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Bennett Regional Park & Open Space Pavilion Project Manual

Proposal Number:

RFP 16-008

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1.01 CONDITIONS AND REQUIREMENTS

- A. Division 1 - General Requirements govern work under all divisions of Specifications.

1.02 SCHEDULE OF DRAWINGS, SPECIFICATIONS AND ADDENDA

- A. Drawings: See index on drawings.
- B. Project Manual: BRPOS-Pavilion, dated August 2, 2016.
- C. Addenda: All Addenda issued prior to bidding.

1.03 EXAMINATION OF SITE

- A. Failure to Visit Site: Will not relieve Contractor from necessity of furnishing materials or performing work that may be required to complete work in accordance with drawings and Specifications without additional cost to Owner.

1.04 CONTRACTS

- A. Single Contract: All work under this contract will be executed under one prime contract between Owner and General Contractor.

1.05 CONTRACTOR USE OF PREMISES

- A. Limitations: Operations of the General Contractor shall be limited to areas where work is indicated.

1.06 COORDINATION

- A. General: Coordinate work of various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating work performed.

1.07 ACCESS/STAGING

- A. The only site access available for construction traffic/use is off Antelope Hills Blvd., Antelope Hills Sub-division, adjacent to the BRPOS Maintenance building. No parking is allowed in the former club house parking lot, which is privately owned. Care should be taken not to work outside the existing access easement in the cul-de-sac area. Stake property corners, if necessary, to delineate the property boundaries.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. Summary of Work: Section 01010.
- B. Field Engineering: Section 01050.
- C. Quality Control: Section 01400.
- D. Contract Closeout: Section 01700.

1.02 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, all underground utilities.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown as closely as practicable.
- D. Coordinate completion and clean up of work of separate Sections in preparation for Completion of Work.
- E. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.03 INSPECTION COORDINATION

- A. The Contractor is required to coordinate his work schedule with the Landscape Architect so that key inspection points, as determined by the Landscape Architect may be observed. If the Contractor fails to provide reasonably adequate notice or proceeds without the required inspection, the work shall be re-exposed or redone in its entirety. No extra compensation will be awarded to the Contractor when he is required to redo work due to his failure to coordinate inspections with the Landscape Architect.
- B. In the event that the Contractor schedules an inspection and the inspector arrives at the designated time and location and the work is not ready for inspection or has already been performed and an additional inspection will have to be made, the Contractor shall bear the cost of the initial "wasted" inspection. The cost of the "wasted" inspection shall be deducted directly from partial and final payments made to the Contractor and shall be based on the actual time and materials billing rates then in effect.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Related Work:

1. Excavation and Backfill: Section 02200.
2. Asphaltic Concrete Paving: Section 02510.

B. Work Included: The Contractor shall be responsible for all cutting, fitting and patching including related excavation and backfill, required to complete the work or to:

1. Make its parts fit together properly.
2. Uncover portions of the work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

1.02 QUALITY ASSURANCE

A. Notification of Landscape Architect: Notify Landscape Architect well in advance of executing any boring, cutting or alteration which affects:

1. The work of the Owner or any separate contractor.
2. The structural value or integrity of any element to the Project.
3. The integrity of effectiveness of weather - exposed or moisture-resistant elements or systems.
4. The efficiency, operational life, maintenance or safety of operational elements.
5. The visual qualities of sight-exposed elements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with Specifications and standards for each specific product involved.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect existing conditions of the Project, including elements subject to damage or to movement during boring, cutting and patching.
- B. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work.
- C. Report unsatisfactory or questionable conditions to the Landscape Architect; do not proceed with the work until the Landscape Architect has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work.
- B. Provide devices and methods to protect other portions of the project from damage.
- C. Provide protection from the elements for that portion of the project which may be exposed by boring, cutting and patching work, and maintain excavations free from water.

3.03 BORING, CUTTING AND PATCHING

- A. General: Openings in construction which are required by other contractors shall be left by crafts involved. It is the responsibility of various contractors to supply in advance, proper and sufficiently detailed information. In event of failure to supply this advance information, all cutting as may be required shall be done only after concurrence of Landscape Architect and at expense of negligent party.
- B. Cutting:
 - 1. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation or repairs.
 - 2. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.
 - 3. Employ the installer or fabricator of work on this project to perform boring, cutting and patching for:
 - a. Boring under existing track surface for sleeves to accommodate:
 - 1. An electrical sleeve for irrigation control wire.
 - 2. A 6" sleeve for field drainage pipe connection at existing catch basin.
 - 4. Cut asphalt, concrete or masonry using a masonry saw or core drill as applicable.
- C. Fitting:
 - 1. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
 - 2. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- D. Patching: See Section 02510 and Section 03300.
- E. Finishing:
 - 1. Where surfaces are exposed, finish with same materials specified in finish schedule or material that is on constructed surfaces as required.
 - 2. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - a. For continuous surfaces, refinish to nearest intersection.
 - b. For an assembly, refinish the entire unit.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Field engineering services required for proper execution and completion of work under this contract.
- B. Related Sections:
 - 1. Record Documents: Section 01700 Contract Closeout.

