

CHASE GULCH DAM & RESERVOIR
TOE DRAIN REPAIR
C-1743B

GILPIN COUNTY, COLORADO
WATER DIVISION 1, WATER DISTRICT 7
DAMID: 070314

TECHNICAL SPECIFICATIONS



PREPARED FOR:

CITY OF CENTRAL
P.O. Box 249
CENTRAL CITY, CO 80427

D&A JOB No. CG-0117.001.13

MAY 2016

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CERTIFICATION SHEET

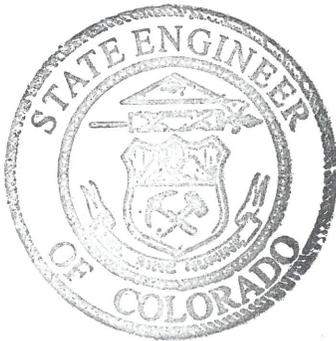
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DAM ID 070314

I hereby certify that these plans and specifications for the construction of Chase Gulch Dam & Reservoir Toe Drain Repair were prepared under my direct supervision for the Owner thereof.



By: 
Glen G. Church, P.E. No. 31642

Approved on this 13TH day of JULY, 2016.



By: Dick Wolfe
State Engineer


William T. McCormick, III
Chief - Dam Safety Branch
Colorado P.E., No. 29127

Chase Gulch Dam & Reservoir Toe Drain Repair

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TECHNICAL SPECIFICATIONS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 14 01
STATE ENGINEER OFFICE REQUIREMENTS

PART 1 GENERAL

1.01 SEO STATEMENTS

“Approved plans and specifications shall not be materially changed without prior written approval of the State Engineer in accordance with Rule 9.1.8,” and

“The State Engineer has the authority to require the material used and the work of construction to be accomplished according to the rules and regulations and that construction shall not be considered completed until the State Engineer has accepted the same in writing,” and

“The Owner’s engineer shall monitor the quality of construction as specified in Rule 9 of the Rules and Regulations for Dam Safety and Dam Construction, January 1, 2007.”

All requests for SEO approval of changes and project acceptance shall come from the Owner’s engineer.

1.02 PRECONSTRUCTION CONFERENCE

Included in attendance at the preconstruction conference shall be a representative of the State Engineer’s Office (SEO).

END OF SECTION

SECTION 01 33 00
CONTRACTOR SUBMITTALS

PART 1 GENERAL

1.01 GENERAL

- A. Wherever submittals are required in the Contract Documents, submit them to Construction Manager.
- B. Contractor shall be responsible for the accuracy, completeness, and coordination of submittals. Contractor shall not delegate this responsibility in whole or in part to any Subcontractor. Submittals may be prepared by Contractor, Subcontractor, or Supplier, but before submitting it, Contractor shall ascertain that each submittal meets the requirements of the Contract and the Project. Contractor shall verify that there is no conflict with other submittals and shall notify Construction Manager in each case where Contractor's submittal may affect the work of another contractor or the Owner. Contractor shall coordinate submittals of related crafts and Subcontractors.

1.02 ELECTRONIC SUBMITTALS REQUIRED

- A. Unless specifically accepted in this specification, by the Owner or elsewhere in the Contract Documents, each submittal shall be made in an electronic format using the designated Electronic Document Management System.
- B. Samples shall be submitted via hard copy as described in this Section and using the designated Electronic Document Management System. Other submittals that include large format drawings or very lengthy documents may be considered by the Owner for hardcopy distribution. Hardcopy submittals, except for material samples, will not be accepted by the Owner without prior approval.
- C. Each submittal will be an electronic file in the Adobe Acrobat Portable Document Format (PDF). Use the latest version available at the time of execution of the Agreement. Electronic files that contain more than 10 pages in Adobe Acrobat format shall contain internal book-marking from an index page to major sections of the document. PDF files shall be set to open "Bookmarks and Page" view. General information shall be added to each PDF file, including Title, Subject, Author, and Keywords. Adobe 7.0 or higher is required.
 - 1. PDF files shall be unsecured, unencrypted and not password protected.
 - 2. The following actions within Adobe Acrobat shall be allowed:
 - a. Printing
 - b. Changing
 - c. Assembling
 - d. Content copying or extraction
 - e. Extraction for access
 - f. Commenting
 - g. Fitting of form fields
 - h. Signing
 - i. Creation of duplicate information
- D. The PDF files shall be set up to print legibly at either 8-1/2-in by 11-in, 11-in by 17-in, or 22-in by 34-in paper sizes. No other paper sizes will be accepted.
- E. New electronic files shall be required for each re-submittal.
- F. The Owner will reject any submittal that is not electronically submitted.
- G. Contractor shall provide the Owner with the authorization to reproduce and/or redistribute each file as many times as necessary for the project.
- H. Contractor shall include all costs for preparation of electronic and hard copies of the submittal material in its bid, including all re-submittals, record copies, and final copies.

1.03 SCHEDULE OF SUBMITTALS

- A. Refer to Articles 2.05 and 2.06 of the General Conditions for submission of the preliminary and final versions of the Contractor's Schedule of Submittals.
- B. The Schedule of Submittals (list) shall be compiled using Microsoft Excel software.
- C. The submittal schedule shall contain all submittals required by the Contract Documents as well as any additional submittals that Contractor or Subcontractors may know to exist or wish to include. Contractor's submittal schedule shall include all Subcontractor submittals.
- D. The submittal schedule shall allow as steady of a rate of submittals as possible. Long lead items shall be submitted as early as possible.

1.04 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference, Contractor shall submit and discuss the following items:
 - 1. The preliminary Schedule of Submittals.
 - 2. A list of permits and licenses Contractor shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. Preliminary and detailed Schedule of Values in accordance with General Conditions.
 - 4. The names and qualifications of the Designated Safety Representative and Designated Competent Persons.

1.05 SHOP DRAWINGS

- A. Wherever Shop Drawings are called for in the Contract Documents or where required by the Owner, Contractor shall furnish electronic submittals in PDF as described in this Section.
- B. Shop Drawings may include detailed design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. If Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in Colorado, unless otherwise indicated.
- C. Organization
 - 1. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple specification sections will not be acceptable, unless the primary section references other sections for components.
 - 2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification section paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.
 - 3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.
- D. Format:
 - 1. Minimum sheet size shall be 8-1/2-in by 11-in. Maximum sheet size shall be 22-in by 34-in.
 - 2. On the transmittal form, index the components of the submittal and insert tabs into the submittal to match the index.
 - 3. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. The Owner will not collate sheets or copies.
 - 4. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
 - a. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

- b. Time for review will commence from the date of receipt by the Owner for each submittal received by 12:00 noon Mountain Standard Time (MST) on any work Day. For submittals received after 12:00 noon MST, the time for review will commence on the following work Day.
- c. The Owner will return comments or scans of each submittal to the Contractor with comments noted thereon.
- d. It is considered reasonable that the Contractor will make a complete and acceptable submittal to the Owner by the first resubmittal on an item. The Owner reserves the right to withhold monies due to the Contractor to cover additional costs of the Owner's and Engineer's review times beyond the first resubmittal.
- e. The maximum review period for each submittal or resubmittal will be 30 days. Thus, for a submittal that requires two resubmittals before it is complete, the maximum review period could be 90 Days.
- f. If a submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required. Contractor may incorporate the products or implement Work covered by the submittal.
- g. If a submittal is returned marked "MAKE CORRECTIONS NOTED," Contractor may incorporate the products or implement the Work covered by the submittal and implement it according to the Designer's notations, but formal revision and resubmission will not be required.
- h. If a submittal is returned marked "REVISE-RESUBMIT," the Contractor shall not incorporate the products or implement the Work covered by the submittal, but shall revise it and shall resubmit. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE - RESUBMIT," the submittal as a whole is deemed "AMEND - RESUBMIT," and 10 drawings are required to be resubmitted.
- i. If a submittal is returned marked "REJECTED - RESUBMIT," Contractor shall not incorporate the products or implement the Work covered by the submittal. Either the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or it is a substitution request not submitted in accordance with the General Conditions. In the first two cases, the Contractor shall prepare a new submittal and shall submit the required number of copies. In the latter case, the Contractor shall submit the substitution request according to the General Conditions.
- j. Resubmittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.
- k. Fabrication of an item may commence only after the Owner has reviewed the pertinent submittals and returned copies to Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- l. Submittals shall be carefully reviewed by an authorized representative of Contractor prior to submission to the Owner. Each submittal shall be dated and signed by Contractor as being correct and in strict conformance with the Contract Documents and shall include the following statement: "I have verified that the equipment or material in this submittal meets all the requirements specified or shown in the Contract Documents without exception." In the case of Shop Drawings, each sheet shall be so dated, signed, and certified.
- m. The Owner will only accept submittals that have been so verified by Contractor. Non-verified submittals will be returned to Contractor without action taken by the Owner, and any delays caused thereby shall be the total responsibility of Contractor. No changes in the Contract Times will be made for schedule delays resulting from non-compliant submittals.

- n. Corrections or comments made on Contractor's Shop Drawings during review do not relieve Contractor from compliance with Contract Drawings and specifications. Contractor is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

1.06 SAMPLES

- A. Submit the number of samples indicated by the Specifications. If the number is not indicated, submit not less than three samples. Where the amount of each sample is not indicated, submit such amount as necessary for proper examination and testing by the methods indicated.
- B. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and manufacturer's name. Upon acceptance by Designer, one set of the samples will be stamped and dated by the Owner and returned to Contractor, one set of samples will be retained by the Owner, and one set shall remain at the Site in Contractor's field office until completion of Work.

1.07 SURVEY DATA

- A. Make available for examination throughout the construction period field books, notes, and other data developed by Contractor in performing the surveys required by the Work and submit such data to the Owner with documentation required for final acceptance of Work.

1.08 QUALITY ASSURANCE/QUALITY CONTROL PLAN

- A. Prepare and submit a Quality Assurance/Quality Control Plan for the Work within 20 days after Notice to Proceed. This plan shall comply with Section 01 45 00, Quality Assurance/Quality Control.

1.09 RECORD DRAWINGS

- A. Maintain one set of Drawings at the Site for the preparation of record drawings. On these, mark in red pencil every project condition, location, configuration, and any other change or deviation from the executed, conformed Contract Drawings, including buried or concealed construction and utility features that are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of buried utilities that differ from the locations indicated or that were not indicated on the Contract Drawings. Said record drawings' shall be supplemented by any detailed sketches as necessary or as Contractor is directed, to fully indicate the Work as actually constructed. These record drawings are the Contractor's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the Work. Red pencil shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date.
- B. This may be accomplished either by the above method or by 'an electronic overlay method. If the electronic method is used the time constraints still apply but the submittal can be electronic.
- C. On the 20th Day of every third month after the month in which the Notice to Proceed is given the Owner and Engineer will review the field marked up drawing sets and determine if a revision needs to be issued. If one is required, submit paper or electronic markups to the designer for update and reissue. At the completion of the work, submit one final set of markups (paper or electronic) for creation of an as-built set of drawings.
- D. Disorganized or incomplete record drawings will not be accepted. Contractor shall revise them and resubmit within 10 days.
- E. Make record drawings accessible the Owner and Engineer during the construction period. Record drawings will be audited regularly by the Owner and Engineer after the month in which the Notice to Proceed is given as well as on completion of Work. Failure to properly maintain record drawings in an up- to-date condition may result in the withholding of payments due to Contractor at the sole discretion of Owner.

