placement of the adjacent pass. Do not take Joint cores where the "Joint" is comprised of existing asphalt or concrete. Use 6" diameter cores for joint density determination.
(b) Report and calculate all density values to 0.1%.

2. Follow all other requirements of Article E: Compaction.

G. **Thickness**: A Lot is acceptable if average of test deficiencies, applied to the **total design thickness**, exceeds design thickness or is within pay factor 1.00 limits; and no sublot or individual test below 0.90 pay factor.

1. Un-Accepted Lots: At the Engineer's discretion, a lot with an average deviation that does not meet 1.00 pay factor and does not have a sub-lot test deviation greater than pay factor 0.90 allowed limits may be accepted with a pay factor in accordance with Table 2.

a. Lots with a pay factor lower than 0.90 or with a sub-lot with a test deviation greater than the pay factor 0.90 limits, and with Engineer and Contractor concurrence, are subject to an Engineering Analysis.

Table 2 – Thickness Pay Factor	
Pay Factors	**Deficiency Limits, in Inches**
1.00	0.00 to 0.25
0.90	0.25 to 0.375
Remediate	>0.375

2. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
3. Sampling Protocol: Use ASTM D3665 to randomly select at least one surface test location and one longitudinal joint test location in each sub-lot. Samples are full depth. Overlay construction measured only on overlay portion of core sample. Use one of the following methods for thickness determination:

a. Measurement of Density Cores

b. Probe of uncooled mix – perform between intermediate and final rolling operations.

c. Ground Penetrating Radar (not applicable to overlay applications).

1) Perform GPR evaluation by scanning and recording depth for full-width of the pavement at one random location for each sublot. Engineer will mark locations for scans. Measure HMA thickness every 6 inches on the recorded scan. Calculate the average thickness, and the percentage of the thickness below each of the tolerance levels described in Article 1.8 F 5.

4. **Testing Protocol:** ASTM D3549:

a. Minimum Specified Thickness (Cores or Probes): A Lot specified to have minimum thickness will be accepted if all sub-lot measurements meet or exceed minimum.

1) Cores not meeting full payment will be provided to the Contractor for verification of measurements.

2) If thickness is deficient, additional material may be placed over the deficient thickness if rotomilling is utilized for edge tie-in; placement matches this section's thickness tolerance; surface continues to drain; and roughness tolerance is met.

b. Actual Specified Thickness (Cores or Probes): A Lot specified to have actual thickness is acceptable if any sub-lot measurement does not exceed deficiency limits for thickness pay factor 1.00.

c. A lot is accepted for thickness based on GPR evaluation when:

1) The average thickness of all scans is not more than ¼ inch less than the total thickness specified.

2) No individual scan shows a deficient thickness of more than ⅜ inch for more than 5% of any scan.

5. Thickness Dispute Resolution:

a. CONTRACTOR:

1) Hire an Independent Testing Agency, Section 01 45 00, or perform in the presence of Engineer (or their representative)

2) Coring Option:

i. Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.

ii. Patch core holes.

3) Ground Penetrating Radar (GPR) Option:

i. Use GPR to determine extents of deficient area.

4) Conduct testing at no additional cost to OWNER.

b. ENGINEER:

1) Graph deficient areas by plotting new cores and original cores, or GRP results, to define deficient areas assuming the following.

a) The graph represents the thickness of the pavement.

b) Thicknesses vary linearly along the pavement length from core depth to core depth.

c) The pavement is a constant depth in the transverse direction.

2) Accept Lot at full pay if new information shows minimum of 95% of sub-lot area is in compliance, or

3) Accept Lot at pay reduction using new test information, or

4) Reject Lot.

c. REJECT LOTS:

1) Remediate reject thickness lots by adding additional thickness of bituminous concrete, adhering to all requirements of Sections 32 12 05 and 32 1216.13.

2) Utilize rotomilling as necessary to achieve proper cross-slope and elevations in relation to existing curb and gutter.

6. **Excess Thickness**: For projects paid by the ton, payment will be made for excess tonnage for thickness up to ½" over design thickness. Additional tonnage for thickness above ½" will be paid at a 50% pay factor.

G. Profile Roughness and Profile Deviation: Section 32 01 31

1.9 **WARRANTY**

A. Joints at Street Fixtures and Portland Cement Concrete Flat Work: If wider than 1/2 inch before end of the correction period seal joints with asphalt rubber or rubberized asphalt; Section 32 01 17.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Bituminous concrete, Section 32 12 05.

B. Rubberized asphalt concrete, Section 32 12 08.

C. Tack coat, Section 32 12 13.13.

D. Prime coat, Section 32 12 13.19.

E. Paving geotextile, Section 31 05 19.

F. Paving geogrid, Section 31 05 21.

G. Warm Mix Asphalt (WMA), Section 32 12 05

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver Machine: Use track equipment when operating on fabrics, geogrids or pavement mats hotter than 180 deg F

B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

C. HMHMA Placement: Place HMHMA with a Material Transfer Vehicle (MTV) to apply all courses of asphalt mix. Use an MTV that internally performs additional mixing of the asphalt mix and then deposits material into the paver at a uniform temperature and consistency.

1. Do not use HMHMA for hand work.

3.2 PREPARATION

A. General:

1. Locate and preserve utilities Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
4. Fill cracks and fix Potholes, Section 32 01 17.
5. Stabilize Portland cement concrete subgrade slabs.

B. Traffic Control:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. Aggregate Base Course:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat applications.

3.3 PROTECTION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts from physical damage. Remove spatter, over-coat, or mar.

C. Do not discharge bituminous materials into borrow pits or gutters.

D. Protect hot pavement from traffic until cool enough not to become marred.

E. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

3.4 TEMPORARY SURFACING

A. Place, roll, maintain, remove and dispose of temporary Pavement surfaces.

B. In sidewalk areas construct temporary pavements at least 1 inch thick and in all other areas at least two (2) inches thick. At major intersections and other critical locations a greater thickness may be required.

3.5 LINE AND GRADE CONTROL

A. Provide necessary survey stakes for horizontal and vertical control.

B. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for placing pavement, matching existing pavement surfaces, etc.

C. **Speed Bump or Speed Table:** Provide line and grade as shown in the Drawings or APWA Plan 761 or 762.

3.6 FABRIC PLACEMENT

A. Section 31 05 19.

3.7 PAVEMENT PLACEMENT

A. General:

1. Barricade off or eliminate fall off edges.
2. Provide continuous forward paver movement so temperature 10 feet behind paver is as follows:
   a. Warm Mix Placement: 200 deg F minimum.
   b. Hot Mix Placement:

Table 3 – Minimum Pavement Temperature in Degrees F.

Air Temperature Deg F	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 – 50	–	–	–	–	280	265
50 - 59	–	–	–	280	270	255
60 - 69	–	–	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

B. Overlays or Subsequent Lifts:

1. Allow new base pavement or new inlay pavement to cure (harden) before placing overlays.
2. Apply tack coat per Section 32 12 13.13 if inlay or sub-base Pavement surface is dirty or older than 24 hours.

C. Irregular Areas: Handwork is acceptable if specified grade, slope, compaction and smoothness are achieved.

D. Compaction:

1. Test mix placement until a compaction pattern is acceptable to CONTRACTOR. Continue random quality control testing.
2. Do not over compact or under compact.
3. Complete compaction before the following temperature are reached:
   a. 180 deg F for hot mixes.
   b. 140 deg F for warm mixes.

E. Joints:

1. Construct joints to industry standards for texture, density and smoothness.
2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new pavements, or between successive day's work.
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least six (6) feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges before making another pass with paver if mix has cooled to 90 deg F

3.8 QUALITY CONTROL

A. For projects less than 500 tons, perform Quality Control as identified below if identified as required by section 32 12 05s or project documents. For projects greater than or equal to 500 tons, perform Quality Control as identified below.

B. Compaction

1. Use trained and experienced Density Technicians

a. Use technicians trained in the aspects of gauge operation and offsets, rolling patterns, mat temperature maintenance.

b. Use technicians that have controlled a minimum of 3 previous projects under the supervision of a UDOT TTQP certified (current certifications that cover sampling, density and field asphalt properties) technician.

2. Develop Rolling Pattern for achieving density using gauges (nuclear or non-nuclear) correlated to mix being supplied.

3. Perform systematic testing to verify full lot placement (length, width and joints) is in conformance with density requirements.

4. Do not substitute owner Quality Assurance activities for Quality Control. Owner QA activities may be used to correlate Quality Control activities and devices.

C. Thickness

1. Perform systematic depth determinations throughout each sublot. Determinations may be made on compacted mix, or on uncompacted mix with appropriate adjustment for compaction.

2. Perform a minimum of two depth determinations for each edge of paving pass and for center of paving pass for each sublot.

D. Submit Quality Control Documentation to Engineer within 72 hours of placement of Lot, or prior to any subsequent overlay, whichever is sooner.

3.8 TOLERANCES

A. Lift Thickness: If not indicated, meet the following tolerances.

Table 4 – Lift Thickness Tolerance[a]

Mix	Minimum	Maximum
Bituminous Concrete	2.5 times *nominal* aggregate size	4.0 inches[b]

NOTES
(a) Thickness is measured after compaction.
(b) Maximum lift thickness may be exceeded if contractor can demonstrate ability to achieve consistent compaction from top to bottom of lift without breaking down aggregate. Determine compaction consistency by cutting a minimum of 3 random cores in half vertically and testing top and bottom half of cores. If density range between top half and bottom half of each core is equal to or less than 1%, compaction consistency is verified. If range exceeds 1%, placement must adhere to Maximum lift thickness requirement.

B. Smoothness:

1. Parallel to Centerline: Section 32 01 31.

2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

3.9 SURFACE REPAIR

A. Repair ride disturbing or unsafe butt joints. Repair expense is at no additional cost to OWNER.

B. If pavement smoothness is deficient, follow Section 32 01 31 repair requirements.

C. Corrective Action for Profile Deviations (“Must Grinds”): Grinding is acceptable. See Section 32 01 26. Apply a fog seal over grind areas. See Section 32 01 13.50. If depressions cannot be corrected by grinding, remove and replace.

D. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a fog seal over grind areas. See Section 32 01 13.50.

E. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.

F. Defective Joints, Seams, Edges: Repair.

G. Unacceptable Paving: Remove and replace.

3.10 OPENING TO TRAFFIC

A. Temperature of pavement surface is not more than 180 deg F

3.11 Pavement Placement – Warm Mix Asphalt (WMA)

A. Additives may be introduced by way of terminally blending at the binder supplier's facility or by way of in-line injection at the asphalt mix producer's facility as described below:

1. Terminal Blend

a.) WMA additive shall be metered into each bulk load of asphalt at the rate prescribed in the asphalt mix design.

b.) WMA product name and dosage shall be listed on the Bill of Lading (BOL).

c. The additive temperature must be stored and pumped per the manufacturer's recommendations.

2. In-line Asphalt Plant Injection

a.) Ensure that the additive metering equipment is calibrated and tied into asphalt plant's computer system so that flow rates can be continuously monitored by the plant operator.

b.) Ensure that metering systems can vary the amount of additive being introduced and interlock the additive pump system with the asphalt plant's computer system so that flow is automatically controlled by the plant's production rate. Do not allow the additive rate to go outside of the manufacture's recommendations.

c.) Provide calibration protocol and frequency within the contractor's QC Plan.

d.) Ensure that the additive equipment stops flow, or if a control or equipment failure occurs, the computer system immediately notifies the plant operator, and all asphalt production is stopped until the system is repaired and checked.

e.) Upon request, the contractor shall produce proof that an approved warm mix additive was purchased for the awarded project.

B. WMA Dispute Resolution

1. APWA and the CONTRACTOR shall use calibrated temperature probes at the same time at the asphalt plan to to determine temperature.

END OF SECTION

SECTION 32 12 16.15

WARM MIX ASPHALT

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Warm Mix Asphalt (WMA) is defined as asphalt produced with a maximum production temperature equal to or less than the values in Table 1.

B. To meet the requirements of WMA, asphalt shall be produced using the chemical additive at the dosage rate recommended by the product manufacturer.

1.2 **REFERENCES** Not Used

1.3 **DEFINITIONS**

A. Warm Mix Asphalt (WMA): Asphalt produced with a maximum production temperature equal to or less than the values in Table 1.

1.4 **SUBMITTALS**

A. Chemical additive dosage shall be declared on the mix design.

B. Production target dosage shall be a minimum and maximum percentage by weight of total binder (RAP + Virgin AC) per manufacturer recommendations.

C. When adding a warm mix chemical to an existing approved mix design, provide documentation that the mix still meets APWA specifications.

1.5 **QUALITY ASSURANCE**

A. WMA must be produced using an approved additive that is listed on the Department's APL (Authorized Product List).

B. Approved additives must be evaluated and published by the National Transportation Product Evaluation Program (NTPEP).

C. The binder supplier shall confirm compatibility between their binder and the maximum dosage of additive to be used.

1.6 **ACCEPTANCE**

A. Dispute Resolution

1. APWA and the Contractor shall use calibrated temperature probes at the same time at the asphalt plant to determine temperature.

PART 2 PRODUCTS

2.1 **BINDER** Not Used

2.2 **AGGREGATE** Not Used.

2.3 **ADDITIVES**

Addition Method - Additives may be introduced by way of terminally blending at the binder supplier's facility or by way of in-line injection at the asphalt mix producer's facility as described below:

A. Terminal Blend

1. WMA additive shall be metered into each bulk load of asphalt at the rate prescribed in the asphalt mix design.
2. WMA product name and dosage shall be listed on the Bill of Lading (BOL).
3. The additive temperature must be stored and pumped per the manufacturer's recommendations.

B. In-line Asphalt Plant Injection

1. Ensure that the additive metering equipment is calibrated and tied into the asphalt plant's computer system so that flow rates can be continuously monitored by the plant operator.
2. Ensure that metering systems can vary the amount of additive added based on actual asphalt binder flow, as controlled by the plant's production rate.
3. Do not allow the additive rate to go outside of the manufacturer's recommendations.

2.4 **MIX DESIGN**

A. Existing asphalt mix designs can be modified to WMA provided that all standard asphalt specifications continue to be met.

B. New volumetric mix design verifications shall be completed with the additive in the mix.

C. Chemical additive dosage shall be declared on the mix design.

D. Production target dosage shall be a minimum and maximum percentage by weight of total binder (RAP + Virgin AC) per manufacturer recommendations.

E. The binder supplier shall confirm compatibility between their binder and the maximum dosage of additive to be used.

2.5 **SOURCE QUALITY CONTROL**

A. Provide calibration protocol and frequency within the contractor's QC Plan.

B. Ensure that if the additive equipment stops flow, or if a control or equipment failure occurs, the computer system immediately notifies the plant operator, and all asphalt production is stopped until the system is repaired and checked.

C. Upon request, the contractor shall produce proof that an approved warm mix additive was purchased for the awarded project.

Table 1 – TEMPERATURE FOR WMA

Target Temperature Binder Grade	Temperature (°F)
PG58	>270°F
PG64	>280°F
PG70	>290°F
PG76	>300°F

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT** Not Used

3.2 **INSTALLATION** Not Used

END OF SECTION

SECTION 32 12 16.18

RECYCLE BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Make a base, leveling, or surface course using an existing bituminous concrete that is in-place.

B. Mix design requirements.

1.2 REFERENCES

A. **ASTM Standards**:

D2950 Density of Bituminous Concrete In Place by Nuclear Method.

D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

1.3 DEFINITIONS

A. **RAP**: Acronym for reclaimed asphalt pavement. Refer to Section 32 12 05.

B. **RAC**: Acronym for recycled asphalt concrete. A bituminous mix product consisting of RAP or ROSP, new aggregates and Binder or Binder with a recycle rejuvenating agent, the mixture of which creates a new bituminous concrete.

C. **ROSP**: Acronym for reclaimed Oil Sand pavement. Refer to Section 32 12 05.

1.4 SUBMITTALS

A. Before commencing work of this Section, submit:

1. Traffic control plan, Section 01 55 26.
2. A list of equipment to be used.
3. Type of Binder to be used, Section 32 12 03.

B. RAC Mix Design: Determine conditions and properties of existing materials. Identify recycling agent and submit the following data as applicable:

1. If RAP or ROSP is 15 percent or less of the RAC, submit a mix design formula if Supplier does not have a mix design formula at the plant. The formula shall be based on current test data.
2. If RAP or ROSP added to the RAC is over 15 percent, submit a mix design formula.

C. RAC Delivery Tickets, Section 32 12 16.19.

1.5 QUALITY ASSURANCE

A. Section 32 12 16.13.

1.6 WEATHER

A. Section 32 12 16.13.

1.7 NOTICE

A. Section 32 12 16.13.

1.8 ACCEPTANCE

A. Section 32 12 16.13.

PART 2 PRODUCTS

2.1 MATERIAL

A. Recycle asphalt (RA), Section 32 12 03.

B. Tack coat, Section 32 12 13.13.

C. Paving geotextile, Section 31 05 19.

D. Paving geogrid, Section 31 05 21.

E. RAP OR ROSP: Free of detrimental quantities of deleterious materials. Graded (on a non-dried basis) as follows.

Sieve Size	Percent Passing by Weight
1–1/2"	100
1"	90

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Laydown Machine: Provide track equipment when operating on fabrics or geogrid, otherwise type of equipment is CONTRACTOR's choice.

B. Compactors: Steel wheeled static or vibratory.

3.2 PREPARATION

A. General:

1. Locate and preserve utilities, Section 31 23 16. **Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.**

2. Lower Street Fixtures if pavement recycler machine is not capable of releasing pavement-cutting mechanism to protect fixtures.

3. Remove plant materials from cracks, edges and joints. Sweep surface clean. Blow cracks clean.

4. Stabilize concrete subgrade slabs.

5. Apply tack coat, Section 32 12 13.13.

6. Verify surfaces are dry.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.

2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.

C. Traffic Control:

1. Control pedestrian and vehicular traffic, Section 01 55 26.

2. Protect pavement from traffic until mixture has cooled enough not to become marked.

3. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

D. Milling, Section 32 01 16.71

3.3 PLACING RAC

A. Hot-laid RAC, Section 32 12 16.13

B. Cold-laid RAC, Section 32 12 16.19

C. Mix and blend milled aggregate, recycling asphalt, virgin asphalt and virgin aggregate per mix design.

3.4 TOLERANCES

A. Compaction, lift thickness, grade, cross slope, Section 32 12 16.19

B. Complete compaction of RAC within five (5) minutes of placing RAC and before its temperature drops below 200 deg F

3.5 PROTECTION AND REPAIR

A. Section 32 12 16.19.

END OF SECTION

SECTION 32 12 16.19

COLD-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct a bituminous concrete pavement base course, leveling course, or surface course by placing a bitumen cement over an in-place aggregate and mixing and compacting the product in-place.

B. Bituminous concrete material is not specified in this section. Refer to Section 32 12 05.

1.2 REFERENCES

A. **ASTM Standards**:

D1461 Moisture or Volatile Distillates in Bituminous Paving Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

D2399 Selection of Cutback Asphalts.

D3628 Selection and Use of Emulsified Asphalts.

D5581 Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen).

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Laboratory mix design, Section 32 12 05.

C. Batch Delivery Tickets: Submit ticket for each batch delivered to the work site. Include information specified in Section 32 12 16.13.

1.4 WEATHER

A. Section 32 12 16.13.

1.5 NOTICE

A. Section 32 12 16.13

1.6 ACCEPTANCE

A. Section 32 12 16.13.

PART 2 PRODUCTS

2.1 MATERIALS

A. Bituminous Binder: Emulsified asphalt or medium curing cutback asphalt, Section 32 12 03. If type is not indicated CONTRACTOR is to select the material recommended in the following ASTM standards.

1. Emulsified asphalt, ASTM D3628.
2. Cutback asphalt, ASTM D2399.

B. Aggregate, Section 32 12 05: Use an aggregate containing not more than two (2) percent moisture. If more, dry before applying bituminous product. An exception may be made for unusually porous material, when laboratory tests indicate excess moisture will not produce an unstable mix.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Lay-down Machine: Use track equipment when operating on fabrics or geogrid.

B. Compactors: Steel wheeled static or vibratory. Use a pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.

2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to the OWNER.

B. Traffic Control:

1. Provide worker and public safety, Section 01 55 26.

2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

3.3 PREPARATION OF AGGREGATE

A. On unpaved surfaces, prime coat whole roadway surface receiving cold-mix application, Section 32 12 13.19.

B. Place aggregate on the prepared base in a uniform windrow or windrows.

C. Notify ENGINEER 48 hours in advance of applying bituminous material to permit check of aggregate with respect to volume, moisture content, unit weight, and proper amount of bituminous material to be used.

3.4 PROPORTIONING AND MIXING

A. Unless specified otherwise, method of mixing may be traveling mixer method, stationary mixer method, or blade mixing method.

B. Traveling Mixer Method:

1. Accomplish mixing by means of mixer that will thoroughly blend aggregate and bitumen. Use metering devices that will accurately introduce required quantity of bitumen during the mixing process. Produce a satisfactory mixture that is uniform in appearance, texture and bitumen content, free from pockets of segregated aggregates.

2. When necessary, supplement travel plant mixing with blade mixing to obtain desired degree of aeration of mix. Continue mixing until not more than 50 percent of original volatiles present in the bituminous material remain in the mix, ASTM D1461.

C. Blade Mixing Method:

1. Spread and windrow aggregate on the prepared base, after that, uniformly apply bituminous material over the aggregate.

2. Apply bituminous material in two (2) or more applications over a section of definite limits. Limit amount of bitumen spread in any 1 application to 0.50 gallon per square yard. Exercise care to avoid overlapping of spreads onto adjoining sections. Immediately after each application, partially mix the bituminous material with the aggregate.

3. After the last application of bituminous material and partial mixing, windrow the entire mass of bitumen and aggregate and mix by blading material from side to side of roadway. Blade to produce a satisfactory mixture that is uniform in appearance, texture, and bitumen content, and free from pockets of segregated aggregates and continue until not more than 50 percent of original volatiles present in the bitumen remain in the mix, ASTM D1461. While mixing, take care to avoid cutting into underlying base course or contaminating the bituminous mixture with earth or other foreign matter.

D. Stationary Mixing Method:

1. Dry aggregate to optimum moisture content before mixing. Use same application of bituminous material and mixing as required for traveling mixer.

2. After mixing, haul and place mix on the roadway surface in windrows. All requirements as to uniformity, percent of volatiles, and textures are as required for traveling mixer that may require supplemental blade mixing.

3.5 TEMPERATURE CONTROL

A. Maintain temperature range of cold road mix material at time of application so viscosity will be between 50 and 200 centistokes, ASTM D2170.

3.6 **PLACING PAVEMENT MIXTURE**

A. When mixing has been completed, spread mixture in such a manner that the finished surface conforms to the elevations, grades, and cross-sections indicated.

B. At the end of each day's work or when the work is interrupted by adverse weather conditions, blade all loose material into a windrow, whether mixing is completed or not. Do not leave material spread on the roadbed overnight.

3.7 **TOLERANCES**

A. Section 32 12 16.13.

3.8 **PROTECTION AND REPAIR**

A. Section 32 12 16.13.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place Portland cement concrete in a base course, surface course, overlay course, or an inlay course.

B. This specification does not apply to concrete flat work.

1.2 REFERENCES

A. **ACI Standards**:

305 Hot Weather Concreting.

306 Cold Weather Concreting.

318 Building Code Requirements for Reinforced Concrete.

B. **APWA (Utah) Standards**:

Plan 261 Concrete pavement joints.

Plan 761 Speed bump.

Plan 762 Speed table.

Plan 880 Bus stop pad.

C. **ASTM Standards**:

A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C94 Ready-Mixed Concrete.

C174 Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D3665 Random Sampling of Construction Materials.

D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

E950 Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

E1274 Measuring Pavement Roughness Using a Profilograph.

D. **DOT Standards**:

1. Publication No. HIF-07-004: Integrated Materials and Construction Practices for Concrete Pavement.

1.3 DEFINITIONS

A. Must Grind: Defined in Section 32 01 31.

B. Road Class: Defined in Section 32 01 31

1.4 SUBMITTALS

A. **Before delivery**: Submit 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.

2. Joint layout plan.

3. Concrete placement plan. Identify items such as but not limited to grade control system, placement start and stop timing, hydration control during cold conditions (ACI 306), hot and windy conditions (ACI 305), timing for

evaporation retarder application, timing for curing agent application, floating restrictions, concrete saw-cut timing, header joints.

4. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of concrete. Refer to ACI 305.

5. Evaporation Retarder Data Sheet. Identify product components, application, and manufacturer's recommendations.

6. Proof of finisher's ACI certification.

7. Make and model name of paving machine, grade trimmer, and gang drill mechanism.

8. Pre-approved concrete mix design or supplier's mix number, Section 03 30 04.

9. Certification of profilograph calibration and profilograph operator.

10. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

B. **At Delivery**: Submit batch ticket, Section 03 30 10.

C. **After Placement**: Before final payment submit summary report describing profile deviation and profile roughness. See Section 32 01 31 requirements.

1.5 **QUALITY ASSURANCE**

A. Do not change concrete supplier until ENGINEER accepts new source and new mix design.

B. Reject product that does not meet requirements of Section 03 30 04.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. Lead finishing mechanic is ACI certified.

F. Follow state of practice for quality assurance as published in FHWA Publication No. HIF-07-004.

G. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR its Suppliers.

1.6 **WEATHER**

A. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F in the shade.

B. Cold weather, ACI 306 Accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength is achieved. When removing heat, limit temperature changes next to concrete surface to 20 deg F per 12 hours until the concrete surface temperature reaches ambient:

1. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.

2. Do not use chemical additives to prevent freezing.

3. Prevent loss of moisture during protection.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. Lot size is one day production and as listed below.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.

3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

4. Opening a paved surface to traffic does not constitute acceptance.

5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

B. **Temperature, Slump, Air**:

1. Lot size is one (1) random batch.

2. Testing Frequency: Section 03 30 05.

3. Reject non-complying batches until two (2) consecutive batches are compliant then continue in random batch testing for acceptance.

Table 1 – Strength Pay Factor			
Criteria	**Pay Factor**	**PSI Below 28 day Compressive Strength**	**Lot Size, in Square Yards**
Compression (ASTM C39)	0.98	1 to 100	500
	0.94	101 to 200	
	0.88	201 to 300	
	0.80	301 to 400	
	Reject	Greater than 400	
Flexure (ASTM C78)	0.95	1 to 29	750
	0.85	30 to 60	
	Reject	Greater than 60	

1. Strength Dispute Resolution:

a) CONTRACTOR:

1) Hire an Independent Testing Agency, Section 01 45 00.

2) Follow Section 03 30 05 requirements.

3) Conduct testing at no additional cost to OWNER. Retesting must be completed within 40 calendar days after placement.

b) ENGINEER:

1) Accept lot at full pay if average strength of three (3) cores from the defective lot is greater than or equal to 85 percent of compressive strength (f_c'), and if no single strength retest is less than 75 percent of f_c'.

2) Use original cylinder compressive strengths for pay factor determination if any of above criteria are not met.

D. **Placement**: Section 03 30 10.

1. Verify grade, cross slope, finish, and dimensions.

2. No standing water in curb and gutter.

3. Curing membrane applied at twice coverage rate recommended by curing membrane Supplier.

E. **Thickness**: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with greater sub-lot deficiencies may be accepted if pay is adjusted using one of the following applicable pay factors or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor		
Pay Factors	**Deficiency Limits, in Inches**	
	Residential street	**Non-residential street**
1.00	0.00 to 0.25	0 to 1/8
0.90	0.26 to 0.50	1/8 to 1/4
0.75	--	1/4 to 1/2
0.70	0.51 to 0.75	--
0.60	--	1/2 to 3/4
0.50	0.76 to 1.00	--
Reject	Greater than 1.00	Greater than 3/4

1. Lot Size: 1,000 square yards or part thereof.
2. Sampling Protocol: Use ASTM D3665 to randomly select at least one (1) test location in each lot. Collect two (2) samples at each test location. Samples are full depth. Patch core holes.
3. Testing Protocol: ASTM C174.
4. Thickness Dispute Resolution:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Pay Factor: The pay factor will be calculated over the Lot's deficient area or over areas extending into adjacent Lots.
      3) Accept lot at full pay if new information shows compliance, or
      4) Accept Lot at pay reduction using new test information, or
      5) Reject Lot.

F. **Profile Roughness and Profile Deviation**: Verify tolerances required in Section 32 01 31.

PART 2 PRODUCTS

2.1 CONCRETE

A. Compression Design: Class 4000, Section 03 30 04. Slump per mix design.

B. Flexure Design:

1. Strength: 650 psi, ASTM C78.
2. Cement Content: 6.5 bags.
3. Water cement Ratio: 0.44 maximum by weight (before pozzolan exchange), ACI 318.
4. Entrained Air: Five (5) to seven (7) percent, ASTM C231 (pressure).

5. Slump per accepted mix design.

2.2 **EVAPORATION RETARDER**

A. Water based spray-on liquid that forms a mono-molecular film over the plastic concrete surface.

2.3 **CONCRETE CURING COMPOUND**

A. Type II Class A or B (white pigmented) liquid membrane forming compound, ASTM C1315.

2.4 **JOINT MATERIALS**

A. Section 32 13 73.

1. Expansion Joint Filler: F1 sheet.
2. Contraction Joint Filler (Backer Rod): Type 1 round, ASTM D5249.
3. Contraction Joint Sealer: HAS1, HAS4, or CAS6.

2.5 **STEEL REINFORCEMENT**

A. Section 03 20 00.

B. Tie Bar: Grade 60 or higher deformed billet steel bars galvanized, or epoxy coated.

C. Dowel Bar: Grade 60 or higher billet steel bar, galvanized, or epoxy coated with plastic expansion cap on one (1) end.

D. Chair and Basket Assemblies: Plastic chairs. Galvanized or epoxy coated grade 60 billet steel bar basket assemblies.

E. Hook Bolts: Galvanized ASTM A307, grade A steel, nuts, and shaft internally and externally threaded.

2.6 **BOND BREAKER**

A. Wax based compound.

2.7 **EPOXY ADHESIVE GROUT**

A. Two components, Section 03 61 00.

2.8 **EVAPORATIVE REDUCER**

A. Water-based mono-molecular polymer liquid at application rates recommended by manufacturer. **DO NOT use as a finishing aid**.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. **Mixing plant**: ASTM C94, Option C:

1. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
2. Mixing time must exceed 80 seconds after adding air entrainment admixture.

B. **Cylinder Storage Device**: A container at the work site that maintains an interior temperature of 60 to 80 deg F. equipped with an automatic 7-days temperature recorder, accurate within 2-degrees and having a permanent recording feature. A 24 hours test run may be required. Cease concrete operation when storage capacity of storage device is reached.

C. **Concrete Hauling Vehicle**:

1. Truck mixer: Not allowed if ready mix product can be provided. If allowed:
   a. Fill drum no more than 63 percent of the gross drum volume and no less than 2-cubic yards is occupied.
   b. Use drum manufacturer's recommended mixing speed (between 12 and 18 rpm)
   c. Driver of vehicle has and follows Supplier's manual of standard operational procedures.
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 and 6 rpm).

3. Dump truck. End dump or side dump is acceptable. Air content must be controlled at the mixing plant.

D. **Trimmer**: A self-propelled unit to strike off and shape surface of road base material so future placement of concrete pavement meets specified thickness. The trimmer uses the same line and grade control assembly or system that the paving machine uses.

E. **Slip Form Paving Machine**:

1. Capable of providing one pass between crown line and back of curb unless specified otherwise.
2. Self-Propelled with two or four tracks
3. Steering and elevation controlled from reference string lines.
4. Paving width up to 50 feet (depending upon model and attachments).
5. Weight 2,000 pounds per foot of paving lane width.
6. Continuous auger, hydraulic plow-pans, or conveyor system to distribute concrete in front of the screed.
7. Variable speed internal vibrators.
8. Capable of consolidating mats up to 15 inches thick.
9. Various finishing attachments.

F. **Fixed Form Paving Machine:**

1. Capable of providing one pass between crown line and lip of gutter.
2. Ride on forms or on self-propelled wheels.
3. Steering and elevation controlled by fixed forms.
4. Various paving width.
5. Weight about 1,000 pounds per foot of paving width.
6. Suspended screw auger to spread concrete in front of screed or roller.
7. Has one or two vibrators that move transversely in front of the screed. May also use fixed vibrators near the form edges.
8. Capable of consolidating amts up to 10 inches thick.

G. **Vibrating Screed**:

1. Capable of providing one pass between crown line and lip of gutter.
2. Various paving width.
3. Elevation controlled by fixed forms or string-line.

H. **Finishing and Texturing Equipment**.

1. Machine float may be attached to paver.
2. Texturing equipment acceptable to ENGINEER.
3. Curing compound application device with a fully atomizing type power spray and a wind protection hood.

I. **Straight Edge**: 10 to 20 feet long hand-operated. Successive straightedge checks should overlap by one-half the length of the straightedge.

J. **Profilograph**:

1. Capable of producing results required by ASTM E950 and ASTM E1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

3.2 PREPARATION

A. **General**:

1. Locate and preserve utilities, Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
3. Coat surface of Street Fixtures with oil to prevent bond with concrete pavement.

4. Remove sand, leaves and other objectionable materials before placing paving course.
5. Notify ENGINEER at least 24 hours before commencement of concreting operations.

B. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. **Aggregate Base Course**:

1. Verify base course is placed to grade, compacted, and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat requirement.

D. **Cement Treated or Lean Concrete Base**:

1. Aggregate Subgrade: Moisten surface but do not place concrete over standing water.
2. Concrete Subgrade:
   a. Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course.
   b. Apply a double coat of bond breaker before placing surface concrete.

3.3 PROTECTION

A. Protect placed concrete, Section 03 30 10 and as follows:

1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either:
   a) Maturity meter.
   b) Concrete cylinders.
2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and spillage of materials as they occur.
3. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants, and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

3.4 LAYOUT OF WORK

1. Construction survey requirements. Section 01 71 23.
2. **Speed Bump or Speed Table:** Provide layout with line and grade as shown in the Drawings or APWA Plan 761 or 762.
3. **Bus Stop Pad:** Install as shown in the Drawings or APWA Plan 880.

3.5 LINE AND GRADE CONTROL

A. **General**:

1. Furnish, place, and maintain forms, supports, wire devices, and materials as required for providing continuous line and grade control.
2. Use survey staking. Distances between line and grade control points are as follows:
   a. 25 feet maximum on tangent sections.
   b. 10 feet maximum on vertical curve high points and low points, and on horizontal curves from PC to PT points.
3. Provide additional grade control at high points, low points,
4. Check line and grade control immediately before paving operation.

5. Use the same grade control system to control the paver and the grade trimmer.

B. **Slip Form Paving**. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades and transverse cross slopes.

C. **Formed Paving.** Section 03 11 00. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge. Tightly join formed sections and stop paving operation if the side forms to not meet or hold the following line and grade:

1. Top of forms not more than 1/4 inch from true grade.
2. Vertical face on longitudinal axis not more than 1/4 inch from true line.

3.6 REINFORCEMENT PLACEMENT

A. Section 03 20 00.

B. Use smooth dowel in expansion joints.

C. Interrupt reinforcement placement at expansion joints.

D. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.

E. Position mats on bar chair supports and properly tie before concrete is poured. Keep mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide at least two (2) inch overlap to adjacent mats.

F. DO NOT place the end of a dowel or tie bar within 18 inches of any joint

3.7 JOINTS

A. **General**:

1. Lay our joints as shown in the Drawings or APWA Plan 261.
2. Review joint layout with ENGINEER.
3. Do not allow edge slump when placing tie-bars or by over-working edge of slab.
4. If CONTRACTOR chooses to open the roadway to construction or public traffic before final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

B. **Contraction Joints (Crack Control Joint):**

1. Joint spacing measured in feet not to exceed twice the slab thickness measured in inches or 15 feet maximum.
2. Joint depth = T/3. T is depth of concrete slab in inches.
3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
4. Make transverse joints align with end at curb and gutter joints.
5. Leave forms in place until paving operations are resumed on the other side of the joint.
6. Keep a minimum of 3 working power saws on site when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.

C. **Expansion Joints**:

1. Joint Filler Type:
   a. Place joint filler vertical in position, in straight lines. Secure fillers to formwork or other to prevent movement. When butted together, do not leave voids or gaps between filler units.
   b. Set joint fillers full depth if no joint sealant is specified. Recess joint fillers if backer rods and joint sealant are specified.
2. Dowel Bar Type:
   a. Provide expansion cap on end of dowel bar.
   b. If a deformed bar is used in an expansion joint, provide sleeve for movement.

D. **Header Joints (Transverse Construction Joints) in Slip Form Paving:** Extend concrete paving placement an addition 5-feet at the end of a day of work or at an interruption for a bridge, intersection, or leave-out. When hardened, saw cut and remove the five feet to create the header. Install dowels into the hardened concrete and continue concrete placement.

E. **Volunteer Crack Joint**:

1. If a volunteer crack joint falls within 5-feet of the location of proposed contraction joint, omit the contraction joint.

2. Rout volunteer crack joints to a depth of ¼-slab thickness or as shown in the Drawings or APWA Plan 261 Detail 1. Clean and fill crack joint with backer rod and joint sealant.

3. If a volunteer crack joint develops within 2-feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.

F. **Joint Sealing**: Section 32 13 73.

3.8 PLACEMENT

A. Section 03 30 10.

B. Do not place concrete until concrete subbase and surface course forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around manholes or other structures until they are at required finish elevation and cross slope.

C. At the beginning of concrete placement:

1. Test slump and air. If corrections are necessary, placement may proceed after 2-subsequent and consecutive batches pass testing.

2. Tempering, not allowed unless Section 03 30 10 requirements are followed or mix design makes allowance for water addition.

3. Admixtures (such as for air entrainment) not allowed unless specified elsewhere.

D. **Any delay more than 15 minutes from placing to start of finishing operations is cause for stopping placement work**.

E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained a compressive strength of 2,500 psi as determined by maturity meter or cast cylinders.

G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than ½-hour, place a construction joint.