1.02 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Surveyor or Engineer: Submit name and address of surveyor or professional engineer to be employed by Contractor to Landscape Architect for acceptance before beginning work at site.
 - 2. Documentation and Records: Surveyor or engineer shall maintain complete and accurate log of control and survey work as it progresses. On request of Landscape Architect submit documentation to verify accuracy of field engineering work.
 - 3. Completion Certificate: Upon completion of work, submit certificate to Landscape Architect signed by surveyor or engineer certifying that elevations and locations are in conformance with Contract Documents. Note any items of non-conformance.
 - 4. Structural Engineered stamped plans for the pavilion piers / footings.

1.03 QUALITY ASSURANCE

- A. Qualifications: Contractor shall employ land surveyor or professional engineer registered in State of Colorado and acceptable to Owner.
- B. Surveyor or Engineer: Responsible for location of major site elements; establishment of horizontal and vertical controls; installation of control stakes as required; and final certification that finish grading has been completed within tolerances specified.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 PROJECT SURVEY REQUIREMENTS

- A. Reference Points: Owner's Representative will identify existing control points and property line stakes indicated on drawings and site survey. Immediately upon entering project, locate and maintain bench marks and all other grades, lines, levels and dimensions. Report any errors or inconsistencies to Owner's Representative before commencing work.
- B. Permanent Bench Marks: Surveyor or engineer shall establish minimum of two (2) permanent bench marks on site, referenced to data established by survey control points.
- C. Preservation of Monuments and Stakes: Carefully preserve monuments, bench marks, property markers, reference points, and stakes.
 - 1. In case of his destruction of these, the Contractor shall be charged with expense of replacement and shall be responsible for any mistake or loss of time that may be caused.
 - 2. Protect permanent monuments or bench marks which must be removed or disturbed until properly referenced for relocation.
 - 3. Furnish materials and assistance for proper replacement of such monuments or bench marks.
- D. Layout and control by Surveyor or Engineer:

1. Site: Establish lines, levels and locations by instrumentation. Set control stakes for finish grading. Reset stakes as required during progress of work.
- E. Completion: Upon completion of work, surveyor or engineer shall survey site to verify that locations and elevations required by Contract Documents have been achieved within specified tolerances.
 - F. Each Subcontractor: Provide complete engineering layout for work to be performed under his subcontract, including grades, elevations, and all other engineering required to perform his scope of work.

END OF SECTION

1.01 PERMITS AND FEES

- A. See General Conditions.
- B. The Contractor shall be responsible for obtaining and paying for all permits and licenses required to perform the specified work.

1.02 CODES AND ORDINANCES

- A. Compliance: All contractors shall comply with all applicable codes, ordinances and regulations in effect at time of bid opening including but not necessarily limited to the following:

- Applicable local codes and ordinances.
- Governing fire department requirements.
- Utility company requirements.
- State Department of Labor Requirements.
- State Department of Health Requirements.
- National Fire Protection Association Standards.
- State and Federal Safety and Health Laws.
- NFPA 70 - National Electrical Code.

1.03 DISCREPANCIES

- A. If discrepancies occur between Contract Documents, local codes, local utility requirements, etc., most stringent requirements shall apply.

END OF SECTION

1.01 QUALITY ASSURANCE

- A. Reference Standards: For products or workmanship specified by association, trade or federal standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
 - 1. No provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change duties and responsibilities of Owner, Contractor or Landscape Architect or any of their consultants, agents or employees from those set forth in Contract Documents, nor shall it be effective to assign to Landscape Architect or any of his consultants, agents or employees any duty or authority to supervise or direct furnishing or performance of work or any duty or authority to undertake responsibilities contrary to provisions of General Conditions.
- B. Effective Date: Date of standard is that in effect as of documents date except when specific date is specified or when standard is part of applicable code which includes edition date.
- C. Copies: When required by individual sections, obtain copy of standard. Maintain copy at job site during work.