- F. Final payment will not be acted upon until the record drawings have been completed and delivered to the Owner. Said record drawings shall be in the form of a set of prints with carefully plotted information overlaid and an electronic form under the latest release of Adobe Acrobat.
- G. Information submitted by Contractor will be assumed to be correct, and Contractor shall be responsible for the accuracy of such information

1.10 QUALITY CONTROL (QC) SUBMITTALS

- A. Quality control submittals are defined by Section 01 45 00, Quality Assurance/Quality Control and the technical Specifications.
- B. Unless otherwise indicated, QC submittals shall be submitted:
 - 1. Before delivery and unloading, for the following types of submittals:
 - a. Manufacturers' installation instructions
 - b. Manufacturers' and Installers' experience qualifications
 - c. Ready mix concrete delivery tickets
 - d. Design calculations
 - e. Affidavits and manufacturers' certification of compliance with indicated product requirements
 - f. Laboratory analysis results
 - g. Factory test reports
 - 2. Within 30 days following the event documented for the following types of submittals:
 - a. Manufacturers' field representative certification of proper installation
 - b. Field measurement
 - c. Field test reports
 - d. Receipt of permit
 - e. Receipt of regulatory approval
- C. Engineer will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

1.11 OPERATION AND MAINTENANCE (O&M) MANUAL

- A. Submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the O&M Manual. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff. All O&M Manual materials shall be submitted in electronic and hard copy format. Submittal shall be in Adobe Acrobat format and any drawings shall not exceed 11-in by 17-in in size and text pages shall be only 8-1/2-in by 11-in in size.
- B. The O&M Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):
 - 1. Category 1 -Equipment Summary
 - a. Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
 - b. Form: Owner will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the Work. Fill in the relevant information on the form and include it in Part 1.
 - 2. Category 2- Operational Procedures
 - a. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:
 - 1) Installation
 - 2) Adjustment
 - 3) Startup
 - 4) Location of controls, special tools, equipment required, or related instrumentation needed for operation

- 5) Operation procedures
 - 6) Load changes
 - 7) Calibration
 - 8) Shutdown
 - 9) Troubleshooting
 - 10) Disassembly
 - 11) Reassembly
 - 12) Realignment
 - 13) Testing to determine performance efficiency
 - 14) Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices
 - 15) List of all electrical relay settings including alarm and contact settings
3. Category 3 - Preventive Maintenance Procedures
 - a. Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.
 - b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.
 4. Category 4 - Parts List
 - a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
 - b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.
 5. Category 5 - Wiring Diagrams
 - a. Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.
 6. Category 6 - Shop Drawings
 - a. Drawings: This category includes approved shop or fabrication drawings with Designer comments and corrections incorporated, complete with dimensions.
 7. Category 7 - Safety
 - a. Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.
 8. Category 8 – Documentation:
 - a. Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the technical specifications shall be placed in this category.
- C. Format
1. Each hard copy O&M Manual shall be bound in standard size 3-ring hardcover binders labeled on the spine and cover with project name, Owner's project number, specification section number, equipment name, and equipment identification number.
 2. Each binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.
 3. Documents in binders shall be 3-hole punched, no text shall be punched out, and pages larger than 8-1/2-in by 11-in shall be folded to 8-1/2-in by 11-in.
 4. Each final set of O&M Manuals shall include a CD with electronic files:
 - a. Project specific files created in Adobe Acrobat portable document format.
 - b. Manufacturer literature in Adobe Acrobat portable document format.
- D. Review Process
1. Contractor shall furnish 2 hard copies and one electronic copy of the draft O&M Manuals for each Specification Section that requires a Manual. Contractor will forward one hard copy each to Owner and Designer, and will refer other reviewers to the electronic version. Owner will return both copies to Contractor with review

comments.

2. Contractor shall incorporate comments into the draft and submit two hard copy and 5 electronic copies on CD of the final Manual for acceptance.

E. Schedule

1. Except where indicated otherwise, manuals shall be submitted in final form to the Owner not later than the 75 percent of construction completion date. Discrepancies found by the Owner shall be corrected within 30 Days from the date of written notification by the Owner.
2. Work under this Contract involves commissioning of equipment in multiple areas. Manuals shall be complete for each piece of equipment' prior to placing equipment into service. Final acceptance of the equipment by the Owner will be dependent on operational training of the Owner's personnel. Except where indicated otherwise, manuals shall be submitted for review in final form a minimum of 30 days prior to pre-commissioning and commissioning the start of performance testing for each piece of equipment. Discrepancies found by the Owner shall be corrected within 30 days from the date of written notification by the Owner.

1.12 SPARE PARTS LIST

- A. Furnish to Owner five identical sets of spare parts information for mechanical, electrical, and instrumentation equipment. The spare parts list shall include those spare parts that each manufacturer recommends be maintained by the Owner in inventory.
 1. Sources and Pricing: The spare parts list shall include a current list price of each spare part. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to assist the Owner in ordering.
- B. Format: The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2-1/2-in. Each copy of the spare parts lists shall be accompanied by a CD containing the lists in files created under Adobe Acrobat.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 ABBREVIATIONS AND ACRONYMS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used. Additional abbreviations and acronyms are defined in the Contract Drawings.

1. AA Aluminum Association
2. AABC Associated Air Balance Council
3. AASHTO American Association of State Highway and Transportation Officials
4. ABMA American Bearing Manufacturer's Association
5. ACGIH American Conference of Governmental Industrial Hygienists
6. ACI American Concrete Institute
7. AF&PA American Forest and Paper Association
8. AGA American Gas Association
9. AGMA American Gear Manufacturers' Association
10. AI Asphalt Institute
11. AIA American Institute of Architects
12. AIHA American Industrial Hygiene Association
13. AIIM Association for Information and Image Management
14. AISC American Iron and Steel Construction
15. AISI American Iron and Steel Institute
16. AMCA Air Movement and Control Association
17. ANSI American National Standards Institute
18. API American Petroleum Institute
19. APWA American Public Works Association
20. ASAE American Society of Agricultural Engineers
21. ASCE American Society of Civil Engineers
22. ASME American Society of Mechanical Engineers
23. ASNT American Society for Nondestructive Testing
24. ASQ American Society for Quality
25. ASTM ASTM International
26. ATSSA American Traffic Safety Services Association
27. AWCI American Wire Cloth Institute
28. AWS American Welding Society
29. AWWA American Water Works Association
30. BBC Basic Building Code, Building Officials and Code Administrators International
31. BHMA Builders Hardware Manufacturers' Association
32. CABO Council of American Building Officials
33. CBM Certified Ballast Manufacturer
34. CDA Copper Development Association
35. CDOT Colorado Department of Transportation
36. CEMA Conveyors Equipment Manufacturer's Association
37. CGA Compressed Gas Association
38. CISPI Cast Iron Soil Pipe Institute
39. CLFMI Chain Link Fence Manufacturer's Institute
40. CMAA Crane Manufacturers' Association of America
41. CRSI Concrete Reinforcing Steel Institute
42. CS Commercial Standard
43. CSA Canadian Standards Association
44. CSI Construction Specifications Institute
45. DCDMA Diamond Core Drilling Manufacturer's Association

46. DIN	Deutsches Institut für Normung e.V.
47. DIRPA	Ductile Iron Pipe Research Association
48. EI	Energy Institute
49. EIA	Electronic Industries Alliance
50. EJCDC	Engineers Joint Contract Documents Committee
51. FA	Federal Aviation Administration
52. FCC	Federal Communications Commission
53. FCI	Fluids Controls Institute
54. FDA	Food and Drug Administration
55. FEMA	Federal Emergency Management Agency
56. FHWA	Federal Highway Administration
57. FIPS	Federal Information Processing Standards
58. Fed. Spec.	Federal Specifications (FAA Specifications)
59. FS	Federal Specifications and Standards (Technical Specifications)
60. GESC	Grading, Erosion, and Sediment Control (Arapahoe County)
61. HI	Hydraulic Institute
62. HMI	Hoist Manufacturers' Institute
63. HSWA	Federal Hazardous and Solid Waste Amendments
64. IAPMO	International Association of Plumbing and Mechanical Officials
65. IBC	International Building Code
66. ICBO	International Conference of Building Officials
67. ICC	International Code Council
68. ICEA	Insulated Cable Engineers' Association
69. IFC	International Fire Code
70. IEEE	Institute of Electrical and Electronic Engineers, Inc.
71. IFI	Industrial Fasteners Institute
72. IMC	International Mechanical Code
73. INDA	Association of the Nonwoven Fabrics Industry
74. IPC	International Plumbing Code
75. ISA	Instrumentation, Systems, and Automation Society
76. ISO	International Organization for Standardization
77. ITL	Independent Testing Laboratory
78. JIC	Joint Industry Conferences of Hydraulic Manufacturers
79. MIL	Military Specifications
80. MUTCD	Manual of Uniform Traffic Control Devices
81. NACE	NACE International
82. NEBB	National Environmental Balancing Bureau
83. NEC	National Electrical Code
84. NECA	National Electrical Contractor's Association
85. NEMA	National Electrical Manufacturers' Association
86. NESC	National Electrical Safety Code
87. NETA	InterNationalElectrical Testing Association
88. NFPA	National Fire Protection Association
89. NICET	National Institute for Certification in Engineering Technologies
90. NIST	National Institute of Standards and Technology
91. NRCA	National Roofing Contractors Association
92. NRTL	Nationally Recognized Testing Laboratories
93. NSF	NSF International
94. NSPE	National Society of Professional Engineers
95. OSHA	Occupational Safety and Health Act (both Federal and State)
96. PCI	Precast/Prestressed Concrete Institute
97. PEI	Porcelain Enamel Institute
98. PPI	Plastic Pipe Institute
99. PS	Product Standards Section-U.S. Department of Commerce
100. RMA	Rubber Manufacturers' Association
101. RUS	Rural Utilities Service

102.	SAE	Society of Automotive Engineers
103.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
104.	SPI	Society of the Plastics Industry
105.	SSPC	The Society for Protective Coatings
106.	TEMA	Tubular Exchanger Manufacturers' Association
107.	TIA	Telecommunications Industry Association
108.	UBC	Uniform Building Code
109.	UFC	Uniform Fire Code
110.	UL	Underwriters Laboratories Inc.
111.	UMC	Uniform Mechanical Code
112.	UNCC	Utility Notification Center of Colorado
113.	USSR	U.S. Bureau of Reclamation

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Paragraph 3.02 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.
- B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.
- C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.
- D. Where two or more standards are specified to establish quality, product, and workmanship shall meet or exceed requirements of most stringent.
- E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.
- F. Copies of most applicable referenced standards have not been bound in these Contract Documents.
- G. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor's personnel, Subcontractors, Owner, and Owner's Representative.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 GENERAL

1.01 GENERAL

The contractor shall have a certified and qualified field and laboratory testing form to complete the required Quality Control testing including but not limited to nuclear density testing, soil laboratory testing, concrete field testing, and concrete laboratory testing.

1.02 SUBMITTALS

- A. Qualifications of the Contractor's Quality Control (QC) Representative must include all qualifying registrations and show that the candidate has had experience on State Engineer Office projects of similar type and size.
- B. Contractor's QC Plan: No payments will be made to Contractor until the Plan is accepted by the Owner.
- C. Contractor's Daily QC Report: Submit to Engineer within 2 days of completion of each inspection.
- D. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.02 CONTRACTOR'S INSPECTION OF THE WORK

- A. Work performed by Contractor shall be inspected by the Contractor's QC Representative. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.
- B. No materials or equipment shall be used in the Work without inspection and acceptance by Contractor's QC Representative.
- C. Materials and equipment furnished to Contractor by Owner shall be inspected by Contractor's QC Representative upon receipt of such materials and equipment, with the results of the inspection included in the Contractor's Daily Inspection Report. In the event Contractor believes any material or equipment provided by Owner to be of insufficient quality for use in the Work, Contractor shall immediately notify the Engineer.

1.03 OWNER'S INSPECTION AND TESTING

- A. The Work will be conducted under the general observation of the Engineer and is subject to inspection by representatives of the Owner to ensure strict compliance with the requirements of the Contract Documents.
- B. Engineer may perform independent QA audits to verify that actions specified in the Contractor's QC Plan have been implemented. No Engineer audit finding or report shall in any way relieve Contractor from any requirements of this Contract.
- C. Testing services provided by the Owner are for the sole benefit of the Owner; however, one copy of the results of each field and laboratory test made will be made available to the Contractor and any nonconforming results shall be corrected by the Contractor at no additional cost to the Owner. All cost for retesting required shall be reimbursed to the Owner.
- D. Testing necessary to satisfy the Contractor's internal QC procedures shall be the sole responsibility of the Contractor.

1.04 QUALIFICATIONS

- A. Contractor's QC Representative: Demonstrate having performed similar QC functions on similar type projects. Submit records of personnel experience, training, and qualifications.

1.05 COVERING WORK

- A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 3 days in advance to request Inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 13 of the General Conditions.

1.06 REJECTED WORK

- A. Failure to promptly remove and replace rejected Work will be considered a breach of this Contract, and Owner may proceed under provisions of the General Conditions.