H. Place the concrete to the full width of the pavement in a single construction operation unless indicated otherwise.

3.9 SCREEDING AND FLOATING

A. Strike-off, consolidate, and provide a smooth surface by screeding

B. After screeding, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities.

C. Apply an evaporation retarder immediately after screeding (or after floating if floating is required). Apply retarder BEFORE bleed water has vanished. **Do not use the retarder as a finishing aid**.

D. Use floating hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture. Refloat repaired areas to provide a continuous smooth finish.

3.10 FINISHING

A. Section 03 35 00.

B. DO NOT use steel finishing equipment (floats, trowels, etc.).

C. **Any delay more than 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct difficulties**.

D. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.

E. Surface Texture: After floating when excess moisture or surface sheen has disappeared:

1. For speed less than 45 mph: Apply 1/16-inch-deep burlap drag, turf drag, or broom.

2. For speeds 45 mph and greater: Apply 1/8-inch-deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2-inches.

F. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.11 **CURE**

A. Section 03 39 00.

B. Immediately after floating and texturing as the water sheen of the surface is disappearing, apply curing agent in 2 directions for total white coverage on all exposed surfaces.

C. Apply agent at 2-times the rate recommended by the compound manufacturer. Applying curing agent too late (after concrete dampness has disappeared) may cause work rejection by ENGINEER.

D. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air temperature.

3.12 **TOLERANCES**

A. **Slab Thickness**: Not more than ¼-inch deficient.

B. **Smoothness**:

1. Parallel to Centerline: Section 32 01 31.
2. Cross Slope: ¼-inch in 10 feet except at cross section grade breaks.

C. **Dowel Bar**:

1. Maximum allowable skew is 0.375 inches per 12 inches (3 percent) in the horizontal and vertical planes.
2. Embedment is 6-inches minimum.
3. Position in slab is center plus or minus 1/2-inch.

3.13 **REPAIR**

A. General: Section 03 30 10. All expenses are at no additional cost to OWNER.

B. Corrective Action for Profile Deviations (“Must Grinds”): Grinding per Section 32 01 26 is acceptable after concrete cure. Apply a water repelling product, Section 07 19 00 over grind surfaces. If depressions cannot be corrected by grinding, remove and replace.

C. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a water repelling product, Section 07 19 00 over grind areas.

D. Corrective Action for Cracks: Consider repair options published in guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with Portland cement concrete bonded to pavement with epoxy adhesive.

3.14 **OPENING TO TRAFFIC**

A. Not less than 3,000 psi compressive or 400 psi flexure strength.

END OF SECTION

SECTION 32 13 73
CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joints and joint sealants in horizontal concrete sidewalks, curb, gutter and roadway Pavement surfaces.

1.2 REFERENCES

A. **ASTM Standards**:

C920 Elastomeric Joint Sealants.

D545 Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

D994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).

D1190 Concrete Joint Sealer, Hot-Poured Elastic Type.

D1191 Testing Concrete Joint Sealers.

D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D1851 Concrete Joint Sealers, Cold-Application Type.

D2240 Rubber Property - Durometer Hardness.

D2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

D3405 Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3406 Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3407 Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3408 Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3542 Preformed Polychloroprene Elastomeric Joint Seals for Bridges.

D3569 Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.

D3575 Flexible Cellular Materials Made from Olefin Polymers.

D3581 Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3582 Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3583 Joint Sealant, Hot-Applied, Elastomeric Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot Applied, Elastomeric, Jet Fuel Resistant Type, for Portland Cement Concrete Pavements.

D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

D5893 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

B. **FS Standards**:

SS-S-200 Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 SYSTEM PERFORMANCES

A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.

B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 **SUBMITTALS**

A. Manufacturer's certification that product was manufactured, tested and supplied meeting source quality control requirements specified herein, together with a report of the test results and the date each test was completed.

B. Manufacturer's instruction for joint preparation, type of cleaning and installation.

C. Manufacturer's product data and samples for each joint sealant product required.

D. Safety data sheets.

1.5 **QUALITY ASSURANCE**

A. Installation of joint systems are to follow manufacturer’s published directions.

B. For cold applied joint sealant installation, use installers approved by joint sealant supplier.

C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Compatibility: Provide joint fillers, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.2 **JOINT VOID - FORMER**

A. Plastic with a water stop.

B. 1/4 depth of concrete structural section.

2.3 **JOINT FILLER - SHEET TYPE**

A. **F-1**: Bituminous (asphalt or tar) mastic, ASTM D994. Formed and encased between two (2) layers of bituminous saturated felt or two (2) layers of glass-fiber felt.

B. **F-2**: Cane or other cellulosic fiber, ASTM D1751. Saturated with asphalt.

C. **F-3**: Granulated cork, ASTM D1751. In an Asphalt Binder; encased between two (2) layers of asphalt saturated felt or two (2) layers of glass-fiber felt.

D. **F-4**: Sponge rubber fully compressible, ASTM C1752. With resiliency recovery rate of 90 percent minimum.

E. **F-5**: Cork, ASTM C1752. Impregnated and bound with asphalt, compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.

F. **F-6**: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 pounds per cubic foot density maximum, And of size and shape to control sealant depth and performance.

2.4 **JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE**

A. Backer material, ASTM D5249 for cold-applied and hot-applied joint sealant in Portland cement concrete or bituminous concrete pavements joints:

1. Type 1: Round rods.
2. Type 2: Sheets or strips, laminated or skived.
3. Type 3: Poured fills that completely fills pavement joint.

2.5 **JOINT SEALANT - GENERAL**

A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 **JOINT SEALANT – HOT APPLIED**

A. **HAS-1**: Asphalt base type, ASTM D3405.

B. **HAS-2**: Thermoplastic type, ASTM D3581. Jet-fuel resistant without rubber unless indicated otherwise.

C. **HAS-3**: Elastic type, ASTM D1190.

D. **HAS-4**: Elastomeric type, ASTM D3406. One component, for Portland cement concrete pavements.

E. **HAS-5**: Elastomeric type, ASTM D3569. One component, jet-fuel resistant, for Portland cement concrete pavements.

2.7 **JOINT SEALANT – COLD APPLIED**

A. **CAS-1**: Elastomeric type, ASTM C920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O:

1. Self leveling.
2. Shore A Hardness, ASTM D2240: 40 plus or minus 5.
3. Final cure: Four (4) days maximum.
4. Service range: -10 to 150 deg F

B. **CAS-2**: Mastic type, ASTM D1851. Single or multiple component; for joints having a minimum width of 1/2 inch.

C. **CAS-3**: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.

D. **CAS-4**: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio:

1. For concrete pavement seal, ASTM D2628.
2. For concrete bridge seals, ASTM D3542.

E. **CAS-5**: Silicone type, ASTM D5893. Single component, non-sag or self leveling, chemically curing sealant based on polymers of polysiloxane structure intended for use in Portland cement concrete pavements.

F. **CAS-6**: Asphalt base meeting ASTM D3405.

G. **CAS-7**: Olefin polymer, ASTM D3575 as follows:

1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
2. Tensile strength 115 psi minimum, Suffix T
3. Density 2.9 plus or minus three (3) lbs/cubic foot, Suffix W, Method A
4. Water absorption 0.025 lbs/square foot maximum, Suffix L.

2.8 **SOURCE QUALITY CONTROL**

A. Preformed Expansion Joint Fillers: Non-extruding and resilient types, ASTM D545.

B. Hot-Applied Joint Sealants:

1. Elastic type used in concrete pavements, bridges, other structures, ASTM D1191.
2. Bituminous type for Portland cement concrete and bituminous concrete pavements, ASTM D3407.
3. Elastomeric type for hydraulic concrete pavement, ASTM D3408.

C. Jet-Fuel-Resistant Joint Sealant: Hot applied, ASTM D3582 and ASTM D3583.

D. Cold-Applied Mastic Joint Sealant: Cold applied, ASTM D1851.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus five (5) degrees.

B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.

C. Remove frost and moisture in concrete joint substrates before commencing sealing.

D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 JOINT SEALING

A. General:

1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.

2. Except as otherwise indicated, fill sealant rabbet flush with surface.

3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.

2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.

3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.

C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.

D. Heating: Do not use overheated hot-applied sealants.

E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of substantial completion.

B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

SECTION 32 14 13
PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortarless interlocking concrete pavers for sidewalks, roadways and similar paving.

1.2 REFERENCES

A. ASTM Standards:

C33 Concrete Aggregates.

C67 Sampling and Testing Brick and Structural Clay Tile.

C136 Sieve Analysis for Fine and Coarse Aggregates.

C140 Sampling and Testing Concrete Masonry Units.

C144 Aggregate for Masonry Mortar.

C150 Portland Cement.

C936 Solid Interlocking Concrete Paving Units.

C979 Coloring Agents for Concrete.

D1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using a 10 lb (4.54-kg) Rammer and an 19-In. (457-mm) Drop.

D3786 Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics Diaphragm Bursting Strength Tester Method.

D 4751 Determining Apparent Opening Size for a Geotextile.

B. ICPI Standards.

1.3 SUBMITTALS

A. Data sheets:

1. Bedding sand gradation.
2. Joint sand gradation.
3. Joint sand stabilizer.
4. Paver strength and absorption. Test results not older than 365 days.

B. Certification that paver unit complies with ASTM C936.

1.4 QUALITY ASSURANCE

A. Installer:

1. Certified by, and knowledgeable of Interlocking Concrete Pavement Institute (ICPI) technical bulletins.
2. Completed at least three (3) unit paver applications of similar size and scope.
3. Will assign mechanics from earlier applications to the work of which one will serve as lead mechanic.

1.5 PRODUCT HANDLING

A. Protect unit pavers against soilage. Protect sand against intermixture with earth or other types of materials.

B. Remove damaged pavers.

PART 2 PRODUCTS

2.1 CONCRETE PAVERS

A. Solid interlocking units with spacer bars, ASTM C936:

1. Cement: ASTM C150 hydraulic cement.
2. Aggregates: Sand and natural aggregates (washed and graded with no expanded shale or light weight aggregates) , ASTM C33.
3. Average Compressive Strength: Greater than 8,000 psi with no individual unit test less than 7,200 psi.
4. Average Absorption: Less than five (5) percent with no individual unit greater than seven (7) percent, ASTM C140.
5. Freeze-Thaw: Resistance to 50 cycles, ASTM C67.
6. Efflorescence Prevention: Admixture per recommendation of manufacturer.

B. Shape: 200 mm x 100 mm unless specified elsewhere.

C. Thickness:

1. Sidewalks: 60 mm.
2. Roadways: 80 mm.
3. Crosswalks: 80 mm.
4. Driveway Approaches: 80 mm.

D. Color: Reddish brown using an inorganic mineral oxide.

2.2 BEDDING AND JOINT SAND

A. Clean, non-plastic, naturally occurring silica sand conforming to ASTM C33 or ASTM C144, with no more than five (5) percent acid soluble material.

B. Gradation: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Material passing any sieve and retained on the next consecutive sieve is 45 percent maximum.

Table 1 – Bedding and Joint Sand Grading Bands

Sieve	Bedding Sand	Joint Sand
	ASTM C33	ASTM C144
3/8 inch	100	--
No. 4	95 to100	100
No. 8	80 to 100	95 to 100
No. 16	50 to 85	50 to 100
No. 30	25 to 60	40 to 100
No. 50	5 to 30	20 to 40
No. 100	0 to 10	10 to 25
No. 200	--	0 to 10

2.3 JOINT SAND STABILIZER

A. Water based polymer sealer capable of penetrating the joint sand to a depth of 1/2 inch before polymerization.

B. No significant discoloration.

C. No significant static coefficient of friction reduction.

2.4 GEOTEXTILE FILTER FABRIC

A. Non-woven with the following properties:

1. Apparent Opening Size (OAS): 70 sieve, ASTM D4751.
2. Puncture: 65 lbs minimum, ASTM D3786.
3. Thickness: 60 mils average.

B. Consult fabric manufacturer if:

1. Subgrade CBR less than 2, or
2. Surfaces are subject to highway or industrial loads.

2.5 SOURCE QUALITY CONTROL

A. ICPI member manufacturer.

B. Concrete masonry units, ASTM C140.

PART 3 EXECUTION

3.1 PREPARATION

A. Environment:

1. Do not build on saturated or frozen subgrade or setting beds.
2. Do not install pavers during heavy rain or snowfall.

B. Pavers on soil base:

1. Soil base surface tolerance is 3/8 inch in 10 feet and sloped to drain.
2. Compaction is 95 percent or greater relative to a modified proctor density, Section 31 23 26.

C. Pavers on concrete base:

1. Concrete surface is free from hydrostatic pressure and moisture content is less than five (5) percent.
2. Weep holes:
   a. 2 inch diameter.
   b. At lowest elevations against curbs, walls, or other permanent structure.
   c. Filled with washed pea gravel and covered over with geotextile.

D. Layout:

1. Verify Subgrade is compacted, ready to receive substrate materials, and is sloped to drain.
2. Check final elevations and patterns for conformance to drawings.

3.2 INSTALLATION

A. Concrete Base Preparation:

1. Sweep the surface clean.
2. Fill any cracks under 3/16 inches wide with mortar.

B. Bedding Sand:

1. Place and screed allowing for paver height and compaction.
2. After screeding, do not disturb or compact. Fill screed rails voids with loose sand.
3. Remove all compressions in the bedding sand.
4. Remove from bedding sand any concrete dust or waste from the paver cutting operation.

C. Cutting Pavers:

1. Point up joints to provide a neat, uniform appearance.
2. Minimum cut length is 3/4 paver, or 1/2 paver providing adjacent paver is also reduced no more than 1/2 its original length.
3. Cut vertical faces with masonry saw.
4. No chipping or breaking for shaping.
5. No modification of top or bottom face of paver.

D. Pavers:

1. Do not install paver over saturated or dry sand. Sand should be damp.
2. Paver surface to be 1/8 to 3/16 inch above grade or edge restraints after compaction.
3. Keep paver lines straight, true, and square.
4. Use a low amplitude, high frequency plate vibrator capable of at least 5,000 lbf (pound force) at a frequency of 75 hz to 10 hz.
5. Do not vibrate within six (6) feet of an unrestrained edge of pavers.

E. Control and Structural Joints:

1. Extend control and structural joints through full depth of paving units.
2. Install joints at all building facades or other vertical surfaces.

F. Joints Between Paver Units:

1. 1.5 to 4 mm.
2. Maximum 50 percent between 2mm–3mm and 10 percent between 3mm–4mm in any three (3) feet square area.

G. Joint Sand and Stabilizer:

1. After setting pavers, sweep joint sand into joints and vibrate again until joints are full.
2. Bedding sand may be used for joint sand, however, extra effort in sweeping and compacting the pavers may be required in order to completely fill the joints.
3. After final vibration remove excess sand and debris.
4. Apply joint sand stabilizer within 1 week of installing joint sand.

3.3 **TOLERANCES**

A. Lippage: 1/16 inch maximum elevation difference unit to unit.

B. Cross Slope: 1/8 inch in 10 feet.

C. Longitudinal:

1. Sidewalks: 1/8 inch in 10 feet.
2. Roadway:
   a. 1/8 inch in 10 feet parallel to centerline.
   b. 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.

D. Drainage Inlets, Concrete Collars or Channels: Paver is 1/8 inch to 1/4 inch higher

3.4 **PROTECTION AND REPAIR**

A. Provide final protection and maintain conditions in a manner acceptable to installer.

B. Repair:

1. Remove and replace non-matching pavers or pavers which are chipped, broken, stained or otherwise damaged. Fill joints with joint sand and compact with plate compactor.
2. Remove excess sand.

END OF SECTION

SECTION 32 14 16
BRICK UNIT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Handling and installation procedures for paving brick.

B. Material requirements and tolerances.

1.2 REFERENCES

A. **ASTM Standards**:

C33 Concrete Aggregates.

C144 Aggregate for Masonry Mortar.

C150 Portland Cement.

C207 Hydrated Lime for Masonry Purposes.

C902 Pedestrian and Light Traffic Paving Brick.

B. **BIA Standards**.

1.3 SUBMITTALS

A. Test Reports: Submit control testing reports as requested verifying compliance with specified standards.

B. Brick samples: Before commencing work, obtain approval of representative samples of the brick specified.

1.4 PRODUCT HANDLING

A. Handle and store paving brick in a manner to avoid chipping, breakage, intrusion of foreign matter, and staining.

B. Handle, store, mix and apply proprietary setting and grouting materials in strict compliance with the manufacturer's instructions.

C. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

PART 2 PRODUCTS

2.1 PAVING BRICK

A. ASTM C902 classification Type SX (freeze resistant), Traffic Type 1 (extensive abrasion), application PX (without mortar joints) unless indicated otherwise:

1. Nominal Size:
   a. 3-5/8 inches x 7-5/8 inches x 2 inches for roadway or driveway areas.
   b. 3-5/8 inches x 7-5/8 inches x 1 inch for sidewalk areas.
2. Color: Reddish brown if not elsewhere specified.
3. Friction Test: 0.5 minimum for wet leather and wet brick.

2.2 MORTAR AND GROUT

A. Mixture of water, ASTM C150 type I Portland cement, ASTM C207 type S lime, ASTM C144 mason's sand, ASTM C33 concrete sand to provide the following:

1. Compressive Strength:
   a. Thick bed mortar, 3,000 psi minimum.
   b. Thin bed, bonding, grouting mortars, 5,000 psi minimum.
2. Tensile Strength: Thin bed, bonding, grouting mortars, 500 psi minimum.
3. Bond Strength: Thin bed, bonding, grouting mortars, 500 psi minimum.

4. Water Absorption: 4.0 percent maximum.
5. Ozone Resistance: 200 hours at 200 ppm. No loss of strength.
6. Smoke Contribution Factor: 0
7. Flame Contribution Factor: 0

B. Resistant to urine, dilute acid, dilute alkali, sugar, brine, and food waste products.

C. Additives compatible from one manufacturer, non-toxic, non-flammable, and non-hazardous during storage, mixing, application, and when cured. The addition of water or other materials to dilute the mortar additive on the job site will not be permitted.

2.3 **REINFORCING MESH**

A. 6 x 6 x 10 gage galvanized welded wire mesh, Section 03 20 00.

2.4 **WATER REPELLANT**

A. Penetrating compound, Section 07 19 00.

2.5 **JOINT SEALING COMPOUND**

A. CAS1 polyurethane, Section 32 13 73 unless indicated otherwise.

PART 3 EXECUTION

3.1 **INSPECTION**

A. Inspect surfaces scheduled to receive brick paving for:

1. Defects that will affect the execution and quality of work.
2. Deviations beyond allowable tolerances over the substrate.

B. Correct unsatisfactory conditions.

3.2 **PREPARATION**

A. Clean surfaces as required to remove materials that will affect installation.

B. Place concrete base to nominal finish grade (minus paving brick thickness and setting bed mortar).

C. Wet cure concrete base. Remove curing compounds by sandblast before placing setting bed mortar.

3.3 **INSTALLATION**

A. Install per ANSI and BIA recommendations.

B. Cut units with powered masonry saw.

C. Lay units out so fields or patterns center in areas.

D. Lay units out to minimize pieces smaller than 1/2 brick.

E. Set units into setting bed while mortar is still plastic or set in thin set mortar over prepared setting bed.

F. Tap each unit firmly into place to assure full adhesion.

G. Set units with nominal 3/8 inch joints between units.

H. Force grout between units to fill joints completely.

I. Remove surplus grout and leave faces clean.

J. Flood brick paving to determine any areas of standing water. Remove and replace any area where ponding is found.

K. Provide sealant joints where brick abuts vertical surfaces, around penetrations, and over expansion or control joints where indicated.

L. Apply surface sealer per manufacturer's recommendation.

3.4 **TOLERANCES**

A. For finish surface of paving, do not exceed 1/16 inch unit to unit offset to flush, and a tolerance of 1/8 inch in two (2) feet and 1/4 inch in 10 feet from level or slope indicated.

3.5 **PROTECTION**

A. Protect installed pavers from damage.

B. Do not allow vehicular traffic on brick paving for 14 days or until the mortar and underlying concrete has reached a strength of 3,000 psi.

C. Provide alternate access to adjacent properties.

3.6 **CLEANING**

A. Remove protective coverings.

B. Clean entire surface with cleaning compound.

C. Protect adjacent surfaces from damage due to cleaning operations.

D. Additional brick masonry cleaning requirements, refer to Section 04 21 00 requirements.

END OF SECTION

SECTION 32 16 13
DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Concrete flat work such as waterways, waterway transition structures, sidewalks, curb, gutters, Driveway Approaches, etc.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 205 Curb and gutter.
Plan 206 Curb and gutter dowel tie-in.
Plan 209 Curbs.
Plan 211 Waterway.
Plan 213 Waterway transition structure.
Plan 215 Dip driveway approach.
Plan 216 Mountable curb driveway approach.
Plan 221 Flare driveway approach.
Plan 222 Saw-cut driveway approach.
Plan 225 Open driveway approach.
Plan 229 Bridge driveway approach.
Plan 231 Sidewalk.
Plan 232 Patterned concrete.
Plan 235 Curb cut assembly.
Plan 237 Islands and median.
Plan 238 Detectable warning surface.
Plan 251 Bituminous concrete pavement tie-in.
Plan 252 Curb and gutter replacement without pavement tie-in.

B. **ASTM Standards**:

A36 Structural Steel.
C39 Compressive Strength of Cylindrical Concrete Specimens.
C172 Sampling Freshly Mixed Concrete.

1.3 DEFINITIONS

A. **Driveway**: A paved or unpaved vehicular thoroughfare outside of but connected to a public road right-of-way or highway right-of-way.

B. **Driveway Approach**: A paved or unpaved vehicular thoroughfare connecting a public road or highway to a Driveway.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Concrete mix design, Section 03 30 04.

C. Batch ticket, Section 03 30 10.

1.5 **QUALITY ASSURANCE**

A. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least two (2) days before work starts.

B. Indicate when concrete work will take place and when driveway approach can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 **ACCEPTANCE**

A. **General**:

1. Acceptance is by lot. One lot is one day production.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.

3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. **Concrete Mix**:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C172.

2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.

3. Strength: Lot size is 50 cubic yards. At ENGINEER's discretion and ASTM C39, a lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Pay Factor	PSI Below 28 days Compressive Strength
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

C. **Placement**, Section 03 30 10:

1. Verify line, grade, cross slope, finish, and dimensions.

2. No standing water in curb and gutter.

3. Membrane curing compound applied for total coverage at two (2) times manufacturer's recommended rate in two (2) directions after finishing and texturing.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Concrete Mix:

1. Class 4000 cast-in-place, Section 03 30 04.

2. Slump range per mix design.

B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00, deformed.

C. Expansion Joint Filler: F1 sheet 1/2 inch thick, Section 32 13 73.

D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round, Section 32 13 73.

E. Contraction Joint Sealer: HAS1 or HAS4 hot applied, Section 32 13 73.

F. Curing Compound: Membrane forming compound, Section 03 39 00.

G. Plate Steel: Galvanized Steel, ASTM A36, Section 05 05 10.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Slip Form Machines:

1. Placement must produce required cross-section, line, grade, finish, and jointing as specified for formed concrete.

2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION

A. Implement notification and traffic control plan requirements, Section 01 55 26.

B. Examine surfaces scheduled to receive concrete formwork for defects.

C. Do not start work until defects are corrected.

D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 CONCRETE PLACEMENT

A. **Preparation:**

1. Make sure base course is uniformly damp at tie of concrete placememt.

2. Obtain ENGINEER's review of base course and forms before placing concrete.

3. Do not segregate the mix.

B. **Placement:** Section 03 30 10. Time between end of placement and beginning of finishing is less than 15 minutes.

1. Curb, Gutter, Waterway. Waterway Transition Structure: Place as shown in the Drawings or APWA Plans 205, 209, 211, 213 as applicable.

2. Driveway Approach: Place as shown in the Drawings or APWA Plans 221, 222, 225, 229 as applicable.

3. Sidewalk, Crosswalk: Place as shown in the Drawings or APWA Plans 231, 232 as applicable.

4. Curb Cut Assembly: Place as shown in the Drawings or APWA Plans 235, 236, 238 as applicable.

5. Islands and Median: Place as shown in the Drawings or APWA Plan 237.

C. **Consolidate Concrete:** Use vibrator or other acceptable method. Prevent dislocation of inserts.

3.4 CONTRACTION JOINTS

A. Section 32 13 73.

B. Geometrics:

1. Tooled Joints (Score Lines):

a. Depth = T/4. T is the depth of the concrete slab in inches.

b. Top radius = 1/2 inch.

2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.

3. Template Joints: 1/8-to-3/16 inch wide 1/4-depth of slab.

C. Sidewalks.

1. At intervals equal to the width of the sidewalk and transverse to the line of walk.

2. Radial at curbs and walk returns.

3. Place longitudinal joints in walks when width of walk, in feet, is greater than two (2) times the walk thickness in inches. (e.g. maximum width of a four (4) inch thick walk before placement of a longitudinal contraction joint is eight (8) feet). Make longitudinal joints parallel to, or concentric with, the lines of the walk.

4. In walk returns make at least one (1) radial joint midway between beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with joints in adjacent walks.

D. Curb, Gutter, Waterway:

1. Place joints at intervals not exceeding 12 feet.

2. At curb radius and walk returns make joints radial.

3. Where integral curb and gutter is adjacent to concrete pavement, align joints with pavement joints where practical.

3.5 **EXPANSION JOINTS**

A. General: Section 32 13 73:

1. ½-inch-wide full depth filler that is flush with concrete surface. Do not place seal over top of joint filler.

B. Sidewalks:

1. Place expansion joints to separate sidewalk from utility poles, hydrants, manhole frames, buildings, and abutting sidewalks.

2. Place expansion joints between sidewalk and back of curb returns and between sidewalk and sidewalk ramps.

3. Do not place expansion joints in sidewalk ramp surfaces.

4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.

C. Curb, Gutter, Waterway:

1. Do not place longitudinal joint in drain gutter flowline.

2. Where drain gutter transitions extend beyond curb return, place expansion joints at ends of drain gutter transition.

3. Place expansion joints at beginning of curb radius (BCR) and at end of curb radius (ECR).

D. Curb and Gutter Dowel Tie-in: As shown in the Drawings or APWA Plan 206. Tie-in occurs between new and existing curb and gutter.

E. Slip Form Work: Expansion joints are not required except at BCR or ECR.

F. Driveway Approach: Do not place expansion joints in curb returns.

G. Street Intersection Corner: Place expansion joints at BCR and ECR.

3.6 **FINISH**

A. Section 03 35 00.

B. Round edges exposed to public view to a 1/2-inch radius.

C. Apply broom finish longitudinal to curb and gutter flowline.

D. Apply broom finish transverse to sidewalk centerline as follows:

1. Fine hair finish where grades are less than six (6) percent.

2. Rough hair finish where grades exceed six (6) percent.

E. Remove form marks or irregularities from finish surfaces.

3.7 **PAVEMENT TIE-IN**

A. As shown in the Drawings or APWA Plan 251 and 252.

3.8 **TOLERANCES**

A. Curb, Gutter, Curb and Gutter: APWA Plan 205, 209, 211, 213.

1. Dimensions: As shown in the Drawings or APWA Plan 215, 216, 221, 225, 229 as applicable.

2. Line: Less than ½-inch variance in 10 feet and not more than 1 inch from true line at any location.

3. Grade: Not more than ¼-inch variance in 10 feet. Flood curb and gutter with water after final set has been reached. Remove and replace any area where ponding is found.

4. Standing Water: None allowed.

B. Sidewalk:

1. Dimensions: As shown in the Drawings or APWA Plan 231.
2. Cross slope: one (1) percent minimum, two (2) percent maximum.
3. Standing Water: None allowed.

C. Driveway Approach: As shown in the Drawings or APWA Plan 215, 216, 221, 225, 229.

D. Patterned Concrete Park Strips and Crosswalks: As shown in the Drawings or APWA Plan 232.

3.9 **CURING**

A. Section 03 39 00.

B. Curing compound: Apply at two (2) times manufacturer's recommended rate. Apply total coverage in two (2) directions after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.10 **PROTECTION AND REPAIRS**

A. General: All expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10:

1. Protect concrete work from deicing chemicals during the 28 days cure period.
2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C. Repair: Section 03 30 10. Consider also guidelines published by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option:

1. Correct all humps or depressions.
2. Standing Water: Remove and replace any area where ponding is found. If necessary, flood construction to determine ponding extent.
3. Restore surfaces damaged by saw cutting, grinding, or removal operations.

END OF SECTION

SECTION 32 16 14
CURB CUT ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete flat work for public right-of-way accessibility.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 235 Corner curb cut assembly.

Plan 236 Tangent curb cut assembly.

Plan 237 Islands and median.

Plan 238 Detectable warning surface.

1.3 DEFINITIONS

A. **Approach**: An Element in a pedestrian access route that connects a sidewalk to a Blended Transition or a Turning Space. It has a Running Slope of 8.33 percent (1:12) maximum, a Cross Slope of five (5) percent (1:20) maximum, and a Running Length to be determined by the ENGINEER.

B. **Blended Transition**: An Element in a pedestrian access route that connects a sidewalk or an Approach to a Crosswalk. It is 4 feet wide minimum and has a Running Slope of 5 percent (1:20) or less. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

C. **Clear Space**: An Element in a pedestrian access route that is located beyond the foot of a Curb Ramp, Turning Space, or Blended Transition and is within the width of the Crosswalk. Its dimensions are 4 feet minimum by 4 feet minimum with a Running Slope of 5 percent (1:20) maximum. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

D. **Counter Slope**: Running Slope of the roadway surface in a Crosswalk (including the pan of the gutter).

E. **Cross Slope**: Grade perpendicular to the direction of pedestrian travel usually expressed in percent.

F. **Cross Width**: Distance perpendicular to the direction of pedestrian travel usually expressed in linear measure.

G. **Crosswalk (or Pedestrian Street Crossing)**:

1. Unmarked: That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the roadway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway. In the absence of a sidewalk on one side of the roadway, that part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line;

2. Marked: Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color.

H. **Curb Ramp**: An Element in a pedestrian access route that is 4 feet wide minimum, has a Running Slope from 5 percent (1:20) to 8.33 percent (1:12) maximum and is not required to be more than 15 feet long. Curb ramps are perpendicular to or parallel with a curb. A perpendicular curb ramp abuts or cuts through the curb and its Turning Space is at the top of the ramp. A parallel curb ramp abuts the curb and its Turning Space abuts or cuts through the curb. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.

2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

I. **Detectable Warning Surface**: A surface feature of truncated dome material built into the walking surface to advise a pedestrian of an upcoming change from pedestrian to vehicular way.

J. **Element**: An architectural or mechanical component of a building, facility, space, site, or public right-of-way.

K. **Grade Break**: The line where two surface planes with different grades meet flush.

L. **Running Length**: Distance parallel to the direction of pedestrian travel usually expressed in linear measure.

M. **Running Slope**: Grade parallel to the direction of pedestrian travel usually expressed in percent.

N. **Turning Space (or Landing)**: An element in a pedestrian access route that connects an Approach or a sidewalk to a Curb Ramp, a Blended Transition or a Clear Space. It is 4 feet minimum by 4 feet minimum. If constrained on 2 sides, it must be 5 feet minimum in the direction of the Curb Ramp or Blended Transition. It's Running Slope and Cross Slope is 2 percent (1:50) maximum. At midblock Crosswalks without stop control, the Cross Slope is permitted to equal the street or highway grade.

1.4 **SUBMITTALS**

A. Field quality control 'pass-fail' checklist data.

B. Traffic control plan, Section 01 55 26.

C. Concrete mix design, Section 03 30 04.

D. Batch ticket, Section 03 30 10.

E. Detectable warning surface product data sheet.

1.5 **OWNER'S INSTRUCTIONS**

A. **Alteration**s: If the direction of water flow in an existing curb and gutter system is not apparent, proceed as follows:

1. Flood curb and gutter system to determine extent of replacement.
2. Flood curb and gutter system after installation to verify drainage.

B. **Steep Slopes**: Prior to placing concrete, allow ENGINEER time to check slopes and dimensions of construction forms.

1.6 **ACCEPTANCE**

A. Clear Space: Located within Crosswalk, Running Slope, Cross Slope.

B. Flow-line: No standing water, no trip hazard.

C. Detectable Warning Surface:

1. Color contrast, dome geometry, joints between units.
2. Cross Width, Running Length.

D. Curb Cut: Cross Width (appropriate to number of crosswalks served).

E. Turning Space: Running Slope, Cross Slope, dimensions.

F. Curb Ramp: Running Slope, Cross Slope, Cross Width.

G. Blended Transition: Running slope, Cross Slope, Cross Width.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Class 4000, Section 03 30 04.

2.2 **DETECTABLE WARNING SURFACE**

A. Concrete paver, ribbed composite panel, or tile.

B. Properties:

1. Homogenous color.
2. High shear strength domes.
3. Slip resistant, freeze thaw resistant, UV resistant.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles.

B. Assist visually impaired and wheel chair users.

C. Provide continuous access to fire hydrants.

D. Keep passage ways free of construction materials, trash and debris.

E. Remove graffiti immediately.

3.2 INSTALLATION

A. Layout, APWA Plans 235, 236, 237, and 238.

B. Place concrete, Section 03 30 10.

C. Install Detectable Warning Surface full width of curb cut.

3.3 FIELD QUALITY CONTROL

A. Use the 'pass-fail' checklist in Table 1 to verify that the curb cut assembly complies with layout requirements.

3.4 CLEANING AND REPAIR

A. Remove all debris and concrete dust.

B. Clean surrounding handrails, sidewalks, driveways approaches, landscaping, and other objects in vicinity of work.

C. Repair surfaces damaged by saw cutting, grinding, or removal operations at no additional cost to OWNER.

END OF SECTION

Table 1 – Field Quality Control Checklist

Date: _____ Time: _____ (am) (pm) Job No. _____
Job Title: _____
Indicate the intersection corner or adjacent sreet address number:
Intersection: _____, NE NW SE SW
Street Address Number: _____

	Criterion	Pass	Fail
Clear Space			
Located in the width of the Crosswalk.....	Yes		
Running Slope.....	≤ 5%		
Proper Crosswalk striping.....	Yes or NA		
Gutter			
Slope (midblock)	Street grade		
Slope (corner without yield or stop control)	≤ 5%		
Slope (corner with yield or stop control) ..	≤ 2%		
Slope (adjacent to a Turning Space)	≤ 2%		
Counter Slope (flow-line to pan lip)	≤ 5%		
Trip hazard at flow-line	No		
Trip hazard at roadway/pan joint	No		
Curb Ramp			
Running Slope	≤ 8.33%		
Blended Transition			
Running Slope	≤ 5%		
Turning Space			
Running Slope (midblock)	Street grade		
Running Slope (corner)	≤ 2%		
Cross Slope	≤ 2%		
Approach			
Running Slope	≤ 8.33%		
Cross Slope	≤ 5%		
Detectable Warning Surface			
Spans curb cut in pedestrian access route	Yes		
Running Length	≥ 24”		
Color contrast	Yes		
Dome dimension and orientation	Yes		
Flare			
Slope (if in pedestrian access route)	≤ 10%		

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Words, striping, and other pavement markings.

B. One-way or two-way prismatic reflectors.

1.2 REFERENCES

A. **AASHTO Standards**:

MP24 Waterborne White and Yellow Traffic Paints

M237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.

M247 Glass Beads Used in Traffic Paint.

M248 Ready-Mixed White and Yellow Traffic Paints.

M249 White and Yellow Reflective Thermoplastic Striping Material (Solid Form).

B. **ASTM Standards**:

D638 Tensile Properties of Plastics.

E303 Measuring Surface Frictional Properties Using the British Pendulum Tester.

E1710Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer.

C. **DOT Standards**:

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. **Retroreflective**: Majority of reflected light is directed back to the light source.

1.4 SUBMITTALS

A. Product data for primer to be used for tape applications.

B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.

C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degrees observation angle.

D. Manufacturer's recommendation for type of adhesive to be used.

E. Samples of each thermoplastic or preformed plastic pavement markings along with manufacturer's instructions of how the materials are to be applied.

1.5 QUALITY ASSURANCE

A. At the end of the correction period, pavement markings, when applied according to the recommendations of the manufacturer, show a neat, durable marking with no flow or distortion due to temperature if the pavement surface remained stable. The tape shows no appreciable fading, lifting or shrinkage, and no significant tearing, roll back or other sign of poor adhesion.

1.6 WEATHER

A. Apply pavement striping and markings only when pavement surface is dry and air temperature is above 40 deg F during daylight hours.

B. Do not apply pavement striping and markings when rain is anticipated within 12 hours.

PART 2 PRODUCTS

2.1 **GLASS BEADS**

A. AASHTO M247.

2.2 **FILM AND ADHESIVE**

A. **Film**: A pliant polymer with retroreflective glass beads distributed throughout its cross-sectional area and bonded to its top surface. The film is selected and blended to conform to standard white or yellow highway colors and has a minimum thickness of 0.06 inches at pattern height.

1. Skid Resistance: 35 BPN minimum, ASTM E303.

2. Tensile Strength: ASTM D638. Using a Sample size 6 x 1 inch, a temperature between 70 and 80 deg F, and a test jaw speed of 10 to 12 inches per minute, the film has an elongation of 75 percent maximum at break and a strength as follows.

a. Type 1: 150 pounds minimum tensile strength per square inch of cross-section area.

b. Type 2: 40 pounds minimum tensile strength per square inch of cross-section area.

3. Reflectivity: Meet film reflectivity in the following table.

Table 1 - Film Reflectivity

Application	Tensile Strength	Color	
		White	Yellow
Non-residential	Type 1	500	350
Residential	Type 2	300	250

NOTES

(a) Follow ASTM E1710 procedures using 30 meter test distance, an entrance angle of 88.76 degrees, and an observation angle of 1.05 degrees.

(b) Reflectivity is measured in millicandelas per square foot per footcandle (mcd/sf/fc).

B. **Adhesive**:

1. Class 1: Without pre-coated adhesive for applications with surface preparation adhesive recommended by the manufacturer at temperatures of 40 deg F or above and moderate humidity.