END OF SECTION

1.01 PRECONSTRUCTION CONFERENCE

- A. Site Mobilization Conference: Meeting will be scheduled by the Owner's Representative at the site immediately prior to Contractor move-in. Representatives of Contractor, Owner, Landscape Architect and Consultants will be present. Job site procedures to include the following items will be discussed:
1. Procedures for maintaining project record documents.
 2. Owner's requirements.
 3. Construction facilities and controls.
 4. Temporary utilities.
 5. Security and housekeeping procedures.
 6. Materials testing.
 7. Services of the Geotechnical Engineer.
 8. Field Engineering.
 9. Communications with Landscape Architect and his consultants.
 10. Access to and use of site.

1.02 PROGRESS MEETINGS

- A. Meetings: Contractor will schedule regular periodic meetings at Contractor's job site field office. Representatives of Owner and Landscape Architect will be invited to attend. Also invited as appropriate to items under discussion, will be selected subcontractors and suppliers and consultants. The following items will be discussed:
1. Review of work progress since previous meetings.
 2. Field observations, problems, conflicts.
 3. Problems which impede construction schedule.
 4. Review of off-site fabrication, delivery schedules.
 5. Corrective measures and procedures to regain projected schedule.
 6. Revisions to construction schedule.
 7. Plan progress, schedule during succeeding work period.
 8. Coordination of schedules.
 9. Maintenance of quality standards.
 10. Review submittal schedules; expedite as required.
 11. Review proposed changes for effect on other trades, construction schedule and completion date.
 12. Coordination of separate contracts.
 13. Other business as required.
- B. Agenda and Minutes: Contractor shall establish agenda, and keep and distribute minutes of progress meetings and lists of those present and others as directed.
- C. Persons Representing Contractor at Meetings: Have authority to commit Contractor to solutions agreed upon in meetings. To maximum extent possible, assign same person or persons to represent Contractor at meetings throughout progress of work.
- D. Coordination Meetings: Progress meetings shall in no way be considered substitute for Contractor/subcontractor coordination meetings.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. List of Subcontractors:
 - 1. General Conditions.
- B. Products List:
 - 1. Section 01600 Materials and Equipment.
- C. Progress Schedule:
 - 1. General Conditions.
- D. Performance Bond/Labor and Material Payment Bond:
 - 1. Instructions to Bidders.
 - 2. General Conditions.
- E. Insurance Certificates:
 - 1. General and Supplementary Conditions.
- F. Applications for Payment:
 - 1. General Conditions.
- G. Project Record Documents:
 - 1. Section 01700 Contract Closeout.
- H. Warranties:
 - 1. Section 01700 Contract Closeout.
- I. Final Paperwork:
 - 1. Section 01700 Contract Closeout.
- J. Contractor's Quality Control System:
 - 1. Section 01400 Quality Control.

1.02 GENERAL

- A. Submittals: Made early enough to account for processing described below and reasonable period for review by Landscape Architect.

1.03 SUBMITTALS LIST, SCHEDULE AND PRODECURES

- A. Submittal: Within fifteen (15) days after award of contract, and before any items are submitted for review, submit to Landscape Architect two (2) copies of submittal list and schedule.
- B. Schedule: Compile complete schedule of all submittals anticipated to be made during progress of work.
 - 1. Include list of each type of item for which Contractor's drawings, shop drawings, product data, Certificates of Compliance, samples, warranties or other types of submittals are required.
 - 2. On acceptance by Landscape Architect, Contractor shall adhere to schedule except when specifically otherwise permitted.
- C. Code Designation: On schedule, designate each item with number code utilizing Specification Section five (5) digit numbers.
 - 1. Each Submittal: Marked with same code designation.
- D. Coordination: Coordinate schedule with subcontractors and materials suppliers.

- E. Revisions: Revise and update schedule as necessary to reflect conditions and sequences. Promptly submit any revised schedules to Landscape Architect for review.
- F. Transmittals: Include transmittal letter with each submittal, identify item by above code designation and reference to Specification Section. Use separate transmittal for each submittal.
 - 1. Each Submittal: Have chronological submittal number.
 - 2. Resubmittals: Have original submittal number and letter in alphabetical order for each resubmittal.
- G. Deviations: Clearly mark and note any deviations from Contract Documents in submittals.