1.07 CONTRACTOR'S QC PROGRAM

- A. General:
 - 1. Establish and execute a QC program for Work. The program shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including fabricators, suppliers, and sub-subcontractors). This program shall be described in a Plan responsive to this Section.
- B. QC Personnel
 - 1. The Contractor QC Representative shall be onsite as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
 - 2. The Contractor is to furnish personnel with assigned QC functions reporting to the QC Representative. Persons performing QC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.
- C. QC Plan:
 - 1. Contractor's QC Plan shall include a statement by the Senior Manager designating the QC Representative and specifying the authority delegated to the QC Representative to direct cessation or removal and replacement of defective Work.
 - 2. Describe the QC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
 - 3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specification Section).
 - 4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed, and tested.
 - 5. Include procedures to verify that procured products and services conform to the requirements of the specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
 - 6. Testing QC: Include procedures to verify that the testing requirements of the Contract Documents are integrated into the Contractor's QC Plan and conform to the requirements of the specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and lower-tier suppliers and/or subcontractors.
 - 7. Include instructions for recording observations and requirements for demonstrating through the Daily Inspection Reports that Work observed was in compliance or a deficiency was noted and action to be taken.
 - 8. Procedures to preclude the covering of deficient or rejected Work.
 - 9. Procedures for halting or rejecting Work.
 - 10. Procedures for resolution of differences between the QC Representative and the production personnel.
 - 11. Identify contractual hold/inspection points, as well as any Contractor-imposed hold/inspections points.
- D. Daily Inspection Report: Include, at a minimum:
 - 1. Items inspected
 - 2. Quality characteristics in compliance
 - 3. Quality characteristics not in compliance
 - 4. Corrective/remedial actions taken
 - 5. Statement of certification
 - 6. QC Manager's signature
- E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated

requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

1. Personnel responsible for identifying deficient and non-complying items within Work.
 2. How and by whom deficient and non-compliant items are documented "in the field."
 3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
 4. Tracking processes and tracking documentation for deficient and non-conforming Work.
 5. Personnel responsible for achieving resolution of outstanding deficiencies.
 6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
- F. Audits: The QC program shall provide for regularly scheduled documented audits to verify that QC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.
- G. Documented Control/Quality Records:
1. Establish methods for control of Contract Documents that describe how Drawings and specifications are received and distributed to assure the correct issue of the document being used. Describe how as-built data are documented and furnished to Engineer.
 2. Maintain evidence of activities affecting quality, including operating logs, records of inspections, audit reports, personnel qualification and certification records, procedures, and document review records.
 3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
 4. Develop a list of specific records as required by the Contract Documents that will be furnished to Project Manager at the completion of activities.
- H. Acceptance of QC Plan: Engineer's acceptance of the QC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's QC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, and without cause, may direct Contractor to remove and replace the QC Representative.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01 GENERAL

- A. Protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation.

1.02 DEFINITIONS

- A. Excavation: Any digging, trenching, auguring, backfilling, ditching, grading, plowing-in, pulling-in, ripping, scraping or tunneling.

1.03 RIGHTS-OF-WAY

- A. The Contractor shall not do any Work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified that the Owner has secured authority from the proper party.
- B. Copies of encroachment agreements and encroachment requirement for work in existing rights of way are included in the Supplement section of this specification. Implement actions required by those agreements and guidelines.
- C. Requirements for work near high voltage overhead power transmission lines are the responsibility of the contractor. Contractor shall be responsible for taking all necessary precautions and complying with these clearance requirements.
- D. After authority has been obtained, Contractor shall give said party due notice of Contractor's intention to begin work, if required by said party, and remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROTECTION OF STREET OR ROADWAY MARKERS

- A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization.
- B. No pavement breaking or Excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed shall be accurately restored after street or roadway resurfacing has been completed.
- C. Contractor is responsible for the cleanliness and safety of all roadways adjacent to the construction site. If at any time, these roadways are found to be dangerous or not passable due to debris or mud, local jurisdictions may shut down the project until necessary clean-up is carried out by the contractor at his expense. If clean-up is deemed to be unsatisfactory or if the local jurisdiction chooses, the local jurisdiction may carry out required clean-up and bill the Owner or Contractor. The Contractor is required to incur the cost of all such clean-up.

3.03 EXISTING UTILITIES AND IMPROVEMENTS

- A. Protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Maintaining in Service: Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said utilities.
- C. Except where the Drawings indicate utilities have been field located during design or certain

utility locations will be exposed as part of the Work, make exploratory Excavations as deemed necessary to determine the exact locations and depths of utilities which may interfere with the Work. All such exploratory Excavations shall be performed within a sufficient time in advance of construction to avoid possible delays. Notify the Owner if such exploratory Excavations show the noted utility locations to be in error.

- D. Utilities to be Relocated: If necessary to relocate the property of any utility owner, coordinate with the utility owner to relocate such property.
- E. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to Excavation and that are to be retained, and all utility lines that are constructed during Excavation operations shall be protected from damage and, if damaged, shall be immediately repaired or replaced, unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged facility performs its own repairs, reimburse said owner for the costs of repair.
- F. Underground Utilities Not Indicated: In the event of damages to existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to Excavation, immediately report the damage to the owner of the damaged utility. Also provide an immediate verbal report of such damage to the Owner, to be followed by a prompt written report to both the Owner and the utility owner.
- G. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other Work.

3.04 UTILITY COORDINATION

- A. Contact and coordinate with utility companies regarding protection of existing utilities and special requirements at utility crossing locations and other conditions where the Work is nearby existing utilities. Contractor shall be responsible for all costs of coordination with utilities including but not limited to outages, protection or support and any fees for costs from the utility. Furnish copies of all written agreements obtained by Contractor to the Owner.

3.05 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAYS AND PROTECTED LIMITS

- A. General: Except where trees or shrubs are indicated to be removed, exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits. Do not trim or remove trees unless so approved by the owner of the tree or shrub and as directed by the Engineer.
- B. Trimming: Symmetry of the tree shall be preserved; no stubs or split or tom branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.
- C. Replacement: Immediately notify the Engineer if any tree or shrub is damaged by the Contractor's operations so that the Engineer may notify the tree or shrub's owner. Replace the tree or shrub if, in the opinion of said owner, the damage is such that replacement is necessary. The replacement tree or shrub shall be of a like size and variety as the one damaged.

END OF SECTION

SECTION 01 55 00
SITE ACCESS AND STORAGE

PART 1 GENERAL

1.01 CONTRACTOR'S WORK AND STORAGE AREA

- A. Staging areas shall be designated by the owner. Staging areas are for the exclusive use by the Contractor during the term of the Contract as a storage and shop area for its construction operations on the Work. At completion of the Work, return these areas to their original condition, including grading and landscaping, unless otherwise shown.
- B. Maintain a separate area within the staging area for hazardous materials used in constructing the Work.
 - 1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, 2 part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
 - 2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
 - 3. Obtain and submit to the Owner a single EPA number for wastes generated at the Site.
 - 4. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.
 - 5. The separate storage area shall be inspected by the Owner prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.
 - 6. Hazardous materials that are delivered in containers shall be stored in the original containers until use. Hazardous materials delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.02 PARKING

- A. The Contractor shall direct its employees to park in areas requested by the Owner.
- B. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

DIVISION 02 – SITE WORK

SECTION 02 00 00
EXISTING CONDITIONS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Prepare the site for construction.
- B. Move in personnel and equipment.
- C. Set up temporary offices, buildings, facilities, and utilities.
- D. Procure all necessary permits.

1.2 RELATED WORK

- A. General Conditions
- B. Special Conditions
- C. 01 41 26 Permits and Agreements

1.3 SITE CONDITIONS

- A. The Owner has provided the right-of-way, easement or project site for all permanent access or permanent construction for the project. Any additional access, access right-of-way, construction areas, or additional needed land which may be involved in the construction of this project shall be the responsibility of the Contractor.
- B. Only the area within the construction limits shown in the Drawings, may be used as site headquarters, storage yard, or base of operations provided that the use of said land meets with all of the requirements and restrictions imposed by the Owner at the time of usage. Any waste materials, including petroleum products, shall be removed from the area and disposed of in an approved location. Any areas outside the reservoir project used by the Contractor shall be restored to its original condition on completion of the construction.
- C. Access to other parts of the site shall be limited to the work to be performed at that location.

1.4 SITE PREPARATION FOR CONTRACTOR OCCUPANCY

- A. The Contractor shall provide all temporary facilities as required for performing the work.
- B. The Contractor shall secure and maintain proper storage areas for equipment and materials in locations he may deem necessary for the proper execution of the job as approved by the Owner.
- C. No storage yard or project headquarters site may be utilized in conflict with objections from the adjacent property owners unless the Contractor obtains from the Owner specific written permission for such objectionable use.
- D. No objectionable material will be allowed to blow from, wash off or drain off of any storage yard on to adjacent property or the designated wetlands. The Contractor shall maintain all storage yards in as neat and orderly manner as possible, allowing no accumulation of waste materials or disposal piles.
- E. The Contractor may construct a temporary security fence for the protection of materials, tools, and equipment. The fence shall be maintained during the construction period. Upon completion of work, the security fence shall be removed from the site.
- F. The Contractor shall provide adequate parking facilities within the designated area for personnel working on the project.
- G. The Contractor shall provide adequate sanitary facilities within the designated area for personnel working on the project.
- H. The Contractor shall obtain the necessary permits for connection to necessary services provided by utility companies serving the project area.

- I. Materials, equipment, and work required for temporary storm water management during the construction period shall be provided by the Contractor as required to ensure public safety, protect the environment, protect work in progress, and protect materials stored onsite.
- J. Prior to commencing work, Contractor shall install reinforced silt fencing and other structures as needed to insure that designated wetlands and other areas to be protected are not accessed and that no material washes into them.

1.5 DAMAGE OR USE-FEE CLAIMS

- A. Any damage or use-fee claims filed against the Contractor may become a part of the final settlement of this project and may be cause for delay of final acceptance or delay of final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CONSTRUCTION STAKING

- A. Prior to the commencement of construction surveying, the Contractor shall verify the location and elevation of the project benchmarks and verify that they are consistent with the benchmarks shown on the Construction Plans. The Contractor shall report any inconsistencies to the Engineer.
- B. The Contractor shall stake out the construction limits, establish temporary benchmarks, lines, levels, batterboards, reference points, centerlines, and verify all dimensions in relation to connection with existing facilities. The Contractor shall be solely responsible for all errors in connection with this work.
- C. Prior to commencement of the work, the Contractor shall report to the Engineer any inconsistencies in the proposed lines, levels, grades, dimensions, or locations shown on the Drawings.

3.2 OBSTRUCTIONS

- A. The location of some utilities and obstructions may not be shown. The Contractor is advised to carefully inspect the existing facilities before preparing his proposal. It is the Contractor's responsibility to initiate utility locates and to field verify the location of all utilities prior to the commencement of any construction activity. The removal and replacement of minor obstructions such as electrical conduits, air, water and water piping, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned. Major obstructions encountered that are not shown on the Contract Drawings or could not have been foreseen by visual inspection of the site prior to bidding should immediately be brought to the attention of the Project Manager. The Engineer will make a determination for proceeding with the work. If the Project Manager finds that the obstruction adversely affects the Contractor's costs or schedule for completion, a proper adjustment to the Contract will be made in accordance with the General Conditions or revised plan provided at the discretion of the Owner.

3.3 DEMOLITION

- A. Any existing structures encountered during construction shall be preserved until accepted for removal by the Project Manager. The Contractor shall be required to repair pipes or structures in use that are damaged during construction at no cost to the Owner. The removal of abandoned pipes shall be subject to approval by the Engineer and may require Contractor coordination with the original utility owner.

3.4 REMOVAL AND SALVAGE OF MATERIALS

- A. The Contractor shall carefully remove materials specified to be reused or salvaged so as not to damage the material.
- B. Reuse by the Contractor of salvaged material will not be permitted, except as specifically shown or specified herein.
- C. Existing materials to be removed or replaced and not specifically designated for salvage shall become the property of the Contractor.

3.5 CLEARING THE SITE

- A. All areas underlying new structures for the service and principal spillways and dam embankment shall be cleared of stumps, shrubs, brush, and other vegetative growth. The top 6-in to 12-in of soil will be removed and stockpiled for future use as topsoil. Soil shall be removed to such a depth that no black, organic soil is visible.
- B. Upon completion of the project, completion of a particular phase of the project, or termination of the use of any particular area, site, storage yard, right-of-way, or easement, the Contractor shall promptly and neatly clean up the area and re-establish the ground to the contours required by the project or conditions prior to project commencement.

END OF SECTION

DIVISION 03 - CONCRETE

**SECTION 03 20 00
REINFORCING STEEL**

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This work shall consist of furnishing and placing reinforcing steel in accordance with these specifications and in conformity with the Contract Documents.