2. Class 2: With pre-coated pressure sensitive adhesive with minimum adhesion value of 1.1 pounds per inch width, AASHTO M237

2.3 **PAINT**

A. Acrylic waterborne pavement marking paint, AASHTO MP 24.

B. Thermoplastic, AASHTO M249.

2.4 **PRISMATIC REFLECTORS**

A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated:

1. With a cast iron housing and acrylic prismatic reflector.

2. With an overall size not less than nine (9) inches long, five (5) inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above its base.

3. With a minimum reflective area of 1.6 square inches per face.

B. Reflector Specific Intensity: Meet intensity in the following table.

Table 2 - Intensity		
Color	**Entrance Angle**	
	0 Degrees	**20 Degrees**
White Yellow	3.0 1.8	1.2 0.72
NOTES (a) Intensity measured at 0.2 degree observation angle.		

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Use equipment manufactured for pavement marking. Use workers experienced in operating such equipment.

B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of six (6) inches over that cycle.

C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

D. For thermoplastic paint materials, use equipment that is designed to agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

A. **General**: DO NOT begin pavement painting and marking operations without ENGINEER's knowledge of such activity.

B. **Repair of Receiving Surface**: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
2. Crack sealing and crack repairing, Section 32 01 17.
3. Pushing or shoving pavement repair.
   a. Mill damaged area at least three (3) inches below required surface elevation.
   b. Install and compact three (3) inches of bituminous concrete, Section 32 12 16.13. ENGINEER to determine Mix Designator.

C. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.
2. Grind off confusing pavement markings and lane stripes.

D. **Cleaning**: Broom or flush the surface to remove dirt, loose stones, or other foreign material. For better adhesion results clean the surface using high velocity compressed air.

E. **Mark Roadway**: Mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

F. **Markings**: Markings that adhere to bituminous concrete or Portland cement concrete by either a pressure sensitive pre-coated adhesive or an epoxy cement shall mold to the pavement contours by traffic action at normal pavement temperatures and shall be ready for traffic immediately after application.

3.3 INSTALLATION - ACRYLIC WATERBORNE PAINT STRIPING

A. Adjust pavement striping machine to apply paint at rate recommended by paint manufacturer. Provide two (2) applications over new pavement (pavement correction period has not expired)

B. Glass Bead Application Rate (Final Application): 8 pounds per gallon of paint.

C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.4 INSTALLATION - THERMOPLASTIC PAINT STRIPING

A. Clean off dirt, glaze, and grease before pre-striping.

B. Pre-stripe the application area with a binder material that will form, when sprayed, a continuous film over pavement surface, and will dry rapidly and mechanically adhere to pavement surface. Install material in varying widths if indicated.

C. At a temperature recommended by the equipment manufacturer, extrude thermoplastic material from equipment that is proven to produce a line 1/8 inch to 3/16 inch thick, continuous, uniform in shape and has clean and sharp dimensions.

D. Do not use material that produces fumes that are toxic, obnoxious, or injurious to persons or property.

E. Apply so finished lines have well-defined edges free of waviness.

F. Glass Bead Application Rate: Six (6) pounds of glass beads to every 100 square feet of marking.

3.5 INSTALLATION - TAPE STRIPING

A. Apply pavement marking tape as indicated or directed. ENGINEER will establish control points.

B. Apply tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.

C. Maintain the line on established control points. Apply intermittent pavement marking tape 24 inches long, spaced approximately 100 feet on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

D. Press down tape immediately after application until it adheres and conforms to pavement surface.

E. Completely remove all tape on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.

3.6 INSTALLATION PAVEMENT MARKING FILMS

A. Apply before traffic is allowed on freshly paved surface.

B. Unless indicated otherwise, provide Type 1, Class 2, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.

C. When indicated, inlay markings in fresh bituminous concrete pavement with a compaction roller during the paving operation.

D. Apply all markings in accordance with manufacturer's recommendations.

3.7 INSTALLATION - PRISMATIC REFLECTORS

A. Install reflectors by cutting pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.

B. Install markers so that housing top surface and edges are flush with pavement surface.

3.8 INSTALLATION - WORDS, SYMBOLS AND OTHER MARKINGS

A. Wet sandblast existing or temporary pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.

B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.9 REPAIR

A. Before the end of the correction period, renew stripes and markings if original visual effectiveness is reduced by 50 percent.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chain link fabric, posts, braces, anchorage, gates, miscellaneous hardware and appurtenances.

1.2 REFERENCES

A. **ASTM Standards**:

A53 Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless.

A121 Zinc Coated (Galvanized) Steel Barbed Wire.

A392 Zinc Coated Steel Chain-Link Fence Fabric.

A491 Aluminum Coated Steel Chain-Link Fence Fabric.

A585 Aluminum Coated Steel Barbed Wire.

A641 Zinc Coated (Galvanized) Carbon Steel Wire.

F567 Installation of Chain-Link Fence.

F573 Residential Zinc Coated Steel Chain-Link Fence Fabric.

F626 Fence Fittings.

F654 Residential Chain-Link Fence Gates.

F668 Poly(Vinyl Chloride) (PVC) Coated Steel Chain-Link Fence Fabric.

F1043 Strength and Protective Coatings on Steel Industrial Chain Link Fence and Framework.

B. **CLFMI Standards**:

Manual for Chain Link Fence Installation.

1.3 SUBMITTALS

A. Drawings: Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.

B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.

C. Submit sample of fence fabric and typical accessories.

PART 2 PRODUCTS

2.1 GENERAL

A. Galvanizing: Class 3, ASTM A121.

B. Aluminizing: Class 2, ASTM A585.

C. Polyvinyl Chloride (PVC): For PVC coated materials, paint all posts, fittings, hardware and accessories to match PVC color.

D. Steel Post: Schedule 40, ASTM A53.

E. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

2.2 CHAIN LINK FABRIC

A. Steel wire fabric, 11 gage for all fences less than 60 inches in height and nine (9) gage for fences over 60 inches coated as follows:

1. Zinc coating, ASTM A392.

2. Aluminum coating, ASTM A491.

3. Polyvinyl chloride coating, ASTM F668. The fabric shall be hot dipped galvanized steel wire complying with ASTM A392 and coated with a continuous PVC bonding process (minimum 15 mil thickness). Color of PVC coating as indicated and applied free of voids, cracks, tears and to have a smooth and lustrous surface.

B. For residential fabric, provide zinc coated fabric, ASTM F573.

C. Unless indicated otherwise use chain link fabric that has approximately two (2) inches square mesh and coated after fabrication.

D. Knuckle finish top edge and twist and barb bottom edge on fabric less than 60 inches wide. For wider fabric, twist and barb finish on both edges. Provide fabric with barbing done by cutting the wire on bias.

E. If indicated, insert slats in fabric.

2.3 **BARBED WIRE**

A. Two strand, 12-1/2 gage wire with 14 gage, four (4) point round barbs spaced approximately five (5) inches on center.

2.4 **TENSION WIRES AND FABRIC TIES**

A. Tension Wires: Seven (7) gage galvanized coil spring steel wire, ASTM A641.

B. Fabric Fasteners: None (9) gage galvanized or six (6) gage aluminum wire, or approved non-corrosive metal bands, for ties to fasten fabric to posts, rails, and gate frames. Fasten fabric to bottom tension wire spaced 24 inches on center.

2.5 **TRUSS OR TENSION BARS**

A. Galvanized steel rod 3/8 inch diameter for truss or tension bars used in trussing gate frames and line posts adjacent in end, corner, slope, or gate posts. When used in trussing line posts, provide adjustment by means of galvanized turnbuckles or other suitable tightening devices.

B. Tension Bars:

1. Galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch for tensions bars to fasten fabric to end and corner posts and gate frames. Provide 1 tension bar for each end post and two (2) for each corner and pull post per section of fabric.

2. Use tension bar bands made from heavy pressed galvanized steel spaced on 15 inch centers to secure tension bars to posts.

2.6 **POSTS, CAPS, RAILS, COUPLINGS**

A. Posts, Frames, Stiffeners, Rails: ASTM F1043.

Table 1 – Posts, Frames, Stiffeners, Rails	
Proposed Use	**Nominal Type and Size**
End, corner, slope and gate posts for single gates 6 feet or less in width and double gate 12 feet or less in width for	
1. Fence less than 72 in. high	2" pipe
2. Fence 72 inches or higher	2-1/2" pipe
Gate posts for single swing gates over 6 feet, but not over 13 feet in width and double swing gates over 12 feet, but not over 26 feet in width or for all slide gates with leaves larger than 6 feet	3-1/2" pipe
Gate posts for single swing gates over 13 feet, but not over 18 feet in width and double swing gates over 26 feet, but not over 36 feet in width	6" pipe
Gate posts for single swing gates over 18 feet in width and double swing gates over 36 feet in width	8" pipe
Frame for gates	1-1/2" pipe
Stiffeners for gates	1-1/4" pipe
Line posts for fence 72 in. or higher	2" pipe
Line posts for fences less than 72 in. high	1-1/2" pipe, or 1-1/8" x 1-5/8" H
Top rail	1-1/4" pipe, or 1-1/2" x 1-1/4" H
Bottom rail	6-gage, coiled spring steel tension wire

B. Posts: Galvanized steel, at indicated length.

C. Caps: Pressed galvanized steel or malleable iron designed to fit securely over post ends forming a weather tight closure. Where top rail is used, provide cap to permit passage of top rail. "H" section posts do not require caps.

D. Top, Intermediate and Bottom Rails: Galvanized steel, in required lengths. Provide joint couplings to connect rails securely. Provide means for attaching top rail securely to each end, corner, line, slope and gate posts.

E. Joint Coupling: Galvanized steel, six (6) inches long minimum for each joint. 1 coupling in five (5) shall have expansion spring. Couplings shall be outside sleeve type with bore of sleeve true to maintain adjacent lengths of rail in alignment.

2.7 **FITTINGS AND HARDWARE**

A. Galvanize fittings and hardware.

B. Rivets: Galvanized steel.

2.8 **SUPPORT OR EXTENSION ARM**

A. Use support or extension arms for barbed wire that are of a type that can be attached to tops of the posts and carry number of wires indicated.

B. Use only support arms that are capable of supporting a 250 pound vertical load at the end of the arm without causing permanent deflection.

C. Single support arms are to be integral with a top post weather cap and have a hole for passage of the top rail when required.

2.9 **GATES**

A. Residential Gates: ASTM F654.

B. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.

C. Assemble gate frames and attach hardware by welding or by using fittings and rivets to make rigid connections. Use same fabric as for fence. Install fabric with stretcher bars to gate frame at not more than 15 inch on center.

D. Provide diagonal cross-bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to prevent frame from sagging or twisting.

2.10 **GATE HARDWARE**

A. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide minimum of one pair of hinges for each leaf.

B. Latch: Forked steel type or plunger-bar steel type to permit operation from either side of gate. Provide locking device and padlock eye as integral part of latch.

C. Keeper: Provide keeper for all vehicle gates which automatically engages the gate leaf and holds it in the open position until manually released.

D. Gate Stops: Mushroom type or flush plate with anchors set in concrete to engage the center drop rod or plunger bar.

E. Sliding Gates: Manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, steel wheel or rubber wheel, and accessories as required.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

C. Review to ASTM F567 and CLFMI products manual for chain link fence installation.

D. Protect roots and branches of trees and plants to remain.

E. Limit amount of clearing and grading along fence line to permit proper installation.

3.2 **LAYOUT OF WORK**

A. Accurately locate and stake locations and points necessary for installation of fence and gates.

B. General arrangements and location of fence and gates are indicated. Install except for minor changes required by unforeseen conflicts with work of other trades.

3.3 **INSTALLATION OF POSTS**

A. Space line posts as follows:

1. Tangent sections to 500 feet radius: 10 feet maximum.
2. 200 feet radius to under 500 feet radius: Eight (8) feet maximum.
3. 100 feet radius to under 200 feet radius: Six (6) feet maximum.
4. Under 100 feet radius: Five (5) feet maximum.

B. Provide pull posts at 500 feet maximum intervals. Changes in line of 30 degrees or more are considered corners.

C. Set all posts to true line and grade in concrete bases or in approved pipe sleeves or sockets. Check for vertical and horizontal alignment.

D. Construct concrete bases for posts at least 10 inches in diameter. Place a minimum of six (6) inches concrete below each post. Depth of post in concrete as follows:

1. Line Posts: 18 inches.
2. End, Pull, Corner and Gate Posts Less Than six (6) inches Diameter: 24 inches
3. Gate Posts: 30 inches.

E. Where posts are required to be set in concrete walls or masonry, set sockets for posts to a depth of at least 18 inches. Use sockets that consist of lengths of 0.048 inch galvanized metal pipe sleeves, with an inside diameter

sufficient to allow the posts to fit loosely. Coat inside of socket and outside of posts with bituminous paint. Caulk posts securely in place with lead wool.

3.4 INSTALLATION OF BRACE ASSEMBLIES

A. Attached brace rail from end, pull, corner or gate posts to first ensuing line post. Install braces so posts are plumb when diagonal truss rod is under proper tension.

3.5 INSTALLATION OF RAILS

A. Install rails level and plumb with grade between posts and attached to posts before stretching fabric. Top rails shall form continuous brace from end-to-end of each run of fence.

3.6 INSTALLATION OF FENCE FABRIC

A. Place fence fabric on security side of posts unless otherwise specified. Place fabric approximately 1 inch above the ground. Maintain a straight grade between posts by excavating ground high points. Filling depressions with soil.

B. Stretch fabric taut and securely fasten to posts. Fasten to end, gate, corner, and pull posts. Secure stretcher bars with metal bands spaced at 15 inch intervals. Cut the fabric and fasten each span independently at all pull and corner posts. Fasten to line posts with tie wire, metal bands, or other at 15 inches intervals. Attach the top edge of fabric to the top rail or tension cable at approximately 24 inches intervals. Attach bottom tension wire to fabric with tie wires at 24 inches intervals and secure to end of pull posts with brace bands.

C. Draw barbed wire to assure minimum sag at high temperature and no breakage at low temperature. Connect wires and arms by means of 0.142 gauge galvanized wire stays.

3.7 INSTALLATION OF GATES

A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation.

3.8 REPAIR DAMAGED COATING

A. Grind smooth and wire brush all welds made after galvanizing to remove loose or burned zinc coating, after which neatly coat the areas with 50-50 solder or as otherwise directed by ENGINEER. Make repairs to abraded or otherwise damaged zinc coating in a similar manner. Replace PVC coating.

END OF SECTION

SECTION 32 31 16
WELDED WIRE FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wire fences and gates for roadway right-of-way lines.

1.2 REFERENCES

A. **AASHTO Standards**:

M133 Preservatives and Pressure Treatment Process for Timber.

B. **ASTM Standards**:

A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

A116 Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.

A121 Zinc-Coated (Galvanized) Steel Barbed Wire.

A585 Aluminum-Coated Steel Barbed Wire.

A641 Zinc-Coated (Galva-nized) Carbon Steel Wire.

A702 Steel Fence Posts and Assemblies, Hot-Wrought.

C. **NFPA Standards**:

70 National Electric Code.

1.3 SUBMITTALS

A. Drawings: Indicate plan layout, grid, spacing of components, accessories, fittings, and anchorage.

B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.

PART 2 PRODUCTS

2.1 GENERAL

A. Galvanizing, ASTM A121: Class 3.

B. Aluminizing, ASTM A585: Class 2.

C. Polyvinyl Chloride (PVC): For PVC coated materials, paint all posts, fittings, hardware and accessories as indicated to match PVC color.

D. Steel Pipe, ASTM A53: Schedule 40.

E. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

2.2 WIRE MESH FABRIC

A. Class II, ASTM A116, nominal 0.099 inch Farm Grade with a six (6) inch vertical wire spacing with wire mesh and spiral stays having a Class 1 zinc coating.

B. For PVC coated fabric, the fabic shall be hot dipped galvanized steel wire complying with ASTM A392 and coated with a continuous PVC bonding process (minimum 15 mil thickness) in accordance with ASTM F668. Color of PVC coating as indicated. Applied free of voids, cracks, tears and to have a smooth and lustrous surface.

2.3 BARBED WIRE

A. Two strand, 12-1/2 gage wire with 14 gage, four (4) point round barbs spaced approximately five (5) inches on center.

2.4 UNTREATED WOOD POSTS FOR LINES, GATES, ENDS AND CORNERS

A. Line posts: 10 inches minimum circumference Juniper or acceptable alternate.

B. Gate, Brace, and Corner Posts: 12 inches minimum circumference minimum Juniper or acceptable alternate.

C. Use only sound straight posts that are free from decay or defects.

2.5 **TREATED WOOD POSTS AND WOOD BRACE RAILS**

A. Douglas Fir, Hemlock, or Pine as follows:

1. Line Posts: 10 inches minimum circumference.
2. Gate, Brace, and Corner Posts: 12 inches minimum circumference.
3. Rectangular Posts: 12 square inches minimum cross-section area rough sawn or finished.

B. Pressure treat wood members before fabrication, AASHTO M133.

C. Before painting, treat lumber per AASHTO M133 requirements using pentachloro-phenol solution.

D. Sawing or field drilling of holes is allowable if all exposed untreated surfaces of members are field treated with two (2) coats of the same material originally treated.

2.6 **METAL POSTS AND BRACES**

A. Steel posts, ASTM A702.

B. The anchor plate may be omitted provided posts are set in a concrete footing with a minimum cross-sectional dimension of six (6) inches and a depth equal to full penetration of the post plus six (6) inches.

C. Galvanized posts may be used in the place of the painted posts. Use posts galvanized by the hot-dipped process.

2.7 **TUBULAR STEEL FRAME GATE WITH WIRE FABRIC**

A. Gate frames manufactured with steel pipe 1 inch nominal diameter steel pipe minimum.

B. Place steel pipe braces vertically in each drive gate to provide uniform size panels. Provide one vertical support for 10 and 12 feet wide gates and two (2) vertical supports for 14 to 16 feet wide gates.

C. Gate dimensions are the minimum clear openings between gate posts. Provide a gate with fittings to fill the opening.

D. Provide galvanized woven wire fabric of the same type and quality as indicated for the fence, and space the horizontal wires corresponding to that of the fence. Provide an adjustable steel truss rod of 3/8 inch minimum diameter to prevent sagging on gates 10 feet or more in length.

E. Galvanize steel fitting and hardware, Section 05 05 10.

F. For 10 feet wide and wider gates use pintles not less than 5/8 inch diameter.

G. For single gate fasteners furnish an 18 inches length of galvanized chain secured to the gate at one end and fitted with a snap fastener on the loose end. For all double drive gates use a center latch in lieu of a chain fastener with a pin that fits in a socket embedded in concrete.

H. For sliding gates use a frame made from 1-1/4 inch steel tubing with fence fabric equal to the adjoining fence. Support the opening end on a set of six (6) inches minimum diameter wheels. Provide a 1-1/2 inch minimum schedule 40 pipe to support the other end with a steel wheel that rides on the support pipe. On gates wider than 12 feet use two (2) support pipes. If a pre-manufactured gate is to be used, submit details for review.

2.8 **STAPLES**

A. Galvanized steel No. 9 wire 1-1/2 inches long minimum with an ASTM A641, Class I coating.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

C. Limit amount of clearing and grading along fence line to permit proper installation.

3.2 **INSTALLATION**

A. Install permanent end braced posts for existing cross fences which are intersected by the new fence alignment. Place all end braced posts in position in existing cross fence to serve as line posts for connection to the new fence. Space fence posts at intervals and depth required. Install all posts in a vertical position.

B. After wood post has been set, cut off top to height indicated at an angle of approximately 30 degrees from horizontal.

C. Brace corner and end post in two directions.

D. Set metal corner, end, gate, and brace posts in concrete footings that are 12 inches larger in diameter than the post and at least 24 inches deep. Crown top to shed water. Install no materials on posts or place strain on guys until seven (7) days after placing concrete.

E. Draw wire mesh fabric tight to remove all sag.

F. Excavate high points along the ground surface that interferes with placing of wire mesh. Provide a minimum clearance of 1 inch and four (4) inches maximum.

G. Draw barbed wire to assure minimum sag at high temperatures and no breakage at low temperatures. Connect the lateral wires between posts by means of 0.142 inch diameter galvanized wire stays of length indicated.

H. Fasten top and bottom wires and every alternate lateral wire in mesh fabric and each strand of barbed wire to each post by means of the staple or clamp.

I. Connect wood braces to adjacent posts with 3/8 inch x 4 inch galvanized steel dowels and tension brace wires until installation is rigid.

J. Fasten metal braces to metal post by the use of a securely bolted assembly or butt welding.

K. Provide double diagonal wire bracing at each timber bracing consisting of two 0.192 inch diameter galvanized wires securely fastened to wood posts.

L. Construct gates to operate freely without sag. Provide fittings and locks.

M. At each location where an electric transmission distribution or secondary line crosses any fence with wood posts, install an electric ground conforming to NFPA 70 requirements.

END OF SECTION

SECTION 32 32 26
CRIB WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabrication and installation requirements for modular concrete crib or steel crib retaining walls.

1.2 REFERENCES

A. **AASHTO Standards**:

M36Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.

M243 Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches.

1.3 SUBMITTALS

A. Shop Drawings or manufacturer's specifications showing components to be used, erection and component tolerances, overall layout, typical construction details, and construction procedures.

B. Specific engineered design calculations for the particular wall.

PART 2 PRODUCTS

2.1 GENERAL

A. Concrete crib retaining walls consist of cribs composed of headers, stretchers, closers, and false headers. These components are held together principally by friction and are filled with crushed Rock or soil. Cribs can be interlocked to increase base width and wall mass.

B. Metal bin retaining walls consist of a plurality of pairs of columns, one column of each pair is in the plane of the front wall and the other column is in the plane of the rear of the wall. The pairs of columns are spaced longitudinally with overlapping S-shaped facing and rear members (stringer). They are shaped transversely with overlapping U-shaped tie members (spacers).

C. Hot dip galvanize all metal materials, including bolts, appurtenances, and connections. Refer to metal galvanizing requirements in Section 05 05 10.

2.2 MANUFACTURE OF CONCRETE CRIBWALL COMPONENTS

A. Concrete and Steel for Manufacture of Components:

1. Concrete: Class 4000, minimum cast-in-place, Section 03 30 04.
2. Reinforcement: Steel, Section 03 20 00.

B. Lengths and widths of component surfaces in contact with the molds during manufacture shall not depart from nominal approved design values by more than plus or minus 1/8 inch.

C. Distances between bearing surfaces shall not depart from the nominal design value by more than plus or minus 1/16 inch.

D. Bearing surfaces shall be parallel to within plus or minus 1/32 inch in the width of the units.

E. All components except false headers shall contain reinforcing steel that extends to within 1-1/2 inches of the end of the unit. In no case shall the diameter of the reinforcing steel be less than 3/8 inch.

F. All reinforcing steel shall be covered with at least 1-1/2 inch of concrete at the time of manufacture.

2.3 FABRICATION OF METAL BINS

A. Steel bin materials of the shapes and dimensions required.

B. Gage or thickness of wall construction members not less than 0.06 inch nominal.

C. When forming units, maintain a minimum-forming radius of 1 inch, or if units are formed with less than 1 inch radius, hot-dip galvanize after forming.

D. Assemble units into a continuous closed faced wall of connected bins.

E. Fabricate all units of the same nominal size so they are fully interchangeable. No drilling, punching, or drifting to correct defects in manufacturing will be permitted. Any units having holes improperly punched or galvanized will be rejected.

F. Field coat all buried portions and the back side of metal bin retaining wall units with an asphalt cement per AASHTO M243.

2.4 **ACCESSORIES**

A. Fill: Use only crushed Rock with a maximum diameter of three (3) inches or an approved soil fill which is free from organic matter and conforms to the gradation limits of 100 percent passing a three (3) inches sieve and not more than 15 percent passing a number 200 sieve.

B. Geotextile: Woven or nonwoven fabric, Section 31 05 19

PART 3 EXECUTION

3.1 **PREPARATION**

A. Excavation, Section 31 23 16.

B. Excavate for wall construction to 18 inches below finish ground line at the toe of the wall and slope the Excavation to the heel of the wall at the appropriate counter-batter as indicated in CONTRACTOR's submitted design calculations.

C. The material under the base of the wall shall be either undisturbed native soil free from organic matter or an approved crushed aggregate base that is compacted equal to or greater than 90 percent of maximum dry density.

D. Install required geotextile, Section 31 05 19.

3.2 **BACKFILLING AND COMPACTION**

A. Place fill carefully in lifts not exceeding 12 inches uncompacted depth and work between parallel crib wall components.

B. Soil used for wall fill, compact the fill equal to or greater than 90 percent of maximum dry density within the rear 2/3 of the face crib and in all multiple cribs.

C. Place and compact the backfill behind the cribs concurrently with the filling of the cribs.

3.3 **ERECTION - GENERAL**

A. Obtain site review by ENGINEER after wall and base cuts are completed and before start of wall construction.

B. Up to two (2) inches of sand or fine gravel may be used on top of the prepared base to adjust exact elevation of the base course of closers.

C. Handle component units carefully. Repair or replace damaged units.

D. Maintain all field tolerances to within plus or minus 1/2 inch in 10 feet of the nominal design tolerances.

E. Do not exceed the maximum height shown in the engineered wall calculations for each crib width shown.

F. In the construction of a wall on a curve, obtain the proper curvature for the face by the use of shorter stringers in the front or rear panels of retaining walls.

3.4 **ERECTION - CONCRETE CRIB WALL**

A. If cutting of the units requires the exposure of the ends of the reinforcing steel, coat the exposed steel with an epoxy or an aspalt cement.

B. If shims are required to maintain tolerances in wall, only shims made from asphaltic felt or fiberglass roofing material shall be permitted.

3.5 **ERECTION - STEEL CRIB WALL**

A. Bolt ends of steel stringers to corner columns by means of connecting channels.

B. Coat field cut of steel ends in accordance with AASHTO M36.

C. The wall height and depth may be varied. Do not exceed maximum dimensions shown for design selected. Two or more retaining walls may be incorporated in the same wall by the use of standard split columns to make the connection on the step-back.

END OF SECTION

SECTION 32 84 23
UNDERGROUND IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a pressurized irrigation system complete with heads, valves, controls, and accessories.

B. Refer to Section 33 41 00 if installation is a non-pressure irrigation supply system.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 621 Stationary head.

Plan 622 Pop-up head.

Plan 631 Backflow preventer.

Plan 632 Drain valve.

Plan 633 Control valve.

Plan 635 Isolation valve.

Plan 651 Wire runs for landscape irrigation.

B. **ASSE Standards**:

1013 Reduced Pressure Principle Backflow Preventers.

C. **ASTM Standards**:

B88 Copper Pipe.

B687 Brass, Copper, and Chromium-Plated Pipe Nipples.

D1785 Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80, and 120.

D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 80.

D2466 Poly (Vinyl Chloride)(PVC), Plastic Pipe Fittings; Schedule 40.

D2672 Joints for IPS PVC Pipe Using Solvent Cement.

F656 Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D. **NFPA Standards**:

70 National Electric Code.

1.3 DEFINITIONS

A. **Irrigation System**: The arrangement of valves, controls, heads, and accessories including lateral and mainline pipe systems.

B. **Mainline Pipe**: Pipe that carries water from point of connection at supply system to the valves.

C. **Lateral Pipe**: Pipe that carries water from the valves to the sprinkler heads or emitters.

1.4 PERFORMANCE REQUIREMENTS

A. Design Pressure: As indicated at the heads.

B. Location of Heads: Design location is approximate. Adjust as necessary to avoid plantings and other obstructions.

C. Water Coverage: Turf and other planting areas, 100 percent. Modify layout to obtain coverage and rate of application and to suit manufacturer's standard heads. Do not decrease number of heads indicated unless acceptable to ENGINEER.

D. Pipe Testing Schedule: Section 33 08 00.

E. Flush pipe clean before head placement.

F. Leave system dry if work is Substantially Complete after October 15 unless otherwise acceptable to ENGINEER.

1.5 **SUBMITTALS**

A. Product Data: Manufacturer's technical data and installation instructions.

B. Layout drawings and details illustrating piping layout to water supply location and type and coverage of heads, valves, piping circuits, controls, landscaping features, list of fittings and accessories.

C. Pipeline test report: Section 33 08 00.

D. Operation and Maintenance Data: Section 01 78 23:

1. Submit instructions covering full operation, care, and maintenance of system (and controls) and manufacturers parts catalog.

2. Include year-to-year schedule showing length of time each valve is to be open to provide determined amount of water, drain procedures, cleanout features, etc.

3. Instruct OWNER's maintenance personnel how to operate controller and adjust sprinkler heads

E. Manual Valve Key Operator:

1. Gate valve key.

2. Stop and waste valve key, rigid stee, with "T" handle, standing three (3) feet above ground when used and key end to fit stop and waste valve nut.

PART 2 PRODUCTS

2.1 **PIPE, FITTINGS, OTHER**

A. Mainline Pipe, Lateral Pipe: PVC, Schedule 40 up to 2 ½-inch diameter, then Class 200 for larger diameters, ASTM D1785:

1. Smaller than three (3) inches diameter, solvent welded, ASTM D2672.

2. 3-inches and larger diameter, threaded or mechanical joint.

B. Fittings: Solvent welded or threaded.

C. Sleeves, PVC: Four (4) inch minimum.

D. Riser:

1. Threaded schedule 80 PVC pipe ½-inch diameter. Length as required.

2. Half inch barbed swing pipe adapter.

E. Valve Fittings: PVC: Schedule 80 threaded.

F. Copper Pipe: Type K, ASTM B88.

G. Copper Fittings: Wrought or cast, ASTM B687.

2.2 **VALVES**

A. Manual Control Valve: Gate type with cast bronze body, resilient integral taper seat, non-rising stem, and fitted for key operation.

B. Manual Drain Valve: Ball type, ¾-inch bronze body, with replaceable seat disc.

C. Automatic Control Valve:

1. Globe type, normally closed, fitted for manual flow adjustment.

2. Totally encapsulated low power replaceable solenoid.

3. High-strength rubber or synthetic rubber diaphragm.

4. Pressure regulating (set for site conditions).

D. Automatic Drain Valve: Designed to open for drainage when line pressure drops below three (3) psi. (NOT for use on mainline pipe.)

2.3 **DRAIN SUMP**

A. Sewer rock or pea gravel, Section 31 05 13.

2.4 **BACKFLOW PREVENTER**

A. Manufacturer's standard, State or OWNER approved, to suit sprinkler system and the following:

1. Reduced Pressure Principle Device: Above ground type, ASSE 1013.
2. Capable of being tested and serviced without removal from pipeline.
3. Body and caps constructed of bronze with wear and corrosion resistant internal parts complete with bronze quarter turn ball valves.
4. When underground irrigation system is designed for liquid fertilizer, provide a reduced pressure backflow prevention device. The drain to daylight must be a minimum of 12 inches below the bottom of the release valve for devices four (4) inches in diameter and smaller, or 12 inches plus the nominal diameter of the devices over four (4) inches in diameter.

2.5 **SPRINKLER HEADS**

A. In General: Heads are placed to provide uniform coverage over entire area of spray indicated at available water pressure.

B. Pop-up Spray Head:

1. Fixed pattern with screw type flow adjustment and stainless-steel retraction spring.
2. Pop-up of 4, 6, and 12 inches.
3. Side and bottom inlets on six (6) and 12-inch heads.

C. Rotary Head:

1. Gear driven, high-impact plastic construction full circle and part circle design.
2. Built-in check valve.

D. Pop-up Impact Head:

1. High-impact plastic construction, full circle, part circle, with plastic clapper, and heavy-duty steel retraction spring.
2. Side or bottom inlet.
3. Built-in check valve required when used with more than three (3) feet of elevation change on the lateral line.
4. Plastic sprinkler nozzles, interchangeable.

E. Above-ground Impact:

1. Brass construction with stainless steel clapper.
2. Mounted above ground with no pop-up features.
3. Brass sprinkler nozzles interchangeable.

2.6 **NOZZLES**

A. Fixed Spray:

1. Radius pattern and gal/min as required.
2. Matched precipitation rates.
3. Stainless steel adjustment screw.
4. Threaded to match riser.
5. Pressure regulating: (Required when the psi at the sprinkler does not fall within the range recommended for its use). See manufacturer’s specifications.
6. Filter Screen.

B. Bubbler:

1. Made of high-impact plastic.
2. Pressure compensating with adjustable flow and radius as required.
3. Threaded to match riser.
4. Attached to fixed riser or pop-up spray.
5. Filter screen.

2.7 **VALVE BOX**

A. Precast concrete or plastic with adequate hand room to operate small tools and provisions for locking cover to frame.

B. For drain pockets, ASTM size no. 2 gravel (2-1/2 inch) Section 31 05 13.

2.8 **DRIP TUBING**

A. Self-cleaning, pressure compensating, polyethylene dripper line.

B. Dripper discharge: 0.6 to 0.9 gal/hour and choice of 12, 18 or 24 inches spacing.

C. Pressure compensation range from eight (8) to 60 psi.

2.9 **LINE FLUSHING VALVE**

A. Automatic cleaning, high impact, ½-inch diameter, plastic.

B. Maximum flow rate per flush valve: 15 gal/min.

C. Can be disassembled allowing for winterization blow-out.

2.10 **AIR/VACUUM RELIEF VALVE**

A. Brass body and cap and rated to 200 psi.

B. Temperature resistant silicone disc seat.

2.11 **FILTER**

A. Disk:

1. Corrosion resistant thermoplastic, threaded.
2. Multiple disk filter design: 120 mesh.
3. Shut-off valve.
4. Constructed of durable, non-corrosive components and equipped with O-ring seals.

B. “Y”:

1. Threaded inlet and outlet.
2. Polyester 0.01 mesh filter screen.
3. Durable, non-corrosive components and equipped with an O-ring seal.
4. Operating flow range of 1 to 15 gal/min with a pressure range of 10 to 150 psi.
5. Easily removable cap and screen.

2.12 **SWING PIPE**

A. Pipe: Polyethylene, flexible, rated for 80 psi.

B. Elbow: Barbed plastic suiting pipe diameter.

2.13 **QUICK COUPLER**

A. Heavy duty brass, one-piece body design.

B. Operating flow range of five (5) to 125 gal/min with a pressure range of 125 psi.

C. Brass key to match valve type and size.

D. Stainless steel spring.

2.14 **JOINT PRIMER AND SOLVENT CEMENT**

A. Refer to ASTM F656, and ASTM D2672 requirements.

2.15 **VALVE BOX**

A. Two-inch diameter, Schedule 40 PVC with removable cap, length as required.

2.16 **TEFLON TAPE**

A. For use on threaded joints. Quality grade, 0.004 inch.

2.17 AUTOMATIC CONTROL SYSTEM

A. General: Furnish low voltage system manufactured expressly for control of automatic circuit valves of underground irrigation systems. Provide unit of capacity to suit number of circuits.

B. Control Enclosure - External Applications: Manufacturer's standard weatherproof enclosure with locking cover, complying with NFPA 70.

C. Control Enclosure - Internal Applications: Manufacturer's standard with locking cover, complying with NFPA 70.

D. Wire:

1. Provide wire for connecting remote control valves to automatic controllers that is Type "UF", 600 volts, stranded or solid copper, single conductor wire with PVC insulation and bearing UL approval for direct underground burial feeder cable. Make all connections with UL approved type seal to make a waterproof connection. Bury wires in the same trench as the pipe where possible.

2. Provide wire with 4/64-inch insulation, minimum covering of ICC-100 compound for positive weatherproofing protection. For wire sizes 14, 12, 10, and 8 use a single conductor solid copper wire, and for sizes 6 and 4 use stranded copper wire. Make control or "hot" wires red and all common or "ground" wires white.

3. Verify wire types and installation procedures conform to local codes.

Table 1 – Valve Wire Sizing Chart

Voltage at Controller	Wire Control Common	Maximum Allowable Length in Feet from Controller to Valves			
		No. of Valves (Solenoids)			
		1	2	3	4
14	14	2765	1309	846	549
14	12	3393	1608	1039	673
14	10	3962	1877	1213	783
12	12	4394	2082	1346	6872
12	10	5397	2557	1652	1071
12	8	6364	3018	1949	1263
10	10	6986	3311	2140	1387

E. Transformer: To convert service voltage to control voltage and in accordance with manufacturer's recommendations.

F. Circuit Control: Each circuit variable from approximately five (5) to 60 minutes. Include switch for manual or automatic operation of each circuit.

G. Timing Device: Adjustable, 24 hours and 14 days clocks to operate any time of day and skip any day in a 14-day period. Allow for manual or semiautomatic operation without disturbing preset mechanical operation.

PART 3 EXECUTION

3.1 EXCAVATION

A. Section 31 23 16.

B. Excavate trenches for sprinkler system pipe to provide 18 inches of cover over Mainline Pipe and 10 inches over Lateral Pipe. Before excavating, establish location of all underground utilities and obstructions.

C. Trench for sprinkler system to ensure proper grades and slopes to drain points.

D. Barricade trenches within the right of way and along pedestrian routes that are left open overnight or that may be a hazard during construction, Section 01 55 26.

3.2 INSTALLATION

A. **General:** Plans are diagrammatic. Proceed with installation in accordance with the following:

1. Run all Lateral and Mainline pipe as required. Within planting areas avoid conflict with trees. Where trenching is required in proximity to trees which are to remain, do not damage roots.

2. Install stop and waste valves, isolation valves, vacuum breakers, pressure reduction valves, and other equipment required by local authorities according to Laws and Regulations in order to make system complete.

3. Slope Lateral Pipe to drain.

4. After completion of grading, seeding or sodding, and rolling of grass areas, adjust heads to be flush with finished grades.

B. **Piping:**

1. Assemble all Lateral and Mainline Pipe in accordance with manufacturer's recommendations. Assure positive drainage.

2. At wall penetrations, pack opening around pipe with Section 03 61 00 non-shrink grout. At exterior face, fill perimeter slot with backer rod and sealant. Repair below grade waterproofing and make penetration watertight.

3. Install PVC pipe in dry weather above 40 deg F Allow joint to cure a minimum of eight (8) hours before testing.

C. **Irrigation and Potable Water Inter-Connect:**

1. For pump interface, use connection system shown in the Drawings or APWA Plan 593 Sheet 1.

2. For backflow preventer interface, use connection system shown in the Drawings or APWA Plan 593 Sheet 2.

D. Sleeves:

1. Install sleeves before concrete work.

2. Under roadway, install PVC sleeve if cover over sleeve exceeds two (2) feet, otherwise use cast iron or ductile iron sleeve.