1.04 SHOP DRAWINGS

- A. Shop Drawings: Make particular note of field-measured dimensions, as-built conditions, and conditions requiring special coordination with other contractors and requirements of activities of Owner.
- B. Subcontractor: Submit one (1) sepia tracing and two (2) prints per shop drawing sheet and specified number of samples to Contractor.
- C. Contractor:
 - 1. Review shop drawings for accuracy, completeness, and conformity with Contract Documents. Make notes and corrections on sepia tracings and prints.
 - 2. Stamp with Contractor's stamp/date. Signature of individual who reviewed shop drawings is required below Contractor's stamp.
 - 3. Print as required for Contractor's record.
 - 4. Send sepia tracings and three (3) prints to Landscape Architect.
 - 5. Shop drawings not stamped and signed by Contractor will be returned.
- D. Landscape Architect:
 - 1. Check drawings by making notes and corrections on sepia tracings and prints, stamp "No Exceptions Taken", "Revise and Resubmit", "Rejected", etc. as required.
 - 2. In event that shop drawings require consultant's check, route sepia and print through consultant and back to Landscape Architect as necessary. Consultant will retain one (1) set of prints.
 - 3. Retain one (1) set of prints for record and transmit one (1) set to Owner if required.
 - 4. Return marked sepias to Contractor.
- E. Contractor:
 - 1. Send sepia tracings to subcontractor.
- F. Subcontractor:
 - 1. Print necessary copies for record, distribution, etc.
- G. Resubmittal: In event shop drawings have to be resubmitted to Landscape Architect, original sepia tracings and prints shall be returned directly to Contractor. Subcontractor shall make his corrections and re-route new sepia tracings and prints as outlined above.
- H. References: Reference shop drawings to applicable drawings and Specification Sections to facilitate ease and accuracy of checking.

1.05 PRODUCT DATA

- A. Subcontractor: Submit six (6) copies of brochure material and any required samples.

- B. Routing: Routing will be as indicated above for shop drawings with Landscape Architect retaining two (2) copies for file and returning four (4) copies to Contractor for his file and distribution to subcontractor as applicable.
 - C. Reference: Reference product data to applicable drawings and Specification Sections to facilitate ease and accuracy of checking.
 - D. When contents of submitted literature from Manufacturers includes data not pertinent to submittal, clearly indicate which portion of contents is being submitted for review.
- 1.06 JOB SITE DOCUMENTS
- A. Documents: Keep complete set of accepted shop drawings or product data at jobsite.
- 1.07 FIELD MEASUREMENTS
- A. Field Measurements: Responsibility of Contractor.
- 1.08 CERTIFICATES OF COMPLIANCE
- A. Certificates:
 1. Where Certificates of Compliance are specified, show on each certification, name and location of work, name and address of Contractor, quantity and date or dates of shipment or delivery to which certificate applies, and name of Manufacturer.
 2. Certification: In form of letter or company standard forms.
 3. Certificates: Signed by officer of Manufacturer.
 4. Laboratory Test Reports: Show date of testing, specified requirements for which testing was performed, and results of tests.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. Cost of Testing: General Conditions.

1.02 TESTING

A. General:

1. The Contractor is responsible for providing all test data needed to verify that any off-site material he is providing for the job meet the contract requirements. The Owner will provide testing to determine that the work is performed in accordance with the Specifications and to check that material specifications are met. Any tests ordered at Owner's direction which show that the subject Contractor supplied material or installation does not meet the Contract requirements shall be paid for by the Contractor. The Contractor shall pay all cost associated with making failed tests including, but not limited to, field labor and laboratory testing. The cost of failed tests will be deducted directly from partial and final payments made to the Contractor. The Owner will not pay for any tests ordered by the Contractor.
2. The Contractor shall provide the manpower and equipment necessary to explore selected portions of the project for testing. No extra compensation will be awarded for these services.
3. The Contractor is required to coordinate his work schedule with the Landscape Architect so that key testing points, may be observed. If the Contractor fails to provide reasonably adequate notice or proceeds without the required testing, the subject work shall be re-exposed or redone in its entirety, while the inspector is present. No extra compensation will be awarded to the Contractor when he is required to redo work due to his failure to coordinate testing with the Landscape Architect.
4. Do not use materials or equipment represented by samples until tests, if required, have been made and materials or equipment found to be acceptable.
5. Do not incorporate any product into work which becomes unfit for use after acceptance thereof.

- B. Testing: Materials or equipment proposed to be used may be tested at any time during their preparation or use. Furnish required samples without charge and give sufficient notice of placing of orders to permit testing. Products may be sampled either prior to shipment or after being received at site of work.

- C. Tests: Made by accredited testing laboratory selected by Owner. Except as otherwise provided, sampling and testing of materials and laboratory methods and testing equipment shall be in accordance with latest standards and tentative methods of ASTM.