1.2 RELATED WORK

- A. Section 03 30 00 – Cast-In-Place Concrete

PART 2 MATERIALS

2.1 GENERAL

- A. Materials used in the work shall meet the requirements for the class of material named. Unless otherwise provided on the plans, in the specifications or in the contract, all bar steel reinforcement shall be of the deformed type. Reinforcing steel shall conform to the requirements of the following specifications:
1. Deformed Billet-Steel Bars for Concrete
 2. Reinforcement--AASHTO M31, ASTM A615 (Grade 60)
 3. Deformed Steel Wire for Concrete Reinforcement--AASHTO M225 (ASTM A496)
 4. Cold-Drawn Steel Wire for Concrete Reinforcement--AASHTO M32 (ASTM A82)

PART 3 EXECUTION

3.1 BAR LIST

- A. Copies of a list of all reinforcing steel and bending diagrams shall be furnished to the Engineer at the site of the work at least 2 weeks before the placing of reinforcing steel is begun. The Contractor shall be responsible for the accuracy of the lists and for furnishing and placing all reinforcing steel in accordance with the details shown on the plans.
- B. Bar lists and bending diagrams for structures, which are included in the plans, do not have to be furnished by the Contractor. When bar lists and bending diagrams are included in the plans, they are intended for estimating approximate quantities. The Contractor shall verify the quantity, size and shape of the bar reinforcement against those shown on the plans and make any necessary corrections before ordering.

3.2 STORING AND SURFACE CONDITION OF REINFORCEMENT

- A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross section area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

3.3 FABRICATION

- A. Fabrication tolerances for straight and bent bars shall be in accordance with the requirements of Subsection 4.3, Tolerance, of the American Concrete Institute Standard 315.

3.4 PLACING AND FASTENING

- A. The placing, fastening, splicing and supporting of reinforcing steel and bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". In case of discrepancy between the plans and the CRSI publication stated above, the plans shall govern.
- B. Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete by means of spacer strips, stays, metal chairs or other approved devices or supports. When metal chairs are used, the part of the chair in contact with the form and at least 1 inch from the form shall be hot dip galvanized or plastic coated. Other coatings or treatments will be acceptable when specifically accepted by the Engineer. Precast concrete bricks or other accepted bricks or blocking may be used in structures to support reinforcement in footings or slabs placed on grade; however, the bricks or blocking shall not contact the reinforcement over a distance greater than the depth of a standard concrete brick. Reinforcing shall be embedded with 3" of concrete where cast against earth and 2" of concrete elsewhere unless otherwise noted on the Plans.

- C. Bars shall be securely tied at all intersections except where spacing is less than 1' in each direction, when alternate intersections shall be tied. Tying of steel by spot welding will not be permitted unless specifically authorized by the Engineer. The placing and securing of the reinforcement in any unit or section shall be accepted by the Engineer before any concrete is placed in any such unit or section. At the time the concrete is placed, the reinforcing steel required shall be free from flaky rust, mud, oil or other coatings that will destroy or reduce the bond.

3.5 SPLICING

- A. Bar Steel reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the written acceptance of the engineer. All splicing shall strictly follow and adhere to all ACI codes and requirements. Splices shall preferably be staggered. In cases where permission is granted to splice bars, other than those shown on the plans, the additional material required for the lap shall be furnished by the contractor at his own expense.

MINIMUM LAP LENGTHS

<u>Bar No.</u>	<u>Splice Lap Length (in.)</u>
4	25
5	31
6	37
7	54
8	62
9	70

3.6 BENDING

- A. All bars shall be bent cold. No bars partially embedded in concrete shall be field-bent.
 B. Bends on all bars shall have a radii on the inside of the bar not less than the value of the following:

<u>Bar Size</u>	<u>Minimum Radii</u>
#3, #4, #5	2 1/2 bar diameters
#6, #7, #8	3 bar diameter
#9, #10, #11	4 bar diameter

3.7 TIES, CHAIRS, SPACERS

- A. Reinforcement shall be accurately placed and adequately supported by concrete, metal or other approved spacers or ties and secured against displacement within the tolerance permitted.

3.8 PLACEMENT

- A. Unless otherwise specified by the Engineer, reinforcement shall be placed in specified positions within the following tolerances:
1. In walls and floors, all reinforcement shall be placed within, plus or minus, one-quarter inch of specified location.
 2. Longitudinal location of bends and ends of bars, plus or minus, two inches except where specified concrete cover at ends of members shall not be reduced.
- B. The final length of the vertical bars will need to be adjusted per the Contractor's field survey elevations.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide cast-in-place concrete, joints in concrete, reinforcement and appurtenant Work, formwork, bracing, shoring, supports, and shall design and construct falsework, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All codes, as referenced herein are specified in Section 01 42 19 – Reference Standards.

B. Federal Specifications:

TT-S-227E Joint Sealer

TT-S-230C Joint Sealer

C. Commercial Standards:

ACI 117	Standard Specifications for Tolerances for Concrete Construction Materials
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 304	Measuring, Mixing, Transporting, and Placing Concrete
ACI 305	Hot Weather Concrete
ACI 306	Cold Weather Concrete
ACI 315	Details of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ACI 347	Recommended Practice for Concrete Formwork
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM C31	Standard Practice for Making and Curing Concrete
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for portland Cement
ASTM C156	Standard Test Method for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete
ASTM C157	Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C192	Method For Making and Curing Test Specimens

ASTM C260	Standard Specification of Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C920	Standard Specification for Electromeric Joint Sealants
ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete raw Materials
AASHTO T 303	Standard Method of Test for Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction
IBC 1704	Special Inspections

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Shop Drawings:
 1. Mix Designs: Prior to beginning the Work, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete. The mix designs shall be checked by an independent testing laboratory acceptable to the Engineer. Costs related to such checking shall be the Contractor's responsibility. When a water reducing admixture is to be used, the Contractor shall furnish mix designs for concrete both with and without the admixture.
 2. Provide the following Submittals in Accordance with ACI 301:
 - a. Mill tests for cement
 - b. Admixture Certification (Chloride ion content shall be included.)
 - c. Aggregate gradation and certification
 - d. Materials and methods for curing
 3. Reinforcement fabrication, erection and placement drawings:
 - a. Shop bending diagrams, placing lists, and drawings of reinforcing steel prior to fabrication. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the earliest possible date after receipt by the Contractor of the Notice to Proceed. Include bar placement diagrams.
 - b. Shop drawings shall conform to ACI 315.
 - c. Placement drawings shall include location of reinforcement, water stops, anchor bolts and other items embedded in concrete that influences placement of reinforcement.
 4. Manufacturer's information demonstrating compliance with requirements of the following:
 - a. Preformed joint filler
 - b. Backing rod
 - c. Bond breaker

- d. Form ties and related accessories
 - e. Form gaskets
 - f. Form release agent
 - g. List of form materials and locations of use
 - h. Material for water stop
 - i. Floor covering and joint filler materials
5. Placement drawings showing the location and type of joints for each structure.
 6. Samples of working floor surface coatings.

C. **Delivery Tickets:** Where ready-mix concrete is used, the Contractor shall furnish certified delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each certificate shall state the mix number, total yield in cubic yards, the amount of water that can be added to the concrete mix at the site which maintains the required water cement ratio, and the time of day to the nearest minute, corresponding to the time when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

1.4 QUALITY CONTROL

A. Testing of Materials:

1. The contractor shall hire a qualified concrete field and laboratory testers. The laboratory shall meet or exceed the requirements of ASTM C1077.
2. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as indicated herein. Tests for determining slump will be in accordance with the requirements of ASTM C143.
3. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness in accordance with ASTM C33 and AASHTO T260.
4. If required by the Owner, concrete for Quality Assurance testing shall be furnished by the Contractor at no cost to the Owner, and the Contractor shall assist the Engineer in obtaining samples and disposal and cleanup of excess material.

B. Field and Laboratory Testing:

1. Field testing of concrete samples shall include slump, percent air entrained, density, temperature, and as required cylinders specimens for compression testing. The first two readymix trucks shall be tested and every third truck tested thereafter. If a test fails, the interval of testing shall reset and the next two trucks will be tested and every third truck tested thereafter.
2. Compression test specimens shall be taken during construction from the first placement of each class of concrete and at intervals selected by the Engineer to insure continued compliance with these Specifications. Each set of test specimens will be a minimum of 4 cylinders. A set of compression cylinders shall be taken for each concrete placement or one for every 25 cubic yard.
3. Compression test specimens for concrete will be made in accordance with ASTM C31. 4-inches diameter by 8-inches high cylinders is acceptable.
4. Compression tests will be performed in accordance with ASTM C39. One (1) test cylinder will be tested at seven (7) Days and two (2) at 28 Days. The remaining cylinder will be held to verify test results, if needed.
5. If the Contractor intends to remove forms or otherwise work near the placed concrete prior to 7 days, additional cylinders shall be taken to verify the concrete compression strength.

- C. Evaluation and Acceptance of Concrete:
1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318.
 2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.
 3. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement as part of the Work.
- D. **Construction Tolerances:** The Contractor shall set and maintain concrete forms and perform finishing operations so that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not indicated, permissible deviations will be in accordance with ACI 117.
1. The variation from required lines or grades shall not exceed 1/4-inch in 10-feet and there shall be no offsets or visible waviness in the finished surface.

PART 2 -- PRODUCTS

2.1 FORM AND FALSEWORK MATERIALS

- A. Except as otherwise expressly accepted by the Engineer, lumber brought on the Site for use as forms, shoring, or bracing shall be new material.
- B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform US Product Standard PS 1 - Construction and Industrial Plywood for Concrete Forms, Class 1, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade required. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
- C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- D. Forms and falsework to support roof and floor slabs shall be designed for a minimum form dead load of 10 psf plus a 50 psf minimum live load. Live load shall be increased when motorized carts are used to a minimum of 75 psf. These loads shall be in addition to concrete dead load.

2.2 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form-tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be **Penta Tie System** by **MeadowBurke**, **Snap Ties** by **Dayton Superior**, or equal.
- B. Removable taper ties may be used when approved by the Engineer. Taper ties shall be **Taper Ties** by **MeadowBurke**, **Taper Ties** by **Dayton Superior**, or equal.

2.3 REINFORCING STEEL

- A. **General:** Reinforcing steel for cast-in-place reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement, unless otherwise indicated.
 2. Welded wire fabric (WWF) shall conform to ASTM A185 and the details indicated. WWF with longitudinal wire of W4 size wire and smaller shall be in flat sheets or in rolls with a core diameter of not less than 10 inches. WWF with longitudinal wires larger than W4 size shall be in flat sheets only.
- B. Accessories:
1. Include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position and secure reinforcement during concrete placement. Bar supports shall conform to CRSI Manual of Standard Practice. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
 2. Concrete blocks (dobies) used to support and position reinforcing steel shall have the same or higher compressive strength as required for the concrete in which they are located. Wire ties shall be embedded in concrete block bar supports.
 3. Accessories in contact with epoxy coated bars shall conform to CRSI Manual of Standard Practice and ASTM A934.

2.4 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the order that it is received.
- B. Materials for the Work shall conform to ACI 301.
- C. Storage of materials shall conform to ACI 301.
- D. Materials for concrete shall conform to the following requirements:
1. Cement shall be standard brand portland cement conforming to ASTM C150 - portland cement for Type I, Type II, or Type I/II.
 2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.
 3. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, and shall conform to ASTM C33. Items (d) and (e) below are required to achieve well-graded aggregates for a 1-1/2" maximum aggregate size, with corresponding testing of these criteria required. "Gap-graded" aggregates will not be permitted. Aggregates shall be non-reactive with alkalis in cement.
 4. Well graded crushed stone or washed gravel with limits of deleterious substances and physical property requirements (per weathering region).
 - a. Coarse Aggregates: Maximum size of coarse aggregates shall be 1-1/2".
 - b. Fine aggregate: Lightweight sand for fine aggregate will not be permitted. Sand shall be washed, natural and clean conforming to ASTM C33.
 - c. The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement proposed for the project. If aggregates proposed for use do not meet this requirement, then satisfy either 1) or 2) below.

- 1) Total equivalent alkali content of the cement used shall not exceed 0.60 percent as provided in the Optional Chemical Requirements of ASTM C150.
- 2) The fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.10 percent in 16 days when tested in accordance with ASTM C1260 and using the cement and fly ash proposed for the project. The proportions of the cement-fly ash mix shall be the same as those proposed for the project.

d. The aggregate shall conform to ACI 302.1R-04, with particular attention paid to the grading criteria. The range of percentage retained per sieve size by weight shall be as discussed in section 5.4 of ACI 302.1R-04 pertaining to 1-1/2" minimum aggregate size.

e. The following aggregate gradation range is the intended range and represents an approximate mix of 60% No. 57 coarse aggregate and 40% ASTM concrete sand fine aggregate.