E. **Valves:**

1. Control Valve:

a. Install control valves to manufacturer's recommendation. Assemble system as shown in the Drawings or APWA Plan 633.

b. Use Schedule 80 PVC pipe for nipples on valve header, length as necessary. Install valves one per each plastic valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.

2. Isolation Valve:

a. Install valves to manufacturer’s recommendation. Assemble system as shown in the Drawings or APWA Plan 635.

F. **Automatic Drains**:

1. Install per manufacturer's recommendations at low point of Lateral Pipes and Mainline Pipes.

2. Assemble system as shown in the Drawings or APWA Plan 632.

G. **Manual Drains**:

1. Install per manufacturer's recommendations on upstream and downstream side of backflow preventers and at lowest point along Mainline Pipe.

2. Install by teeing down to 1-inch drain valve. Provide a drainage sump sized to receive volume of drain water.

3. Make manual drain valves accessible by installing an adjustable pipe sleeve to meet finished grade with locking valve marker lid flush with finish grade.

4. Assemble system as shown in the Drawings or APWA Plan 632.

H. **Quick-Coupling Valves:** Install using ¾-inch flexible lateral with galvanized elbow and riser. Locations as indicated.

I. Backflow Preventers: Assemble preventers as shown in the Drawings or APWA Plan 631 Sheet 1 or Sheet 2 as applicable.

1. Install assembly complete for sprinkler systems with two (2) drain valves and two (2) shut off valves per local Laws and Regulations, and manufacturer's requirements.

2. In below grade installations install assemblies with drain valves. Provide open box floor with gravel drain sump.

J. **Valve Access Boxes:**

1. Install over-all remote-control valves, manual control valves, zone shutoff valves, gate valves or globe valves. Valves to be installed using valve markers will not require access boxes.
2. Install boxes on level subgrade to proper grade and proper drainage.
3. Provide boxes with proper length and size extensions.

K. **Automatic Controller:**

1. Mount the panel enclosure so adjustments can be conveniently made by the operator.
2. Ground controller per local Laws and Regulations.
3. Make all control wire connections to automatic controllers.
4. Coordinate controller installation with electrical work.

L. **Wire and Electrical Work:** Install as shown in the Drawings or APWA Plan 651. Use electrical control and ground wire suitable for sprinkler control cable of size indicated.

M. **Sprinkler Heads, Emitters, Bubblers, Small Rotators** (less than 10 gallons per minute): Install as shown in the Drawings or APWA Plan 621 or Plan 622 as applicable.

1. Install with flexible lateral and spiral barbed PVC elbows and riser (length as required).
2. Install shrub spray heads a minimum of 12 inches above finished grade of plantings.
3. Install tree bubblers 1/2 inch below crown of tree roots.
4. Flush Lateral Pipe thoroughly. Remove all foreign materials prior sprinkler head installation.

N. **Large Rotator Heads** (10 gallons per minute or more): Install pressurized swings joints with O-ring seals.

O. **Swivel Hose Elbows:** Install brass swivel hose elbows, accurately machined pipe with hose threads and "O" ring seals.

3.3 FLUSHING AND TESTING

A. Mainline Pipe: Section 33 08 00. Test at design pressure:

1. Flush pipe clean before pressure testing.
2. Pressure test in sections to expedite backfilling.
3. Notify ENGINEER 24 hours in advance of pressure testing pipe. Before backfilling and after air pockets have been vented from the lines, pressure test for three consecutive hours. Repair all leaks.

B. Lateral Pipe: Section 33 08 00. Test at design pressure:

1. Pressure test in sections to expedite backfilling is permitted.
2. Flush pipe clean before head placement.
3. Provide one hundred (100) percent precipitation coverage.

3.4 BACKFILLING

A. Section 33 05 20.

B. Backfill above pipe with soil free of rocks over 1 inch diameter, debris, or organic matter. Backfill final four (4) inches with soil of like quality to adjacent areas.

C. Compact Trench backfill thoroughly to prevent settling damage to grades or plant materials. Repair at no additional cost to OWNER.

3.5 SURFACE FINISHING

A. Protect existing landscaping.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.6 **FIELD QUALITY CONTROL**

A. Piping may be tested in sections to expedite backfilling.

B. Notify ENGINEER to schedule final inspection after irrigation system is completely installed and fully functional.

C. Make required field adjustment before inspection and changes after inspection as required by OWNER and ENGINEER.

END OF SECTION

SECTION 32 91 13
STRUCTURAL SOIL MIX

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Soil mix under urban sidewalks to enhance plant root growth and minimize flat work lifting or settlement from root growth.

1.2 REFERENCES

A. ASTM Standards:

C136 Sieve Analysis of Fine and Coarse Aggregates.

D1883 CBR (California Bearing Ratio) of Laboratory Compacted Soils.

F1647 Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 SUBMITTALS

A. Mix design. Identify:

1. Target proportions of mix ingredients.
2. Target CBR (California Bearing Ratio).

B. Source Sample: Submit gradation, CBR and pH test results.

PART 2 PRODUCTS

2.1 CRUSHED STONE

A. Material: Granite, sandstone, or light-weight borrow (limestone not allowed). River or pit run gravel not allowed.

B. Gradation: ASTM C136.

Sieve	Percent Passing
1 ½	90 to 100
1	20 to 55
¾	10 minimum

2.2 CLAY LOAM

A. Composition:

Composition

Material	Percentage
Gravel	Less than 5
Sand	20 - 45
Silt	20 - 50
Clay	20 - 40
Humus	2 – 5

B. Humus determined by ASTM F1647.

C. Peat may be used as an organic amendment to meet the humus requirements.

2.3 SOIL BINDER

A. Potassium propenoate-propenamide copolymer hydrogel.

2.4 **MIX DESIGN**

A. The following is provided as a guide in the development of a mix design:

Crushed Stone	100 parts.
Clay Loam	20 parts.
Soil Binder	0.03 parts.
Water	Moisture content 10 percent.
pH	Between 5.5 and 6.0
CBR	Target is greater than 50, ASTM D1883.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Mixing may be done on site provided a uniform blend is produced, before placement.

B. Excavation and limits as shown or identified by ENGINEER.

C. Layout and grading, Section 32 91 19.

D. Install in eight (8) inch thick lifts before compaction.

E. Compact to 95 percent relative to a standard proctor density, Section 31 23 26.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Landscape grading requirements.

B. Backfill materials.

1.2 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.3 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during the backfilling process. Work closely with ENGINEER particularly when grading and construction berms, channels, or other aesthetic considerations.

D. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.4 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

C. Avoid displacement of and injury to Work while compacting or operating equipment.

D. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.5 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.6 ACCEPTANCE

A. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Crushed aggregate base, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

1.7 WARRANTY

A. Any settlement noted in landscaped surfaces will be considered to be caused by improper compaction methods and shall be corrected at no additional cost to the OWNER.

B. Restore incidentals damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Cement treated fill, Section 31 05 15.

C. Crushed aggregate base, Section 32 11 23.

D. Structural soil mix, Section 32 91 13.

2.2 WATER

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

E. Verify stockpiled fill meets gradation requirements, areas to be backfilled are free of debris, snow, ice or water, and ground surface is not frozen.

F. If subgrade is not readily compactable secure written authorization for stabilization excavation and backfill. Refer to Section 31 23 16.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Protect subgrade from desiccation, flooding and freezing.

D. Do not fill adjacent to structures until Excavation is checked by ENGINEER.

E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches.

G. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

B. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 BACKFILLING

A. General: Conduct work in an orderly manner. Do not create a nuisance. Do not permit soil accumulation on streets or sidewalks. Do not allow soil to be washed into sewers and storm drains.

B. Grading Intent: Spot elevations and contours indicated are based on the best available data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference

in elevation between points change, then the minimum percentage of slope as a result of field adjustment of specific spot elevations is as follows:

1. Pavement Areas: 1 percent.
2. Concrete or Brick Areas: 0.30 percent.
3. Lawn or Planted Area: 0.75 percent.

C. Planted Surfaces:

1. Place backfill to a finished grade.
2. Grade slopes to provide adequate drainage after compaction. Do not create water pockets or ridges. Prevent erosion of freshly graded areas during construction until surfaces have been constructed and landscaping areas have taken hold.
3. Remove surface stones greater than 1 inch from finished grading.

D. Hard Surfaces: Place structural soil to depth specified.

3.5 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.6 COMPACTION

A. Ninety-two (92) percent relative to a standard proctor density, Section 31 23 26, unless indicated elsewhere.

3.7 SURFACE FINISHING

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surfaces to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

1. Backfill areas to contours and elevations required. Do not use frozen materials.
2. Make smooth changes in grade. Blend slopes into level areas.
3. Remove surplus backfill materials from site.
4. Leave stockpile areas completely free of excess fill materials.
5. Slope grade away from building at a minimum of five (5) percent for ten (10) feet unless indicated otherwise.

3.8 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 92 00
TURF AND GRASS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seed and sod requirements.

B. Soil preparation and fertilizers.

1.2 REFERENCES

A. **FS Standards**:

OF 241 Fertilizers, Mixed, Commercial.

B. **ASPA Standards**:

Guideline Specifications for Sodding.

1.3 SUBMITTALS

A. Submit name of sod supplier or location.

B. Submit laboratory analysis of top soil, if requested by ENGINEER.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date and location of packaging. Damaged packages are not acceptable.

B. Strip sod no more than 24 hours before laying.

C. Deliver fertilizer in containers showing weight, chemical analysis, and name of manufacturer. Store fertilizer in a weatherproof location.

PART 2 PRODUCTS

2.1 SEED

A. Furnish grass seed that is fresh, clean, and new crop composed of varieties indicated and tested to have minimum of 90 percent purity and minimum of 80 percent germination.

B. Use seed that conforms to applicable Laws and Regulations.

C. Do not use wet, moldy or otherwise damaged seed.

2.2 SOD

A. Obtain all shipments of sod from approved sources.

B. Mowed regularly and carefully maintained from planting to harvest to assure reasonable quality and uniformity.

C. Free of grassy and broadleaf weeds, and bare or burned spots.

D. Clean, strongly rooted sod of variety indicated.

E. Cut sod in pieces not exceeding 1 square yard. Limit depth of cut to 1/2 inch minimum and 1 inch maximum.

2.3 TOP SOIL

A. Section 31 05 13.

2.4 ACCESSORIES

A. Fertilizer: Uniform in composition, dry and free flowing. Comply with FS O-F-241. Provide nutrients required by soil analysis.

B. Mulching Material: Wood or wood cellulose fiber free of growth or germination inhibiting ingredients.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect existing underground improvements from damage.

B. Do not place turf and grasses until existing weeds have been removed and soil has been prepared.

C. Do not sow immediately following rain, when ground is too dry, too hard, or during windy periods without first loosening the surface.

3.2 GRADING

A. Establish finished grades after settling to provide adequate drainage so no water pockets or ridges will be created.

B. Till soil to a depth of four (4) inches and remove rocks and debris over two (2) inches diameter and any vegetation and weeds. Fine grade entire site to a smooth, loose, and uniform surface. Use native or approved imported topsoil and plant after proper preparation.

C. When subgrade has been established, roll areas to remove ridges and depressions so surface is parallel with finished grade. Limit weight of rolling equipment to 110 pounds minimum or 250 pounds maximum per square foot.

D. Site tolerances:

1. Total topsoil depth for lawns or grasses: Five (5) inches.
2. Elevation of topsoil relative to walks, hard surfaces or edges:
   a. Seed Areas: 1/2 inch below.
   b. Sod Areas: 1-1/2 inches below.
3. Slope away from building five (5) percent for 10 feet minimum. Fill low spots and pockets. High point of finish grade shall be at least six (6) inches below finish floor level.

3.3 FERTILIZING

A. Apply fertilizer in formulation and quantity required by soil analysis.

B. Apply after fine grading and mix thoroughly into upper two (2) inches of topsoil.

C. Do not apply grass seed and fertilizer at same time in same machine unless one step hydro seeding is used.

D. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.4 SEEDING

A. Unless indicated otherwise, apply seed at a rate of five (5) pounds per 1,000 square feet evenly in two (2) intersecting directions. Rake in lightly.

B. Apply fine spray water immediately after each area has been sown.

3.5 ONE STEP HYDRO SEEDING

A. Unless indicated otherwise, on lawn areas apply seed at the rate of five (5) pounds per 1,000 square feet and fertilizer at the rate of 15 pounds per 1,000 square feet of area.

B. Mix seed and fertilizer with a specially prepared dyed wood cellulose fiber and water to form a slurry.

C. Mix slurry in tanks having continuous agitation so that a homogenous mixture is discharged hydraulically on area to be seeded.

D. Apply wood fiber mulch in suspension at a rate of 2,000 pounds per acre or as indicated otherwise.

3.6 TWO STEP HYDRO SEEDING

A. Make soil surface smooth, loose and uniformly fine texture before seeding. Do not prepare more ground than can be seeded in a work day period.

B. Mix fertilizer at a rate of 15 pounds per 1,000 square feet, with wood fiber mulch and water to form a slurry.

C. Maintain a well mixed fertilizer slurry in the mix tank.

D. Spray the fertilizer mixture at the rate of 2,000 pounds per acre.

E. Sow seed on fertilized areas at the rate of five (5) pounds per 1,000 square feet of area, in two (2) directions with a cyclone or other type mechanical seeder.

3.7 SEED PROTECTION ON SLOPES

A. Blankets: Section 31 25 00.

3.8 LAYING SOD

A. Maintain the sod moist, live, and in good condition to encourage immediate growth.

B. Comply with ASPA guidelines for sodding.

C. Lay sod on smooth, moist topsoil, working off planks if required. Rake to loosen and level before placing each course of sod. Ensure sod is not stretched or overlapped and all joints are butted tight. Place sod to break joints on ends. Keep length seams in a straight line.

D. Roll sod immediately after placing. Thoroughly water with a fine spray to a depth sufficient that the underside of the new sod and soil immediately below the sod are thoroughly wet.

E. On slopes two (2) horizontal to one (1) vertical and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at 2 feet maximum on center. Drive pegs flush with soil portion of sod.

3.9 RESTORATION

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surfacesto match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

3.10 CLEANING AND MAINTENANCE

A. Remove from site foreign materials collected during cultivation.

B. Dispose of cleanings.

C. Grass maintenance, Section 32 01 90.

END OF SECTION

SECTION 32 93 13
GROUND COVER

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Plants and ground cover requirements.

B. Bedding, topsoil, and temporary support.

1.2 **REFERENCES**

A. **APWA (Utah) Standards:**

Plan 242 Form strip filler.

Plan 683 Shrubs and bushes.

B. **AAN Standards**:

ANSI Z60.1 American Standard for Nursery Stock.

C. **FS Standard**:

OF 241 Fertilizers, Mixed, Commercial.

1.3 **QUALITY ASSURANCE**

A. Perform work in conformity with applicable requirements of AAN.

B. Obtain nursery stock and other plant materials from acceptable sources.

C. Provide plants free of disease and insects.

1.4 **SUBMITTALS**

A. Submit samples of fertilizers and a complete listing of all plantings, origins and sizes.

B. All necessary inspection certificates for each shipment of plants as required by Laws and Regulations.

C. Schedule of planting times.

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. Exercise care in digging, transporting, handling, and packing of all plants.

B. Handle plants so roots are always protected. If delivery is in open vehicles, cover entire load without causing overheating.

C. Deliver plant materials immediately before placement. Keep plant materials moist.

D. Protect balls from sun and wind by covering with soil or other suitable material if not planted immediately on delivery.

E. Store fertilizer in a weatherproof location such so its effectiveness will not be impaired.

1.6 **ACCEPTANCE**

A. Ball of earth surrounding roots has not been cracked or broken.

B. Burlap, staves, and ropes required in connection with transplanting are installed.

C. Heeled in stock from cold storage not accepted.

1.7 **WARRANTY**

A. Warrant plantings through one year plus one continuous growing season. Replace any unsatisfactory or dead plantings within 10 days of written notice. Make corrections at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Provide plants of normal growth and uniform height, according to species, with straight canes and well-developed leaders, roots, and tops.

B. Provide plants of sizes indicated, Size stated in each case being interpreted to mean dimensions of plant as to stands in its natural position in nursery without straightening of any branches or leaders.

C. Provide legible labels attached to all plants, specimens, bundles, boxes, bales, or other containers indicating botanical genus, species, and size of each.

D. Plants cut back from larger sizes to meet Specifications shall be rejected.

E. Container growth deciduous shrubs will be acceptable in lieu of bailed and burlapped deciduous shrubs subject to limitations for container grown stock.

2.2 **NATIVE GRASSES AND WILDFLOWERS**

A. Unless indicated otherwise, provide the following mixture: 77 percent Festuca ovina duriuscula (Hard Fescue) and 23% Wildflower seeds of equal proportioned quantities of the following, Aster alpinus (Alpine Aster), Campanual carpatica 'Jacqueline' (Bluebells), Coreopsis grandiflora 'Sunray' (Dwarf Coreopsis), Eschschlzia californica (California Poppy), linum Lewisii (Blue Flax), Primula (While Primrose), Tagetes (Marigold), Viguiera Multiflora (Showy golden eye).

B. Purity of all seed types: 90 percent.

C. Germination of all seed types: 90 percent.

2.3 **ORGANIC MULCH**

A. Horticultural grade Class A decomposed plant material, elastic and homogeneous, free of decomposed colloidal residue, wood-sulphur, and iron.

B. pH value of 5.5 to 7.5.

C. 60 percent organic matter by weight, moisture content not exceeding 15 percent, and water absorption capacity of not less than 300 percent by weight on oven dry basis.

2.4 **ACCESSORIES**

A. Fertilizer, FS O-F-241: Uniform in composition, dry and free flowing. Provide nutrients required by soil analysis.

B. Wrapping Materials: Quality burlap tightly tied around plant root system.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Plan to install materials during normal planting seasons for each type of landscape work required. Correlate planting time with maintenance periods and warranty.

B. Verify area to receive plants is to grade, all work is completed in the area, and topsoil has been placed. Follow Section 31 23 23 grading requirements.

C. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Examine grade, verify elevations, observe conditions under which work is to be performed, and notify ENGINEER of unsatisfactory conditions.

3.2 **GRADING**

A. Site tolerances:

1. 12 inches minimum total topsoil depth.
2. 2 inches below walks, hard surfaces or edges.

B. Do not expose or damage existing shrub or tree roots.

C. Slope away from building five (5) percent for 10 feet minimum. Fill low spots and pockets. High point of finish grade shall be at least six (6) inches below finish floor level.

3.3 **FERTILIZING SEEDED AREAS**

A. Apply fertilizer in formulation and quantity required by soil analysis.

B. Apply after fine grading and mix thoroughly into upper two (2) inches of topsoil.

C. Do not apply seed and fertilizer at same time in same machine unless one step hydro seeding is used.

D. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.4 INSTALLATION

A. **General:** Place plant materials for orientation approval by ENGINEER before installation.

B. **Shrubs:** Installed as shown in the Drawings or APWA Plan 683. Set all shrubs slightly lower than finished grade. Use plant mix consisting of three (3) parts topsoil and 1 part organic mulch. Do not fill around stems. Carefully place and tamp plant mix soil to fill all voids.

C. **Seeding:** Sow seed at the rate of 78 pounds per acre. Rake seed into soil and top-dress all seeded areas with 1/4 inch topsoil. Do not let seed installation be subject to damage by climatic conditions.

D. **Restoration:**

1. Spread excess soil from excavated plant pits in surrounding planting beds.

2. Restore form strips as shown in the Drawings or APWA Plan 242.

3. Restore pavements, grassed areas, planted areas, and other improvements damaged to a condition equal to original conditions.

3.5 CLEANING AND MAINTENANCE

A. Remove from site foreign materials collected during cultivation.

B. Dispose of cleanings.

C. Trees, plants, and ground cover maintenance, Section 32 01 90.

END OF SECTION

SECTION 32 93 43

TREE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply and install tree.

B. Site preparation and backfill requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 681 Tree

B. **ANSI Standards**:

A300 Tree, Shrub and Other Woody Plant Maintenance Practices.

Z60.1 American Standard for Nursery Stock.

C. **International Society of Arboriculture (ISA) Standards**.

1.3 SUBMITTALS

A. Copy of CONTRACTOR's notice to property owner. Format to be substantially as follows:

NOTICE TO PROPERTY OWNER

Your new tree is a: ___ (*Name of tree*)

How to take care of your new tree.

- Water thoroughly once every 7 to 10 days during the spring, summer and fall for at least two (2) years. Put your hose by the base of the tree and run water gently for about 20 minutes. Then as tree matures, water at the drip line (straight down under the tips of the branches) every three (3) to four (4) weeks.
- Do not fertilize until second year and only then if needed.
- Do not use weed killer near new trees.
- Protect new tree from damage by cars, lawn mowers, grass trimmers, bikes, vandals, etc.
- Maintain a mulch cover at the base of the new tree.

1.4 QUALITY ASSURANCE

A. Provide an ISA certified arborist to observe tree planting. Upon ENGINEER's request, provide a copy of the arborist's ISA certificate and registration number on file with the State Division of Commercial Code.

B. Nursery: Use a company specializing in growing and cultivating trees with minimum three (3) years experience.

C. Installer: Use a company specializing in installing and planting tree.

D. Planting Plan: Correlate planting time with maintenance periods and warranty.

E. Rejection: Reject any tree upon the following basis:

1. Tree has cracked or broken ball of earth surrounding roots before or during process of planting.
2. Tree was cut back from a larger plant to meet Specifications.
3. Tree is not specified size.
4. Tree has been pruned improperly.

5. Tree has disease or insect infestations.
6. Tree was damaged during transplant.

1.5 **ACCEPTANCE**

A. Tree will be accepted not less than 60 days after planting, watering and successful growth.

1.6 **WARRANTY**

A. Vegetation establishment priod, Section 32 98 00.

B. Include coverage of trees from death, unhealthy conditions, or if tree dies from poor planting practice. Replace any unsatisfactory or dead tree within 10 days of written notice.

C. Replacements: Provide tree of same size and species, planted in the next growing season, with a new warranty commencing on date of planting.

D. Additional Cost: All corrective work will be at no additional cost to OWNER.

1.7 **MAINTENANCE**

A. Period is until acceptance.

B. Maintain tree health immediately after placement.

C. Notify property owner of tree watering practice.

D. Trim off dead or broken branches. Remove clippings and dead branches from site.

E. Control disease.

PART 2 PRODUCTS

2.1 **TREE MATERIALS**

A. Species and size specified, grown in climatic conditions similar to those in locality of Work with branching configuration and cane requirements required in ANSI Z60.1.

B. Provide tree of normal growth and uniform height, according to species, with straight trunk and well developed leaders, laterals and roots. Heeled in stock from cold storage not accepted.

C. Provide tree size indicated, (size being interpreted to mean dimension of tree as its stand in its natural position in nursery without straightening of any branches or leaders).

D. Provide legible labels attached to tree indicating botanical genus, species, and size.

2.2 **SOILS**

A. Backfill of Root Ball Pit: Native soil if not excessively rocky, compactable or clayey; otherwise amend at a rate of two (2) parts native soil to 1 part topsoil. Mix together thoroughly.

B. Topsoil: Section 31 05 13.

2.3 **ORGANIC MULCH**

A. Horticultural grade class A decomposed plant material, elastic and monogenous, free of decomposed colloidal residue, wood sulphur, and iron.

B. pH value of 5.5 to 7.5.

C. 60 percent organic matter by weight, moisture content not exceeding 15 percent, and water absorption capacity of not less than 300 percent by weight on oven dry basis.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Plan to install materials during normal planting season.

B. Notify ENGINEER of unsatisfactory conditions.

3.2 **EXCAVATION**

A. Excavate only for depth of root ball.

B. In park strips adjacent to paved thoroughfares, the traditional round hole barely big enough to accommodate the root ball is not permitted. Excavate the site in the shape of a rectangle. Make excavated area width at least two (2) times diameter of tree root ball and length-at least three (3) times its' diameter:

1. Compact both sides of root ball parallel to street.
2. Loosen sides of planting site that are perpendicular to street.

C. In other landscaped areas, excavated area for tree planting at least three (3) times diameter of root ball.

D. Place plant materials for final orientation review by ENGINEER before backfilling root ball.

3.3 **INSTALLATION**

A. APWA Plan 681.

B. Remove wire baskets and twine from around root ball. If possible, remove all burlap material, or remove top 1/3 from root ball.

C. Maintain plant in vertical position. Eliminate voids and air pockets.

D. Remove all cardboard and twine from tree trunks.

E. Follow arborist's instructions.

3.4 **PRUNING**

A. Comply with ANSI A300 and directions of arborist.

3.5 **PROTECTION**

A. Do not touch directly or indirectly any overhead wire, cable, or power line.

B. Shelter the root ball. Do not let the root ball dry out.

C. Do not damage any irrigation line or emitter system.

D. Do not lift or maneuver the tree by the trunk.

E. Do no add gravel to the bottom of the hole.

F. Do not stake the tree unless carefully monitored by ENGINEER.

G. Do not compact the backfill.

H. Do not use grass clippings as mulch.

I. Do not over water, under water, over prune, paint or wrap the trunk, or fertilize during planting.

J. Do not forget to watch for people using the street or sidewalk while planting.

K. Do not over prune.

L. Do not allow grass, flowers, or vines to grow next to the trunk.

M. Protect roots and branches of existing trees.

N. Do not permit heavy equipment or stockpiling of materials or debris within the drip line. Do not permit earth surface within the drip line to be changed in any way except as required.

O. Replace existing trees damaged by construction operations at no additional cost to OWNER.

END OF SECTION

SECTION 32 98 00

VEGETATION ESTABLISHMENT PERIOD

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Establish and care for plantings requiring watering.

B. Length of time CONTRACTOR is responsible to care for and establish plant materials.

1.2 **ACCEPTANCE**

A. At ENGINEER's discretion conduct one or more inspections to determine condition of planting.

B. Acceptance occurs at end of establishment period or if ENGINEER accepts plantings in writing.

1.3 **WARRANTY**

A. Begins after irrigation system and plant installation inspections and acceptance have been completed and continues for one (1) calendar year, or indicated otherwise in the Contract Documents.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Establish healthy trees, shrubs, groundcovers, and turf.

B. Replace defective plant materials at no additional cost to OWNER.

C. CONTRACTOR will not be held responsible for damage due to acts of nature, vandalism, errant vehicles. Notify ENGINEER immediately if such event occurs.

3.2 **PLANTS**

A. Watering: As necessary to establish and maintain growth.

B. Keep weed-free plant basins and areas where mulch has been placed.

C. Prune broken or dead branches. Replace sub-standard sized plants that require excessive pruning to American Nurseryman Standards.

D. Repair non-functional water basins.

3.3 **LAWNS**

A. Apply 16-0-0 fertilizer (NPK ratio) in fall season following manufacturer's recommendation.

B. Control broadleaf weeds using selective herbicide.

C. Repair, reseed or resod areas showing rodent damage, erosion damage and other damage.

3.4 **LAWN MOWING AND TRIMMING**

A. Times are 7:00 to 10:00 a.m. or 5:00 to 8:00 p.m.

B. Height three (3) inches.

C. Clean cut with sharp blade.

3.5 **IRRIGATION SYSTEMS**

A. Repair installed pressurized irrigation systems to operate properly.

B. Repair erosion. settlement around Street Fixtures and irrigation system components.

C. Winterize system after October 15. Use compressed air at 100 psi only in pressurized systems. Do not put 100 psi air through drip circuits. Coordinate with ENGINEER.

D. Repair irrigation system components broken by CONTRACTOR.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 01 30.73
RELINING PIPE CULVERTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a pipe within an existing pipe with or without restrained ends.

1.2 REFERENCES

A. **ASTM Standards**:

F585 Insertion of Flexible Polyethylene Pipe into Existing Sewers.

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Structural Data: Identify:

1. Specific lateral or main line liner (by trade name).
2. Nominal and true inside and outside liner diameters.
3. Net wall area of liner in square inches per linear foot of pipe liner.
4. Liner structure must be capable of supporting the maximum fill height at the subject location.
5. Maximum ovality will be assumed at five percent.

C. Insertion Plan – Clarify the following:

1. Method of liner insertion (pulled or pushed).
2. Clearly identify manufacturer's recommended method if pushing will be done.
3. Clearly identify the attachment method or pulling head being used to guide and ease the liner into place if pulling will be done.
4. Identify manufacturer's recommended maximum pulling force for the attachment method or pulling head being used if pulling will be done.
5. Proposed length, access, and termination points for each run.

D. Manufacturer's recommendations. Identify:

1. Maximum external grouting pressure.
2. Maximum, minimum and ideal installation temperature.

E. Manufacturer Certification. Show:

1. The liner materials furnished are compatible for the intended installation method, service conditions, and hose pipe material.
2. Copy of manufacturer's installation procedure guidelines.
3. Liner joint assembly recommendations.

F. Restrained Ends: Identify connections at each end of liner pipe that are designed to stop liner pipe shrinkage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Liner Pipe: Smooth wall HDPE having fused or manufactured commercial interlocking joints in each end of a pipe section, Section 33 05 06.

B. Grout: Hydraulic cement, pozzolans, sand, and water. Compressive strength of 250 psi at 28 days.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Before placing pipe liner, verify liner will fit the host pipe. Use of a test head or "PIG" is recommended. Inform ENGINEER if host pipe has collapsed or is otherwise impassable.

3.2 LINER INSTALLATION

A. Host Pipe:

1. Clean host pipe before insertion.
2. Prevent sediment transport into waters of the state.
3. Host pipe may contain flowing water throughout the year. Dewater the pipe to facilitate liner insertion.

B. Liner:

1. Follow ASTM F585 and manufacturer's recommendations.
2. Minimize time insertion excavation area is open and exposed.
3. Remove sections of the inlet and outlet ends of the host pipe, fence, and other items not otherwise specified for removal to provide room for construction of an insertion area. Replace and install new items of the same size, shape, and material as those removed.
4. Where ends of liner pipe are to be restrained, install restraint devices.

C. Grout Annular Space:

1. Wait for temperature of host pipe and pipe liner to equalize before grouting.
2. Do not exceed manufacturer's rated collapse pressure of pipe liner.
3. Grout entire annular space along full length of the liner.
4. Prevent excess grout from entering downstream water courses.
5. Prevent movement from excessive buoyant forces on liner.
6. Trim grout flush and smooth with headwall.

3.3 RESTORE EXCAVATED AREA

A. Restore excavated or disturbed area to previous condition.

END OF SECTION

SECTION 33 05 01

ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. ABS Pipe, fittings and joint materials.

1.2 REFERENCES

A. ASTM Standards:

C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

D1527 Acrylonitrile-Buta-diene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.

D1788 Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics.

D2235 Solvent Cement for Acrylonitrile-Butadiene-Stryene (ABS) Plastic Pipe and Fittings.

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2468 Acrylonitrile-Butadiene- Stryene (ABS) Plastic Pipe Fittings, Schedule 40.

D2469 Acrylonitrile-Butadiene- Stryene (ABS) Plastic Pipe Fittings, Schedule 80.

D2680 Acrylonitrile-Butadiene-Stryene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

D2751 Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

1.3 QUALITY ASSURANCE

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 GRAVITY PIPE SYSTEMS

A. Material: Rigid ABS, ASTM D1788 based on short term tests. Select from the following:

1. Type I, Grade 1, cell (322).
2. Type IV, Grade 1, cell (133).

B. Pipe: ASTM D2751 for two (2) inches to 12 inches ABS pipe and ASTM D2680 for eight (8) inches to 15 inches ABS composite sewer pipe.

C. Fittings, ASTM D2751.

D. Joints:

1. Bell and spigot with solvent cement, ASTM D2235.
2. Mechanical-seal joint with gasket, ASTM C443.

E. Flattening, ASTM D2412: No evidence of splitting, cracking, or breaking.

2.2 PRESSURE PIPE SYSTEMS

A. Material: Rigid ABS, ASTM D1788 based on short term tests. Select from the following:

1. Type I, Grade 2, cell (522).
2. Type I, Grade 3, cell (355).
3. Type II, Grade 1, cell (445).

B. Pipe, ASTM D1527. For 1/8 inch to 12 inch pipe use schedule 40 or 80 for pressure rating required.

C. Joints:

1. Socket type with Iron Pipe Size (IPS) outside diameter, ASTM D2468 for Schedule 40 pipe and ASTM D2469 for Schedule 80 pipe.
2. Bell and spigot with solvent cement, ASTM D2235 or mechanical-seal joint with gasket, ASTM C443.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 02
CONCRETE PIPE AND CULVERT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforced and non-reinforced concrete pipe and culvert, fittings and joint materials.

1.2 REFERENCES

A. **AASHTO Standards**:

HB-17 Highway Bridges.

LRFD Bridge Design Specifications, Customary U.S. Units.

M198 Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants.

B. **ASTM Standards**:

C14 Concrete Sewer, Storm Drain, Culvert Pipe.

C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

C118 Concrete Pipe for Irrigation or Drainage.

C150 Portland Cement.

C361 Reinforced Concrete Low-Head Pressure Pipe.

C412 Concrete Drain Tile.

C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

C444 Perforated Concrete Pipe.

C497 Testing Concrete Pipe, Sections, or Tile.

C505 Non-Reinforced Concrete Irrigation Pipe with Rubber Gasket Joints.

C507 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

C654 Porous Concrete Pipe.

C655 Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe.

C985 Non-reinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe.

C1433 Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers. (Designed according to AASHTO BH-17).

C1479 Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

C1504 Precast Reinforced Concrete 3 Sided Structures for Culverts and Storm Drains.

C1577 Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewer (Designed according to AASHTO LRFD).

C. **AWWA Standards**:

C302 Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.

1.3 SUBMITTALS

A. Precast box culvert design summary.

B. Manufacturer’s proof of certification.

1.4 QUALITY ASSURANCE

A. Manufacturer and Transporter: Certified per Section 03 34 00.

B. Pipe:

1. Remove and replace pipe that show exposed reinforcing steel, honeycomb or open texture.
2. Repair or replace reinforced concrete pipe if cracks are greater than 0.10 inch.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Provide type, class, strength and size of pipe and fittings required.

B. Concrete:

1. Use ASTM C150 or C1157 cement unless required otherwise.
2. Admixtures and pozzolans may be used only with approval.

C. Gravity Pipe System:

1. Reinforced Concrete Pipe: ASTM C76 or ASTM C655.
2. Non-reinforced Pipe: ASTM C14 in sizes up to 36" diameter and ASTM C985 for pipe up to 60" diameter.
3. Irrigation or Drainage Pipe: ASTM C118 or ASTM C505.
4. Drainage Tile: ASTM C412.
5. Perforated Pipe: ASTM C14 Type 1 Class 2 or ASTM C444.
6. Elliptical Pipe: ASTM C507.
7. Porous Concrete Pipe: ASTM C654.
8. Perforated Concrete Pipe: ASTM C444.
9. Precast Box Section Bridge: ASTM C1433 or ASTM C1577 as applicable.
10. Three Sided Culvert: ASTM C1504.

D. Low Head Pressure Pipe Systems: ASTM C361 or AWWA C302.

2.2 JOINTS

A. Use ASTM C443 rubber gasket bell and spigot type joints.

B. For box sections use tongue and groove joints with bituminous mastic joint sealant.

C. For elliptical sections use tongue and groove joints with bituminous mastic joint sealant, AASHTO M198.

D. Mortar: Portland cement, Section 04 05 16.

2.3 SOURCE QUALITY CONTROL

A. Pipe and tile, ASTM C497.

B. Box sections, ASTM C1433.

C. Three sided culverts, ASTM C1504.

PART 3 EXECUTION

3.1 FACTORY FITTINGS

A. Fit all service tees and other miscellaneous fittings with an expanding plug.

B. Grout all fittings to provide a smooth interior and exterior surface.

C. When providing pipe or box sections specifically manufactured with branch connections, carefully shape and fit adjoining pieces to facilitate grouting. Grout all fittings to provide a smooth interior and exterior surface. Lateral pipe or sections shall not project beyond the inner surface of pipe.

D. Use epoxy adhesive grout, Section 03 61 00 as interface between new and existing concrete and piping materials.

3.2 INSTALLATION - PIPE AND FITTINGS

A. Assembly: Abide by manufacturer's instructions, ASTM C1479, and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.

b. Underground irrigation, Section 32 84 23.

2. Gravity Systems:

a. Sanitary sewers, Section 33 31 00.

b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following.

1. Place circular concrete pipe that contains elliptical reinforcing so that the reference lines designating the top of the pipes will not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe.

3.3 INSTALLATION - BOX SECTIONS

A. Assembly: Abide by manufacturer's instructions, and Section 33 41 00 for under drains and storm drain systems. Use the more stringent provisions if there are any conflicts.

1. Install per manufacturer’s instructions.

2. Provide a leveling course under box section. Use Sewer Rock unless specified otherwise.

3. Pull sections together using internal winches or tugger. Do not push box section together. Pushing causes joint misalignment.

4. Limit joint gap to maximum specified by manufacturer. Remove excess bituminous mastic joint sealant from interior box wall, floor, and ceiling.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 05 03
COPPER PIPE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Copper pipe, couplings, fittings, and joint materials for buried water utility applications.

1.2 **REFERENCES**

A. **ASTM Standards:**

B88 Seamless Copper Water Tube.

B. **AWWA Standards**:

C800 Underground Service Line Valves and Fittings.

1.3 **QUALITY ASSURANCE**

A. Reject cracked, chipped, crushed, dented, kinked, or otherwise unacceptable pipe.

PART 2 PRODUCTS

2.1 **PIPE**

A. Type K copper, ASTM B88 Table 3, "Dimension, Weight and Tolerances," and capable of connecting to AWWA standard water service taps and fittings.

B. Outside diameter greater than two (2) inches requires ENGINEER acceptance.

C. Smooth surface free from bumps, flexible enough to be coiled.

2.2 **CONNECTIONS**

A. Flared or compression.

B. Dielectric insulating unions for dissimilar connections.

C. Fittings, AWWA C800.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer’s instructions and the following. Use the more stringent provisins if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 05 04
CORRUGATED METAL PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Corrugated metal pipe, fittings, and joining materials.