1. Specific information concerning testing methods, sample sizes, etc., is included under applicable Sections of Specifications.
2. Any modification of, or elaboration on, these test procedures included for specific materials under their respective Sections in Specifications shall take precedence over these procedures.

1.03 TESTS PAID FOR BY OWNER

- A. Control Tests of Fill and Backfill: At such times and in such numbers as specified in Sections 02200 and 02221.

- B. Control Test of Asphalt Paving Base and Finish Courses: At such times and in such numbers as specified in Section 02511 Asphaltic Concrete Paving.

1.04 OTHER TESTING

- A. Following Testing: Performed at expense of installing contractor:

1. Other Tests: Any other tests required by Contract Documents not listed in Article above.
2. Any additional tests required because of any tests that fail subject to the following conditions:
 - a. Quantity and Nature of Tests: Determined by Landscape Architect.
 - b. Tests: Taken in presence of Landscape Architect.

- c. Proof of Noncompliance: Contractor liable for corrective action which the Landscape Architect feels is required including complete removal and replacement of defective material.
 - 3. Material Substitution: Any tests of material or equipment offered as substitute for specified item on which test may be required in order to prove its compliance with Specifications.
 - B. Contractor: May have tests performed on material and equipment for his own information and job control so long as Owner does not assume responsibility for costs or for giving them consideration when appraising quality of materials.
- 1.05 TEST REPORTS
- A. Reports of tests made by testing laboratories shall be distributed by testing laboratory as follows:
 - 1 Copy - Contractor.
 - 1 Copy - Applicable Supplier or Subcontractor.
 - 1 Copy - Landscape Architect.
 - 1 Copy - Applicable Engineer.
 - 1 Copy - Owner.Other Copies - As Directed.
- 1.06 CONTRACTOR'S QUALITY CONTROL SYSTEM
- A. Quality Control: Establish system to perform sufficient inspection and tests of all items of work, including that of subcontractors, to ensure conformance to Contract Documents for materials, workmanship, construction, finish, functional performance and identification.
 - 1. Control System: Establish for all construction except where Contract Documents provide for specific compliance tests by testing laboratories and engineers employed by Owner.
 - 2. Control System: Specifically include all testing required by various Sections of Specifications.
 - B. Quality Control System: Means by which Contractor assures himself that construction complies with requirements of Contract Documents.
 - 1. Controls: Adequate to cover all construction operations and keyed to proposed construction schedule.
 - C. Records: Maintain correct records on appropriate form for all inspections and tests performed, instructions received from Landscape Architect and actions taken as result of those instructions.
 - 1. Records: Include evidence that required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken.
 - 2. Document inspections and tests as required by each Section of Specifications.

END OF SECTION

1.01 TEMPORARY ELECTRICITY

A. Service and Distribution:

1. Contractor may connect to existing service with Owner's permission.
2. Provide temporary wiring, outlets, lights, etc. as required for construction power and lighting during construction period.
3. Properly ground service and distribution system in accordance with NEC. Provide ground fault interrupters as required by code.
4. Remove temporary electrical service and wiring upon completion of work.
5. Distribution equipment and wiring devices for temporary power and lighting need not be new, however, installation shall conform to safe general practice as required by OSHA.
6. Contractor shall be responsible for any damage done to the permanent wiring or fixtures as a result of use of same.

B. Electrical Consumption: Owner will pay for electricity used through temporary and permanent systems.

1.02 TEMPORARY HEAT AND ENCLOSURES

A. Temporary Heat: Provide temporary heat necessary for execution of work. Install, maintain and operate temporary heating apparatus in manner to facilitate work, so work can continue and so finished work will not be damaged.

1.03 TEMPORARY WATER

A. Temporary Water: Contractor may connect to existing system with Owner's permission.

1. Provide service, temporary connections, plumbing, piping, etc. necessary to convey same to places needed.
2. Owner will pay for water used through temporary and permanent systems.

1.04 TEMPORARY SANITARY FACILITIES

A. Toilet Facilities: Provide and maintain, in neat and sanitary condition, adequate chemical toilet facilities for use of employees engaged on work, in compliance with requirements of applicable codes, regulations, laws and ordinances. Existing toilets may not be utilized.

1.05 FIELD OFFICE AND OTHER TEMPORARY STRUCTURES

A. Field Office: Provide and maintain suitable temporary field office.

1. Telephone Service: Install telephone in field office. Pay for installation, maintenance, removal and other charges for use of telephone.
2. Make office and telephone available for use by Landscape Architect.