<u>Sieve Size</u>	<u>Percent Passing</u>
1-1/2"	100
1"	90-100
1/2"	50-75
No. 4	30-65
No. 8	20-50
No. 16	10-40
No. 30	5-30
No. 50	5-25
No. 100	1-4
No. 200	0-3

This aggregate gradation is intended to minimize aggregate gap gradations, as well as shrinkage potential of the concrete once placed. Other similar aggregate gradations may be considered and submitted for Engineer approval if it can be shown that it meets the design intent.

5. Ready-mix concrete shall conform to the requirements of ASTM C94.
6. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.
 - a. Air-entraining agent meeting the requirements of ASTM C260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 5 to 7 percent. The Owner reserves the right, at any time, to sample and test the air-entraining agent received on the job by the Contractor. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be **Daravair 1000 by Grace Construction Products; Sika AEA-15 by Sika Corporation;** or equal.
 - b. Set controlling and water reducing admixtures: Admixtures may be added at the Contractor's option to control the set, effect water reduction, and increase workability.

The addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the Engineer. Admixtures specified herein shall conform to the requirements of ASTM C494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

- 1) Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the Engineer.
- 2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as **Plastocrete 161 MR by Sika Corporation; Daratard 17 by Grace Construction Products;** or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a non-corrosive set accelerating admixture such as **Plastocrete 161 FL by Sika Corporation; Daraset 200 by Grace Construction Products;** or equal shall be used.
- 3) Normal range water reducer shall conform to ASTM C494, Type A. **WRDA 82 by Grace Construction Products; Plastocrete 161 by Sika Corporation;** or equal. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
- 4) High range water reducer shall conform to ASTM C494, Type F or G. **Plastol 5000 by Euclid Chemical Company, Sikament FF by Sika Corporation;** or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.
- 5) If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3-inches \pm 1/2-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
- 6) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

7. Calcium Chloride: Calcium chloride will not be permitted in concrete.

2.5 CURING MATERIALS

A. Materials for curing concrete shall conform to the following requirements and ASTM C309:

1. Curing compounds shall be white-pigmented and resin-based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be **Kurez VOX White Pigmented by Euclid Chemical Company, Cure R-2 by L&M Construction Chemicals, 1200-White by W.R. Meadows,** or equal. When curing compound must be removed for finishes or grouting, curing compounds shall be **Kurez DR VOX by Euclid Chemical Company, L&M Cure R by L&M Construction Chemicals, 1100-Clear by WR Meadows,** or equal. Curing compounds shall meet local VOC requirements.
2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6-mils. The loss of moisture when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

3. Evaporation retardant shall be a material such as **Confilm** by **BASF**, **Eucobar** by **Euclid Chemical Company**, **E-CON** by **L&M Construction Chemicals, Inc.**, or equal.

2.6 JOINT MATERIALS

A. Materials for joints in concrete shall conform to the following requirements:

1. Sponge rubber joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752; for Type I, except as otherwise indicated.
2. Elastomeric joint sealers:
 - a. Two component, self leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type 1 and ASTM C920, Type M, Class 25, Grade P.
 - 1) **SikaFlex 2cNs** by **Sika Corporation**
 - 2) **Chem-Calk 500** by **Bostic**, or equal.
 - b. One component, self-leveling, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-230C, Class A, Type 1, and ASTM C920, Type S, Class 25, Grade P.
 - 1) **SikaFlex-15LM** by **Sika Corporation**
 - 2) **Vulkem 45** by **Tremco**, or equal.
 - c. One component, gun grade polyurethane based, non sag, vertical and horizontal sealant.
 - 1) **Vulkem 116** by **Tremco**
 - 2) **Vulkem 921** by **Tremco**
 - 3) **SikaFlex-15LM** by **Sika Corporation**
 - 4) **SikaFlex 1A** by **Sika Corporation**, or equal.
3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the Engineer.
4. Preformed joint filler (PJF) shall be a non-extruding resilient, bituminous type conforming to the requirements of ASTM D1751.

2.7 MISCELLANEOUS MATERIALS

- A. Floor sealer/hardener shall be a colorless, aqueous solution of zinc and/or magnesium fluosilicate or of sodium silicate, and shall be as manufactured by **Grace Construction Products**, **Sika Corporation**; or equal. The solution shall be delivered ready for use in the manufacturer's original sealed containers. Each gallon of the fluosilicate solution shall contain not less than 2 pounds of crystals.
- B. Dampproofing agent shall be an asphalt emulsion such as **Hydrocide 600** by **Sonneborn**, **Dehydratine 75, 85, 95** by **Euclid Chemical Company**, **Sealmastic** by **W. R. Meadows Inc.**, or equal.
- C. Epoxy adhesives shall be the following products:

1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive** by **Sika Corporation**, **Concresive Liquid (LPL)** by **BASF**; **BurkEpoxy MV** by **Edoco**, or equal.
 2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** by **Sika Corporation**, **BurkEpoxy NS** by **Edoco**, **Concresive Paste (LPL)** by **BASF**; or equal.
- D. Epoxy adhesive for reinforcing bars and anchors shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Adhesive shall have an ICC/ES Evaluation Report that shows acceptability of the product for use in the conditions used.
- E. Working Floor Surface Coatings:
1. **Epoxy WP-70 by Wooster Products Safety Coatings Systems**, or equal.

2.8 CONCRETE DESIGN REQUIREMENTS

- A. General:
1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. Mix changes shall be subject to review by the Engineer.
 2. The Contractor is cautioned that the limiting parameters below are **NOT** a mix design. Admixtures may be required to achieve workability required by the Contractor's construction methods and aggregates. The Contractor is responsible for providing concrete with the required workability.
- B. **Water-Cement Ratio and Compressive Strength:** The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

Type of Work	Class of Concrete Min 28-Day Compressive Strength, psi	Max Size Aggregate in	Cement Content Per cu yd, lbs	Max W/C Ratio (by weight)
Structural concrete	4,000	1	564 to 600	0.45

2.9 CONSISTENCY

- A. Consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C143. The slumps shall be 3-inches plus or minus 1-inch

2.10 MEASUREMENT OF CEMENT AND AGGREGATE

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the Contractor and acceptable to the Engineer; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

2.11 MEASUREMENT OF WATER

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device that is acceptable to the Engineer and capable of measuring the water in variable amounts within a tolerance of one percent.

2.12 READY-MIXED CONCRETE

- A. At the Contractor's option, ready-mixed concrete shall be used. Materials, batching, mixing, transporting, placing, shall conform to ASTM C94 and this specification.
- B. Ready-mixed concrete shall be delivered to the Work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever comes first. In hot weather, under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counter shall be actuated at the time of starting the mixer at mixing speed.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. Materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- E. Each batch of ready-mixed concrete delivered to the Work shall be accompanied by a delivery ticket furnished to the Engineer in accordance with the requirements above.
- F. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

PART 3 -- EXECUTION

3.1 EVALUATION OF CONCRETE, GROUT OR MORTAR TEST RESULTS

- A. Tests.
 - 1. Test results for standard molded and cured test cylinders to be evaluated separately for each mix design. Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards. For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests. A strength test shall be the average of two cylinders from the same sample tested at 28 days.
 - 2. Drying shrinkage tests shall be made in advance of submission at the time of the first placement of each class of concrete, and during construction to insure continued compliance with these Specifications.
 - 3. Drying shrinkage specimens shall be 4 in by 4 in by 11 in prisms with an effective gage length of 10 IN, fabricated, cured, dried, and measured in accordance with ASTM C157 modified as follows:
 - a. Specimens shall be removed from molds at an age of 23 ± 1 hours after trial batching, shall be placed immediately in water at $70 \text{ degrees F} \pm 3 \text{ degrees F}$ for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at $73 \text{ degrees F} \pm 3 \text{ degrees F}$.
 - b. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at $73 \text{ degrees F} \pm 3 \text{ degrees F}$ and $50 \text{ percent} \pm 4 \text{ percent}$ relative humidity for the remainder of the test.
 - c. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

4. The drying shrinking deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 IN at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 IN, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project.

B. Acceptance:

1. Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
 - a. Average of all sets of three consecutive strength tests equal or exceed the required specified 28-day compressive strength.
 - b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.
2. Shrinkage Limitation
 - a. The maximum concrete shrinkage, as measured at 21-day drying age or at 28 day drying age, shall be 0.036 percent or 0.042 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements.
 - b. The maximum concrete shrinkage for specimens cast in the field shall not exceed average maximum shrinkage requirement by more than 25 percent.
 - c. If the required shrinkage limitation is not met during construction, the Contractor shall take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement, and/or admixtures; reducing water content; washing of aggregate to reduce fines; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.
3. Alkali-Silica Reactivity limitations:
 - a. The maximum percentage in specimen length at 14 days shall not exceed 0.1 percent per AASHTO T-303.
 - b. Mix design shall be modified to show proportions of ASR inhibitor.
 - c. If the ASR limitation is not met during construction, the Contractor shall take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement, and/or admixtures; or other actions designed to minimize reactivity without deleterious effect on concrete properties.

3.2 GENERAL FORMWORK REQUIREMENTS

- A. Forms to confine and shape the concrete to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and federal regulations. Design, construction, maintenance, preparation, and removal of forms shall be in accordance with ACI 347.
- B. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.3 CONSTRUCTION

- A. **Vertical Surfaces:** Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Form Ties:
1. **Embedded Ties:** Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
 2. **Removable Ties:** Where taper ties are approved for use, after the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink or regular cement grout. Exposed faces of walls shall have at least the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have their forms removed until they have attained at least 75 percent of the 28-Day strength of the concrete. Forms for vertical walls and columns shall remain in place at least 48 hours after the concrete has been placed. Forms for parts of the Work not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347.

3.6 GENERAL REINFORCEMENT REQUIREMENTS

- A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.

3.7 FABRICATION

- A. General:

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
 2. The Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the Contractor.
 3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.
- B. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner that will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the Engineer.

3.8 PLACING

- A. Reinforcement shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. Reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. The portions of accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
- D. Bars additional to those indicated which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor as part of the Work.
- E. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. The minimum spacing requirements of ACI 318 shall be followed for reinforcing steel.

3.9 SPLICING

- A. **General:** Reinforcement splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be reviewed and accepted by the Engineer.
- B. Splices of Reinforcement
1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, for a Class B splice.
 2. Welded splices shall be performed in accordance with AWS D1.4.
 3. Laps of WWF shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3.10 CLEANING AND PROTECTION

- A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign

substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

3.11 PROPORTIONING AND MIXING

- A. **Proportioning:** Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.
- B. **Mixing:** Mixing of concrete shall conform to the requirements of Chapter 7 ACI 301.
- C. **Slump:** Slumps shall be as indicated herein.
- D. **Retempering:** Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.12 PREPARATION OF SURFACES FOR CONCRETING

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. **Joints in Concrete:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, and foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the Engineer.
- D. **Embedded Items**
 - 1. No concrete shall be placed until formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.
 - 2. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated or by Shop Drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
- E. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.
- F. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to the review of the Engineer.

- G. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- H. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided for during the placing of concrete.
- I. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

3.13 HANDLING, TRANSPORTING, AND PLACING

- A. **General:** Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. **Non-Conforming Work or Materials:** Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications or which is of inferior quality shall be removed and replaced at the expense of the Contractor.
- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the Engineer. The Contractor shall notify the Engineer in writing at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall and Column Forms:
 - 1. Concrete shall not be dropped through reinforcement steel or into any deep form nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4-feet in walls and 8-feet in columns below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6-feet in horizontal direction. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2-feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5-feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of forms so that the concrete at the places of deposit is visible from the deck or runway.
 - 2. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel, and laitance shall be removed.
- E. **Conveyor Belts and Chutes:** Ends of chutes, hopper gates, and other points of concrete discharge throughout the Contractor's conveying, hoisting, and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50-feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the required consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. Conveyor belts and chutes shall be covered.

F. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the required minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water, using ice, or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

G. Cold Weather Placement:

1. Placement of concrete shall conform to ACI - 306, and the following:
 - a. Earth foundations shall be free from frost or ice when concrete is placed upon or against them.
 - b. Maintain the concrete temperature above 50 degrees F for at least 72-hours after placement.

3.14 PUMPING OF CONCRETE

A. **General:** If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment:

1. The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the Site during pumping.
2. The minimum diameter of the hose conduits shall be in accordance with ACI 304.
3. Pumping equipment and hose conduits that are not functioning properly shall be replaced.
4. Aluminum conduits for conveying the concrete shall not be permitted.