1.2 REFERENCES

A. **AASHTO References**:

M36 Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.

M167 Structural Plate for Pipe, Pipe-Arches, and Arches.

M190 Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.

M196 Corrugated Aluminum Alloy Culverts and Underdrains.

M197 Clad Aluminum Alloy Sheets for Culverts and Under-drains.

M218 Zinc Coated (Galvanized) Steel Sheets For Culverts and Underdrains.

M219 Aluminum Alloy Structural Plate for Field Bolted Conduits.

M245 Precoated, Galvanized Steel Culverts and Underdrains.

M246 Precoated Galvanized Steel Sheet For Culverts And Underdrains.

M274 Steel Sheet, Aluminum-Coated (Type 2) by the Hot-Dip Process For Sewer And Drainage Pipe.

M289 Aluminum-Zinc Alloy Coated Sheet Steel for Corrugated Steel Pipe.

B. **ASTM Standards**:

D1187 Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

C. **FS Standards**:

TT-P-636 Paint, Coating, Alkyd, Wood and Ferrous Metal.

1.4 DEFINITIONS

A. **Nominal Diameter**: Average distance measured from inside crest to inside crest of corrugations.

1.5 QUALITY ASSURANCE

A. Reject pipe and fittings that do not meet requirements of this Section including elliptical shaping; variation from a straight centerline; ragged edges; unevenly lined or spaced bolt holes; illegible brands, Abraided or scaled or broken spelter coatings; dents; bends in the metal; or uneven laps.

PART 2 PRODUCTS

2.1 CORRUGATED PIPE

A. Type of Corrugations, AASHTO M218:

1. Annular or helical corrugations using lap joints with riveted or spot welded seams, or
2. Helical corrugations using continuous helical lock seams or ultra high-frequency resistance butt-welded seams.

B. Corrugated Steel Pipe, AASHTO M36: Select type of pipe corrugations, unless indicated:

1. Type I: Circular Section.
2. Type II: Noncircular Section.
3. Type III: Underdrain With or Without Perforations.

C. Corrugated Aluminum Pipe: AASHTO M196 or AASHTO M197 pipe as applicable. Select type of pipe corrugations, unless indicated.

D. Gage:

1. Circular Section Pipe: 16 minimum.
2. Arch Pipe: 14 minimum.

2.2 **STRUCTURAL PLATE PIPE**

A. Galvanized Steel: Thickness, AASHTO M167.

B. Aluminum Alloy: Gage and tolerances, values in AASHTO M219.

C. Pitch and Depth of Corrugations: AASHTO M167 or AASHTO M219. Select pitch and depth unless indicated.

2.3 **COUPLING BANDS**

A. Same base metal and coating as pipe, AASHTO M36 or M 245. Sixteen (16) gage but not less than 2 gage step lighter than pipe gage.

B. Provide circumferential and longitudinal strength to preserve pipe alignment, to prevent separation of pipe, to prevent infiltration of site fill material and to provide water tight joints.

2.4 **COATINGS AND LININGS**

A. Zinc Coating: AASHTO M218.

B. Galvanized Coating: AASHTO M245.

C. Bituminous Coating and Lining:

1. AASHTO M190. Coating thickness to be 0.05 inch measured on the crest of the corrugations. Linings, a minimum coating of 1/8 inch thickness above the crest of each corrugation:
   a. Coating A. Fully bituminous coating.
   b. Coating B. Half bituminous coating with paved-invert lining.
   c. Coating C. Fully bituminous coating and paved-invert lining.
   d. Coating D. Fully bituminous coating and 100 percent lining.
2. When fiber bonded bituminous coating is specified, embed fiber in the molten galvanizing before bituminous coating.

D. Polymer Coating: 10 mils thick minimum, AASHTO M245 or AASHTO M246:

1. Coating A. One side polymeric coating.
2. Coating B. Two side polymeric coating.

E. Aluminum Coating: AASHTO M274.

F. Aluminum-Zinc Coating: AASHTO M289.

2.5 **FITTINGS AND ACCESSORIES**

A. All fittings and bolts shall meet applicable specifications of pipe being joined. Use accessories and gaskets recommended by manufacturer.

B. When providing pipe specifically manufactured with branch connections, extend fittings to but not beyond inner surface of pipe.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions, Section 33 41 00 and the following. Use the more stringent provisions if there are any conflicts.

1. Tighten joint bands evenly.
2. Install elliptical pipe so the major or minor axis coincides with the proposed pipe alignment.
3. Do not cut coated pipe with a welding torch.
4. Coat aluminum pipe to prevent direct contact with concrete with an ASTM D1187 bituminous coating or an FS TT-P-636 zinc chromate primer.

B. Burial: Comply with Section 33 05 20.

3.2 **REPAIR**

A. Repair damaged coatings, Section 05 05 10.

END OF SECTION

SECTION 33 05 05
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Ductile iron pipe, couplings, fittings, and joint materials.

1.2 REFERENCES
A. **AWWA Standards**:
- C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- C110 Ductile-Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
- C153 Ductile-Iron Compact Fittings.
- C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
- C115 Flanged Ductile-Iron and Gray Iron Pipe with Threaded Flanges.
- C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE
A. Repair damaged delaminated, or scaled coating on pipe.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS
A. Buried Applications:
1. Class 52 or pressure class 350 psi ductile iron pipe, AWWA C151 with push-on joints, AWWA C111.
2. Cement lining for all pipe and fittings, AWWA C104.
3. Class 250 fittings with AWWA C110 joints.
4. Coupler with mechanical joint fittings, AWWA C104, C110, C111, and C153.
5. Rubber gasket slip-on pipe joints, AWWA C111 with gasket lubricant.
6. Bronze wedges with current capacity of 400 amps each for each joint as follows:

Pipe Diameter	No. of Wedges
less than 10”	2
10”	3
12”	4
greater than 12”	6

B. Above Ground Applications: As buried applications, except use bolted flanged fittings, AWWA C104, C110, and C115.

2.2 COVERINGS
A. Buried Mechanical Joints: Grease and eight (8) mil vinyl wrap plastic cover.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer's instructions, AWWA C600, and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20.

1. Protect ferrous materials with polyethylene sheet that is at least six (6) mil thick. Tape wrap the sheet around the pipe.

END OF SECTION

SECTION 33 05 06
POLYETHYLENE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyethylene pipe, couplings, fittings and joint materials.

1.2 REFERENCES

A. **AASHTO Standards**:

M252 Corrugated Polyethylene Drainage Pipe.

M294 Corrugated Polyethylene Drainage Pipe 300-1200 mm Diameter.

MP7-97 Corrugated Polyethylene Pipe – 1350 and 1500 mm Diameter.

NTPEP National Transportation Product Evaluation Program.

B. **ASME Standards**:

B1.1 Unified Inch Screw Threads (UN and UNR Thread Form), Supplement.

C. **ASTM Standards**:

A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

D2239 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter.

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2657 Heat Joining of Thermoplastic Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

D3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

D3350 Polyethylene Plastics Pipe and Fittings Materials.

F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

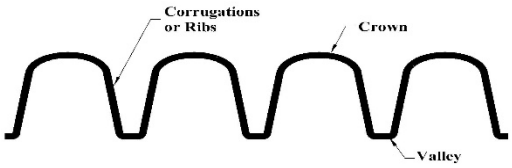
F1055 Electofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.3 DEFINITIONS

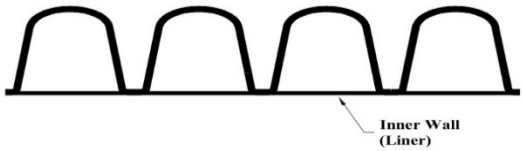
A. **Standard Dimension Ratio (SDR):** Average diameter of pipe divided by the minimum wall thickness. The diameter may be either inside or outside measurement depending upon which standard is referenced.

B. **Code Designation**: A rating system by the Plastic Pipe Institute for smooth wall polyethylene pipe materials. The designation PE 3408 designates the type of plastic pipe (PE), the grade (34), and the hydrostatic design stress measured in units of 100 psi (08) at 23 deg C.

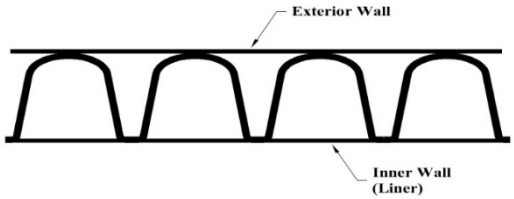
C. **Corrugated Wall Pipe Classifications**: Classifications are shown below. Types S and D have corrugations either annular or helical.



Type C



Type S



Type D

D. **Porous Corrugated Wall Pipe**: Classified as follows.

1. Type CP - This is Type C pipe with perforations.
2. Type SP - This is Type S pipe with perforations.

1.4 **SUBMITTALS**

A. Thermoplastic pipe manufacturer is compliant with AASHTO NTPEP for the diameter of pipe specified in the Contract Documents.

1.5 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 **SMOOTH WALL PIPE SYSTEMS**

A. Material: PE 3408 per ASTM D2239 with a minimum cell classification of 345434C per ASTM D3350.

B. Pipe: Smooth wall inside and out with an SDR or working pressure rating indicated or accepted by ENGINEER with exterior markings as follows:

1. ASTM Standard Number.
2. Pipe Size.
3. Class and profile number.
4. Production code.
5. Standard dimension ratio.

C. Fittings:

1. Resin same as pipe.
2. Working pressure same or greater than pipe.

D. Joints:

1. Thermally welded butt fusion, ASTM D3261.
2. Flanged, ASTM D2657.
3. Ultra high molecular weight electo-fusion tape with a polyethylene coupler meeting ASTM F1055 requirements.

2.2 **CORRUGATED WALL PIPE SYSTEMS**

A. Material: Polyethylene, ASTM D3350 with a cell class as required in AASHTO M252, AASHTO M294 or AASHTO MP7-97

B. Pipe: Type S or D unless indicated elsewhere.

C. Fittings:

1. Blow molded with cell class 335420C, ASTM D3350.
2. Rotational molded with cell class 213320C, ASTM D3350.
3. Shop or field remanufactured of the same material as the pipe

D. Joints:

1. Bell and spigot with gaskets, ASTM F477. Foam type weather stripping not allowed.
2. Split corrugated couplings with plastic or stainless steel ties and leak resistant neoprene gasket.

2.3 **NUTS AND BOLTS**

A. Carbon steel machined heavy hex heads, Class 2 fit, ASTM A307; Grade B, threads, ASME B1.1.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.
3. Protect ferrous materials with polyethylene sheet that is at least six (6) mil thick. Tape wrap the sheet around the pipe.

END OF SECTION

SECTION 33 05 07

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 REFERENCES

A. **ASTM Standards**:

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

D2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C153 Ductile-Iron Compact Fittings

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 48 In., for Water Distribution.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 DEFINITIONS

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

1.4 QUALITY ASSURANCE

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 PRESSURE PIPE SYSTEM

A. Pipe: AWWA C900, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, AWWA C110 or AWWA C153.

2.2 **GRAVITY PIPE SYSTEM**

A. Pipe:

1. Solid smooth wall:
   a. 4 to 27 inch diameter, ASTM D3034.

2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F949.

B. Fittings: ASTM D1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when flattened to 60 percent deflection, ASTM D2412.

2.3 **PERFORATED PIPE SYSTEM**

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D2729.

C. Joints: Push-on, solvent weld or other.

2.4 **SOLVENT WELDS**

A. Primer, ASTM F656.

B. Glue, ASTM D2564.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00, AWWA C900, C905, and C909.
   b. Underground irrigation, Section 32 84 23, and ASTM D2855.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 08
PRE-STRESSED CONCRETE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete cylinder pipe in sizes 12 inches through 72 inches composed of a welded steel cylinder, steel joint rings welded to the cylinder, a centrifugally spun cement-mortar lining, a pretensioned rod wrapping helically wound around the steel cylinder under measured tension, and an exterior cement-mortar coating.

B. Couplings, fittings, and joint materials.

1.2 REFERENCES

A. **AISI Standards**:

No. 1012: Standard Nonsilverized Carbon Steel.

B. **ASTM Standards**:

A283 Low and Intermediate Tensile Strength Carbon Steel Plates.

A370 Test Methods and Definitions for Mechanical Testing of Steel Products.

A569 Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

A611 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.

A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C33 Concrete Aggregates.

C150 Portland Cement.

C. **AWWA Standards**:

C200 Steel Water Pipe 6 In. and Larger.

C208 Dimensions for Fabricated Steel Water Pipe Fittings.

C303 Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids.

1.3 SUBMITTALS

A. Design Summary: Before fabrication, submit a design summary for each size and class of pipe together with line layout drawings or line schedules that show the location of each section of pipe and each special fitting to be furnished.

1.4 DELIVERY, STORAGE AND HANDLING

A. Attach end covers to pipe stored either in the yard or in the field. Reject injurious drying out of concrete.

B. Stalls: Remain in place during storage.

C. Gaskets: Store in cool, well ventilated place and protect from direct sunlight.

PART 2 PRODUCTS

2.1 STEEL CYLINDER

A. Fabricated from either:

1. Hot-rolled carbon steel sheets: ASTM A570, Grade C, or ASTM A611, or ASTM A569 except that the maximum carbon content may be 0.25 percent and a minimum yield strength of 33,000 psi.

2. Plates: ASTM A283, Grade D.

3. Gauge of cylinder steel.

Pipe Size	Gauge	Pipe Size	Gauge
12” to 16”	16	54” to 57”	11
18” to 21”	15	60” to 63”	10
24” to 33”	14	66” to 69”	9
36” to 51”	12	72”	8

B. Seams: Fabricate sheets or plates into cylinders with longitudinal or helical seams. Where longitudinal seams are used, fabricate in courses, which may consist of two or more sheets or plates. Produce welds with a tensile strength at least equal to the specified minimum tensile strength of the sheet or plate. Cut test specimens from the cylinder and test per ASTM A370 when required.

C. Specified Diameter: The inside diameter of the concrete section.

D. Circumference of Steel Cylinders: Not to deviate from the design value by more than +3/16 inch for pipe sizes 16 inches and smaller or more than +1/4 inch for larger sizes.

2.2 **STEEL CYLINDER AND ROD AREA**

A. Total Cross-Section Area (cylinder plus rod reinforcement): Computed on the basis of a maximum stress of 16,500 psi, in the steel at the design pressure with no allowance for tensile strength of the concrete.

B. Rod Wrap: Not less than 7/32 inch diameter.

C. Maximum Center to Center Spacing Between Rods: No greater than 1-1/2 inches with cylinder thickness less than 14 gage nor greater than two (2) inches with cylinder thickness 14 gage and heavier.

D. Minimum Cross-Section Area of Rod Reinforcement per Lineal Foot of Pipe: Numerically equal to at least 1 percent of the nominal inside diameter of the pipe in inches.

E. Minimum Center to Center Spacing Between Rods: No closer than two (2) rod diameters.

F. Cross-Sectional Area of the Rod Reinforcement: Not to exceed 60 percent of the total required area of steel.

2.3 **ROD WRAPPINGS**

A. Rod Reinforcement: Steele grade 40, ASTM A615 except:

1. Bars: Plain round bars except the requirements of ASTM A615, Sec. 6, 7 and 14.3 shall not apply.
2. Intermediate Diameter Bars: Meet the requirements for the next smaller bar number designation.
3. Bars of Diameter Less Than No. 3: Meet the requirements for No. 3 bar.

B. Helically wind rods and space equally along the length of the cylinder and continue over the cylindrical portion of the bell ring.

C. Use a suitable device for stressing, measuring, and visibly indicating the tension in the rod during the winding operation. Hold the tension within 110 to 125 percent of the difference between the specified minimum yield strengths of the cylinder and rod. Continue the rod wrapping from end to end of the cylinder and weld to the joint rings. Lap weld the welded splices in the rod for a distance of four (4) rod diameters or butt weld in such a manner that the joint develops a tensile strength at least equal to the specified minimum strength of the rod. Test each butt welding to the stress of 25,000 psi tension.

2.4 **JOINTS**

A. Steel Joint Rings: Bell and spigot rubber gasket type, self-centering without the gasket supporting the weight of the pipe and the steel conforming to the requirements of AISI Steel Designation No. 1012.

B. Spigot Rings: Fabricated from a specially rolled section which includes a gasket groove. Proportion the groove that, upon proper closure of the joint, the gasket will be suitable compressed and will effect a watertight seal which provides for expansion, contraction and deflection.

C. Bell Ring Thickness Plus Rod Reinforcement Over the Bell: Provide a total cross-sectional area not less than 1/3 greater than that furnished for an equivalent length along the barrel of the pipe.

D. Sizing: Size both the bell and spigot rings to the same design diameter by expanding the rings beyond the elastic limit of the steel.

E. Tolerances:

1. Minimum bell ring thickness: U.S. standard 10 gage for pipe sizes 12 inches through 16 inches and 3/16 inch for larger sizes.

2. Circumference of the inside bell ring contact surface: Not to exceed the circumference of the outside spigot ring contact surface by more than 3/16 inch.

2.5 **TESTING STEEL CYLINDERS**

A. After each cylinder is completed, but before lining or coating, test hydrostatically to a minimum hydrostatic pressure which develops a circumferential tensile stress of not less than 20,000 psi and not more than 25,000 psi. Reweld cylinders that show any leakage under test at the points of leakage and subject them to another hydrostatic test. Continue procedure until completely watertight under the required test pressure.

2.6 **RUBBER GASKETS**

A. Shape: Circular cross-section.

B. Gasket Compounds: Conform to the requirements of AWWA C200 consisting of first grade natural rubber, synthetic rubber, or a suitable combination thereof. Form and cure in such a manner as to be dense and homogenous with a smooth surface free from blisters, pits, and other imperfections.

2.7 **CEMENT**

A. Cement: Type II, ASTM C150 unless indicated otherwise.

2.8 **AGGREGATES**

A. Sand for Cement-Mortar: "Fine Aggregate", ASTM C33, except that the gradation may be modified to provide a lining of optimum density.

2.9 **CEMENT-MORTAR LINING**

A. Cement-Mortar: One part cement to not more than three (3) parts fine aggregate by weight. Control water content to obtain dense, workable, durable mortar.

B. Spin the lining in the cylinder to obtain a nominal thickness of 1/2 inch for pipe sizes 12 inches through 16 inches and to a nominal thickness of 3/4 inch for pipe sizes 18 inches and larger. Use gage rings at the ends of the pipe to control the thickness. Take adequate measures to limit the deviation from the mean diameter of the cylinder, at any section, to a maximum of 1/2 percent of the mean diameter. Where required, place external roundup rings around the cylinder before the spinning to ensure roundness of the cylinder and uniformity of lining thickness. After the mortar has been placed in the cylinder, revolve at a speed that will cause the cement-mortar to level out to a uniform thickness throughout the cylinder. Continue the spinning until the lining is thoroughly compacted and surplus water removed, and the finished lining is smooth and uniform throughout.

C. Moist cure the lining for a minimum period of 24 hours after spinning before wrapping the cylinder with rod. This may be accomplished by tightly sealing the ends of the cylinder with a waterproof membrane to retain the moisture in the mortar. Vapor curing may be used in lieu of or in combination with moist curing on a time ratio basis of one (1) hour vapor curing to four (4) hours moist curing. Transport, support, and cure in a manner to prevent damage to the lining.

D. Lining Thickness Tolerance: Not more than plus or minus 25 percent from the specified nominal thickness.

2.10 **EXTERIOR COATING**

A. Cement-Mortar for Coating: Ratio of 1 part of cement to not more than three (3) parts of fine aggregate, by weight. Control the water content to obtain a dense, workable, durable mortar. Rebound may be reclaimed and used as aggregate.

B. Apply by mechanical means producing a dense, uniform finished coating adhering tightly to the pipe. Provide a minimum nominal coating applied over the cylinder of 3/4 inch over the rod wrap.

C. Cement Slurry Coating: One bag of cement to not more than 10 gallons of water applied concurrent with the coating application to coat the steel assembly surface under the rod and the mortar-coating leading edge.

D. Suitably support the pipe during handling and curing to prevent damage to the lining and coating.

2.11 **CURING COMPLETED PIPE**

A. Moist cure the lining for a minimum period of six (6) days. Vapor curing may be used in lieu of or in combination with moist curing on a time ratio basis of one (1) hour vapor curing to four (4)hours moist curing.

B. Protect the mortar lining from temperatures below 40 deg F during the application.

2.12 **JOINT LENGTHS**

A. 40 feet except where shorter lengths are required for fittings, curves, or closures.

2.13 **BENDS AND SPECIFIC FITTINGS**

A. Fabricated short radius bends or special fittings such as wyes, tees and crosses from previously tested steel cylinders, AWWA C208. Fabricate bends or special fittings at least equal in strength to the abutting pipe sections and mortar line and coat after fabrication. Obtain approval of the design before fabrication.

B. Test all seams of bends or special fittings, except those seams previously tested as cylinders. Test seams by the air soap method or by the dye-check method. Repair any leaks by welding and retest the seam and recoat if required.

2.14 **OUTLETS**

A. Fabricate outlets into the wall of the pipe, before testing, for blow-offs, branches, air valves, and access manholes. Provide cast or fabricated steel fittings of suitable design and securely weld to the cylinder before being coated. Reinforce the pipe cylinder, as necessary, for the required opening. Obtain approval of the design of such outlets before fabrication.

2.15 **WELDED JOINTS**

A. Where welded joints are shown on the drawings, the rubber gasketed joint may be welded by inserting a filler rod under the flare of the bell and welding in place to the bell ring and to the spigot ring, or special joints for field welding may be furnished.

2.16 **BEVELED ENDS**

A. Where curves are required which have a shorter radius than can be obtained by unsymmetrical closure of the joint, sections of pipe may be furnished with beveled ends. An end of beveled pipe may have a maximum bevel of five (5) degrees measured from a plane perpendicular to the axis of the pipe. The long point of the bevel shall be so marked on the pipe.

2.17 **SOURCE QUALITY CONTROL**

A. Refer to AWWA C303.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and Section 33 11 00 requirements for water distribution and transmission. Use the more stringent provisions if there are any conflicts.

1. Use slings or pipe manufacturer approved lifting devices.
2. Lay pipe to curved alignment by means of unsymmetrical joint closure.
   a. Use a joint deflection of up to 3/4 inch for pipe sizes 12 inches through 24 inches.
   b. Use a joint deflection of up to 1 inch for pipe sizes 27 inches and larger.
3. Where curves are required which have shorter radius than can be obtained by unsymmetrical closure of the joint, furnish sections of pipe with beveled ends. The end of a beveled pipe may have a maximum bevel of five (5) degrees measured from a plane perpendicular to the axis of the pipe. Mark the long point of the bevel on the pipe.
4. Joints to be grouted inside and outside as per manufacturer's recommendations.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 05 09

STEEL PIPE - LINED AND COATED

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cement mortar lined and coated steel pipe, couplings, fittings, and joint materials in sizes four (4) inches through 120 inches.

1.2 REFERENCES

A. ASTM Standards:

A82 Steel Wire, Plain, for Concrete Reinforcement.

A283 Low and Intermediate Tensile Strength Carbon Steel Plates.

A370 Mechanical Testing of Steel Products.

A569 Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

C33 Concrete Aggregates.

C150 Portland Cement.

B. AWWA Standards:

C200 Steel Water Pipe 6 In. and Larger.

C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.

C208 Fabricated Steel Water Pipe Fittings.

C303 Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pre-Tensioned, for Water and Other Liquids.

1.3 SUBMITTALS

A. Design Summary: Before any fabrication, submit a design summary for each size and class of pipe and line layout drawings or line schedules that show the location of each section of pipe and each special fitting to be furnished.

B. Shop Drawings of special fitting and outlets.

1.4 QUALITY ASSURANCE

A. Perform quality assurance tests required by AWWA C303.

1.5 DELIVERY, STORAGE AND HANDLING

A. Attach end covers to pipe stored either in the yard or in the field to prevent drying out of concrete.

B. Stalls: Remain in place during storage.

C. Gaskets: Store in a cool, well ventilated place and protect from direct sunlight.

PART 2 PRODUCTS

2.1 STEEL CYLINDERS

A. Fabricated from either:

1. Hot-rolled Carbon Steel Sheets: Conform to ASTM A570, Grades B, C, D, or E, or ASTM A569 except that the maximum carbon content may be 0.25 percent and a minimum yield strength of 33,000 psi.

2. Plates: Conform to ASTM A283, Grade C or D.

B. Seams: Fabricate sheets or plates into cylinders with longitudinal seams. Produce welds with a tensile strength at least equal to the specified minimum tensile strength of the sheet or plate. Cut test specimens from the cylinder and test per ASTM A370 when specified.

C. Specified Diameter: The inside diameter of the concrete section.

D. Circumference of Steel Cylinders: Not to deviate from the design value by more than +3/16 inch for pipe sizes 16 inches and smaller or more than +1/4 inch for larger sizes.

E. Test Steel Cylinders: Test hydrostatically to a minimum hydrostatic pressure which develops a fiber stress equal to 75 percent of the specified minimum yield strength of the steel. Reweld cylinders that show any leakage under test at the points of leakage and subject them to another hydrostatic test. Continue procedure until completely watertight under the required test pressure.

2.2 **JOINTS**

A. General: As indicated using one of the following procedures.

B. Bell and Spigot for Rubber Gasket: Fabricate the bell and spigot ends by either forming integrally with the steel cylinder or welding steel joint rings to the cylinder. Make the bell and spigot ends circular in shape and fabricated so that when the pipe is laid the joint will be self centering with a gasket of sufficient size and cross-section to seal the joint. The difference in circumferential measurement between the outside circumference of the spigot and the inside circumference of the bell must not exceed 0.200 inch.

C. Belled Ends for Welding: Form a bell on the cylinder to accommodate the spigot. Make the spigot stub approximately 1-1/2 inches. Remove weld beads on the outside of the spigot and the inside of the bell to permit easy entry.

D. Plain Ends for Welding: Make both ends of pipe section plain and remove edge burrs.

E. Ends for Mechanical Couplings: Make ends of pipe section plain, grooved, or banded. Grind any weld beads on exterior of pipe flush with the pipe for a sufficient distance from the ends of the pipe to accommodate the coupling. Prepare grooved or banded ends to fit the type of mechanical coupling to be used.

2.3 **CEMENT MORTAR**

A. Cement: Type I or II, ASTM C150.

B. Sand: "Fine aggregate", ASTM C33, except the gradation may be modified to provide a lining of optimum density.

C. Cement-Mortar Mix: One part cement to not more that three (3) parts of sand by weight. Control water content to obtain dense, workable, durable mortar. Rebound may be reclaimed and used as aggregate.

2.4 **RUBBER GASKETS**

A. Shape: Circular cross-section.

B. Gasket Compounds: Conform to the requirements of AWWA C200 consisting of first-grade natural rubber, synthetic rubber, or a suitable combination thereof. Form and cure to be dense and homogenous with a smooth surface free from blisters, pits, and other imperfections.

2.5 **INTERIOR LINING**

A. Use gage rings at the ends of the pipe to control the spinning thickness. Spin the lining in the cylinder to obtain nominal thickness as follows:

1. 5/16 inch for pipe sizes four (4) inches through 12 inches.
2. 3/8 inch for pipe sizes 14 inches through 18 inches.
3. 1/2 inch for 20 inches and larger.
4. Other lining thickness, as specified in AWWA C205 or indicated.

B. After mortar has been placed in the cylinder, revolve at a speed that causes the cement-mortar to level out to a uniform thickness throughout the cylinder. Continue the spinning until the lining is thoroughly compacted and surplus water removed, and the finished lining is smooth and uniform throughout.

C. Lining Thickness Tolerance: Not more than 1 percent less or 25 percent more than the specified nominal thickness.

2.6 **EXTERIOR COATING**

A. Apply cement mortar exterior coating by mechanical means producing a dense, uniform finished coating adhering tightly to the pipe. Additional coating thickness may be specified to resist excessive external loads. Provide a minimum nominal coating applied over the cylinder as follows.

1. 1/2 inch for pipe sizes four (4) inches through 12 inches.
2. 5/8 inch for pipe sizes 14 inches pipe through 18 inches.
3. 3/4 inch for pipe sizes 20 inches and over.

B. Cement Slurry Coating: One bag of cement to not more than 10 gallons of water applied concurrent with the coating application to coat the steel assembly surface and the mortar-coating leading edge.

C. Steel Reinforcement: 14 gage cold-drawn steel wire conforming to ASTM A82, helically wound and embedded in middle third of the coating.

D. Suitably support the pipe during handing and curing to prevent damage to the lining coating.

2.7 **CURING**

A. Moist cure the lining for a minimum period of 24 hours after spinning. This may be accomplished by tightly sealing the ends of the cylinder with a waterproof membrane to retain the moisture in the mortar. Steam curing may be used in lieu of or in combination with moist curing on a time ratio basis of one (1) hour steam curing to four (4) hours moist curing.

B. Moist cure the completed pipe for six (6) days minimum. Steam curing may be used in lieu of moist curing.

C. Protect the mortar lining from temperatures below 40 deg F during the application and curing.

2.8 **PIPE LENGTHS**

A. 40 feet except where shorter lengths are required for fittings, curves, or closures.

2.9 **BENDS AND SPECIFIC FITTINGS**

A. Fabricate short radius bends or special fittings such as wyes, tees and crosses from previously tested steel cylinders, AWWA C208. Fabricate bends or special fittings at least equal in strength to the abutting pipe sections and line and coat with the same material as the pipeline. Obtain approval of design before fabrication.

B. Test all seams of bends or special fittings, except those seams previously tested as cylinders. Test seams by the air soap method or by the dye-check method. Repair any leaks by welding and retest the seam and recoat if required.

2.10 **OUTLETS**

A. Build outlets into the wall of the pipe, before testing, for blow-offs, branches, air valves, access manholes, etc. Provide cast or fabricated steel fittings of suitable design and securely weld to the cylinder before being coated. Reinforce the pipe cylinder, as necessary, for the required opening. Obtain approval of the design of such outlets before fabrication.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and Section 33 11 00 requirements for water distribution and transmission. Use the more stringent provisions if there are any conflicts.

1. Provide a maximum joint deflection on curved alignment by means of unsymmetrical closure of spigot into bell as per manufacturer's recommendation but not greater than the following:
   a. 3/4 inch for pipes 12 inches through 24 inches.
   b. 1 inch for pipes 27 inches through 72 inches.
2. Joints to be grouted inside and outside as per manufacturer's requirements.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 05 10
VITRIFIED CLAY PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vitrified clay pipe, fittings, and joint materials.

1.2 REFERENCES

A. **ASTM Standards**:

C12 Installing Vitrified Clay Pipe Lines.

C301 Testing Vitrified Clay Pipe.

C425 Compression Joints for Vitrified Clay Pipe and Fittings.

C700 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

1.3 QUALITY ASSURANCE

A. Fractures, cracks, or other defects passing through the walls or joints sufficient to impair strength, durability, function of product serviceability require evaluation. Recommend appropriate action. ENGINEER may require certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 PIPE

A. Vitrified clay: Extra strength, ASTM C700.

B. Furnish branches with connections completed and fastened to the barrel of the pipe in the process of manufacture.

2.2 JOINTS

A. Bell and spigot, ASTM C425.

B. Compression couplings for plain end pipe

2.3 SOURCE QUALITY CONTROL

A. Loading tests and quantities tested, ASTM C301. Pipe shall withstand the following minimum loads for a three (3) edge bearing test.

Nominal Size in Inches	Load in lb. per lineal foot	Nominal Size in Inches	Load in lb. per lineal foot
4	2000	21	4200
6	2000	24	4800
8	2200	27	5200
10	2400	30	5500
12	2600	33	5800
15	3100	36	6300
18	3600	39	6600
		42	7000

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Sanitary sewers, Section 33 31 00.
2. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following.

1. Provide bedding class "B" encasement, ASTM C12.

END OF SECTION

SECTION 33 05 11
POLYPROPYLENE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polypropylene (PP) pipe, fittings, joint requirements, and installation.

1.2 REFERENCES

A. **AASHTO Standards**:

M330 Polypropylene Pipe, 300 to 1500 mm (12 to 60 in.) Diameter.

NTPEP National Transportation Product Evaluation Program.

B. **ASTM Standards**:

D 2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow applications.

D 2774 Underground installation of Thermoplastic pressure piping.

D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

F 2389 Pressure-rated Polypropylene (PP) Piping Systems.

F 2736 6 to 30 in. Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe.

F 2764 30 to 60 in. Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.

F 2881 12 to 60 in. Polypropylene Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.

1.3 DEFINITIONS

A. Corrugated Wall PP Pipe Classifications: Classified as Types C, Type S, and Type D. See Section 33 05 06.

B. Porous Corrugated Wall PP Pipe Classification: Classified as follows.

1. Type CP - This is Type C pipe with perforations.
2. Type SP - This is Type S pipe with perforations.

1.4 SUBMITTALS

A. Certificate showing product compliance per AASHTO NTPEP.

PART 2 PRODUCTS

2.1 PIPE

A. **General**: Pressurized and non-pressurized pipe may be required in a PP pipe system. ENGINEER to select if not specified elsewhere.

B. **Sanitary Sewer Pipe**:

1. Type S (corrugated single wall) per ASTM F 2736 (6-30") or
2. Type D (corrugated double wall) per ASTM F 2764 (30-60").

C. **Storm Drain Pipe**: Type S per ASTM F 2881 (12-60").

D. **Under Drain Pipe**: Type C, S, CP, or SP. Type CP and SP have Class 1 or Class 2 perforations indicated in AASHTO M 330. Provide Class 2 perforations if not indicated elsewhere. Class 1 perforations are for pipe intended to be used for under drains or combination under drain and storm drain. Class 2 perforations are for pipe intended to be used for under drains.

E. **Pressurized Pipe**:

1. Solid smooth wall, ASTM F 2389.
2. Working pressure rating indicated or accepted by ENGINEER.
3. Minimum exterior markings as follows.
   a. ASTM Standard Number.
   b. Pipe Size.
   c. Production Code.

2.2 **JOINTS**

A. **General**: Provide joints with a working pressure at least equal to or greater than the pipe's working pressure and acceptable to ENGINEER.

B. **Storm Drain and Sanitary Sewer Joints**: Bell and spigot meeting ASTM D 3212 with gasket that complies with ASTM F 477. Other joining methods such as external snap couplers, split couplers, solvent welding, etc. must meet performance requirements herein, manufacturer's recommendations, and ENGINEER's review.

1. When using bell retaining bands, use corrosive resistant materials such as fiberglass or stainless steel.
2. Foam type weather stripping not allowed.

C. **Under Drain Joints**: If not water tight, wrap with geotextile and tape to prevent detritus entry.

D. **Pressurized Joints**: ASTM F 2389.

2.3 **FITTINGS**

A. Supplied or recommended by pipe manufacturer.

B. Structural and pressure performance same as pipe or greater.

C. Vacuum test certified by manufacturer.

2.4 **VALVES, MANIFOLDS, ETC.**

A. ASTM F 2389.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. **Assembly**: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. **Burial**: Comply with Section 33 05 20 and the following.

1. ASTM D 2774 for pressure systems.
2. ASTM D 2321 for gravity systems.

END OF SECTION

SECTION 33 05 14
UTILITY GRADE ADJUSTMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raise, lower, or change slope of Street Fixtures.

B. Install Cover Collars.

C. This specification is NOT APPLICABLE to raising and lowering Street Fixtures that withstand internal pressure.

1.2 REFERENCES

A. **APWA (Utah) Standards**.

Plan 273 Frame and cover for monument.

Plan 335 Adjust reinforced concrete deck to grade.

Plan 345 Concrete deck.

Plan 360 Grade ring.

Plan 362 Cover collar for storm drains.

Plan 413 Cover collar for sanitary sewer manhole.

Plan 574 Cover collar for water valve box.

1.3 DEFINITIONS

A. **Box**: A structure such as a valve box, meter box, monument box, fire hydrant box, electrical pull box, cleanout box or other like structure not intended for human entry.

B. **Cover Collar**: A concrete filled annular space between the frame of a Street Fixture and the adjacent pavement surface usually one (1) foot wide.

C. **Extension Ring**: A concrete or metal ring used to adjust surface elevations and surface cross slopes of Street Fixtures covers. Metal rings are used between metal frames and metal covers or grates. Concrete rings are used below metal frames or in the concrete structure below.

D. **Manhole**: A structure designed to permit human entry and working space inside and to confine and control the flow of pipe-conveyed fluids. These structures are collectively referred to as manholes regardless of composition, design, type or depth.

E. **Street Fixture**: The top of existing structures such as but not limited to Manholes, catch basin, sumps, inlets, valve boxes, meter boxes, monument boxes, and similar structure in a thoroughfare surface.

F. **Vault**: A structure intended for human entry containing electrical or telephone facilities or other like utilities.

PART 2 PRODUCTS

2.1 PAVEMENT

A. Bituminous Concrete: Unless indicated otherwise in the Bid Documents or by ENGINEER, provide PG64-22, DM-1/2, 50 blow, product per Section 32 12 05.

B. Concrete: Class 4000 cast-in-place, Section 03 30 04.

2.2 GROUT

A. Portland cement grout, Section 03 61 00.

2.3 EXTENSION RINGS

A. Metal: Class 20 grey iron, arrangement as shown on the Drawings or APWA Plan 273.

B. Concrete: 4000 psi Portland cement, arrangement as shown on the Drawings or APWA Plan 360 Sheet 1.

C. Plastic: Arranged as shown in the Drawings or APWA Plan 360 Sheet 2.

PART 3 EXECUTION

3.1 PREPARATION

A. Determine condition of existing incidental structure. Any item not reported damaged before construction shall be considered unbroken and must be replaced by CONTRACTOR at no additional cost to OWNER.

B. Provide Invert Cover over pipe in cleanout box to prevent gravel, concrete, or debris from entering pipeline.

C. Unless required otherwise, arrange for utility companies to adjust their own structures.

D. Coordinate all adjustments with requirements of affected utility company.

3.2 ADJUST STRUCTURE TO GRADE

A. Restrict excavation around structure to a minimum.

B. After structure adjustment, backfill void around structure and compact before paving or landscaping.

C. Apply mortar to inside and outside of concrete grade rings.

D. If the cone is cracked during construction, restack the manhole with shorter manhole sections and install a new cone at no additional cost to the OWNER.