B. Temporary Structures: Provide temporary structures and storage areas as required.

1. Remove offices and other temporary structures from site upon completion of work.

1.06 TEMPORARY PROTECTIVE FACILITIES

A. Provide and maintain protective devices and facilities for protection of public and general protection of workmen on project.

1. Provide warning signs against hazards created by construction.
 - a. Danger Lights: Keep lighted each night from sundown to sunrise.
2. Provide and maintain fire extinguishers and active fire hydrants where required. Maintain fire lanes to hydrants and other equipment as necessary for proper fire protection during construction.

3. Provide temporary walks, roadways, trench covers, barricades, bulkheads, railings, danger lights and signals, etc. required for work by applicable safety laws and building codes.
4. Maintain temporary protective facilities in good condition throughout term of work. Remove at completion of work. Repair and replace work damaged thereby.

1.07 TRACK BRIDGING AND RUNWAYS

- A. Contractor shall photograph/video the site prior to mobilization. Contractor needs to protect the track surfacing with sufficient fabric material, plywood and planking, not only immediately beneath the bridging but laterally beyond for a minimum distance of 30'. Fabric, plywood and planking should combine a minimum depth of 2". Cover, with a significant quantity of earth from infield excavation, to a depth required, to protect the impact of equipment movement overhead, from affecting the surface and structural integrity of the track itself. Every time the "bridge" is removed, clean as necessary to restore to its original condition, so that it is made fully functional for track activities as required. Any damage will be subject to repair and/or replacement and repair as determined by an Owner's Representative.
- B. Runways, Guard Rails, and Similar Temporary Construction:
Provide and maintain for safe performance of Contract.
 1. Provide facilities of type and arrangement as required for their specific use, substantially constructed, strongly supported, and well secured.
 2. Comply with applicable safety laws and codes.

1.08 PROTECTION FOR WORK IN PLACE

- A. Work in Place: When subject to injury because of operations being carried on adjacent, cover, board up, or substantially enclose with adequate protection.
 1. Construct forms of protection in manner than, upon completion, entire work will be delivered to owner in undamaged condition.

1.09 CONSTRUCTION FENCE

- A. Construction Fence: Provide temporary fence as required for security and protection of the public.
 1. Fencing: Orange vinyl with steel posts and top wire support.
 2. At completion of work, remove fences from the site.

1.11 TARP - Not required.

1.12 PROJECT IDENTIFICATION SIGN - Not required.

1.13 ACCESS

- A. Limit access to necessary routes to perform the work.
 1. See Section 01010 for limitations on access to site.

1.14 TEMPORARY CONTROLS

- A. General: Comply with local codes, ordinances and regulations.
- B. Noise: Minimize noise near residential areas. Properly muffle equipment. Do not operate noisy equipment after hours.
- C. Dust: Control when construction procedures result in dust which becomes nuisance to Owner, private property or traffic.
- D. Water: Control flow of water at site to prevent damage to Owner's private and public facilities. Under no circumstances shall water be allowed to flow unrestricted from the construction area.

- E. Debris: Continually police work to prevent collection and scattering of debris uncovered, loosened, or caused by prosecution of work.
 - F. Pollution: Take precautions to prevent spilling and littering of water polluting substances. Do not dump any foreign materials into sewer and storm sewer collection systems.
 - 1. Burning of debris or any other air polluting methods or equipment not allowed.
 - G. Erosion: Provide facilities necessary to prevent erosive damage to Owner's property and to adjacent properties.
- 1.15 CLEAN UP
- A. General: Maintain project and site in clean and orderly condition. Periodically clean interior areas. Regularly remove waste materials, debris and rubbish from site.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. General Conditions.

1.02 PRODUCTS

- A. Products: Include material, equipment and systems.
 - 1. Comply with Specifications and referenced standards as minimum requirements.
 - 2. Components Supplied in Quantity within a Specification Section: Same and interchangeable.

1.03 TRANSPORTATION AND HANDLING

- A. Transportation: Transport products by methods to avoid product damage; deliver in undamaged condition in Manufacturer's unopened containers or packaging, dry.
- B. Handling: Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Inspection: Inspect shipments to assure products comply with requirements, quantities are correct, and products are undamaged.
 - 1. Reject damaged and defective items.
- D. Each Subcontractor: Be responsible for hoisting and stocking of his materials and equipment on site.
 - 1. Material Stocking: Coordinated with Contractor's superintendent.