3.15 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete. Vibrators shall be high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required.

B. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall not contact the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.16 FINISHING CONCRETE SURFACES

A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

- B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects.
1. Surface holes larger than 1/2-inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
- C. **Unformed Surfaces:** After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Whenever the air temperature exceeds 85 degrees F or the wind speed exceeds 25 mph at the time of placement, the concrete shall be treated as follows. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish for unformed concrete surfaces are designated and defined as follows:
1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where indicated or as determined by the Engineer.
 3. Finish U3 - After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of irregularities. Place Working Floor Surface Coating.
 4. Finish U4 - Trowel the Finish U3 surface to remove local depressions or high points. In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE	
Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Slabs	U4
Top surface of walls	U3

3.17 CURING AND DAMPPROOFING

- A. **General:** Concrete shall be cured for not less than seven (7) days after placing, in accordance with the methods indicated below for the different parts of the Work.
- B. **Concrete Curing Method:** The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.
 2. Unstripped forms that are removed within seven (7) days of placing the concrete shall be sprayed with liquid curing compound immediately after stripping forms.
 3. Liquid curing compound shall not be sprayed in construction joints between footings and walls and between floor slabs and columns. The surface of the construction joint shall be free of bond breakers.
 4. Concrete that shall be buried will need to be cured for seven (7) days and have 75% concrete compression strength prior to backfilling.
 5. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the seven (7) day curing period. If the seal is damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 6. Wherever curing compound has been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting or approved method just prior to the placing of new concrete.
 7. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within two (2) hours after removal of forms. Repairs required to be made to formed surfaces shall be made within the said two (2) hour period; provided, however, that any such repairs which cannot be made within the said two (2) hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted or approved method to remove the curing compound.
 8. During the curing period, no traffic of any nature and no depositing of any materials, temporary or otherwise, shall be permitted on surfaces coated with curing compound. Foot traffic and the depositing of materials may be allowed after three (3) days if the surface is covered with 5/8-inch plywood placed over polyethylene sheets.
- C. The Contractor may submit alternate methods of curing which maintain the concrete in a continuously wet condition for acceptance by the Engineer.

3.18 PROTECTION

- A. The Contractor shall protect concrete against injury until final acceptance.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The Contractor shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.19 CURING IN COLD WEATHER

- A. Cold weather concrete shall conform to ACI 306 for cold weather concrete placement.
- B. Water curing of concrete may be reduced to six (6) days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- C. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved

insulation in contact with the forms or concrete surfaces; otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.

- D. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than three (3) days, 72 hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- E. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.20 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be performed promptly.
- B. Defective surfaces to be repaired shall be cut back from true line a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of laitance or soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. Repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.21 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, which becomes defective at any time prior to the final acceptance of the completed Work, which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of

the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

END OF SECTION

DIVISION 31 - EARTHWORK

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section covers furnishing of all labor, materials, tools, equipment, and performing all Work and services for excavating, over excavating, borrowing, removing undesired or excess materials as shown on the Construction Drawings, in accordance with the Contract Documents.
- B. Although such work is not specifically indicated, perform all supplementary work incidental to the services outlined above.
- C. Foundations include footings, floor slabs, walls, mat foundations, aprons, piers, pits, or any other support placed on or in the soil.
- D. This Section does not apply to Trenching and Backfill for pipelines.

1.02 RELATED SECTIONS

- A. Section 31 23 19: Dewatering
- B. Section 31 37 00: Riprap
- C. Section 31 23 23.15: Trenching, Backfilling, and Compaction (Pipelines)
- D. Section 31 23 24: Fill Materials

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. Excavation Plan, detailing:
 - a. Methods and sequencing of excavation
 - b. Proposed locations of stockpiled excavated material
 - c. Proposed onsite and offsite spoil disposal sites
 - d. Numbers, types, and sizes of equipment proposed to perform excavations
 - e. Reclamation of onsite spoil disposal areas
 - 2. Shoring Plan:
 - a. Methods and sequencing
 - b. Detail of loads and design
 - c. Dewatering and water control

1.04 QUALITY ASSURANCE

- A. Provide adequate survey control to avoid unauthorized over excavation. The Construction Manager shall verify adequate survey control designating an individual to perform by spot checking elevations for the Owner. The Engineer shall approve or reject the results.

1.05 WEATHER LIMITATIONS

- A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.
- B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.06 SEQUENCING AND SCHEDULING

- A. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 11 00, Site Preparation, prior to excavating.
- B. Dewatering: Conform to applicable requirements of Section 31 23 19, Dewatering, prior to initiating excavation.

1.07 STANDARD SPECIFICATIONS (N/A)

1.08 SUBSURFACE AND GEOLOGICAL INVESTIGATIONS

- A. An investigation has been made to obtain relative data concerning the character of material being made available to prospective bidders and the Contractor for information purposes only. The Contractor shall satisfy himself as to the kind and type of soil to be encountered and any water or subsurface conditions which might affect the construction of the project.

1.09 CONSTRUCTION REVIEW

- A. The Engineer will review the excavation.
- B. The Contractor's Safety Officer will inspect the excavation and trenches to ensure OSHA and MSHA compliance.
- C. Engineer will review shoring plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall notify the Construction Manager at least 48 hours in advance of the commencement of any phase of the work, as well as any delays or stoppage.
- B. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of +/- 0.1-ft, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, over excavation, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.
- C. Do not excavate below specified over excavation limits without written authorization of the Engineer.
- D. The Contractor will perform all excavation of every description and substance encountered, to the depths indicated in the Drawings or as otherwise specified. During excavation, materials suitable for backfilling will be piled in an orderly manner, a sufficient distance from the banks to avoid overloading and to prevent slides or cave-ins. Topsoil will be removed and piled separately for use in finish grading the grounds. Grading will be done as may be necessary to prevent surface water from flowing into trenches or other excavations. Any water accumulating therein will be removed by pumping or by other approved methods. Sheet piling and shoring will be done as may be necessary for the protection of the work and the safety of the personnel. All trenches left open shall be protected by fencing or other approved methods at the end of each workday.

3.02 TOPSOIL

- A. Topsoil shall be removed and stockpiled as described in Section 31 11 00, Site Preparation.

3.03 EXCAVATION

- A. All excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered to the limits defined or described by the Contract Documents.
- B. The Contractor shall excavate to elevations shown on the Contract Drawings, allowing additional space as required for construction operations and review of foundation construction. All excavation and side slopes shall conform to all applicable regulations. Where engineered cut slopes are required by OSHA regulations, the Contractor shall retain a professional to provide the necessary engineering designs for review by the Engineer. The Contractor shall remove obstructions including but not limited to old foundations, pipe, unsuitable subgrade soils, and any other materials which may be concealed beneath the present grade, as required to construct an acceptable grade for the foundations.

3.04 OVER EXCAVATION

- A. The Contractor shall over-excavate subgrade soils, as shown on the Drawings, or in areas with undesirable or unsuitable soils for foundation support as determined by the Engineer.

- B. Where concrete structures are to be placed, over excavation of 1-ft to 2-ft or as shown on the Drawings is required and the void recompacted with material as specified on the Drawings.

3.05 PREPARATION OF FOUNDATIONS

- A. Where foundations are to rest on subgrade material other than rock, care should be taken to avoid disturbance of the bottom of the excavation. Soils loosened during excavation shall be removed from the excavation, and the excavation restored to a condition at least equal to the undisturbed subgrade.
- B. The Contractor is responsible for notifying the Engineer as soon as excavations are completed in order that subgrade may be reviewed.
- C. Completed excavations shall be protected from becoming unacceptable including but not limited to becoming wet, frozen, overly dry, or soft due to weather, and or construction operations. Grading around excavations for structures shall be performed to prevent water from running into the excavation or from damaging completed foundations. Should any free water, groundwater, or springs be encountered, the Contractor shall be required to keep excavations free from water during construction of the foundations by the use of trenches, well points, or other means as reviewed and accepted by the Engineer.
- D. The Contractor shall shore, sheet pile, slope, and/or brace excavations as required to maintain a safe site and to conform to all local, state, or federal agency regulations having jurisdiction over the work. The Contractor is fully and solely responsible for maintaining safe working conditions during construction. Any shoring necessary to carry out the Work will be submitted and outlined in a shop drawing submittal prior to commencing.
- E. The Contractor is responsible for protecting all monuments, benchmarks, and other reference points to be used to construct the foundations. Reference points disturbed that require restaking will be restaked at the Contractor's expense.

3.06 EMBANKMENT AND CUT SLOPES

- A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
- B. Remove stones and rock that exceed 3-in diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.
- C. Round tops of cut slopes in soil to not less than a 6-ft radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.07 STOCKPILING EXCAVATED MATERIAL

- A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
- B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.
- C. Confine stockpiles to within the construction limits and approved work areas. Do not obstruct roads, streets, or utility easements.
- D. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
- E. Do not stockpile excavated materials near or over or under existing utilities and facilities, adjacent property, or completed Work, if weight and height of stockpiled material could induce excessive settlement.

3.08 DISPOSAL OF SPOIL

- A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, within the floor of the reservoir unless otherwise directed in the Drawings.

- B. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 11 00, Site Preparation, for clearing and grubbing debris. Do not bury onsite.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and perform all installation, maintenance, removal, and area cleanup related to dewatering.

1.02 RELATED WORK

- A. Site Preparation is included in Section 31 11 00.
- B. Fill Materials are included in Section 31 23 24.
- C. Sedimentation and Erosion Control is included in Section 31 25 00.
- D. Excavation is included in Section 31 23 16.
- E. Dewatering Permit information is included in Section 01 41 26

1.03 SUBMITTALS

- A. Informational Submittals
 - 1. Water control plan
 - 2. Discharge permits

1.04 WATER CONTROL PLAN

- A. At a minimum, include:
 - 1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, pollution control facilities, discharge locations to be utilized, sediment control, and provisions for immediate temporary water supply as required by this section.
 - 2. Drawings showing locations, dimensions, and relationships of elements of each system.
 - 3. Design calculations demonstrating adequacy of proposed dewatering systems and components.
- B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.
- C. Include in plan any monitoring and how it will be completed to meet discharge permits or water accounting.

PART 2 MATERIALS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Pleasant Valley Reservoir will be lowered to gage height 8' and maintained at this level during construction. Upon completion and acceptance of the service spillway, a request by the Owner to the Office of the State Engineer may be made to raise the reservoir level to gage height 10.5' prior to the completion of the entire project.
- B. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

3.02 SURFACE WATER CONTROL

- A. Control of surface water shall conform to the requirements of grading, erosion, and sediment control plans included in the Drawings, as well as the Stormwater Management Plan.
- B. Dewatering Sediment Control (reference the permit application coverage under Permit No. 070000 "Colorado Department of Public Health and Environment (CDPHE) General Permit for Construction Dewatering Operations"): Sediment shall be contained within the construction site

and may not be discharged into drainages and/ or jurisdictional waters. Contained sediment should be disposed of at a designated location away from the Site.

- C. Water from dewatering shall conform to the requirements within the construction dewatering permit and shall be filtered so that sediment plumes are not deposited into drainage ways or wetlands.
 - 1. Contractor shall develop a dewatering plan and obtain approval by the Engineer prior to the start of any Work onsite. The plan shall indicate the methodology and equipment that will filter water and indicate where stored sediment will be disposed of offsite. The plan shall designate a person or persons who will monitor the sediment control program and order decreased dewatering, as necessary, to prevent transport of sediment offsite. The plan shall be submitted to the CDPHE to obtain a construction dewatering permit.
 - 2. If any sediment is deposited into jurisdictional water or wetland the Engineer shall be contacted immediately, and Work shall stop until the sediment leak is repaired and discharge ceases.
- D. Remove surface runoff controls when no longer needed.

3.03 DEWATERING SYSTEMS

- A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of 2-ft below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source and until backfilled to final grade.
- B. Design and Operate Dewatering Systems:
 - 1. To prevent loss of ground as water is removed.
 - 2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
 - 3. To relieve artesian pressures and resultant uplift of excavation bottom.
- C. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.
- D. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.04 MONITORING FLOWS

- A. The Contractor shall also perform monitoring as required in the CDPHE Dewatering Permit.