3.3 ADJUST COVER IN PAVEMENT SURFACE

A. Method A - Metal extension rings:

1. Use rings that lock together.
2. Set frame at desired elevation and cross-slope.
3. Seal joints between pavement and ring, Section 32 01 17.

B. Method B – Concrete extension rings: Adjust frame according to the Drawings or APWA Plan 360.

1. Place concrete grade rings under frame or in structure riser shaft.
2. Set frame at desired elevation and cross-slope.
3. Provide 100 percent concrete support under frame. Do not use wood, bricks, concrete fragments, blocks or particles as support.
4. Grout seams between concrete rings and between frame and concrete rings.

C. Method C – Place Concrete:

1. Set frame at desired elevation and cross-slope.
2. Place concrete and provide 100 percent concrete support under frame.

D. Method D – Concrete Deck: Adjust frame according to the Drawings or APWA Plan 335 or 345.

1. Remove existing concrete deck.
2. Reset steel rebar.
3. Set frame to grade, set forms.
4. Pour concrete. Provide complete concrete support under Street Fixtures.

3.4 INSTALL COVER COLLAR

A. Install collar as shown in Drawings or APWA Plans 362, 413, or 574.

B. Open annular space between pavement and Street Fixtures cover. Unless indicated otherwise, make space 12 inches wide.

C. Set concrete collar to 1/4 inch minimum to 1/2 inch maximum below bituminous concrete pavement surface and 1/4 inch below Portland cement concrete pavement surface.

D. Trowel finish, Section 03 35 00.

3.5 SURFACE FINISHING

A. In new streets or overlays, adjust Street Fixture covers after paving is complete.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

END OF SECTION

SECTION 33 05 20
BACKFILLING TRENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backfill materials in trenches and backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Bedding**: That surface of the excavation or portion of the Pipe Zone below the pipe.

B. **Pipe Zone**: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight. And aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. If requested, submit a quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

D. Restore any damaged structure to its original strength and condition.

E. Replace contaminated backfill at no additional cost to OWNER.

1.8 SEQUENCING

A. Coordinate backfilling operation with pipeline commissioning, Section 33 08 00.

1.9 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per lot.

D. Compaction: One test per lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot sizes as follows:

Table 1: Compaction Standard and Lot Size

Material	Proctor	Lot Size
Subgrade	Standard	200 linear feet
Common Fill	Standard	200 linear feet per lift 25 square feet of footing area per lift
Aggregate base course	Modified	200 linear feet per lift 25 square feet of footing area per lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.
(c) Lift thickness above pipe zone before compaction, 8 inches.

E. Flowable Fill Strength: Lot size is one (1) day production with sub-lots of 50 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.10 **WARRANTY**

A. Correct any settlement of Trench backfill or structures built over Trench backfill at no cost to OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

D. Slag or bitumen bearing material NOT ALLOWED in trench.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE FABRIC**

A. Section 31 05 19. Use woven or non-woven stabilization-separation fabric. Select either moderate MARV or high MARV as needed.

2.4 **IDENTIFICATION TAPE**

A. Permanent, bright colored, continuous printed magnetic plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. Tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color as follows.

Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials
Orange	Communications, alarm, signal, cables or conduits
Blue	Potable water
Purple	Reclaimed water, irrigation and slurry lines
Green	Sewer and storm drain lines

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Verify:

1. Backfill material meets gradation requirements.

2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.

3. Trench bottom is not frozen.

E. If ground water is in the intended backfill zone, dewater.

3.2 **SUBGRADE**

A. Protect subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the subgrade:

1. Excavation for Subgrade stabilization is incidental work, Section 31 23 16.

2. Place geotextile fabric. Place acceptable fill in lifts. Compact.

3.3 **PROTECTION**

A. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.

B. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

3.4 **BACKFILLING - GENERAL**

A. Avoid injuring and displacement of conduit, pipe and structures while compacting soil or operating equipment next to pipeline.

B. Place geotextile fabrics; Section 31 05 19.

C. Do not damage corrosion protection on pipe.

D. Repair or replace damaged pipe at no additional cost to OWNER.

E. Withdraw sheathing, shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

F. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

G. Water settling of trench backfill is not permitted. "Jetting" of trench backfill is prohibited.

3.5 **BACKFILLING - PIPE ZONE**

A. As shown in the Drawings or APWA Plan 382.

B. Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

C. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.

D. Do not permit free fall of backfill material that may damage pipe, pipe finish, or pipe alignment.

E. Except where piping must remain exposed for tests, fill pipe zone as soon as possible.

3.6 **BACKFILLING -ABOVE PIPE ZONE.**

A. As shown in the Drawings or APWA Plan 381.

B. Maximum lift thickness before compaction is eight (8) inches.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Install continuous identification tape directly over buried lines 18 inches below finished grade.

3.7 **BACKFILLING - MODIFIED LAYER METHOD**

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions:

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test trench backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

3.10 **SURFACE FINISHING**

A. Provide temporary paved surfaces where trenches pass through roadways, driveway approaches or sidewalks.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

3.11 **CLEANING**

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 05 23.35

TRENCHLESS UTILITY INSTALLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boring or jacking pipe or box culvert.

1.2 REFERENCES

A. **ASTM Standards**:

A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.3 SUBMITTALS

A. Details of jacking pit bracing, casing or conduit, and jacking head to be used.

B. Dimensions and support of pilot tunnel (if used).

C. Details of steel rails in pilot tunnel (if used), including true line and grade.

D. Copy of applicable permits from agency having jurisdiction.

1.4 PERFORMANCE REQUIREMENTS

A. Jack conduit to line and grade indicated. Modify jacking operation to correct any deviation. Correct misalignment in line or grade at no additional cost to OWNER.

B. Methods and equipment used in jacking casing or conduit are CONTRACTOR's choice.

C. Use workers experienced in jacking operations.

PART 2 PRODUCTS

2.1 STEEL CASING

A. ASTM A53, Grade B steel pipe for jacking operations, minimum wall thickness of 0.375 inch, minimum yield stress of 42,000 psi. Use a casing with a diameter equal to the outside bell diameter of the pipe plus four (4) inches minimum.

B. Fillet weld joints continuous around casing and reinforce joints to withstand jacking operations.

2.2 CONCRETE PIPE

A. Section 33 05 02. When concrete pipe is to be jacked, use a pipe section designed to support the superimposed loads and the loads that may be placed upon the pipe during jacking operations. Use pipe sections that have a watertight joint.

2.3 SOIL CEMENT

A. Cement treated fill, Section 31 05 15.

B. Grout: Portland cement type, Section 03 61 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

3.2 JACKING PROCEDURE

A. When casing is to be jacked through a plastic clay, continue uninterrupted operations until casing has been jacked between specified limits.

B. Equip leading section of casing with a jacking head securely attached to prevent any wobble or variation in alignment during jacking operation.

C. Protect driving end against spalling or other damage, and install sufficient bearing shims to intermediate joints to properly distribute jacking stresses. Remove and replace any section showing signs of failure.

D. No excavation in excess of outer dimensions of conduit being jacked will be allowed unless approved. Avoid any loss of earth outside jacking head.

E. Upon completion of jacking operations, pressure grout voids around outside face of the conduit. Grouting around jacked conduit must be started immediately after jacking operations have finished.

F. During the jacking operation, backpack with soil cement any annular space occurring outside of conduit that could affect any surface structure or facility.

3.3 PILOT TUNNEL

A. Construct tunnel where casing 60 inches or greater inside diameter is to be jacked for a distance greater than 32 feet.

B. Remove supports for tunnels as jacking progresses.

3.4 PIPE SUPPORT IN CASING TUNNEL

A. Unless indicated otherwise, use redwood skids throughout the length of the pipe tied at every pipe diameter length to brace pipe installed in casing to prevent shifting or flotation during backfilling of annular ring between the casing and carrier pipe.

B. Backfill annular ring with Portland cement grout, Section 03 61 00 unless indicated otherwise.

C. Install pipe barrels to rest upon support blocks with the pipe bells clearing the casing invert by at least 1/2 inch.

D. Whenever clay pipe is installed in a casing, use mechanical compression joints.

END OF SECTION

SECTION 33 05 23.40

CURED-IN-PLACE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a flexible resin filled pipe liner in an existing gravity pipeline. After installation, the liner is cured with steam or hot water. The pipeline and the cured pipe liner become a continuous rigid composite pipe.

1.2 REFERENCES

A. **ASTM Standards**:

D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D5813 Cured-in-Place Thermosetting Resin Sewer Pipe.

F1216 Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of Resin-Impregnated Tube.

F1743 Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of a Cured-in-Place Thermosetting Resin Pipe.

1.3 PERFORMANCE REQUIREMENTS

A. **General**:

1. All portions of existing pipe are to be provided with a new composite pipe.
2. After installation there shall be completely water tight seals at and through each manhole.
3. All service connections shall be re-established with a water tight seal that eliminates infiltration and is acceptable to the OWNER.

B. **Measurements**: CONTRACTOR will take field measurements and make video observation of the host pipe to properly size the liner and verify the condition and length of the host pipe prior to ordering the liner.

1.4 SUBMITTALS

A. Tube and resin manufacturer's product data, equipment and material specifications.

B. Design calculations report by a licensed design professional showing conformance to the appendix of ASTM F1216 for each length of liner installed. Include in the report

1. Thickness of each proposed cured-in-place segment.
2. Allowance for creep.
3. Stretch allowance during installation, and
4. Comparison of strength of liner to requirements for H-20 and E-80 loading.

C. Bypass pumping plan for host pipe flow diversion. Indicate sequence of diversion operations, temporary plugs, silenced bypass pumping systems, temporary vehicle and pedestrian bypass, and site reinstatement after diversion.

D. Copy of written notice to neighborhood.

E. Traffic control plan, Section 01 55 26.

F. Pre- and post-installation video.

1.5 QUALITY ASSURANCE

A. CONTRACTOR has successfully installed over 30,000 linear feet of cured-in-place pipe.

B. Foreman has at least three (3) years of cured-in-place pipe installation experience with two (2) years experience as an onsite foreman and has directly supervised installation of at least 10,000 linear feet of cured-in-place pipe installations.

C. Foreman's crew has at least two (2) years experience with main line set-up, bypass pumping, materials installation, curing, connecting, and re-establishing lateral connections.

1.6 NOTICE

A. Provide seven (7) days initial notification and 24 hours secondary notification before commencing work.

B. Distribute written notification to property owners, business owners and the like within the project area and areas affected by the project. Provide (1) a description of the work, (2) beginning date and time of the work, (3) work duration, (4) expected, pipeline use restrictions, etc. In the case of sanitary sewer work, inform of potential odors and smells.

C. Provide all residents and businesses 24 hours emergency contact names and phone numbers of onsite superintendant and foreman.

PART 2 PRODUCTS

2.1 RESIN

A. Composed of (1) polyester resin and catalyst, (2) epoxy resin and hardener, or (3) vinyl ester resin and catalyst. When properly cured meet the requirements of ASTM D5813, ASTM F1216, or ASTM F1743.

2.2 TUBE

A. Flexible, absorbent woven or non-woven felt fabric with the outer layer (before inversion) coated with a translucent, impermeable, flexible plastic membrane. The membrane shall not be subject to delamination after curing of the composite pipe. The tube shall be sewn or spot-welded, have sufficient strength to bridge missing segments in the host pipe, stretch to fit irregular host pipe cross-sections and have measurement marks at regular intervals (not to exceed 5 feet) along the flexible plastic membrane.

2.3 STRUCTURAL DESIGN

A. Minimum physical properties of the cured composite pipe are as follows.

Table 1 – Structural Standards

Property	Standard	Cured Composite per ASTM F1216	Resin Properties
Flexural Modulus of Elasticity (Short Term)	D790	400,000 psi	400,000 psi
Flexural Strength (Short Term)	D790	4,500 psi	4,500 psi

The manufacturer must have performed long-term testing for flexural creep of the composite pipe materials installed in other work. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value was used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50 percent of the short-term test results shall not be applied. The materials utilized for the work shall be of a quality equal to, or better than, the materials used in the long-term test with respect to the initial flexural modulus used in the pipe design.

B. The wall thickness of the cured composite pipe shall be based upon the following design parameters and design conditions.

Table 2 – Wall Thickness Design	
Design Parameter	**Criteria**
Safety Factor	2.0
Ovality 2 percent to 5 percent 5 percent to 10 percent Greater than 10 percent	ASTM F1216 Design for 5 percent Design for 10 percent Excavate and repair host pipe
Soil Modulus	1,000 psi
Groundwater Depth (above invert of existing pipe)	Ground surface
Soil Depth	As measured in the field
Live Load	E-80 and H-20 highway
Soil Load	120 lbs per cubic foot
Minimum service life	50 years
Retention Factor for Long-Term Flexural Modulus (Creep Retention)	50 percent
Host Pipe Condition	Fully Deteriorated

Design Conditions
No structural support for hydrostatic, live, or earth loading comes from the host pipe.
Loading for areas away from railroad, H20; for areas under railroad, E80.
Assume a fully deteriorated pipe condition having ground water loading condition measured from the pipe flow-line to the ground surface.
Pipe deflections are based upon actual pipe deflection and pipe damage observed in pipe inspection videos (by CONTRACTOR) but in no case less than two (2) percent. Any existing noticeable pipe deflection, structural damage, pipe ovality or pipe deterioration will require the CONTRACTOR to prove the adequacy of submitted liner thicknesses.

C. The cured composite pipe shall be homogeneous across the entire wall thickness. No dry or unsaturated layers shall be evident. The layers shall be uniformly bonded. It shall not be possible to separate any two (2) layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between layers.

PART 3 EXECUTION

3.1 PREPARATION

A. Obtain required excavation and noise permits.

B. Implement traffic control plan requirements, Section 01 55 26.

C. Provide for bypassing host pipe flows and lateral flows received by the host pipe. Standby pumping capacity for 125 percent flow is required at all times.

D. Control groundwater.

E. Contain overflows and spills.

3.2 CLEANING, INSPECTIONS, REPAIRS

A. Clean host pipe of obstructions, solids or dropped joints, debris and gaskets. Do not use chemical cleaning. If cleaning cannot be done with conventional equipment, excavate and remove the obstruction. Such excavation must be approved by ENGINEER prior to excavation and will be considered as change order work. Pipe deflections, changes in grade and pipe installed on a radius do not qualify for excavation and removal.

B. Inspect, measure and record host pipe conditions using digital video recording equipment in MPEG 1 format with 352x240/320x240x30 fps resolution and audio bit rate of 256 Kbps.

C. Restore or repair interior of the host pipe to an ovality of five (5) percent or less. Provide a smooth, uniform pre-lined surface with no sharp edges or broken rebar.

3.3 INSTALLATION

A. Follow ASTM F1216, Section 7 requirement and the following.

1. Prior to tube installation, use a vacuum process to impregnate the tube and a roller system to uniformly distribute the resin. Fill the volume of air voids in the tube. Allow for polymerization shrinkage and loss of resin through cracks and irregularities in the host pipe wall.
2. After installation, supply a heat source and cure the pipe. Provide temperature recommended by resin manufacturer. At the invert level, monitor temperatures at the insertion point and at the remote end of the tube.
3. After cure, cool pipe temperature below 100 deg F before relieving pressure.

B. The finished composite pipe product shall be continuous over the length of pipe reconstructed and be free from dry spots, delaminating, wrinkling, bubbles and lifts. It shall also meet the leakage requirements specified in ASTM F1216.

3.4 REINSTATEMENT OF SERVICE CONNECTIONS

A. Open branch or lateral connection to buildings, drop manholes, and intersecting mainline connections without excavation.

B. Keep a minimum of two (2) complete working cutters available during the connection process.

C. Provide full diameter lateral connections that produce water tight holes, free from burrs or projections and finished with a smooth, brushed and buffed crack free edge.

D. Collect ALL cutting coupons.

E. Any excavation required for the purpose of reopening connections is at CONTRACTOR’s expense.

3.5 RESTORE MANHOLES

A. Acclimate pipe to atmosphere temperatures before cutting pipe.

B. Remove top of composite pipe that passes through existing manholes.

C. If the liner does not pass through the manhole, or if the liner material changes at the manhole, feather edge the composite pipe to match existing manhole flow-line.

D. Seal openings between the shaft or cone and the liner with a multi-layered poly resin composite liner system consisting of (1) epoxy primer moisture barrier, (2) a surface of polyurethane/polymeric blend foam), and (3) a final barrier coat consisting of a modified polymer.

3.6 SURFACE FINISHING

A. Restore paved surfaces, Section 33 05 25.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.7 FIELD QUALITY CONTROL

A. Leakage testing of the composite pipe shall be accomplished during cure while under a positive head. Comply with Section 33 08 00 requirements for the type of service that the composite pipe provides. Cured-in-place pipe products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method acceptable to ENGINEER.

B. Monitor and record temperatures and curing data throughout the cooling process.

END OF SECTION

SECTION 33 05 25
PAVEMENT RESTORATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aggregate base restoration.

B. Concrete base restoration.

C. Pavement surface restoration.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 255 Bituminous pavement T-patch.

Plan 256 Concrete pavement patch.

B. **ACI Standards**:

305 Hot Weather Concreting.

306 Cold Weather Concreting.

C. **ASTM Standards**:

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C928 Packaged, Dry, Rapid- Hardening Cementitious Materials for Concrete Repairs.

C1315 Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D4 Bitumen Content.

D5 Penetration of Bituminous Materials.

D92 Flash and Fire Points by Cleveland Open Cup.

D95 Water in Petroleum products and Bituminous Materials by Distillation.

D113 Ductility of Bituminous Materials.

D402 Distillation of Cut-Back Asphaltic (Bituminous) Products.

D1664 Coating and Stripping of Bitumen-Aggregate Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Target sieve gradation for aggregate base.

C. Bituminous pavement mix design.

D. Portland cement concrete mix design and data sheets for joint filler board, concrete joint sealer, concrete bond breaker, concrete chemical additives, curing agent, and reinforcement.

1.4 WEATHER

A. Bituminous Pavement Restoration:

1. If air and roadbed temperatures in the shade are less than 40 deg F placement is considered a temporary patch.

2. Remove any temporary patching and provide permanent patch material when temperature exceeds 40 deg F. CONTRACTOR may perform work after cold weather season if authorized in writing by ENGINEER.

B. Portland Cement Concrete Pavement Restoration:

1. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F. in the shade.

2. Cold weather, ACI 306. Concrete accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength. When removing heat, limit temperature changes next to concrete surface to 20 deg F. per 12 hours until the concrete surface temperature reaches ambient.
   a. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
   b. Do not use chemical additives to prevent freezing.
   c. Prevent loss of moisture during protection.

1.5 **ACCEPTANCE**

A. Aggregate Base: Compaction.

B. Concrete Base: Strength.

C. Bituminous Pavement:
1. Compaction.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

D. Concrete Pavement:
1. Reinforcement placement and concrete strength.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Aggregate Base: Untreated base course material, Section 32 11 23.

B. Flowable Fill Base: Section 31 05 15.

C. Portland Cement Concrete Base Course: Class 4000, Section 03 30 04.

D. Tack Coat: Grade SS-1, Section 32 12 13.13.

E. Permanent Marking: Tape or paint, Section 32 17 23.

2.2 **BITUMINOUS PAVEMENT**

A. Permanent Warm Weather Bituminous Concrete: PG64-22, DM-1/2, 50 blow, Section 32 12 05 unless indicated elsewhere.

B. Temporary Cold Weather Bituminous Concrete Patching Material: Type MC250, DM-1/2, 50 blow, Section 32 12 05 with hydrated lime or anti-strip agent as indicated in the mix design.

C. Pavement Sealing:
1. Slurry Seal: SS Type II - RS-1, Section 32 01 13.61.
2. Chip Seal: MC-250. CS-A, Section 32 01 13.64.
3. Fog Seal: Section 32 01 13.50.

2.3 **CONCRETE PAVEMENT**

A. Chairs, Bolsters, Bar Supports, Spacers: Section 03 20 00.

B. Bond Breaker: Paraffin wax, lithium grease, or other semi-solid, inert lubricant.

C. Fillers and Sealer: Section 32 13 73:
1. Expansion joint filler, F1 sheet 1/2 inch thick.
2. Contraction joint filler, closed cell Type 1 round backer rod.
3. Contraction joint sealer, HAS1 or HAS4 hot applied.

D. Adhesive Grout: Epoxy gel type II; Section 03 61 00.

E. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, ASTM A615:

1. Dowel Bar: Smooth.
2. Tie Bar: Deformed.
3. Mat: Deformed.

F. Normal Set Concrete: Class 4000, Section 03 30 04. Slump range per mix design.

G. High Early Strength Concrete: Quick set.

1. Slump range per mix design, Section 03 30 04:
2. Concrete compressive strength of 3,000 psi minimum in four (4) hours.
3. Cementitious Material: Rapid hardening or very rapid hardening, ASTM C928.
4. Cement content of mix, per cement manufacturer's recommendations or approved mix design.
5. Non-reactive aggregates in applications subjected to wetting, extended exposure to humid atmosphere, or contact with moist ground.

H. Curing and Sealing Compound: Membrane type, ASTM C1315:

1. Type II Class A or B (white pigmented) for roadway pavement.
2. Clear with red fugitive dye for concrete flat work.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver: Use bituminous concrete lay-down machine for final lift if surface restoration is over a trench in the direction of traffic flow or if trench is a wide surface excavation.

3.2 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. At site, post name, address and telephone number of CONTRACTOR to contact in emergencies.

C. Notify ENGINEER within 24 hours of commencing work of this Section but not less than four (4) hours.

D. Cutting Pavements: Cut full depth and straight, Section 02 41 14. Remove all bonding inhibitors.

3.3 AGGREGATE BASE

A. Match depth of existing aggregate base or at least eight (8) inches thick.

B. Place lifts not exceeding eight (8) inches before compaction. Compact each lift to 95 percent or greater relative to a modified proctor density.

3.4 CONCRETE SUBSTRATE

A. Match existing substrate thickness.

B. Apply concrete bonding compound, Section 03 30 10, to edge of existing concrete.

C. Place concrete, Section 03 30 10.

3.5 BITUMINOUS PAVEMENT RESTORATION

A. Restore aggregate base and bituminous surface as shown in the Drawings or APWA Plan 255 Sheet 1 or Sheet 2.

B. Match existing pavement thickness plus 1 inch, but not less than four (4) inches. Maximum thickness is six (6) inches in residential areas and eight (8) inches in non-residential areas.

C. Clean all vertical surfaces that butt against new patchwork. Provide full coverage spray tack coat. Do not spray tack coat on surfaces exposed to public view. Do not apply tack coat by brush.

D. Place bituminous pavement in lifts not less than three (3) inches after compaction. Compact to 94 percent of ASTM D2041 (Rice density) plus or minus two (2) percent.

E. Match adjacent surface slopes.

F. Use lay-down machine for final lift if trench is in direction of traffic flow.

3.6 CONCRETE PAVEMENT RESTORATION

A. **Full Depth Restoration:**

1. Restore Portland cement concrete pavement and its aggregate base as shown in the drawings or APWA Plan 256 Sheet 1 or Sheet 2.
2. In vertical load bearing joints, clean vertical surfaces and install tie-bars or dowels. Apply concrete bonding compound, Section 03 30 10.
3. Place concrete. Prevent segregation.
4. Match adjacent surface slopes. Match adjacent surface texture.
5. Saw cut contraction joints.

B. **Partial Depth Restoration:**

1. Chip, hydro-blast or saw cut concrete at least one (1) inch below surface to be replaced.
2. Make prepared surface free of frost, ice, mud, water, grease, dirt and other materials that hamper bonding.
3. Install bonding agent per manufacturer's recommendations.
4. Place concrete. Prevent segregation.
5. Match adjacent surface slopes and surface texture.

C. **Cure:**

1. Protect restoration work from hot or cold weather. Immediately after placement and texturing, apply a membrane forming compound.ASTM C1315 and Section 03 39 00. Apply total coverage in two (2) directions.
2. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete patch.

D. Traffic: Not allowed on the repaired area until concrete strength is achieved.

3.7 CONCRETE PAVERS

A. Screed bedding with a notched and cambered screed board to achieve a crown between existing pavers. Use graded aggregate, geotextile, and bedding sand, Section 32 14 13.

B. After placement, use a plate-type vibrating compactor to compact pavers. Size compactor to provide at least 5,000 lbf force. Sweep joint sand into the joints and vibrate until joints are full. Remove excess joint sand.

C. Match adjacent surface grades with no more than ¼-inch vertical deviation in 10 feet.

3.8 TOLERANCE

A. 1/4 inch vertical deviation from design elevation in 10 feet.

B. Match adjacent surface slopes.

3.9 PAVEMENT MARKINGS

A. Unless indicated otherwise, repair all damaged Pavement markings with matching material types and installation.

3.10 REPAIR

A. Remove bumps and depressions exceeding ¼-inch vertical deviation in 10 feet.

B. Bituminous Pavement: Repair options include mill-and-inlay, or grinding. Feather edges on bituminous concrete repairs are not allowed. Apply a cationic or anionic tack emulsion to make milled surfaces water resistant.

C. Concrete Pavement: Repair options include grinding, or slab replacement. Apply a water repelling product over surfaces that are ground to make the surfaces water resistant. Repair or replace any slab that cracks, shrinks, or otherwise fails. Do not allow traffic on repaired area until concrete strength is achieved.

END OF SECTION

SECTION 33 08 00
COMMISSIONING OF WATER UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tests to be performed for commissioning pressurized and non-pressurized water piping systems.

B. Warning: DO NOT use hydrostatic pressures for air-pressure testing.

1.2 REFERENCES

A. **ASTM Standards**.

C497 Testing Concrete Pipe, Sections, or Tile

C969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1103 Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1214 Test Method for Concrete Pipe Sewerlines by Negative Air Pressure (Vacuum)

F1417 Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

F2497 Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines

B. **NASSCO Standards**.

PACP Pipe Condition Assessment Using CCTV.

C. **UAC Standards.**

R309 Environmental Quality, Drinking Water.

1.3 DEFINITIONS

A. **CCTV**: Acronym for closed-circuit television.

B. **Leakage**: The quantity of water required to maintain specified hydrostatic test pressure after pipeline has been filled with water and air expelled.

C. **Non-rigid Pipe**: Any pipe that requires bedding and pipe zone backfill material for structural support to prevent distortion that may be caused by additional backfill placement.

D. **PACP**: Acronym for pipeline assessment certification program. This program is provided by the National Association of Sewer Service Companies (NASSCO).

1.4 SUBMITTALS

A. **CCTV Report**: Include the following.

1. CCTV personnel are NASSCO PACP certified.
2. NASSCO PACP certified database and electronic worksheets accompany all progress inspection work.
3. All ENGINEER and NASSCO PACP required header information must be fully and accurately entered on all CCTV reports.
4. Corrections to punch list items are submitted in report form prior to final payment.

B. **Commissioning Test Report**: Use the commissioning test schedule (Table 3 this section) which identifies tests to be performed for commissioning potable and non-potable water piping systems. For each test performed, submit the following information as applicable.

1. Type of test.
2. Project number and date of the report.
3. Size, type, location and length of pipe in test section.
4. Test pressure and time.
5. Written and still image documentation of locations where deflection deviations, joint gaps, pipe damage, and any other deficiencies are observed.
6. Statement of whether mandrel was or was not able to pass.

7. Amount of leakage versus allowable.
8. Date of test approval.
9. Signature of test supervisor.
10. Signature of Resident Project Representative witnessing the test.

1.5 **PROJECT CONDITIONS**

A. CCTV: Run water through subject test system prior to video inspection. Conduct inspection prior to installation of paved surfaces. ENGINEER to be present during video inspection.

1. Record vertical and horizontal deviations, joint gaps, cracks, and pipe damage.
2. Video the entire circumference at each joint. Zoom where necessary.
3. Video image must be clear, continuously illuminated, focused, free from roll, static, or other image distortion qualities.
4. Identify the date, pipe reach, slope, upstream and downstream manhole numbers, and manhole to manhole footage.
5. Provide video inspection log as a computerized data report with a map of the system inspected with appropriate identification labels and still images of defects discovered in the video.
6. Repeat unsatisfactory inspections at no additional cost to OWNER.

B. Manual inspections are to be done by ENGINEER.

1.6 **WARRANTY**

A. At the end of the one-year correction period repeat any test requested by ENGINEER to verify warranty of pipeline performance.

B. OWNER will pay for the cost of additional test inspections if pipe tests meet criteria in this section.

PART 2 PRODUCTS

2.1 **TESTING MATERIALS**

A. Medium: Water, air.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Leakage Recording Equipment:

1. Supply all equipment and power to perform leakage testing.
2. Secure approval of pressure and vacuum gages.
3. Locate all gages and recording equipment away from affect of sunshine or unsuitable weather conditions.
4. Place, vents, taps and drains for the test. Repair pipeline at completion of test at no additional cost to OWNER.

B. CCTV:

1. Video operator is currently NASSCO PACP certified.
2. Camera is to be crawler mounted meeting the following.
   a. Head is in the pipe diameter center with lighting sufficient to produce a clear picture of the entire periphery of the pipe.
   b. Pan and tilt to a 90-degree angle with the axis of the pipe.
   c. Rotate 360 degrees.
   d. Crawl at a speed no greater than 30 feet per minute.
3. For pipe lateral replacements constructed by bursting, operate video camera in presence of Project Representative.

C. Mandrel:

1. Diameter whether it is fixed or variable size must be verified with a proving ring or other method according to manufacturer's guideline.

2. Contains at least nine equally spaced runners.

3. Length not less than the diameter.

4. Pulled (not pushed) through pipe.

5. Recommend an alternate method of measurement if mandrel testing would cause damage to internal pipe coating.

3.2 **PREPARATION**

A. Be knowledgeable of applicable rules in UAC R309

B. Notify ENGINEER 48 hours in advance of test.

C. Carry out selected tests as pipeline construction progresses to ensure construction methods are producing satisfactory results.

D. Remove debris, sediment and other material from installed pipe before testing. Do not discharge or flush sand, gravel, concrete, debris or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of receiving systems. Flushing into existing pressurized water systems is NOT ALLOWED.

3.3 **GRADE AND ALIGNMENT TEST**

A. Tolerances for pipe placement are as follows.

Table 1 - Grade and Alignment

Design Grade	Tolerances	
	Grade [a]	Alignment
Greater than 1%	1/2 inch in 10 feet	1" from true line
0.5 to 1%	1/4 inch in 10 feet	1" from true line
Less than 0.5%	1/4 inch in 100 feet	1" from true line

NOTES

(a) Grade does not result in a level or reverse sloping invert. Standing water is evidence of non-compliance.

(b) For culverts, increase tolerances by 50 percent.

3.4 **JOINT TESTS**

A. Gap: Evaluate each pipe joint with a gap exceeding allowance in the following table. Recommend appropriate corrective action according to manufacturer's recommendations.

Table 2 - Joint Gap

Pipe Diameter, inches	Allowance, maximum
Less than 12	(a)
12 - 36	0.75 inch
42 - 48	1.00 inch
54 - 90	1.25 inches
96 - 144	1.75 inches

NOTES

(a) In pipes less than 12 inches diameter, allowable separation is equal to or less than amount permitted by manufacturer.

B. Invert Elevation: Variation in invert elevation where pipe sections join shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

3.5 **INFILTRATION TEST**

A.Tolerance: 200 gallons per inch, per mile, per day maximum (EPA's standard for sanitary sewers is specified). If ground water table is less than two (2) feet above the crown of the pipe the infiltration test is not required.

B. Concrete Pipe: ASTM C969.

C. Plastic Pipe: ASTM F2497.

3.6 **EXFILTRATION TEST**

A. Preparation: Air test or hydrostatic test is CONTRACTOR's choice.

B. Air Test:

1. Plastic Pipe: ASTM F1417.

a. For pipe up to 30 inches diameter, pressure drop is 0.5 psi.

b. For pipe larger than 30 inches diameter, isolated joint test is 3.5 psi. Maximum pressure drop is 1.0 psi in 5 seconds.

2. Concrete Pipe:

a. ASTM C1214 for concrete pipe 4" to 24" diameter.

b. ASTM C1103 for concrete pipe 27" and larger.

C. Hydrostatic Test: Provide air release taps at pipeline's highest elevations and expel all air before the test. Insert permanent plugs after test has been completed.

1. Plastic Pipe: ASTM F2497.

2. Concrete Pipe: ASTM C497. Abide by Section 3 and Section 16 in the ASTM standard and applicable recommendations of manufacturer.

D. Locate and repair leakage and retest until leakage rate is less than allowable.

E. Repair any noticeable leakage even if total leakage is less than allowable.

3.7 **DISTORTION TEST**

A. **Concrete Pipe**: Maximum crack width is 0.1 inch. Provide photographs of all cracks for possible mitigation or monitoring purposes.

1. Record location of cracks smaller than 0.1 inch. ENGINEER will evaluate crack at end of one-year correction period.

2. For cracks exceeding 0.01-inch, measure crack width and provide photographs for monitoring purposes during subsequent inspections.

B. **Plastic and Other Pipe**: Maximum internal diameter reduction in any plane measured full length of installation prior to pavement placement, and at the end of the correction period is as follows.

1. Polyvinyl chloride pipe, 7.5 percent.

2. High density polyethylene pipe, 5 percent.

3. Polypropylene pipe, 5 percent.

4. Ductile iron pipe, 3 percent.

5. Corrugated metal pipe, 7.5 percent.

3.8 **OBSTRUCTION TEST**

A. Maximum protuberance is 1 inch.

3.9 **TRACER WIRE CONTINUITY TEST**

A. Test all tracer wire sections for continuity.

3.10 **COMMISSIONING TEST SCHEDULE**

A. The following table identifies required commissioning tests.

Table 3 - Commissioning Test Schedule

	Alignment	Grade	Joint	Infiltration	Exfiltration	Distortion	Obstruction	Disinfection	Tracer Wire
Gravity Irrigation Landscaping (a)		●							
Pressure Irrigation Landscaping (a,b,c)		●			●				
Sanitary Sewers (b,c)	●	●	●	●	●	●	●		
Sub-drains		●				●	●		
Storm Drains (c,d)	●	●	●	●	●	●	●		
Potable Water (c,d,e)					●	●	●	●	
Non-potable water (d)						●	●		●

NOTES

(a) All lateral pipes drain.

(b) Operational testing: Landscaping systems.

- Perform operational testing after hydrostatic test is complete, backfill is in place, and sprinkler heads are adjusted to final coverage.
- Demonstrate system meets coverage requirements and automatic controls function properly.
- Coverage requirements are based on operation of one (1) circuit at a time.

(c) Exfiltration test for pressure pipeline systems.

(d) Exfiltration when requested by ENGINEER or specified elsewhere.

(e) Legally dispose disinfection and flushing water and ensure no damage to the environment.

3.11 **REPAIR**

A. Repair pipeline system at no additional cost to OWNER until it passes commissioning tests.

END OF SECTION

SECTION 33 11 00
WATER DISTRIBUTION AND TRANSMISSION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a pressurized water pipe system.

B. Refer to Section 33 31 00 if the system is a non-pressure sanitary sewer.

C. Refer to Section 33 41 00 if the system is a non-pressure storm drain, sub-drain, irrigation system, etc.

1.2 REFERENCES

A. **American Concrete Pipe Association (ACPA) Publications**:

Concrete Pipe Handbook.

B. **APWA (Utah) Standards**:

Plan 255 Bituminous pavement T-patch.

Plan 256 Concrete pavement patch.

Plan 373 Concrete pier.

Plan 381 Trench backfill.

Plan 382 Pipe zone backfill.

Plan 521 3/4” and 1” meter.

Plan 522 1-1/2” and 2” meter.

Plan 541 Water service line.

Plan 542 Water service line loop.

Plan 543 Water main loop.

Plan 551 3/4” and 1” service taps.

Plan 552 1-1/2” and 2” service taps.

Plan 561 Direct bearing thrust block.

Plan 562 Tie-down trust restraints.

Plan 574 Cover collar for water valve boxes.

Plan 575 Air release assembly.

C. **AWWA Standards**:

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

C800 Underground Service Line Valves and Fittings.

C901 Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. Through 3 in., for Water Service.

M11 Manual for Steel Pipe - Design and Installation.

D. **UAC Standards:**

R390 Environmental Quality, Drinking Water.

D. Copper Development Association (CDA) Standards.

E. Applicable water company requirements standards.

F. Utah Division of Drinking Water Administrative Code

R309-550 – Facility Design and Operation: Transmission and Distribution Pipelines

1.3 PERFORMANCE REQUIREMENTS

A. Depth of Cover:

1. Minimum as indicated in local building code from top of pipe to ground surface. 72 inches maximum unless ENGINEER authorizes otherwise.

2. If less cover, provide additional protection to withstand frost and external loads.

B. Remove any section of pipe already placed that is found to be defective or damaged. Relay or replace without additional cost to OWNER.

1.4 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.
B. Commissioning: Provide Section 33 08 00 submittals.
C. Record Documents, Section 01 78 39: Include details of underground structures, connections, thrust blocks and anchors. Show interface and spatial relationship between piping and adjacent structures.
D. Operating and Maintenance: Submit data, Section 01 78 23. Include maintenance data, parts list, product data and Shop drawings.

1.5 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Secure acceptance of pipeline lateral tie-in work.

C. Repair public and private facilities damaged by CONTRACTOR.

D. Do not operate any currently active water valve until its owner and water company's permission is secured.

1.6 **ACCEPTANCE**

A. Each component in the distribution and transmission system must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Use only NSF approved products in drinking water systems. All such products shall be appropriately stamped with the NSF logo.

B. Where not indicated, provide proper selection as determined by installer and acceptable to ENGINEER to comply with installation requirements.

C. Provide sizes and types of equipment connections for fittings of material that matches pipe material used in the piping system. Where more than one type of material or product Option is indicated, selection is installer's choice.

D. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **VALVES**

A. Section 33 12 16.

2.3 **VALVE BOX**

A. Buried Valves in Traffic Areas: Cast iron two (2) piece slip sleeve type, 5-1/4 inch shaft, with a drop lid.

B. Buried Valves in Non-Traffic Areas: Cast iron two (2) piece screw adjustable sleeve of height required for installation.