1.04 STORAGE AND PROTECTION

- A. Storage: Store products in accordance with Manufacturer's recommendations, with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by Manufacturer's recommendations.
 - 1. Store loose granular materials on solid surfaces in well drained area; prevent mixing with foreign matter.
- B. Exterior Storage Protection:
 - 1. Fabricated Products: Place on sloped supports above ground.
 - 2. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. Inspection: Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under recommended conditions.

1.05 INSTALLATION

- A. Pre-Installation Conferences: Hold pre-installation meeting at site before installation of each unit of work which requires coordination with other units of work. Installer and Manufacturer's representatives of particular work and affected work shall attend.
 - 1. Notify Landscape Architect of meeting time.
 - 2. Discuss coordination of work with other work including shop drawings, product data, possible conflicts, compatibility concerns, acceptability of substrates, protection, etc.
 - 3. Record significant discussions at each meeting, agreements, disagreements and final plan of action. Distribute record to those in attendance and to Landscape Architect.
 - 4. Do not proceed with unit of work until pre-installation meeting is successfully concluded with agreed upon plan of action.
- B. Inspection of Substrates: Require installer of each major unit of work to inspect substrate to receive work and conditions under which work is to be performed.

1. Installer: Report unsatisfactory conditions to General Contractor in writing with a copy to Landscape Architect.
 2. Do not proceed with work until unsatisfactory conditions have been corrected to satisfaction of installer.
- C. Manufacturer's Instructions: Where installations include manufactured products, comply with Manufacturer's applicable instructions and recommendations for installation, to extent that these instructions and recommendations are more explicit or more stringent than requirements specified or indicated.
1. Notify Landscape Architect of any conflicts between Manufacturer's instructions or recommendations and requirements specified or indicated.
- D. Measurements and Dimensions: Recheck as integral step of starting each installation.
- E. Climatic Conditions and Project Status: Install each unit of work under conditions to ensure best possible results in coordination with entire project.
- 1.06 PRODUCTS LIST
- A. Submittal: Within fifteen (15) days after Notice of Award, transmit three (3) copies of list of major products which are proposed for installation, including name of manufacturer.
1. Tabulate products by specifications section number, title, and article number.
 2. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
- B. Landscape Architect: Will promptly reply in writing whether there is reasonable objection to listed items. Failure to object to listed item shall not constitute waiver of requirements of Contract Documents.
- 1.07 PRODUCTS OPTIONS
- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers with Substitution Paragraph: Products of named manufacturers meeting specifications. Submit request for substitution for any manufacturer not specifically named.
1. Products of acceptable manufacturers are subject to requirements of specifications for specified product.
- C. Products Specified by Naming One or More Manufacturers: Products of named manufacturers meeting specifications; no options, no substitutions.
1. Products of acceptable manufacturers are subject to requirements of specifications for specified product.
- D. Products Specified by Naming Only One Manufacturer: No option, no substitution allowed.
- 1.08 LIMITATION ON SUBSTITUTIONS
- A. General Conditions specifies times for submitting requests for substitutions.
- 1.09 REQUESTS FOR SUBSTITUTIONS
- A. Submittal: Submit two (2) copies of each request. Submit separate request for each substitution.
1. Identify products by specifications section and article numbers.
 2. Provide manufacturer's name and address, trade name of products, and model or catalog number.
 3. List fabricators and suppliers as appropriate.

- B. Documentation: Document each request with complete data substantiating compliance of proposed substitution with requirements of Contract Documents:
 - 1. Attach Product Data as specified in Section 01300.
 - 2. Give itemized comparison of proposed substitution with specified product, listing variation, and reference to specification section and article numbers.
 - 3. Give quality and performance comparison between proposed substitution and specified product.
 - 4. List availability of maintenance services and replacement materials.
 - 5. State effect of substitution on construction schedule, and changes required in other work or products.

1.10 CONTRACTOR REPRESENTATION

- A. Request for Substitution: Representation that Contractor has investigated proposed product and has determined that it is equal to or superior in all respects to specified product:
 - 1. Contractor will provide same warranty for substitution as for specified product.
 - 2. Contractor will coordinate installation of accepted substitute, making such changes as may be required for work to be complete in all respects.
 - 3. Contractor waives claims for additional costs related to substitution which may later become apparent.
- B. Replacement: If substituted products do not meet or exceed above requirements, whether before, during, or after incorporated into work, Contractor shall, at no additional cost to Owner, replace substituted products with products originally specified.