3.05 DISPOSAL OF WATER

- A. Obtain discharge permit for water disposal from authorities having jurisdiction.
- B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge. Also, assure that the effluent limits set forth by the CDPHE Discharge Permit are met.
- C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.
- D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.06 PROTECTION OF PROPERTY

- A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.
- B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.07 PROTECTION OF CLAYSTONE SUBGRADES

- A. Exercise additional care when dewatering claystone subgrades as this material has a strong tendency to desiccate.
- B. Take all appropriate precautions to prevent wetting and subsequent disturbance of claystone/sandstone subgrades within the foundation foot print of the structure and extending to a point 5' beyond the footprint.

END OF SECTION

SECTION 31 23 23.15

TRENCHING, BACKFILLING, AND COMPACTION (PIPELINES)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.
- B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures, and appurtenances.
- C. Furnish and place all sheeting, bracing and supports and remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. All pipelines installed by open cut trench method shall be bedded with granular pipe bedding or flowable fill as required on the drawings and per Section 31 23 24.
- E. All excavation, trenching and related sheeting, bracing, etc., shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P).
- F. Wherever the requirement for 95 percent compaction is referred to herein it shall mean "at least 95 percent of maximum density as determined by ASTM D1557, Method D", modified proctor.
- G. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.
- H. The Contractor will not use private property outside construction easements without first obtaining written permission. A copy of this document shall be provided to the engineer prior to the Contractor using said property.

1.02 RELATED WORK

- A. Dewatering is included in Section 31 23 19.
- B. Granular fill material is included in Section 31 23 24 Fill Materials.
- C.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

- A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be saw-cut along straight lines before excavating.
- B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- C. While excavating and backfilling is in progress all utilities and other property shall be protected as provided in the General Conditions and Contract Documents.
- D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be practical minimum.
- E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose,

"quick," or otherwise unsatisfactory as a result of inadequate excavation, dewatering, or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the Contractor's expense.

- F. Where pipe is to be laid in screened gravel or granular bedding, the trench may be excavated by machinery to the normal depth of the trench provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

3.02 DISPOSAL OF MATERIALS

- A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Excavated material shall be segregated for use in backfilling as specified below.
- B. It is expressly understood that no excavated material shall be removed from the site of the work or disposed of, except as directed by the Engineer. When removal of surplus materials has been approved by the Engineer, dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stockpiled at an area approved by the Engineer. When required, it shall be re-handled and used in backfilling the trench.

3.03 TEST PITS

- A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.04 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the Contractor excavates below grade through error or for the Contractor's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.
- C. If the material at the level of trench bottom consists of fine sand, sand and silt, or soft earth that may work into the screened gravel notwithstanding effective drainage, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-in layer of coarse sand, or a mixture graded from coarse sand to the fine squeegee, as approved by the Engineer, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the Engineer prior to placement. Screened gravel shall then be placed in 6-in layers thoroughly compacted up to the normal grade of the pipe. If directed by the Engineer, bank run gravel shall be used for refill of excavation below grade.
- D. Geotextile filter fabric may be substituted for filter layer if approved by the Engineer. Filter fabric shall be Mirafi 140N; Supac equivalent, or equal.

3.05 BACKFILLING

- A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Bedding material, as specified for the type of pipe installed, shall be placed up to 1-ft over the pipe.
- B. An impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as specified, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding between each manhole where directed or every 300-ft, whichever is less.

- C. Where the pipes are laid cross-country, the remainder of the trench shall be filled with common fill material in layers not to exceed 3-ft and mounded 6-in above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the cleanup process, so that the ground may be restored to its original level and condition.
- D. Where the pipes are laid in streets, the remainder of the trench up to a depth of 12-in (20-in for State Highways) below the bottom of the specified permanent paving shall be backfilled with common fill material in layers not to exceed 1-ft and thoroughly compacted. The subbase layer for paving shall be of bank run gravel thoroughly compacted in 6-in layers.
- E. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or screened gravel has been placed and compacted to a level 1-ft over the pipe.
- F. Bedding material in the pipe zone and subsequent backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to 95 percent compaction, 65 percent relative density, or as a performance specification as agreed upon with the Engineer. Bedding and backfill soils will have a minimum compaction of 95 percent of the maximum dry density determined by ASTM D1557. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench. Where flowable fill is used as pipeline bedding, contractor shall take all measures necessary to prevent flotation of the pipe. Pipe measured to be off grade will be directed for removal and reinstallation at the sole discretion of the Engineer.
- G. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20-lb. The material being spread and compacted in layers not over 6-in in loose measured thickness. Layer thickness may be increased to 12-in when sufficient compaction tests are provided to the Engineer that verifies that a piece of equipment can compact to a depth of 12-in. If necessary, sprinkling shall be employed in conjunction with rolling or ramming. Only hand tamping equipment or vibratory hand units will be allowed within the first 36-in above the top of the pipe.
- H. Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6-in may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2-ft of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.
 - 1. Bituminous paving shall not be placed in backfill. Frozen material shall not be used under any circumstances.
- J. All road surfaces shall be broomed and hose cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.06 RESTORING TRENCH SURFACE

- A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross country areas, thoroughly consolidate the backfill and shall maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.
- B. In and adjacent to streets, the 12-in layer (20-in in State Highways) of trench backfill below the specified initial pavement shall consist of compacted COOT Class 6 base course. Should the Contractor wish to use material excavated from the trench as gravel subbase for pavement replacement, the Contractor, at his/her own expense, have samples of the material tested by an independent testing laboratory at intervals not to exceed 500-ft, in order to establish its compliance with the specifications. Only material which has been tested and approved by the Engineer shall be allowed to be incorporated into the work.

- C. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.
- D. In sections where the pipeline passes through grassed areas, and at the Contractor's own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Engineer.

END OF SECTION

SECTION 31 23 24
FILL MATERIALS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Fill materials are specified in this Section, but their use for bedding pipe, replacement of unsuitable material, pavement base, foundation support, structural backfill, and similar uses are shown and/or specified in detail elsewhere. The Engineer may order the use of fill materials for purposes other than those specified in other Sections, or if not otherwise indicated, if, in the Engineer's opinion, such use is advisable.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Trenching, Backfilling, and Compaction (Pipeline) are included in Section 31 23 23.15.
- B. Individual fill materials may be specified elsewhere in Division 31.

1.03 SUBMITTALS

- A. Submit certified sieve analysis (per ASTM C1361) and source information for each material used, performed by a laboratory meeting CDOT Standards. See Section 01 33 00. See chloride limits under Granular Pipe Bedding. Submit a representative sample (25-lb) of each proposed fill material if requested by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Where applicable, excavated materials that meet the requirements for specific products in this Section may be reused in the back fill, but must have approved information under paragraph 1.03. There will be no change in Contract Price or Schedule for the inability to reuse existing materials in the work or having to wash or modify existing materials in the work.
- B. All materials shall be unfrozen, free of snow, ice, and deleterious materials, in addition to requirements shown below.
- C. **Pipe Bedding**
 - 1. Slotted Filter Drain Pipe, Chimney drain, and Structural Backfill: The bedding around the slotted filter drain pipe, the chimney drain material, and the structural backfill of the manhole shall be No. 67 Rock consisting of hard, durable particles of proper size and gradation, and it shall be free from loam, clay, excess fines, coal and coal byproduct materials, and deleterious materials. The size of the particles shall conform to No. 67 Rock meeting the following requirements:

Sieve No.	Percent Passing
1"	100
3/4"	90 - 100
3/8"	20 - 55
No. 4	0 - 10
No. 8	0 - 5

- D. **Common backfill** shall consist of excavated existing soils, substantially free of organic material, loam, wood, trash, material with high swell potential, and other objectionable material that may be compressible, or that cannot be compacted properly. The soil shall not contain stones larger than 6-in in any dimension, broken concrete, masonry, rubble, asphalt pavement, broken pipe or fragments, or other similar materials.

PART 3 EXECUTION

3.01 INSTALLATION

- A. See other parts of the specifications and Drawings for where these materials should be used. See also paragraph 1.1.A.
- B. Unless otherwise noted, materials shall be placed on unfrozen, firm, solid, undisturbed earth or rock, or well-compacted foundation and shall be placed to the depths specified or shown.
- C. Gravel shall be placed in not greater than 8-in layers and thoroughly compacted by tamping, hand operated vibrators, or otherwise as acceptable by the Engineer.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. All labor, equipment and materials necessary for excavating, placing and grouting of riprap, complete and in-place. Extent of riprap is indicated on the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 31 23 19: Dewatering
- B. Section 31 23 16: Excavation

1.03 CONTRACTOR SUBMITTALS

- A. The Contractor shall provide samples of the riprap material, when required for color verification, to the Engineer for approval prior to delivery to the Site. Gradation test results and mix design will be submitted for bed course material and grout, respectively. The Engineer will approve or reject the material.
- B. The Contractor shall provide gradation test results for the riprap bedding. When required by the Engineer the Contractor shall submit a sample of the riprap for independent gradation testing.
- C. Fiber mesh for grouted riprap.

PART 2 PRODUCTS

2.01 BED COURSE MATERIAL

- A. Bed course material for slope protection, or riprap filter blanket, shall be a porous free draining material consisting of sand, gravel, crushed stone or other approved free draining material. This material shall meet the following gradation requirements:

RIPRAP BEDDING

Sieve Size	Total Percent Passing Square Mesh Sieves
2"	90 - 100
3/4"	20 - 90
3/8"	-
No. 4	0 - 20
No. 16	-
No. 50	-
No. 100	-
No. 200	0 - 3

This gradation is CDOT Type II bedding.

GRADATION FOR GRANULAR BEDDING

Sieve Size	Total Percent Passing Square Mesh Sieves	
	Type I	Type II
2"	-	90 - 100
1-1/2"	-	-
3/4"	-	20 - 90
3/8"	100	-
No. 4	95 - 100	0 - 20
No. 16	45 - 80	-
No. 50	10 - 30	-
No. 100	2 - 10	-
No. 200	0 - 2	0 - 3

2.02 RIPRAP (IMPORTED)

- A. The stone shall have a specific gravity of at least 2.65, a sodium sulfate soundness value less than 12%, and a Los Angeles abrasion value less than 50%. Riprap shall consist of igneous or metamorphic rock fragments which shall be dense, sound and resistant to abrasion; shall be free from cracks, seams, and other defects that would tend to unduly increase their destruction by water and frost actions. Asphalt, broken concrete, concrete slabs or other materials not classified as rock will not be allowed for use as riprap material. Riprap shall meet the following requirements:

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

Rip Rap Designation	% Smaller Than Given Size by Weight	Intermediate Rock Dimension (inches)	d50* (inches)
Type VL	70-100	12	
	50-70	9	
	35-50	6	6
	2-10	2	
Type L	70-100	15	
	50-70	12	
	35-50	9	9
	2-10	3	
Type M	70-100	21	
	50-70	18	
	35-50	12	12
	2-10	4	
Type H	100	30	
	50-70	24	
	35-50	18	18
	2-10	6	
Type VH	100	42	
	50-70	33	
	35-50	24	24
	2-10	9	

*d50 = Mean particle size

Grouted riprap shall meet all requirements for ordinary riprap except that the smallest rock fraction shall be eliminated from the gradation.

PART 3 EXECUTION

3.01 EXCAVATION

- A. The Contractor shall excavate to the lines and grades shown on the Contract Drawings.

3.02 PLACING BED COURSE MATERIAL

- A. Bed course material shall be placed beneath the riprap to the prescribed thickness as shown on the Contract Drawings.
- B. The Contractor shall handle and place the material in a manner to prevent segregation. The bedding need not be compacted, but shall be placed in such a manner as will result in uniform layers of the specified thickness.

3.03 PLACING RIPRAP

- A. Riprap shall be placed in such a manner so as not to cause a segregation of particle sizes. Placing in layers or by dumping into chutes or similar methods which may cause segregation are specifically prohibited. The riprap shall be placed, in one preparation, to the line, grade, and thickness as shown on the Drawings, without undue displacement of the granular filter bedding underneath or damage to geotextile fabric.
- B. Riprap shall be placed to grade in a manner to insure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments in such a manner as will result in a well-keyed, densely placed, uniform layer of riprap of the specified thickness. Consolidation of the riprap by backhoe or other means will be necessary to insure interlocking of rock fragments. Placed riprap shall be uniform and free from bulges, humps, or cavities. Hand placing will be required only to the extent necessary to secure the results specified above.

END OF SECTION

DIVISION 33 – UTILITIES

SECTION 33 05 13
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required to install precast concrete manholes, frames and covers, and appurtenances as shown on the Drawings, as specified herein. Engineer will be the sole judge as to compliance interpretation of the drawings and specifications.