C. Markings: Cast appropriate utility lettering on cover.

2.4 **VALVE CHAMBER**

A. Basin: Class 4000 concrete floor and walls.

B. Steps: Plastic, cast into sidewalls greater than four (4) feet deep.

C. Top: Flat slab class 4000 concrete.

D. Frame and Cover: Scoriated asphalt coated, heavy duty ductile iron conforming to Section 05 56 00 with flat top design and appropriate utility lettering. Shape and size required.

2.5 MORTAR, GROUT, AND CONCRETE

A. Mortar: Portland cement, Section 04 05 16.

B. Grout: Portland cement, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Precast: Class 5000, Section 03 40 00.

2.6 TAPPING SADDLES

A. Bronze alloy or stainless-steel saddles with stainless-steel straps (double straps on pipes over 12 inches diameter).

B. Straight threads. Tapered threads not allowed.

C. Rated working pressure, 300 psi minimum.

D. Neoprene Buna N gaskets.

2.7 SERVICE CONNECTION

A. Taps: Saddle clamp or direct type. Provide plastic spacers or nipples to separate non-similar metals.

B. Service Line:

1. Copper Pipe: Type K, Section 33 05 03 with 200 psi compression fittings according to AWWA C800.
2. Polyethylene Pipe: AWWA C901 with 200 psi compression fittings, and ratings according to AWWA C800.

2.8 ACCESSORIES

A. Bolts, Nuts, Washers: Steel, Section 05 05 23.

B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

C. Corporation Stops: All bronze, straight threads, full port, ball valve.

D. Hydrant and Valve: Dry barrel, Section 33 12 19.

E. Water Meter and Valve: Section 33 12 19.

F. Grease: Non-oxide food grade required where in contact with potable water. Non-oxide poly-fm for all exposed buried metal surfaces for bolts, nuts, washers, restraints, etc.

G. Polyethylene Sheet: Six (6) mil thick minimum.

H. Joint Restraints: Acceptable to ENGINEER prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify trench excavation is ready to receive work, and dimensions, and elevations are as required.

B. Commencing installation means acceptance of existing conditions.

3.2 PREPARATION

A. Excavation, Section 31 23 16. Hand trim to required elevations. Correct over excavations.

B. Remove stones or other hard matter that manufacturer stipulates may damage pipe during embedment or impede backfilling or compaction.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.3 LAYOUT

A. Construction survey requirements, Section 01 71 23.

B. Comply with Utah administrative rules R309-550. As a minimum locate potable water pipe at least 18 inches vertical and 10 feet horizontal edge to edge between water and sewer lines. Place water lines above sewer line.

C. Where potable water pipe crosses under gravity-flow sewer lines, fully encase sewer pipe in concrete for a distance at least 10 feet each side of the crossing:

1. Do not locate any joint in the water line within 36 inches of the crossing.
2. Encase water line if it is within 24 inches of a sewer force main or a sewer inverted syphon.
3. Encase sewer main joints in concrete if joints are horizontally closer than 36 inches to the water line.

D. Do not put potable water lines in the same trench with sewer lines, storm drains or electric wires.

3.4 INSTALLATION - PIPE AND FITTING

A. General:

1. Seal each open end of pipeline at end of day's work.
2. Grease all bolts and nuts then apply polyethylene sheet and tape wrap.
3. Protect sanitary sewer pipe crossings as shown in the Drawings or APWA Plan 373.

B. Steel Pipe: AWWA M11.

C. Ductile Iron Pipe: AWWA C600.

D. Copper Tube: CDA "Copper Tube Handbook".

E. Polyethylene Pipe: For three (3) inches and smaller pipe follow AWWA C901. Install all other sizes per manufacturer's installation instructions.

F. Polyvinyl Chloride Pipe: AWWA C605.

G. Concrete Pipe: ACPA "Concrete Pipe Handbook".

H. Wedges: Install metal wedges on metal pipe systems. Grease and plastic wrap exposed metal wedges.

3.5 INSTALLATION – CONCRETE THRUST BLOCK

A. Install thrust block as shown in the Drawings or APWA Plan 561 or 562.

B. Do not make hydrostatic tests of Section 33 08 00 until thrust block concrete has cured for at least five (5) days.

C. Provide thrust blocks on all plugs, caps, tees, hydrants and vertical or horizontal elbows.

D. Provide stainless steel or epoxy coated steel tie rods and clamps or shackles to restrain thrust.

E. Unless indicated otherwise or directed by ENGINEER, place base and bearing sides of thrust blocking directly against undisturbed earth.

F. Sides of thrust blocking not subject to thrust may be placed against forms. Place thrust blocking so joint fittings will be accessible for repair.

3.6 INSTALLATION - VALVE AND VALVE BOX

A. Valves:

1. Ensure all parts are in working order.
2. Set location of valves outside of sidewalk limits, driveway approach and other pedestrian or vehicular interference.
3. Install plumb with stem pointing up.
4. Grease all exposed bolts and nuts then apply polyethylene sheet and tape wrap.

B. Air Relief Valves:

1. At high points in water mains where air can accumulate, air may be removed by means of hydrants or air relief valves. Install air relief valves as shown in the Drawings or APWA Plan 575.
2. DO NOT use automatic air relief valves where flooding may occur.

C. Valve Box:

1. Set over valve nut so operator's key is plumb with clearance in valve box when opening and closing the valve. Riser must NOT rest on valve or pipe system.
2. Adjust riser to finish grade and clean all dirt or foreign material out of riser.
3. Install valve box concrete collar in bituminous paved surface as shown in the Drawings or APWA Plan 574.

3.7 INSTALLATION – JOINT RESTRAINTS

A. Without Thrust Blocks: Install joint restraints with all valves for the distance acceptable to the ENGINEER.

B. With Thrust Blocks: Install joint restraints for the distance approved by the ENGINEER where concrete block design exceeds three (3) cubic yards, for vertical bends, where soil is disturbed, or where undisturbed soil bearing capacity is less than 1000 pounds per square foot.

3.8 INSTALLATION – SERVICE TAPS

A. Install direct or saddle taps as shown in the Drawings or APWA Plan 551 or 552.

B. Apply for and pay for applicable permits from water company for size and location of tap to water main. Comply with all connection requirements of water company.

C. Make service taps with a tapping machine acceptable to water company. Use Teflon tape on all taps unless indicated otherwise.

D. Minimum distance between taps is 24 inches, with a five (5) degree stagger. Do not make service taps within 24 inches of the end of pipe. Install taps at 60 degrees from vertical, or authorized by ENGINEER.

E. Service saddles are required on all taps except, 3/4 inch or 1 inch taps to new ductile iron pipe

F. Grease all exposed bolts and nuts then apply six (6) mil thick polyethylene sheet and tape wrap.

3.9 INSTALLATION – SERVICE LINE

A. New or Replacement of Existing Water Service Line:

1. Install service line as shown in the Drawings or APWA Plan 541. Follow AWWA C800, Utah drinking water Rules and Regulations and International Building Code requirements.

2. When replacing water service lines, replace non-copper pipe with:

   a. Type K copper pipe, Section 33 05 03, or

   b. Polyethylene pipe, AWWA C901

3. Minimum pipe diameter 3/4 inch, maximum 3 inches.

4. Distance from nearest joint or existing tap is 24 inches minimum unless a greater distance is required by pipe manufacturer.

B. Looping Existing Water Service:

1. Install service line as shown in the Drawings or APWA Plan 542.

1. Minimum pipe diameter is one (1) inch.

2. Use liquid nitrogen to spot freeze active service lines. Pinching tools used to close active service lines may be used only if allowed in writing by ENGINEER.

3. Soldered joints or connections not allowed.

4. For copper to iron connections use a brass pack joint compression coupling with joint locking device.

5. For copper-to-copper connections use a brass compression fittings. Flared end fittings are not allowed.

C. Meter box: Install as shown in the Drawings or APWA Plan 521 or 522. Install box behind curb, outside of sidewalk, outside of driveway approaches, or outside of other vehicular or pedestrian interference.

3.10 INSTALLATION – WATER MAIN LOOP (SYPHON)

A. Install loops under obstructions as shown in the Drawings or APWA Plan 543. If obstruction is a sewer or storm drain, install loop over obstruction with appropriate frost protection.

B. Existing water mains may not match standard size. Excavate to obtain actual pipe diameter and match size.

C. Do not shutdown pipeline until couplings and fittings are on site. Coordinate shutdown with water company.

D. Connections to steel or transite pipe require transition couplings or sleeves with transition gaskets.

E. Grease all exposed bolts and nuts then apply six (6) mil thick polyethylene sheet and tape wrap.

F. Provide thrust blocks except where joints are welded. Follow details shown on drawings.

3.11 DISINFECTION

A. Section 33 13 00.

B. After disinfection, legally dispose of disinfection water.

3.12 **BACKFILLING**

A. Before backfilling secure ENGINEER's acceptance of brass wedge installations and concrete thrust block installations.

B. Trench and Pothole Backfill: Section 33 05 20. Placement as shown in the Drawings or the following.

1. APWA Plan 382 for the pipe zone.
2. APWA Plan 381 above the pipe zone.

C. Landscapes and Structural Backfill: Follow Section 31 23 23 requirements.

3.13 **COMMISSIONING**

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.14 **SURFACE FINISHING**

A. Roadway Trenches and Patches: Follow requirements in Section 33 05 25 and in the following Standard Plans:

1. APWA Plan 255 for bituminous concrete T-patch.
2. APWA Plan 256 for concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.15 **CLEANING**

A, Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, or debris into existing piping systems.

END OF SECTION

SECTION 33 11 11

RELOCATE WATER METERS AND FIRE HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocate existing water meters or fire hydrants because of changes in grade or installation of new improvements that conflict with existing meter and hydrant locations.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 546 Fire hydrant replacement or relocation.

B. **AWWA Standards**:

C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape – Hot-Applied.

C502 Dry-Barrel Fire Hydrants.

C. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 JOB CONDITIONS

A. Secure utility company permit to do relocation work and pay applicable fees.

B. Secure utility company approval of joints, connections, and pipe installations before commencing backfill operations.

PART 2 PRODUCTS

2.1 HYDRANTS

A. Use existing hydrant unless contracted to provide a new unit.

2.2 WATER SERVICE METERS

A. Use existing water meter and yoke unless contracted to provide a new unit.

2.3 CONCRETE

A. Class 3000 or 4000 cast-in-place, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Before commencing work, coordinate location and shutdown of utility lines with utility company and residents, Section 01 31 13.

B. Protect existing hydrants and meters from damage.

C. Control ground water, surface water, storm water.

D. Control pedestrian and vehicular traffic, Section 01 55 26.

E. Be knowledgeable of applicable rules in UAC R309.

3.2 MOVE EXISTING HYDRANT

A. Relocate as shown in the Drawings or APWA Plan 546.

B. Do not disturb location of hydrant lateral tee at water main.

C. The method of harnessing the hydrant (reshackling or reblocking) shall match existing conditions or approval of ENGINEER.

D. Install hydrant so base flange is even with or less than four (4) inches above grade of surrounding surface.

E. Use same type of pipe material as used for existing hydrant piping unless indicated otherwise.

F. Use mechanical and flange joint fittings unless required otherwise. Use only new tees, fittings, and bends.

G. Coat all weld connections and damaged areas of metal piping with coal tar enamel. Follow AWWA C203 requirements. Tape wrap coatings.

3.3 **RECONNECT EXISTING HYDRANT**

A. Hydrant reconnection shall meet new work requirements indicated in Section 33 12 19.

B. When existing tee on water main is to be moved to new location, seal and shackle old tee.

3.4 **HYDRANT BARREL EXTENSION**

A. Follow AWWA C502 to extend barrel, operating stem and flanged adapters in design material and workmanship so hydrant base flange is even with or less than four (4) inches above grade of surrounding surface.

3.5 **MOVE WATER METER AND BOX**

A. Verify with water company for use of Type K copper pipe (Section 33 05 03) or polyethylene pipe (Section 33 05 06) from main to meter yoke.

B. Follow installation procedure in Section 33 12 33. In paved surfaces, follow procedure in Section 33 05 14 when adjusting structures to grade.

3.6 **FIELD QUALITY CONTROL**

A. Hydrostatic tests, Section 33 08 00.

B. Disinfection, Section 33 13 00.

C. Follow applicable rules or UAC R309

END OF SECTION

SECTION 33 12 16
WATER VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gate, butterfly, plug, check, washout, pressure reducing, pressure relief, control valves and their installation.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 571 4-inch Washout valve.

Plan 572 Detector check valve with ¾-inch bypass meter.

Plab 573 6-inch pressure reducing valve with 2-inch bypass.

B. **AWWA Standards**:

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C504 Rubber-Seated Butterfly Valves.

C508 Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS.

C509 Resilient-Seated Gate Valves for Water and Sewerage Systems.

C550 Protective Interior Coatings for Valves and Hydrants.

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

C. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 SUBMITTALS

A. Provide technical information for evaluating quality of valve. As a minimum include dimensions, weights, materials lists and operation charts.

PART 2 PRODUCTS

2.1 VALVES - GENERAL

A. Underground:

1. Less than three (3) inches: Screwed ends.
2. 3 inches and larger: Flanged or mechanical joint ends. Non-rising stem. Two inches square operating nut. Low alloy steel bolts, AWWA C111.

B. Submerged or Above Sewage or Water:

1. Valve body bolts per manufacturer's recommendations.
2. For joining valve to piping system use stainless steel nuts and bolts, Section 05 05 23.

C. Below an Operating Deck: Provide shaft extension from the valve to deck level.

D. Above Ground: Non-rising stems equipped with a hand wheel.

E. Manually Operated Valves Over six (6) feet Above Operating Level: Provide chain operated handles.

F. Clearance: Install so handles clear all obstruction when moved from open to closed.

G. Rated Working Pressure: 150 psi if not indicated.

H. Coating: Interior, AWWA C550. Exterior per manufacturer's recommendation.

2.2 GATE VALVES

A. AWWA C509.

B. 3 inches through 48 inches, cast iron body, bronze mounted, non-rising stem with "O" ring seals.

C. Open counterclockwise.

2.3 **BUTTERFLY VALVES**

A. AWWA C504.

B. 3 inches through 48 inches, cast iron body, bronze mounted.

C. Short body if disc will not interfere with adjacent fittings or long body at CONTRACTOR's option.

D. Wafer Valves: Subject to ENGINEER's approval.

2.4 **ECCENTRIC PLUG VALVES**

A. Material: Cast iron body, bronze mounted, non-lubricated, eccentric, quarter-turn type with resilient face plugs, ductile iron discs with upper and lower shafts integral.

B. Markings: Indicate open and close position.

C. Port Areas: At least 82 percent of full pipe area.

D. Resilient Seat Seals: Buna N, field replaceable.

2.5 **CHECK VALVES**

A. AWWA C508.

B. Less than three (3) inches: Y-pattern, bronze, regrinding, swing check valve, 200 psi working pressure.

C. 3 inches and larger: Iron body, bronze mounted, swing valves with stainless steel hinge pins and outside weight and lever if not indicated otherwise.

2.6 **PRESSURE REDUCING VALVES - SERVICE LINE**

A. Operation: Capable of reducing a varying higher upstream pressure to an adjustable constant lower downstream pressure.

B. Spring and nylon reinforced diaphragm type construction.

C. Equip with Y-strainer upstream of valve.

2.7 **PRESSURE REDUCING VALVES - MAIN LINE**

A. Operation: Capable of maintaining an adjustable constant downstream pressure regardless of upstream pressure.

B. Type: Hydraulically operated using a direct-acting, spring-loaded, normally open, pilot valve-controlled diaphragm:

1. Single removable seat and a resilient disc. No "O" ring type discs permitted. No external packing glands permitted. No pistons operating main valve or pilot controls permitted.

2. Y-strainers on pilot controls, variable closing and opening speed controls and a valve position indicator.

C. Rating: 250 psi working pressure.

D. Connection: Flanged.

E. Pressure Gage: Upstream and downstream of valve capable of accurately measuring system pressures.

2.8 **PRESSURE RELIEF VALVES**

A. Operation: Maintain a constant upstream pressure by passing or relieving excess pressure.

B. Closed Valves: Drip-tight.

C. Type: Hydraulically operated, pilot control using a diaphragm with a single removable seat and resilient disc.

D. Pilot Controls: Direct acting, adjustable between 20 and 200 psi, spring-loaded diaphragm valve.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

2.9 **CONTROL VALVE**

A. Globe: Diaphragm actuated, single seated, composition disc, hydraulically operated.

B. Pilot Controls: Externally mounted, four-way, solenoid pilot valve with self-cleaning strainers and diaphragm type check valves:

1. Equipped with a limit switch for pump control.
2. Equipped with a built-in lift check valve to prevent flow reversal.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

G. Solenoids and Limit Switch: Supplied with operating voltage indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Be knowledgeable of applicable rules in UAC R309.

3.1 INSTALLATION

A. **General:**

1. Flush all lines before valve installation.
2. Install ductile iron water mains per AWWA C600.
3. Install butterfly valve shafts vertical in vault boxes and horizontal otherwise.

B. **Washout Valve:**

1. Install valve as shown in the Drawings or APWA 571.
2. Watermains 12-inches and larger will require a special washout assembly design.

C. **Detector Check Valve System:**

1. Install system shown in the Drawings or APWA Plan 572.
2. Configuration may be changed at ENGINEER’s discretion.

D. **Pressure Reducing Valve System:**

1. Install system as shown in the Drawings or APWA Plan 573.
2. Configuration may be changed at ENGINEER’s discretion

END OF SECTION

SECTION 33 12 19
HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dry-barrel fire hydrants, valves, piping and accessories.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 511 Fire hydrant with valve.

Plan 561 Direct bearing thrust block.

Plan 562 Tie-down thrust restraints.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C209 Cold-Applied Tape Coatings for the Exterior of Special Section, Connections, and Fittings for Steel Water Pipelines.

C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel water Pipelines.

C214 Tape Coating Systems for the Exterior of Steel Water Pipelines.

C502 Dry-Barrel Fire Hydrants.

M17 Manual for Installation, Operation, and Maintenance of Fire Hydrants.

C. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 PRODUCT HANDLING

A. Package fire hydrants, gate valves, and valve boxes for protection against dirt and damage during shipment and storage.

B. Do not plug drain hole.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions.

B. Shop Drawings: Show interface and spatial relationship between piping and adjacent structures.

C. Field Quality Control Reports: For system commissioning, Section 33 08 00.

1.5 JOB CONDITIONS

A. Notify appropriate fire department as soon as hydrant is removed or placed in service.

PART 2 PRODUCTS

2.1 DRY-BARREL FIRE HYDRANT

A. AWWA C502.

B. Cast iron compression type, opening against pressure and closing with pressure, base valve design, 150 psi working pressure, with 1/4 inch diameter minimum tapping and bronze plug in standpipe:

1. Size: 5-1/4 inch valve opening.
2. Direction to Open Hydrant: Counterclockwise.

3. Size and Shape of Operating and Cap Nuts: Pentagon. 1-1/2 inch point to flat.
4. Hose Nozzles: Two 2-1/2 inch national standard thread, cap, gasket and chain.
5. Pumper Nozzle: One 4-1/2 inch national standard thread, cap, gasket and chain.
6. Depth of Burial: 48 inches or consistent with main depth.
7. Connection to Main: Six (6) inches flanges or mechanical joint.
8. Pressure: 150 psi working pressure and 300 psi hydrostatic pressure.
9. Inlet Bottom Connection: Six (6) inches mechanical joint or flanged in accordance with AWWA C110 and AWWA C111, designed to allow separation at the sidewalk or ground level when hydrant is sheared off.
10. Automatic Drain: Opens as the hydrant is closed.

2.2 **PIPE AND FITTINGS**

A. Ductile Iron: Section 33 05 05. Standard drilling with joints per AWWA C110.

B. PVC: Section 33 05 07.

C. Steel: Section 33 05 09. Standard drilling, 150 lb.

D. Spool: Schedule 40 steel, epoxy lined, exterior wrapped with minimum six (6) mil thick polyethylene sheet and tape wrap, AWWA C210 or C213 and C209 or C214 with two welded in place 150 lb. steel ANSI B 16.5 slip on flanges.

2.3 **VALVES**

A. Gate Valve: Section 33 12 19.

B. If indicated, furnish an auxiliary six (6) inch diameter valve with end connections as required.

2.4 **ACCESSORIES**

A. Bolts, Nuts, Washers: Stainless steel, Section 05 05 23.

B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

C. Thrust Blocks: Concrete Class 2000 minimum cast-in-place, Section 03 30 04.

D. Valve Box, Valve Chamber: Section 33 12 19.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Be knowledgeable of applicable rules in UAC R309

B. Excavation, Section 31 23 16.

3.2 **INSTALLATION**

A. Install hydrant according to AWWA M17 and APWA Plan 511.

B. Install hydrants, valves, and valve boxes as indicated and located. Hydrants shall not be connected to or located within 10 feet of a sanitary sewer or storm drain.

C. Install so bottom of hydrant base flange is above grade four (4) inches plus or minus two (2) inches.

D. Point 4-1/2 inch pumper nozzle to face the street.

E. Drain holes at base of hydrant to remain clear with a minimum of 1 cubic yard of clean sewer rock (Section 32 11 23) placed around hydrant base and drain. Place sheet plastic over gravel to prevent silting.

F. Coal tar and tape wrap steel pipe.

G. Grease all buried nuts, bolts, and steel ancillaries then wrap with six (6) mil thick polyethylene sheet and tape wrap.

H. Install thrust blocks as shown in the Drawings or APWA Plan 561 or 562.

3.3 **BACKFILLING**

A. Secure water company permission to commence backfilling operation.

B. Trenches, Section 33 05 20.

C. Structures, Section 31 23 23.

D. Landscaping, Section 32 91 19.

E. Pavements, Section 32 05 10.

3.4 **PAINT**

A. Paint buried portion of hydrant with two coats of coal tar enamel or asphalt.

B. Paint hydrant barrel and caps with one coat primer and final coat per water company paint standards.

3.5 **FIELD QUALITY CONTROL**

A. Commissioning, Section 33 08 00.

B. Disinfection, Section 33 13 00.

C. Follow applicable rules in UAC R309.

END OF SECTION

SECTION 33 12 33
WATER METER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water meters, service connections, materials.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 505 Concrete meter boxes.

Plan 523 3-inch and 4-inch compound meter with 2-inch bypass.

Plan 525 6-inch compound meter with 2-inch bypass.

Plan 527 8-inch compound meter with 2-inch bypass.

Plan 529 10-inch turbo meter with 6-inch turbo meter and 2-inch bypass.

B. **AWWA Standards**:

C704 Cold-Water Meters - Propeller Type for Main Line Applications.

C800 Underground Service Line Valves and Fittings.

C. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 SUBMITTALS

A. Manufacturer's test records for range and accuracy of meter being furnished.

B. Equipment material diagram and parts schematic.

PART 2 PRODUCTS

2.1 METERS FOR SYSTEM PIPING

A. Materials and Construction: AWWA C704:

1. Cast iron bodies, 175 psi working pressure, flanged connections.
2. Built-in straightening vanes.
3. Working pressure 150 psi.
4. Polyethylene plastic propeller.
5. Stainless steel shaft with stainless steel ball bearings, lubricated by means of a single pressure fitting.

B. Accuracy: Plus or minus two (2) percent of scale for velocities over 1 foot per second.

C. Totalizer: Six digits reading in units required.

2.2 METERS FOR SERVICE PIPING

A. Provided by OWNER unless indicated otherwise.

2.3 SERVICE LINE, VALVES, AND FITTINGS

A. Service Pipe: Copper, Section 33 05 03 or smooth wall polyethylene, Section 33 05 06. The service pipe between main and meter and to a point not less than 1 foot from the public way side of the property line cannot exceed the meter size.

B. Service Valves and Fittings: AWWA C800.

C. Meter Setters: Brass, with angle fittings, saddle nuts and gaskets.

D. Corporation Stops and Angle Valves: Invert key design.

E. Bypasses: Not allowed on any service installation without approval of ENGINEER.

2.4 **METER BOXES**

A. Meters to 1" Service: Plastic or asphalt-dipped corrugated metal. Fiber meter boxes not acceptable.

B. Meters 1-1/2" and Larger:

1. Precast or cast-in-place concrete as shown in the Drawings or APWA Plan 505.
2. Minimum clearance of 12-inches

C. Cover: Ductile or cast iron with utility inscription

PART 3 EXECUTION

3.1 **PREPARATION**

A. Be knowledgeable of applicable rules in UAC R309.

B. Meters: Arranged as shown in the Drawings or as follows.

1. 3-inch and 4-inch compound meter with 2-inch bypass, APWA Plan 523.
2. 6-inch compound meter with 2-inch bypass, APWA Plan 525.
3. 8-inch compound meter with 2-inch bypass, APWA Plan 527.
4. 10-inch turbo meter with 6-inch turbo meter and 2-inch bypass, APWA Plan 529.

C. Excavation, Section 31 23 16.

3.1 **INSTALLATION**

A. Install meter box, meter setters, valves, etc. at indicated locations. If not indicated, install in street right-of-way parking strip or at a location approved by ENGINEER.

B. Install meter setters level and horizontal. Provide suitable pipe lengths to prevent stress.

C. DO NOT operate utility agency's main line valves. Contact agency if valves are to be operated. If required by water utility agency notify affected water users, Section 01 31 13.

D. OWNER Supplied Meters: Installed by CONTRACTOR unless indicated otherwise.

E. Follow applicable rules in UAC R309

END OF SECTION

SECTION 33 13 00
DISINFECTION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Disinfection of potable water system.

B. Test and report results.

1.2 **REFERENCES**

A. **AWWA Standards**:

A100 Water Wells.

B300 Hypochlorites.

B301 Liquid Chlorine.

C651 Disinfecting Water Mains.

C652 Disinfection of Water-Storage Facilities.

B. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 **DEFINITIONS**

A. **Disinfectant Residual**: The quantity of disinfectant in treated water.

B. **ppm**: Parts per million.

1.4 **SUBMITTALS**

A. CONTRACTOR's evidence of experience in disinfection.

B. Bacteriological laboratory's certification.

C. Disinfection Report: Three (3) copies containing:

1. Date issued.
2. Project name and location.
3. Treatment contractor's name, address and phone number.
4. Type and form of disinfectant used.
5. Time and date of disinfectant injection started.
6. Time and date of disinfectant injection completed.
7. Test locations.
8. Initial and follow-up disinfectant residuals in ppm for each outlet tested.
9. Time and date of flushing start.
10. Time and date of flushing completion.
11. Disinfectant residual after flushing in ppm for each outlet tested.
12. Flush water disposal location and acceptance by local agency.

D. Bacteriological Report: Three (3) copies including:

1. Date issued.
2. Project name and location.
3. Laboratory's name, certification number, address, and phone number.
4. Time and date of water sample collection.
5. Name of person collecting samples.
6. Test locations.

7. Time and date of laboratory test start.
8. Coliform bacteria test results for each outlet tested.
9. Certification that water conforms or fails to conform to bacterial standards of State of Utah public drinking water regulations.
10. Bacteriologist's signature.

1.5 **QUALITY ASSURANCE**

A. Bacteriological Laboratory: Certified by State of Utah if laboratory is other than OWNER's laboratory.

1.6 **PRODUCT HANDLING**

A. Store and protect disinfectant in accordance with manufacturer's recommendations to protect against damage or contamination. Do not use unsuitable disinfectant.

B. Follow all instruction labeling for safe handling and storage of disinfectant materials.

1.7 **REGULATORY REQUIREMENTS**

A. Conform to State of Utah public drinking water regulations.

PART 2 PRODUCTS

2.1 **DISINFECTANT**

A. AWWA B301. Liquid chlorine 99.5 percent pure by volume.

B. AWWA B300. Sodium hypochlorite not less than 100 grams per liter available chlorine.

C. AWWA B300. Calcium hypochlorite 65 to 70 percent available chlorine by weight in granular form.

D. Powder, tablet, or gas according to manufacturer's specification.

2.2 **ALKALI**

A. Caustic soda or soda ash.

2.3 **ACID**

A. Hydrochloric (muriatic).

PART 3 EXECUTION

3.1 **PREPARATION**

A. Be knowledgeable of applicable rules in UAC R309.

B. Provide necessary signs, barricades, and notices to prevent accidental exposure to disinfecting materials, consuming disinfecting water, or disturbing system being disinfected.

C. Make sure potable water system is complete, clean, and that the system to be disinfected is not connected to an existing system.

3.2 **DISINFECTION OF WATER LINES**

A. Use one method defined under AWWA C651 that is acceptable to ENGINEER.

B. After pressure testing per Section 33 08 00, flush system through hydrants or if a hydrant does not exist, install a tap of sufficient size to provide 2.5 feet per second flushing velocity in the line.

C. Starting at outlet closest to water source, bleed water from each outlet until chlorine residual reaches outlet. Repeat process at each outlet throughout system.

D. Collect a bacteriological water sample at end of line to be tested. If sample fails bacteriological test, flush system and retest. Continue flushing and retesting until a good sample is obtained.

E. If flushing does not produce a passing bacteriological test disperse disinfectant throughout system to obtain 10 to 25 ppm of free chlorine residual.

F. Flush the chlorinated water from the main until chlorine measurements show concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

G. After a passing bacteriological test sample is obtained, let the system relax for 24 hours. Flush and collect a subsequent bacteriological sample for testing. If the subsequent test passes then water line is acceptable.

3.3 DISINFECTION OF CULINARY WELLS

A. Use one method defined under AWWA A100 that is acceptable to ENGINEER.

B. Do not start disinfection until well is thoroughly cleaned.

C. Use a disinfecting solution containing a minimum of 50 ppm residual chlorine.

D. Flush system after disinfection.

3.4 DISINFECTION OF WATER STORAGE RESERVOIRS

A. Use one method defined under AWWA C652 that is acceptable to ENGINEER.

B. Do not start disinfection until water storage tank is thoroughly cleaned.

C. Provide and use necessary safety equipment for workers in contact with disinfectant or gasses.

D. Flush system after disinfection.

3.5 FIELD QUALITY CONTROL

A. Follow applicable rules in UAC R309

B. Bacteriological Test:

1. Collect samples for testing no sooner than 16 hours after system flushing.
2. Analyze water samples per State of Utah requirements.
3. If bacteriological test proves water quality to be unacceptable, repeat system treatment.
4. Do not place water systems into service until a passing bacteriological test is made. Provide a copy of the passing test to ENGINEER.

C. Disposal of Disinfectant:

1. Legally dispose of disinfecting water and ensure no chlorine buildup or damage to the environment.

END OF SECTION

SECTION 33 16 13
WATER TANK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. On grade welded steel water storage tank.

B. Foundation and ring wall construction.

C. Testing requirements.

1.2 REFERENCES

A. **ASME Standards**:

Boiler and Pressure Vessel Code.

B. **AWWA Standards**:

D100 Welded Steel Tanks for Water Storage.

C. **UAC Standards:**

R309 Environmental Quality, Drinking Water.

1.3 QUALITY ASSURANCE

A. Workmanship, Section 01 43 00.

B. Welder Certification:

1. Use only welders qualified in all positions by ASME Boiler and Pressure Vessel Code.
2. Maintain a record of welds and welders employed on each joint.
3. Provide a welding supervisor independent of the tank erection foreman's jurisdiction.

1.4 SUBMITTALS

A. List of five (5) tanks, including name of owner, size, location, and year completed.

B. Certification of welders who will be performing welding.

C. Within 30 days after award of contract, furnish two (2) sets of design calculations and four (4) sets of detail drawings of the tank. Furnish drawings prepared by a licensed design professional.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish a steel tank that is fabricated and erected per AWWA D100 and governing Laws and Regulations.

B. Furnish the tank per Appendix C of AWWA D100. Use a design temperature based on a low one (1) day mean temperature of -10 deg F if not indicated elsewhere.

2.2 TANK ACCESSORIES

A. General: Furnish and install all tank accessories as indicated and as applicable below.

B. Ladder: One fixed ladder with safety cable on the exterior of the tank conforming to OSHA. Extend ladder eight (8) feet above ground surfaces to roof.

C. Shell Manholes: Two 24 inches diameter shell manholes equipped with davits or hinges located near base of tank. Furnish one manhole with a bolting flange for an exhaust fan for ventilation as indicated in AWWA D100.

D. Vent: Mushroom vent of adequate size to handle pressure differential cause by water entering or leaving the tank at the maximum rate indicated. Do not consider the open area of overflow as venting area. Provide a special screened vent to ensure fail-safe operation if screen frosts over or is otherwise clogged. Furnish a vent that is easily dismantled to remove screens for cleaning.

E. Roof Manholes: One 36 inch rainproof roof hatch with hinges and hasp for locking per AWWA D100 and a 24 inch diameter roof manhole with a removable cover.

F. Overflow: Provide tank overflow. Equip overflow with an anti-vortex entrance. Extend overflow down outside of tank.

G. Inlet Nozzle: Equip with a 125 psi working pressure flange connection.

H. Bottom Drain: Weld drain to tank bottom and make required connections.

I. Outlet Nozzle: Equip with a 125 psi working pressure flange connection.

2.3 **FILL MATERIALS UNDER TANK**

A. Well-graded, sandy gravel with a two (2) inch maximum size for filling inside the ring wall.

B. 4 inch thick layer of oiled sand, Section 31 05 13 directly under the tank floor.

2.4 **REINFORCEMENT AND CONCRETE**

A. Reinforcement: Steel Section 03 20 00.

B. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Be knowledgeable of applicable rules in UAC R309.

3.2 **ERECTION**

A. AWWA D100.

3.3 **RADIOGRAPHS**

A. AWWA D100. Inspection, by CONTRACTOR.

B. Spot radiographs are to be taken, AWWA D100. Preplanned sections will not be allowed.

C. Provide an independent evaluation of radiographs by a person qualified to read and evaluate radiographs.

D. Provide ENGINEER access to all radiographic film. After completion of structure, films become property of OWNER.

E. Before any repair of welds, submit radiographs with such information as required.

F. Repair all welds by grinding out bad areas and rewelding. Do a second radiograph at the same location.

3.4 **ROOF AND FLOOR TESTS**

A. Use vacuum box testing on all floor and roof fillet welds.

B. Report results in writing.

3.5 **TANK TOLERANCES**

A. Test for:

1. Plumbness: The maximum variation from plumb of the top of the shell relative to the bottom of the shell shall not exceed 1/200 of the total tank height.
2. Roundness: Radii measured at 1'-0" above the bottom corner weld; a tolerance of 3/4 inch.
3. Peaking: Using a horizontal sweep board 36 inches long, peaking less than 1/2 inch.
4. Banding: Using a vertical sweep board 36 inches long, banding less than 1/2 inch.

B. Be responsible for providing all equipment necessary to check these dimensional tolerances.

3.6 **CONCRETE RING WALL CONSTRUCTION**

A. General: Pour ring wall monolithically.

B. Ring wall Tolerance: Level top of ring wall to within 1/8 inch in any 30 feet of circumference and within 1/4 inch in total circumference.

C. Interior Backfilling: Below ring wall and tank bottom, use Section 32 11 23 untreated base course. Compact backfill to 95 percent or greater relative to a modified proctor density, Section 31 23 26.

D. Exterior Backfilling: Use Section 31 05 13 common fill which is free of trash, trees, roots, organic material, broken concrete, or other objectionable material. Compact backfill to 90 percent or greater relative to a standard proctor density, Section 31 23 26.

3.7 **TANK FINISHING AND PAINTING**

A. Finish, Section 09 97 15. Color as indicated or selected by ENGINEER.

3.8 **TANK TESTING**

A. Follow applicable rules in UAC 309.

B. Close all tank outlets, inspection holes, or other openings below water level.

C. Fill tank to maximum working water depth and let set for 48 hours.

D. Measure change in water depth over next five (5) day period. Take measurement at least once every 24 hours.

E. Mark any leaks or damp areas for later repair.

F. If the drop in the water exceeds 0.25 percent of tank volume repair and retest.

G. Repair all observed leaks or damp areas and retest full tank again until the tank passes.

3.9 **TANK STERILIZATION**

A. Disinfection, Section 33 13 00.

END OF SECTION

SECTION 33 31 00
SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of a buried non-pressure sanitary sewer pipe system.

B. Refer to Section 33 11 00 if installation is a pressurized pipe system.

1.2 **REFERENCES**

A **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch

Plan 256 Concrete pavement patch

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

Plan 411 Sanitary sewer manhole

Plan 431 Sewer lateral connection

Plan 432 Sewer lateral relocation.

Plan 433 Pipe drop.

B. **ASTM Standards**:

C478 Precast Reinforced Concrete Manhole Section.

C891 Installation of Underground Precast Concrete Utility Structures.

C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 **DEFINITIONS**

A. **Non-pressure Pipe System**: Defined in Section 33 41 00.

1.4 **PERFORMANCE REQUIREMENTS**

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each sanitary sewer system component must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.3 **MANHOLES**

A. Basin: Concrete floor and walls, or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 **ABANDONED UTILITIES**

A. Use concrete to plug and cap openings in abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after abandoned utilities have been closed.

3.3 **INSTALLATION - PIPE AND FITTINGS**

A. Protect sanitary sewer pipe crossings as shown in the Drawings or APWA Plan 373.

B. Relocate sanitary sewer laterals as shown in the Drawings or APWA Plan 432.

C. Install pipe and fittings as shown in the Drawings or APWA Plan 382 and 433.

D. Place bell or groove end facing upstream.

E. Install gaskets per manufacturer's recommendations.

F. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

G. Clean interior of pipe of dirt and debris as work progresses.

H. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade.

3.4 **INSTALLATION - JOINTS**

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes as shown in the Drawings or APWA Plan 411.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous Pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 INSTALLATION - TAP CONNECTIONS-6 INCHES AND SMALLER

A. Install connections as shown in the Drawings or APWA Plan 431.

B. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.

C. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.

D. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus six (6) inches overlap, with not less than six (6) inches of concrete.

E. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow three (3) inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.7 INSTALLATION - TAP CONNECTIONS-LARGER THAN 6 INCHES

A. Not allowed. Where laterals are larger than 6-inches, install a Manhole structure as shown in the Drawings or APWA Plan 411.