1.02 RELATED WORK

- A. Granular fill material is included in Section 31 23 24 Fill Materials.

1.03 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01 33 00, shop drawings, product data, materials and details of construction, reinforcing and joints. Submittals shall include at least the following:
 - 1. Base sections, riser sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478.
 - 2. Pipe connections to manholes and catch basins.
 - 3. Manhole frame and cover and catch basin frame and grate with notarized certificate indicating compliance with the specified ASTM standard and Class designation.
 - 4. Method of repair for minor damage to precast concrete sections.
- B. Design Data
 - 1. Precast concrete structures:
 - a. Six copies of sectional plans and elevations showing dimensions and reinforcing steel placement.
 - b. Six copies of structural calculations including assumptions.
 - c. Six copies of concrete design mix.
- C. Test Reports
 - 1. Precast concrete structures:
 - a. Six copies of concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.
 - 2. Results of leakage tests.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48- Standard Specification for Gray Iron Castings.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 3. ASTM C150- Standard Specification for Portland Cement
 - 4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
 - 5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
 - 6. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures
 - 7. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealant.
 - 8. ASTM D4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials
- B. American Concrete Institute (ACI)
 - 1. ACI318 - Building Code Requirements for Structural Concrete
 - 2. ACI350 - Code Requirements for Environmental Engineering Concrete Structures
- C. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. Standard Specifications for Highway Bridges
- D. Occupational Safety and Health Administration (OSHA)

- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All material shall be new and unused.
- B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other Owner representative. Inspection may be made at place of manufacture, at work site following delivery, or both.
- C. Materials will be examined for compliance with ASTM standards, this Section and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions, blisters, cracks, and soundness.
- D. Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Sewer manhole precast concrete sections will be manufactured using the "wet method" of fabrication. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.
- E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Engineer. Epoxy mortar may be utilized for repairs subject to the approval of the Owner.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. Provide lifting lugs or holes in each precast section for proper handling.
- D. Cement shall conform to ASTM C150, Type II cement or equal.
- E. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 3,000 psi compressive strength.
- F. Mark date of manufacture, name, and trademark of manufacturer on the inside of each precast section.

2.02 PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast concrete base sections, riser sections, transition top sections, flat slab tops, and grade rings shall conform to ASTM C478 and meet the following requirements:
 - 1. Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck loading applied at finished grade.
 - 2. Bottom slab thickness shall be no less than the riser wall thickness.
 - 3. Construct precast concrete bases.
 - 4. Base, risers, and transition top sections shall have tongue and groove joints.

2.03 MANHOLE INVERTS

- A. Drain manholes shall have cast-in-place concrete inverts and shelves conforming to one-half the diameter of the largest pipe.
- B. At changes in direction, the cast-in-place concrete inverts shall be laid out in curves of the longest radius possible, tangent to the centerline of the drain pipes. Shelves shall slope towards the invert channels at 1/2-in per foot.

2.04 MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface to exclude surface water and so that the cover shall be level with the top of the ring. Manhole covers shall be provided with a water-tight gasket seal. Manhole covers shall be lockable. The lock shall be similar to the cam lock system by East Jordan Iron Works. Castings shall be thoroughly cleaned and subject to

hammer inspection. Cast iron shall conform to ASTM A48, Class 30.

- B. Manhole rings and covers shall conform to Table 1 below. Covers will have no more than one lifting slot, which must extend beyond the lip of the ring.

TABLE 1
RING AND COVERS

SIZE OF RING AND COVER	SYSTEM	PIPE SIZE
30-in	Storm Drainage	24-in

2.05 MANHOLE STEPS

- A. Manhole steps shall be aluminum cast into the manhole wall when the manhole section is cast. They may also be copolymer polypropylene plastic drilled and installed after the manhole section is in place. Block outs are not allowed.
- B. Steps shall be by Alcoa No. 126538, as manufactured by the Aluminum Company of America, or PS2-PF as manufactured by M.A. Industries, Inc., or Owner approved equal.
- C. Manhole steps shall be no more than 24-in and no less than 18-in from the top of the manhole ring and 24-in from the bench of the manhole. Intermediate steps shall be a minimum of 12-in to a maximum of 16-in apart.
- D. Aluminum steps shall have a bituminous coating on all areas in contact with concrete.
- E. 20-in of clearance shall be maintained between the top step and the opposing wall of the manhole barrel section.

2.06 JOINTING PRECAST MANHOLE SECTIONS

- A. Joints shall be sealed with O-Ring gaskets conforming to ASTM C443.
- B. With approval of the engineer, precast manhole may be sealed with a flexible joint sealing compound. Preformed flexible joint sealant shall conform to ASTM C990-09 and Federal Specifications SS-S-210A. Sealing compounds will remain quite pliable to -20 degrees Fahrenheit and will not become excessively pliable at +120 degrees Fahrenheit.
- C. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.07 PIPE CONNECTIONS TO MANHOLES

- A. Connect pipe to manholes in the following ways:
 1. Flexible sleeve Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N- Sealconnector; PRX Press-Seal Gasket or equal.
 2. Compression gasket Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A- Lok or equal.

2.08 DAMPPROOFING

- A. Two coats of bituminous waterproofing material applied to the exterior surfaces of sanitary sewer manholes by brush or spray and in accordance with the manufacturer's recommendations. See Section 07 14 16 for approved products.

2.09 PROTECTIVE COATING

- A. A protective coating system shall be applied to the interior surfaces of sanitary sewer manholes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manhole Installation.
 - 1. Manholes shall be constructed in conformity with ASTM C891 except as specified herein and to the dimensions shown on the Drawings. Protect all work against flooding and floatation.
 - 2. Place manhole and catch basin base on a bed of 12-in crushed stone as shown on the Drawings. Set manhole and catch basin base grade so that a maximum grade adjustment of 12-in is required to bring the manhole frame and cover to final grade.
 - 3. Manhole rings shall be held in place by being set on mortar. Mortar will be placed over the ring from the edge of the support structure to 1-in from the top edge of the ring for manholes that are not located within a pavement section. Concrete or HOPE manhole rings will be used to adjust the final rim elevation to no further than 24-in to the first step.
 - 4. Set precast concrete barrel sections plumb with a 1/4-in maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O- ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Engineer.
 - 5. Allow joints to set for 14 hours before backfilling unless the Engineer specifically approves a shorter period.
 - 6. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.
 - 7. Backfill carefully and evenly around manhole sections.
- B. Manhole Pipe Connections
 - 1. Construct manhole and catch basin pipe connections, including pipe stubs, as specified herein. Close or seal pipe stubs for future connections with a gasketed watertight plug.
- C. Dampproofing
 - 1. Paint outer surfaces of precast sanitary sewer manholes with two coats of bituminous dampproofing at the rate of 30- to 60-sq-ft/gallon, in accordance with manufacturer's instructions and is specified in Section 07 14 16.

3.02 CLEANING

- A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

SECTION 33 11 00
PIPING AND TOE DRAIN

PART 1 - GENERAL

1.01 WORK INCLUDED

This section covers the furnishing and installation of ductile iron and PVC pipe and fittings.

1.02 RELATED WORK

A. 31 23 23.15 – Trenching, Backfilling, and Compaction (Pipelines)

1.03 SUBMITTALS

See Section 01 33 00 – Contractor Submittals

PART 2 – MATERIALS

2.01 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE

A. Specifications

The pipe shall be designed, manufactured, tested, inspected and marked in accordance with the provisions of this Specification and ASTM Standard D2241, "Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)," except as herein modified. A 10 ga minimum protected tracer wire shall be installed with the pipe and shall be electrically connected to each other. Fittings shall be PVC conforming to the requirements of this specification, or shall be steel conforming to the requirements of Paragraphs 2.02 and 3.02 of this Section.

B. Dimensions

Nominal pipe lengths shall be 20', with shorter lengths provided as required by drawings, alignment and grade. Permissible variations in length, diameter, weight, wall thickness and straightness shall comply with the allowable tolerances specified in the applicable AWWA standards.

C. Thickness

The minimum wall thickness shall be SDR35.

D. Joint Type

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint. The joint shall comply with the requirements of AWWA C-905 when tested to 80 psi. Solvent-cement joints are strictly prohibited.

E. Materials Submittals

The following submittals will be required for review and acceptance by the Engineer:

- °Standard joint detail
- °Restrained joint detail
- °Slot size and spacing
- °Pipe laying schedule

F. Slotted Pipe

Slotted pipe for the toe drain shall have three rows of slots 0.375 inches wide, 2" in length spaced at 0.5" for 8" diameter pipe.

PART 3 – EXECUTION

3.01 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE INSTALLATION

A. General

All PVC pipe shall be installed in accordance with this specification. All pipe shall be handled and installed in accordance with AWWA C-600.

B. Handling

All pipe and fittings shall be handled at all times by lifting with padded cradles of canvas, leather or other suitable material so as to avoid shock or damage. Pipe shall be so handled that the exterior surface, coating and lining will not be damaged. If, however, any part of the exterior surface coating or lining is damaged, the repair or rejection of pipe shall be made by the Contractor at his expense in a manner satisfactory to the Engineer. All pipe handling equipment is to be approved by the Engineer. The use of bare metal cables, chains, or hooks, etc. will not be permitted. Stockpiled pipe shall be supported on wood blocks and/or sand bags placed under the uncoated ends of the pipe. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling the pipe on coated surface will not be permitted. Adequate strutting shall be provided if necessary to prevent damage to pipe lining and coating. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care shall be used in handling PVC pipe during cold weather. Stockpiled PVC pipe stored outside which may be exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover pipe. Air circulation shall be provided under the covering.

C. Bedding

No blocking of pipe will be permitted. Before the pipe is laid, the subgrade shall be prepared by backfilling with clean uniformly graded sand so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb or otherwise damage the subgrade surface over a maximum length of 18" near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle.

D. Joining Push-On Joints

Immediately before joining two lengths of pipe, the inside of the bell, and the outside of the spigot end and the rubber gasket shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The rubber gasket shall be flexed inward and properly inserted in the gasket recess of the bell socket. Caution shall be exercised to ensure the correct type of gasket is used. A thin film of gasket lubricant shall be applied to either the inside face of the gasket or the spigot end of the pipe or both. The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to assure insertion to the full depth of the joint. The spigot end of field cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Whenever it is desirable to deflect push-on joint pipe in order to form a long radius curve, the deflection shall not exceed 80% of the pipe manufacturer's recommendations for maximum deflection.

E. Cutting and Fitting

The Contractor shall make all pipe cuts required to conform to location, line and grade. All cuts on pipe shall be made by the use of pipe cutters or pipe saws. All cuts shall be straight and true.

F. PVC toe drain pipe shall be inspected after a maximum of 3' to 5' of fill has been placed over the pipe and again after remaining fill has been placed.

3.02 PIPE INSTALLATION - GENERAL

A. Underground Interference

A reasonable attempt has been made to locate and identify the underground interferences to be encountered. However, it shall be the responsibility of the Contractor to verify the locations shown on the Drawings. It shall also be the responsibility of the Contractor to locate any interference not shown on the Drawings. The Contractor shall exercise care when working in order to protect all underground interference and shall be fully responsible for any and all damage caused by his operations.

B. Pipe Alignment and Grade

In laying pipe, maximum tolerance is permitted to set line within +/-0.3' and grade within +/-0.1'. Fittings, valves and hydrants shall be installed at the specified locations and elevations, unless written permission to deviate is obtained from the Engineer. When laying pipe in curves, the intent is to lay to the alignment. The pipe shall be kept in alignment by deflecting joints, using short lengths or bends. Any changes in alignment and grade must be authorized by the Engineer and shall be accomplished by the installation of additional fittings, or "breaking" of joints.

C. Deviation from Alignment and Grade Occasioned by Other Structures

Whenever obstructions, not shown on the plans, interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to determine the best method of correction. He may change the plans and order a deviation from line and grade, or he may instruct the Owner to arrange with the Contractor to arrange with the Owners of the structure for its removal, relocation or reconstruction, as best fits the economic and field conditions.

D. Temporary Bulkhead

Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight and of such design as to prevent children, animals, or debris from entering the pipe. If water accumulates in the trench, the plugs shall remain in place until the trench is dry

E. Connection of Dissimilar Metals

Insulated couplings shall be used when joining pipes of dissimilar metal either above or below grade.

F. Toe Drain Pipe Video Inspection

The toe drain pipe(s) shall be inspected and recorded by video camera after fill work is completed over the pipe. Two copies of the completed video shall be supplied to the Owner in a format approved by the Engineer.

END OF SECTION