3.8 BACKFILLING

A. Trench Backfill: Section 33 05 20. Restore pavement patches as shown in the Drawings or the following.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscape and Structural Backfill: Place backfill per Section 31 23 23. Provide product and placement indicated.

C. Repair public and private facilities damaged by CONTRACTOR.

3.9 SURFACE FINISHING

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for Portland cement concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.10 COMMISSIONING

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.11 CLEANING

A. Remove debris, concrete, or other extraneous material that accumulates in existing pipes or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 41 00
DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a buried non-pressure pipe system such as a storm drain, a sub-drain, irrigation, etc.

B. If the system is pressurized, refer to Section 33 11 00 or Section 32 84 32 as applicable.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch

Plan 256 Concrete pavement patch

Plan 315 Catch basin (single or double grate)

Plan 317 Curb face inlet box

Plan 322 Curb face outlet box

Plan 323 Pipe outfall

Plan 331 Cleanout box

Plan 341 Precast manhole

Plan 372 Area drain

Plan 373 Concrete pier

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

Plan 611 Curb face inlet – irrigation

Plan 613 Irrigation diversion box

Plan 614 Irrigation diversion box

B. **ASTM Standards**:

C 478 Precast Reinforced Concrete Manhole Section.

C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 DEFINITIONS

A. **Non-pressure Pipe System**: Pipelines with joints that have no leakage after a sustained hydraulic pressure not exceeding 10.8 psi (22 in. Hg) for 10 minutes or a sustained vacuum pressure not exceeding 3 kPa (5 in. Hg) for 10-minutes.

1.4 PERFORMANCE REQUIREMENTS

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace without additional cost to OWNER.

1.5 SUBMITTALS

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 SITE CONDITIONS

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each drainage system component must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **IN-PLANE WALL DRAINAGE**

A. Drainage Core: Manufacturer's standard three-dimensional non-biodegradable, plastic designed to effectively conduct water to foundation drainage system.

B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 **SUB DRAIN FILL MATERIALS**

A. Sewer rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.5 **MANHOLES**

A. Basin: Concrete floor with cast in place concrete walls or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

2.6 **INLETS, CATCH BASINS, CLEANOUTS**

A. Basin: Concrete floor and walls.

B. Pipe Connectors: Resilient, ASTM C923. Sand mortar grout.

C. Frame and Grate:

1. Asphalt coated, heavy duty, cast iron, Section 05 56 00. Shape and size indicated.
2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10. Shape and size as indicated.

2.7 **OUTFALLS**

A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide riprap, Section 31 37 00, if indicated.

2.8 DRAIN PIPE JOINT SCREENS

A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.

B. Plastic or corrosion resistant metal bands.

2.9 PRECAST BOX

A. Reinforced class 5000 concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Remove stones larger than two (2) inches or other hard matter that could damage pipe or impede backfilling or compaction.

D. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

E. Clearly identify and promptly set aside defective or damaged pipe.

F. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 ABANDONED UTILITIES

A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.3 INSTALLATION - PIPE AND FITTINGS

A. Protect sanitary sewer pipe crossings as shown in the Drawings or APWA Plan 373.

B. Place bell or groove end facing upstream.

C. Install gaskets per manufacturer's recommendations.

D. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

E. Clean interior of pipe of dirt and debris as work progresses.

F. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.

G. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade

3.4 INSTALLATION - JOINTS

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes or cleanouts only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes as shown in the Drawings or APWA Plan 341.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous concrete pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 INSTALLATION - INLETS, CATCH BASINS, CLEANOUTS

A. Install inlets, catch basins, or cleanouts as shown in the Drawings or APWA Plans 315, 316, 317, 331, 332 and 611.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Construct with all connecting piping and appurtenances in their final position.

D. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.7 INSTALLATION SUB DRAIN SYSTEMS

A. Install pipe and fittings per manufacturer's requirements.

B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe circumference, centered over joint.

C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.

D. Place drainage pipe on bed of sewer rock, Section 31 05 13.

3.8 INSTALLATION - TAP CONNECTIONS

A. Not allowed in storm drain systems. Provide a cleanout or manhole structure.

3.9 INSTALLATION - OUTFALLS

A. Install outfalls as shown in the Drawings or APWA Plans 322 and 323.

3.10 INSTALLATION – DIVERSION BOXES AND AREA DRAINS

A. Install boxes and drains as shown in the Drawings or APWA Plans 613, 614 and 372.

3.11 BACKFILLING

A. Trench Backfill: Section 33 05 20. Place backfill as shown in the Drawings or the following.

1. APWA Plan 382 in the pipe zone.
2. APWA Plan 381 above the pipe zone.

B. Structural Backfill: Section 31 23 23.

3.12 SURFACE FINISHING

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.13 COMMISSIONING

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.14 CLEANING

A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 47 00
PONDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing pond site and disposal of debris and unsuitable material.

B. Materials for dikes.

1.2 REFERENCES

A. ASTM Standards:

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.3 SUBMITTALS

A. Laboratory analysis and control testing reports of fill to be used in dikes.

B. Sample of geosynthetics to be installed.

C. Quality assurance test results within 24 hours of completed test results.

1.4 PERFORMANCE

A. Protection: Do not contaminate embankment materials with debris or unsuitable material. Protect existing improvements, trees, structures or other items from damage during construction.

B. Dust Control: Section 01 57 00. Prevent dust from being a nuisance to neighborhood, and performance of separate work.

1.5 QUALITY ASSURANCE

A. Perform density tests to assure compacted backfills comply.

B. Do not interrupt surface drainage systems at site without ENGINEER's approval.

C. Control erosion during construction and correct any damage caused by runoff.

PART 2 PRODUCTS

2.1 BACKFILL SOILS

A. Authorized over-excavation fill, Section 31 23 16.

B. Common fill, Section 31 05 13.

C. Aggregate base course, Section 32 11 23.

D. Cement treated fill, Section 31 05 15.

E. Impermeable embankment, ASTM D3282. A-4, or A-6 material, with a plasticity index of at least 10, and a coefficient of permeability less than 7 x 10^{-6} cm/sec.

F. Obtain approval of backfill soils to be supplied before beginning construction.

2.2 GEOSYNTHETIC MATERIALS

A. Impermeable, nonbiodegradable sheet material, inert to soil chemicals, resistant to molds, mildew, acids and alkalis, and within a pH range of 3 to 12.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Remove and stockpile topsoil material for later placement on outer dike surfaces.

B. Excavation, Section 31 23 16.

C. Level areas where dikes are to be constructed.

D. Scarify subgrade 12 inches and compact to 92 percent minimum relative to a standard proctor density, Section 31 23 26.

E. Place embankment materials in lifts consistent with compaction equipment capability. Compact backfill soils to 95 percent or greater relative to a standard proctor. Do not construct embankment with frozen or unapproved material.

F. Shape dikes to the slopes indicated.

3.2 **TOLERANCES**

A. Dike Surface: Plus or minus 1 inch from true grade.

B. Dike Width: Plus or minus three (3) inches from design dimension.

C. Dike Alignment: Plus or minus six (6) inches from true line.

3.3 **FINISHING**

A. After dikes have been constructed to lines and grades indicated, spread topsoil on dikes and grade to uniform slope and thickness.

B. Dispose of excess or unsuitable materials and smooth grade all affected areas.

C. Leave site free of debris.

END OF SECTION

SECTION 33 71 73
ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Under ground and above ground electrical service systems.

1.2 REFERENCES

A. **NFPA Standards**:

70 National Electric Code.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to.

1. NFPA 70.
2. Electrical authority having jurisdiction.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Conduit: Section 26 05 33.

B. Concrete: Class 3000 minimum, Section 03 30 05, with No. 67 aggregate or larger and dye additive to give permanent red color.

C. Conductors: Section 26 05 13 or required by NFPA 70.

D. Cable Lugs: Suitable for application.

E. Duct Spacers: Fabricated plastic, UL approved.

F. Meter Sockets: Comply with requirements of power utility company.

G. Metering: Sized to capacity of main switch or buss as applicable.

2.2 BACKFILL

A. Sand fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Provide adaptation from conduit to PVC duct.

B. Slope service to drainage point.

C. Terminate service conduit in main panel and transformer with grounding bushings. Make suitable ground connection from bushing to distribution center ground bus.

D. Install on undisturbed soil where possible. Comply with backfill and compaction requirements of Section 31 23 26.

3.3 **DUCTBANK**

A. Place concrete so voids around ducts are filled.

B. Provide minimum concrete thickness between ducts of two (2) inches.

C. Adjust final slopes on site to coordinate with existing utilities.

D. Install drain assembly with saddle cutouts for each conduit. Tape drain assembly to each conduit to prevent entrance of concrete. Band drain assembly with 1/2 inch stainless steel straps to conduit assembly to prevent mechanical displacement. Connect to piping drain.

E. After installation, clean and swab ducts.

F. Install galvanized steel pull wires in spare ducts. Cap spare ducts.

3.4 **DIRECT BURIAL**

A. Level trench with three (3) inches minimum layer of sand. Cover conductors with six (6) inches layer of sand. Provide physical protection acceptable to electrical authority having jurisdiction.

3.5 **SERVICE INSTALLATION**

A. Provide duct bank from property line or supply authority's pole to transformer or building as required.

B. Coordinate with utility company to install conductor from source to meter. Coordinate trenching, supplying and placing of sand and backfilling with power utility company.

3.6 **FIELD QUALITY CONTROL**

A. Inspect, splice and test continuity for all special telemetry cables before backfilling trenches.

END OF SECTION

DIVISION 34

TRANSPORTATION

SECTION 34 41 13
TRAFFIC SIGNALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Traffic signal light system, including pole, mast arm, heads, controller, detectors, junction box, and paint.

1.2 REFERENCES

A. **ANSI Standards**:

C80.1 Electrical Rigid Steel Conduit (ERSC).

B. **APWA (Utah) Standards**:

Plan 255 Bituminous concrete “T” patch.

Plan 256 Concrete pavement patch.

Plan 731 Junction box.

Plan 732 Trench for buried electrical conduit.

Plan 751 Signal pole foundation.

Plan 752 Signal pole wiring.

Plan 753 Signal light head.

Plan 754 Signal cabinet base.

Plan 755 Pedestrian push button pole.

C. **ASTM Standards**:

A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

A501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

B85 Aluminum-Alloy Die Castings.

D. **FS Standards**:

595 Colors.

TT-E-489 Enamel, Alkyd, Gloss, Low VOC Content.

TT-E-529 Enamel, Alkyd, Semigloss, Low VOC Content.

E. **DOT Standards:**

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

F. **IMSA Standards**:

20-1 Polyethylene Insulated Polyethylene Jacketed Signal Cable.

20-2 Polyethylene Insulated Polyethylene Jacketed Push Button, Audible Cable.

40-6 Drop Cable.

50-2 Loop Detection Lead-in Cable, Polyethylene-insulated Polyethylene-jacketed.

51-3 Cross Linked Polyethylene Insulated Loop Detector Wire.

51-7 Loop Wire, Polyethylene-insulated Polyethylene-jacketed.

60-4 Paired, Polyethylene Insulated, Polyethylene Jacketed, Integral Messenger, Fill, Communication Cable with Electrical Shielding.

60-6 Paired, Polyethylene Insulated, Polyethylene Belted, Polyethylene Jacketed, Filled Communication Cable with Electrical Shielding

62 Ground Rods.

G. **ITE Standards**:

VTCSH Vehicle Traffic Control Signal Heads.

PTCSI Pedestrian Traffic Control Signal Installation.

H **NEC Standards**:

770 National Electric Code.

I. **NEMA Standards**:

250 Enclosures for Electrical Equipment (1000 Volts Maximum).

TC-2 Electrical Polyvinyl Chloride (PVC) Conduit.

TC-3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

TS-2 Traffic Control Systems.

J. **NFPA Standards**:

70 National Electric Code.

K. **UL Standards**:

6 Electrical Rigid Metal Conduit – Steel.

94VO Flammability of Plastic Materials for Parts in Devices and Appliances.

1.3 **DEFINITIONS**

A. **Controller Assembly**: A complete electrical mechanism mounted in a cabinet for controlling the operation of a Traffic Signal Light system.

B. **Controller Unit**: That portion of a Controller Assembly that is devoted to the selection and timing of signal displays.

C. **LED**: Acronym for light emitting diode.

D. **Traffic Signal Light**: A power-operated traffic control device with red, amber, green and white lights by which vehicular (and pedestrian) traffic is warned or directed to take specific action.

E. **CCTV**: Acronym for closed circuit television assembly.

1.4 **SUBMITTALS**

A. Shop Drawings of signal poles, signal arms, signal heads and back plate unit, signal light support unit, pedestrian signal head, push button and sign.

B. Controller Assembly Wiring Diagrams: Show

1. Schematic wiring diagrams that have the same phase designations as shown on the plans for the intersection.
2. List of all equipment installed in each cabinet.
3. Sketch showing standards detectors, phasing to be installed in a weatherproof plastic envelope to be attached to the inside of the door of each controller cabinet.

C. Data sheets for conduit, casings, and conductors.

D. Junction box details.

E. Paint data sheets and touch-up paint data.

F. Warranties and instruction sheets.

G. Field quality control testing results. NEMA TS-2 establishes the test procedures required to demonstrate the conformance of controller and subassemblies.

H. LED Traffic Signal Module: Verify certification to the latest VTCSH Standards. Verify it meets applicable NEMA standards.

1. Supply a certified letter from and Independent Testing Laboratory stating the module(s) has been tested and meets the above certifications.
2. Traffic Signal Module: Has the following statement: “Manufactured in Conformance with the Interim Purchase Specification of the ITE for LED Vehicle Traffic Signal Modules”.

3. Bicycle Traffic Signal Module: Has the following statement: “Manufactured in Conformance with the Interim Purchase Specification of the ITE for LED Bicycle Traffic Signal Modules”.

1.5 **QUALITY ASSURANCE**

A. Verify manufacturer has

1. A process to test photometric maintenance compliance of minimum intensity values of LED modules in a controlled and independent laboratory during the warranty period.

2. A a portable, calibrated light meter on-site that allows for field measurement of luminous intensity of modules.

1.6 **MAINTAIN EXISTING SYSTEM**

A. Notify ENGINEER prior to performing any work on existing systems.

B. Provide an officer to control temporary traffic interruptions.

C. Vehicle Detection During Construction: Temporary vehicle detection will be required for all approaches at signalized intersection that currently have loop detection which may be disturbed by construction with duration of 15 days or more. In addition, traffic signal communications (telephone or other) to the central signal computer and CCTV (if present) shall be maintained continuously during the work. CONTRACTOR through the life of the work shall maintain the detection zones and communications by ensuring full functionality 24 hours a day, 7 days a week.

D. Cover all inoperative signal heads in white until placed into operation.

E. Keep existing traffic signal systems in effective operation for the benefit of the traveling public during the progress of the Work, except when shutdown is permitted to allow for alterations or final removal of the systems.

F. Place new signal installation in the appropriate flash operation for 72 hours prior to being placed into full operation.

G. Obtain safety circuit clearance from serving utility daily before starting work on traffic signals adjacent to existing street light series circuits.

1.7 **MANUFACTURER LED MODULE WARRANTY**

A. Replace or repair any LED module if it fails to function as intended for 84 months (7 years) from the date of delivery. If repaired, the warranty covers all parts and labor necessary or incidental to the repair.

B. Provide all guarantees that are customarily issued by the manufacturer.

C. OWNER or its appointee may elect to make minor repairs, with the consent of the manufacturer. Make all other repairs under warranty by the manufacturer. The manufacturer bears all costs including labor, parts, and shipping charges.

D. Replace or repair all LED vehicle traffic signal modules that exhibit luminous intensities less than the minimum values specified by manufacturer for 60 months (5 years) of the date of delivery.

E. Replace or repair all LED bicycle traffic signal modules that exhibit luminous intensities less than the minimum valves specified for 60 months (5 years) of the date of delivery.

1.8 **SYSTEM STARTUP**

A. Maintain existing signal system operating until new system is operational. Remove span wire assembly same day as new signal becomes operational.

B. Before final service connection is made:

1. Arrange for power service disconnects and load centers inspection by owning agency.

2. Terminate branch circuits from service disconnect at end load.

C. Color code cabinet field wiring as indicated in this Section.

D. New signal installations are to be provided with temporary “SIGNAL AHEAD” signs. Signal is to be placed into the appropriate flash operation for at least 72 hours prior to being placed into full operation.

E. Inoperative signal heads are to be covered in white canvas (tied, not taped) until placed into operation.

PART 2 PRODUCTS

2.1 CONDUITS AND CASINGS

A. Conduits and Fittings:

1. PVC: Schedule 40, NEMA TC-2, TC-3, UL listed.
2. Rigid Steel: UL 6, galvanized, ANSI C80.1.

B. Casings and Fittings: Smooth steel with a minimum ¼-inch wall thickness and required diameter.

2.2 CONDUCTOR WIRE

A. Signal Cable: IMSA 20-1.

B. Audible Cable: IMSA 20-2.

C. Buried Cable: IMSA 60-6.

D. Aerial Cable: IMSA 60-4.

E. Drop Cable: IMSA 40-6.

F. Service Cable: Single conductor types RHH-USE-RHW.

G. Interconnect Cable: Twisted pair fill shielded, IMSA 60-6.

H. Loop Detection Lead-in Cable: IMSA 50-2.

I. Loop Wire:

1. PVC Installation: No. 14, single conductor, stranded wire, IMSA 51-3.
2. Saw cut Installation: No. 14 single conductor, stranded wire, IMSA 51-7.

J. Ground Rod: IMSA 62.

K. Enclosure (1000 volts maximum): NEMA 250.

L. Traffic Control System: NEMA TS-2.

M. Fiber Optic: NEC 770.

N. NEMA WC 5: Thermoplastic-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy: NEMA WC 5.

2.3 SIGNAL POLE

A. Pole: Steel, ASTM A570:

1. Allowable Stresses: Fb = 21,750 psi (0.66Fy)
   Fv = 10,800 psi (0.33Fy)
2. Galvanized, ASTM A123.
3. Wind Load: 80 mph with 105 mph gusts.

B. Foundation:

1. Concrete: Class 4000, Section 03 30 04.
2. Reinforcement: Grade 60 ksi deformed steel, Section 03 20 00 epoxy coated or galvanized.
3. Grout: Non-shrink, Section 03 61 00.

C. Anchor Bolts: Galvanized steel, Section 05 05 23.

2.4 TRAFFIC SIGNAL LIGHT SUPPORT UNIT

A. Mast Arm: Steel.

B. Hanging Unit: 1-1/2 inches standard steel pipe with malleable iron or bronze fittings, adjustable through 360 degrees about a vertical axis.

C. Base Support Unit: Clamp type mounting with terminal compartment side away from traffic and parallel with prolongation of nearest curb face.

2.5 TRAFFIC SIGNAL LIGHT COMPONENTS

A. Body: Provide type indicated in Drawings or type shown on APWA Plan 753 Sheet 1.

1. Die cast aluminum, ASTM B85.

2. Each body has provisions for mounting terminal blocks accommodating 1 ½-inch mounting fixtures at each end and attaching back plates. Each end will have serrations on five (5) degree increments. Bodies may be fashioned together to make section signals of the vertical type, three sections, with terminal blocks located in the top section. Body must be adjustable, waterproof, with doors and end plates.

3. All exposed bolts, screws, hinge pins and door locking devices, stainless steel.

4. All interior screws and fittings, stainless steel or nonferrous, corrosion resistant material.

5. All gaskets; neoprene.

6. Terminal blocks fitted with sufficient screw type terminals for independent wire connections. Permanently identify terminals.

B. Door: One-piece die-cast aluminum painted flat black equipped with stainless steel hinge pins. Stainless steel wing nuts hold door against body. Door swings 180 degrees.

C. Visor: One-piece 0.030-inch-thick sheet aluminum attached to door painted flat black. Length of visor for 12 inches section; 11 inches minimum. Removable visor is secured to door with stainless steel hardware. Directional louvers when indicated shall have snug fit and screwed to hoods.

D. Lamp Mounting:

1. Lenses: Glass or polycarbonate resin free from imperfection, circular with a visible diameter of 12 inches of colors red, amber and green.

2. Lamp holder: Vibration resistant, weatherproof, and molded construction. Each lamp holder shall position the lamp filament at the focal center of the reflector and be adjustable for filament burn down position. Provide with two (2) color-coded 18 AWG or larger rubber covered lead wires conforming to ASTM specifications, securely fastened to the socket, and of sufficient length to reach the terminal block.

3. Reflector: One-piece parabolic, alzak finished specular aluminum with a focal length of three (3) inches or as required.

4. Lamps: Clear 165-watt initial output, 130 volt, 8,000 hours rated life, 1950 lumens minimum.

E. LED Mounting:

1. Modules built to VTCSH standard without modification to the modules or body fit into existing body.

2. Arrow modules have at least three rows of LEDs. Balls must be full field design. Both ball and arrow modules must be capable of installation in signal head with reflector in place.

3. Ensure measured chromaticity coordinates of modules is between 500nm and 650nm, conforming to chromaticity requirements of VTCSH standard.

F. Gaskets: Molded one-piece lens gasket to seal lens to reflector assembly and door to form a sealed unit. A second gasket between door and housing to insure weather tight.

G. Back Plate: Aluminum, louvered with 5” border, dull black. Dimensions as shown in the Drawings or APWA Plan 753.

H. Clamp Mounting Bracket and Plumbizer Mount: Dull black.

I. Paint: Two coats of traffic signal enamel; FS TT-E-489, Class A matching FS 595 in colors selected by ENGINEER:

1. Signal Head: Color selected by ENGINEER.

2. Signal Visor (inside): Dull black.

3. Signal Back Plate: Color selected by ENGINEER.

2.6 **CONTROLLER ASSEMBLY**

A. Cabinet: NEMA TS-2.

1. Size 5, Type 1 configuration base mounted.

2. Aluminum with anodized finish.

B. Controller Unit: NEMA TS-2 Type 1.

1. Solid-state Electronic Components: Minimum Design Life of five (5) years based upon 24 hours operation.

2. Timing periods as follows.

Minimum Range	Timing Interval (Seconds)
Walk	0 to 99
Vehicle Initial	0 to 99
Preset Gap	0 to 9.9
Green Clearance	0 to 99
Yellow Clearance	0 to 9.9
All Red Clearance	0 to 9.9

3. Two (2) through eight (8) phase fixed-time, semi-actuated or fully actuated capabilities with RS-232 modems.

C. Signal Load Relay Units: NEMA TS2 Type 1:

1. Solid-state with a Design Life of five (5) years based upon 24 hours operation.
2. Circuit capable of switching 1,000 watts load to signal lamps.
3. The load shall not exceed 1,000-volt amperes when inductive leads are switched.
4. Signal switching function controlled by outputs of ground potential from the traffic signal controller.
5. Plug into standard NEMA sockets.

D. Fail Safe Unit: NEMA TS 2. Activated by any malfunction of the controller or solid-state switching modules. Manual reset by push button on the face of the unit only after malfunction that caused activation has been corrected. Capable of monitoring not less than 16 phases. The unit being separate and self-contained with output latch relay being contained in the unit as a standard feature.

2.7 **DETECTOR, INDUCTIVE LOOP**

A. Loop: NEMA TS 2 Type 1.

B. Adjustable range of sensitivity able to detect all motor vehicles regardless of speed or size capable of operating loops varying in size from 3 x 3 feet to 6 x 12 feet.

C. Modes of Operation: Three (3) phases as follows:

1. Short: Indicate a normal size vehicle at approximately 1/4 second.
2. Middle: Indicate a presence of vehicle from four (4) minutes to not more than 10 minutes.
3. Long: Indicate presence of vehicle indefinitely.

D. The detector shall be fail-safe and shall include in its construction, all material required of the tuning of the detector.

E. A complete detector unit including power supply terminals shall be included with all adjusting switches and dials located on the face of the panel cabinet.

F. Metal objects in the vicinity of, but not within the loops shall not affect detector relay operation.

2.8 **PEDESTRIAN SIGNAL LIGHT HEAD**

A. Housing: One-piece die-cast aluminum 16 inches by 18 inches with serrations on five (5) degree increments in each end. Each body has provisions for mounting terminal blocks, accommodating 1-1/2” mounting fixtures top and bottom.

B. Door: One-piece die-cast aluminum equipped with stainless steel hinge pins. Stainless steel wing nuts hold the door against the body. Door swings 180 degrees.

C. Visor: Aluminum louvered section with polycarbonate plastic members not more than 0.04 inches thick.

D. Reflector: Single piece double parabolic textured polycarbonate plastic. (not required with LED countdown modules).

E. Lens: Tempered glass using international symbols of lunar white person for "walk" and Portland Orange hand for "don't walk" indications that conform to latest ITE standard specifications. (Not required with LED countdown modules).

F. Gaskets: Weather tight molded one-piece lens gasket between the door and housing.

G. Paint: Color selected by ENGINEER. Ultra-violet resistant polyester powder coating electrostatically at 90 kV and baked for 20 minutes at 375 deg F

H. Audible module: Sensitive to ambient noise:

1. Weatherproof.
2. Cuckoo and peep sounds.
3. Audible signal installed behind reflector.
4. Amplifier installed below the man symbol.
5. Speaker installed on bottom pointing down.

I. Countdown Timers: Included.

2.9 **PEDESTRIAN PUSH BUTTON**

A. Housing radius to match poles or adjustable. Weatherproof design to operate at less than 50 volts. Temperature range of minus 30 deg F to plus 165 deg F and 0 to 100 percent relative humidity.

B. ADA accessible with large ADA button.

C. Sign portion printed with international symbol and arrow for crossing direction.

1. Pedestrian Pole: 5”x7”.
2. Signal Pole: 7”x9”.

D. Stainless steel hardware

2.10 **JUNCTION BOXES**

A. Reinforce polymer concrete in landscaping and paved surfaces. Provide type shown in the Drawings or APWA Plan 731.

B. Cover Marking: "Traffic Signal", “Fiber Optic” or as applicable.

C. Type and size selected by CONTRACTOR if not indicated elsewhere.

2.11 **CONCRETE AND GROUT**

A. Concrete: Class 4000, Section 03 30 04.

B. Precast Concrete: Class 5000 minimum, Section 03 40 00.

C. Grout: Shrinkage resistant, Section 03 61 00.

2.12 **PAINT**

A. Oil-alkyd painting system, SSPC 25 BCS:

1. Black; FS 595 color #37056.
2. Green; FS 595 color #14159.
3. Gray; FS 595 color #26306.

2.13 **SAW CUT SEALANT**

A. Moisture cured polyurethane rubber.

B. DO NOT provide epoxy adhesive containing acetate solvent.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Remove all existing electrical equipment to be salvaged in a manner as to maintain its usefulness. Deliver to location designated by ENGINEER.

D. Notify ENGINEER before performing any work on existing systems.

E. Keep existing traffic signal systems in effective operation except when shutdown is permitted to allow for alterations or final removal of the systems.

F. Obtain safety circuit clearance from serving utility daily before starting work on traffic signals adjacent to existing series street lighting circuits.

G. Signal devices, heights and positions conform to MUTCD, power company and other utility regulations.

H. Deliver existing electrical equipment that are salvaged for OWNER to designated location.

3.2 **INSTALLATION - POLE FOUNDATION**

A. Install foundations as shown in the Drawings or APWA Plan 751.

B. Keyhole to verify pole foundation placement.

C. Place and plug conduit ends before concrete pour.

D. Place anchor bolts in proper positions and proper height. Hold until concrete sets.

E. Do not weld reinforcing steel, anchor bolts, or conduit.

F. Signal heights and positions to match MUTCD requirements. Match longitudinal grades of foundation cap with top of existing crown of road when crown of road is higher than existing ground. When existing ground located by pole foundation is higher than crown of road, match pole foundation elevation to surrounding concrete or two (2) inches above surrounding ground.

G. Special inspection will be conducted on the rebar and concrete, notify ENGINEER 24 hours before pouring concrete.

H. Cure foundation seven (7) days before erecting signal pole and achieve concrete design strength before erecting arms.

I. Whenever edge of concrete foundation is within 18 inches of any existing concrete improvement, provide four (4) inches thick concrete slab to meet such improvement.

3.3 **INSTALLATION - POLE**

A. After plumbing pole cut anchor bolt off at 1 inch above top nut. Place grout completely under base pedestal. Coat exposed cut metal surface with spray galvanizing.

B. Repair holes in existing poles:

1. Steel Shaft: Weld a suitable disc, grind smooth to match existing surfaces. Coat exposed surfaces with spray galvanizing or paint as applicable to prevent corrosion.

2. Concrete Shafts: Shrinkage resistant grout to match existing texture and color.

C. Painting: Apply coatings, Section 09 91 00. Paint metallic surfaces a primer coat and two (2) coats of finish paint per ENGINEER's selection of color and type.

3.4 **INSTALLATION – HEAD**

A. Placement and clearances as shown in the Drawings or APWA Plan 753 Sheet 2.

3.5 **INSTALLATION - JUNCTION BOX**

A. Refer to Section 26 56 19.

B. Install as shown in the Drawings or APWA Plan 731 in locations as follows.

1. Park Strip: APWA Plan 732 Sheet 1.

2. Roadway: APWA Plan 732 Sheet 2.

C. Maximum run is 250 feet unless indicated elsewhere.

D. Without additional cost to OWNER, add such additional boxes as may be desired to facilitate work.

3.6 **INSTALLATION - GROUNDING**

A. NFPA 70 and Section 26 56 19.

B. No daisy chain wiring, or wire arrays allowed.

3.7 **INSTALLATION - CONDUIT**

A. Trench excavation, Section 31 23 16.

B. Raceways, Section 26 05 33

C. Buried Conduit, Install as shown in the Drawings or APWA Plan 732 Sheet 1 or Sheet 2.

D. Interconnection as follows.

1. Two (2) inch diameter between traffic light poles.
2. Three (3) inch diameter between controller and communication system.
3. Three (3) inch diameter between power source and pedestal.

E. T-Patch: Restore as shown in the Drawings or APWA Plan 732 Sheet 1 or Sheet 2

1. APWA Plan 255 for bituminous concrete pavement.
2. APWA Plan 256 for Portland cement concrete pavement.

F. Under Railroad: As specified in OWNER's railroad agreement.

G. Direction Boring: Permitted unless specified otherwise.

3.8 **INSTALLATION - WIRING**

A. The power company will install pole conduit and pole standoffs to the power source. It will also install all conductors from the power source to underground service pedestal.

B. Install wires and cables, Section 26 05 13 and NFPA 70. Tape back any wire not used.

C. Cable continues from cabinet to signal head with no in-line splices.

D. Terminated cables with appropriately sized fork crimp connectors.

E. Color code per the Drawings or APWA Plan 752.

3.9 **INSTALLATION - DETECTOR LOOPS**

A. Use one continuous length of conductor from junction box to loop and back to junction box.

B. One turn is once around the loop. Two turns are twice around the loop with the same conductor in the same direction. All loops shall contain four (4) turns of wire.

C. Loop all conductors in the same direction (clockwise or counter-clockwise) for all loops on the same vehicular approach.

D. Label loop conductors in junction box "input" or "output" as applicable.

E. Splicing conductors is not allowed.

F. Splicing of conductor to loop detection lead-in cable to be a soldered splice and made in junction box only.

3.10 **INSTALLATION - CONTROL CABINET**

A. Install foundation as shown in the Drawings or APWA Plan 754 Sheet 1 or Sheet 2 as applicable.

B. Use colored electrician's tape to make cable identifications in signal control cabinet.

	Northbound P2	**Southbound P3**	**Eastbound P4**	**Westbound P1**
Signal Circuit	Blue	Red	Yellow	Orange
Detector Circuit	Blue	Red	Yellow	Orange
Pedestrian -Circuit	Blue & Green	Red & Green	Yellow & Green	Orange & Green
Pedestrian Button	Blue & White	Red & White	Yellow & White	Orange & White
Audible Circuit	Blue & Black	Red & Black	Yellow & Black	Orange & Black

NOTES
(a) Circuit Coding:
1 Band = Through Lanes
2 Bands = Left Turn Lane
3 Bands = Q Loops.

3.11 **INSTALLATION - VIDEO CAMERA**

A. Install, aim, focus camera.

B. Video detection programming by ENGINEER.

3.12 **INSTALLATION – PEDESTRIAN PUSH BUTTON POLE**

A. Install pole as shown in the Drawings or APWA Plan 755.

B. Provide a landing surface if push button pole is not accessible from the pedestrian way.

C. Push button must be within 10 feet of curb cut.

3.13 **PAINT REPAIR**

A. Apply touch-up paint per manufactures' recommendation. Match color and type.

3.14 **FIELD QUALITY CONTROL**

A. Test each detector loop. Document and submit readings for each loop:

1. Continuity under 600 ohm per volt.
2. 200 megohms at 600 volts minimum between conductor and ground.
3. Inductance: 80 to 1000 micro-Henries.

B. Test all signal cabling after installation before turning on:

1. Wire to wire.
2. Wire to ground.

C. Test all grounds after installation before turning on. 3 ohms or less is desirable. Maximum is 10 ohms. Document all readings.

D. Test all electrical circuits for function and document results before turning on.

E. Test all fiber optic cables with OTDR. Document and submit readings for each fiber.

END OF SECTION

SECTION 34 71 13
VEHICLE BARRIERS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Galvanized steel beam guardrail and Jersey barrier systems.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M180 Corrugated Sheet Steel Beams for Highway Guardrail.

B. **ASTM Standards**:

A36 Structural Steel.

C. **WWPA Standards**.

PART 2 PRODUCTS

2.1 **BEAM GUARDRAIL**

A. Steel, ASTM A36 and AASHTO M180. Class A (0.0105 inch thickness) Type 1 with steel compression blocks.

B. Galvanizing, Section 05 05 10.

2.2 **GUARD RAIL POSTS AND OFFSET BLOCKS**

A. Steel, ASTM A36 and AASHTO M180.

B. Wood per douglas fir-larch, hemlock-fir, lodge-pole pine, or ponderosa pine that are Grade No. 1 or better in accordance with WWPA Standard Grading Rules. Provide only one species. Wood posts and blocks may be surfaced or rough sawn.

C. Treat wood guardrail posts, Section 06 10 00. Use preservatives that are compatible with the timber and make rodent repellent for timber in contact with the ground.

2.3 **ACCESSORIES**

A. Bolts, Nuts, Washers: Steel, Section 05 05 23.

2.4 **CONCRETE**

A. Concrete: Class 4000, Section 03 30 04.

B. Precast Concrete: Class 5000 minimum, Section 03 40 00.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

3.2 **POSTS**

A. Space and place posts as required.

B. Drive posts if satisfactory results are obtained without damage to the post. When posts are driven through bituminous concrete, seal area around posts with concrete.

C. Excavate post holes when not driven. Correct over excavated depth of post holes. Compact backfill material around post to 95 percent of a Relative Density and dispose of excess material.

3.3 **RAIL ELEMENTS**

A. Erect rail elements to produce a smooth, continuous rail paralleling line and grade of road surface.

B. Lap rail elements in direction of traffic and offset rail from post with a block.

C. Curve rail elements, before erection.

D. Field drill or punch holes for special details.

E. Provide trailing end elements at ends of all sections including bridge rail connections.

F. On two (2) lane roads construct approach elements at both ends.

G. At bridge approaches and other designated areas, construct a double thickness of rail with additional posts installed midway between the regular posts.

H. Provide impact attenuators, mushroom terminal sections, and roll down ends where required.

3.4 **JERSEY BARRIERS**

A. Install in location to produce a smooth wall surface paralleling line and grade of road surface.

B. Anchor and join each barrier section per manufacturer's recommendations.

C. Provide trailing end elements and impact attenuators.

END OF SECTION

SECTION 34 71 19
VEHICLE DELINEATORS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Delineator reflectors, posts, and layout for roadways.

1.2 **REFERENCES**

A. **APWA (Utah) Standards:**

Plan 241 Parking meter post.

B. **FS Standards**:

LP 380 Plastic Molding Material Methacrylate.

LS 300 Sheeting and Tape, Reflective: Nonexposed Lens.

C. **DOT Standards**:

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 **SUBMITTALS**

A. Submit manufacturer's data on reflector lens candle power.

PART 2 PRODUCTS

2.1 **REFLECTORS**

A. Reflective Sheeting: FS L-S-300 with 2,200 hours minimum durability and not less than 6.5 square inches of reflective area.

B. Lens: Methyl methacrylate per FS L-P-380 requirements, with an overall size not less than 6.5 square inches of reflective area, free from projections or indentations, other than a central mounting hole and identification. Specific intensity of the lens to equal or exceed the following values:

Table 1 – Specific Intensity Candle Power

Type of Lens	Observation Angle (Degrees)	Entrance Angle (Degrees)	Candle Power (Foot–Candle, min.)
White	0.1	00	119
White	0.1	20	47
Amber	0.1	00	84
Amber	0.1	20	39

1. The brightness under rainfall conditions for amber lenses shall not be less than 80 percent of the brightness values of the totally clean and dry lens.

2. Back of Lens: Opaque fused to the lens to seal against dust, water and water vapor.

3. Housing: 0.020 inch 5052-H32 aluminum formed to retain the acrylic reflector and marked with the name and part number of manufacturer.

2.2 **POSTS**

A. Structural Steel: Galvanized, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8-inch diameter mounting holes.

B. Flexible Plastic: Resistant to ultraviolet light, ozone, hydrocarbons, and impact from -30 deg F to 130 deg F, with a minimum width of two (2) inches facing traffic. White, yellow, or orange unless indicated.

C. Length: As determined in the field with a minimum burial of 18 inches or surface attachment bolts.

2.3 **ACCESSORIES**

A. Bolts, Nuts, Washers: Galvanized steel, Section 05 05 23.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. **Mounting**: Four (4) feet above near roadway pavement edge unless indicated otherwise

B. **Delineator Posts:** In line with guard rail or Jersey barrier if present, or not less than two (2) feet nor more than six (6) feet outside of edge of roadway.

C. **Parking Meter Posts:** Install as shown in the Drawings or APWA Plan 241.

3.2 **DELINEATOR AIMING**

A. MUTCD.

END OF SECTION