END OF SECTION

1.01 PROJECT RECORD DOCUMENTS

- A. Project Site Record Documents: Maintain at project site one (1) record copy of the following:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Accepted Shop drawings, Product Data and Samples.
 - 5. Change Orders.
 - 6. Other Modifications to Contract.
 - 7. Field Test Records.
- B. Record Documents: Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.
- C. Record Information: Label each document "Record Document".
 - 1. Mark information with contrasting color using ink.
 - 2. Keep each record current. Do not permanently conceal any work until required information is recorded.
- D. Drawings: Record the following information on drawings.
 - 1. Horizontal and vertical location of underground utilities.
 - 2. Field changes of dimension and detail.
 - 3. Changes by change order or field order.
 - 4. Details not on original contract drawings.
- E. Specifications: Record the following information on Specifications:
 - 1. Manufacturer, trade name, catalog number and supplier of products and items of equipment actually installed.
 - 2. Changes by change order or field order.
 - 3. Other matters not originally specified.
- F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.
- G. Submittal: At completion of project, transfer record documents to autocad disk to be furnished by the Landscape Architect and transmit to the Landscape Architect with transmittal letter containing date, project title and number, Contractor's name and address, title and number of each record document, and certification that each document is complete and accurate. Submittal shall be signed by Contractor.

1.02 CLOSEOUT PROCEDURES

- A. Procedures: The following project closeout procedure defines responsibilities of Contractor, Owner and Landscape Architect in closing project:
 - Step 1 Contractor advises Landscape Architect in writing that he has reached "Substantial Completion" and provides list of items to be completed or corrected. Closeout may be conducted by areas or portions of work if requested by Owner.
 - Step 2 Landscape Architect inspects work to determine if it is substantially complete, and issues Certificate of Substantial Completion plus "Punch List" of items to be completed or corrected.
 - Step 3 Contractor completes and/or corrects all punch list items and notifies Landscape Architect in writing that his work is ready for final inspection. At this time, final application for payment is submitted.
 - Step 4 Landscape Architect makes final inspection.
 - Step 5 Owner issues Notice of Acceptance.

1.03 FINAL PAPERWORK

- A. Final paperwork: Prior to release of final payment, Contractor shall deliver the following items to Landscape Architect:

Inspection Certificates, as applicable.
Contractor's Warranty of Materials and Workmanship.
Maintenance Manuals and Parts Lists, as specified.
All Guaranties, Warranties and Submittals, as specified.
Receipts for Extra Materials Delivered to the Owner.
Miscellaneous Keys, Switches, Etc.
Final Application for Payment.
Consent of Surety to Final Payment.
Project Record Documents.

The above items are described in the following articles or applicable Sections of the Specifications.

1.04 INSPECTION CERTIFICATES.

- A. Each subcontractor shall, upon completion of the work, secure in triplicate, certificates from any state or local governing bodies having jurisdiction in dictating that the work is in strict accordance with the applicable codes and deliver same to the Contractor for transmittal to the Landscape Architect.

1.05 WARRANTIES

- A. Two (2) Year Correction Period: Remedy any defects due to faulty materials or workmanship and pay for any damage to other work resulting therefrom, which shall appear in work within a period of two (2) years from the date of Notice of Acceptance and in accordance with the terms of any special warranties provided in the Contract Documents. The Owner shall give notice of observed defects with reasonable promptness.
- B. Warranty: Upon completion of work, the Contractor shall deliver to the Landscape Architect, in duplicate, a written warranty based on the provisions of the Contract Documents properly signed and notarized.
1. Warranty shall be addressed to the Owner.
 2. Provide separate written warranties from specific subcontractors.
- C. Subcontractor Warranties: Include labor and materials signed by Manufacturer or subcontractor as case may be and countersigned by subcontractor.
1. Address warranty to Owner.
 2. Deliver to Landscape Architect upon completion of project and before or with submission of request for final payment.
- D. Extended Warranties: Deliver in duplicate extended warranties as specified and dated from the date of Notice of Acceptance and signed by subcontractors and manufacturers.
- E. Manufacturer Warranties: Deliver in duplicate Manufacturer's warranties as specified and dated from date of Notice of Substantial Completion signed by Manufacturer.
1. Manufacturer's Warranties: Supplement and not replace implied and express warranties provided for by Uniform Commercial Code. Any statements in Manufacturer's warranties denying or limiting responsibility for such implied and express warranties shall be void.

1.06 MISCELLANEOUS KEYS, SWITCHES AND WRENCHES

- A. Submittal: At completion of project, account for all loose keys, adjustment keys and wrenches keys for electric switches, etc. and turn over to Contractor for transmittal to Owner.

1.07 OPERATING AND MAINTENANCE DATA

A. Not Required.

1.08 DEMONSTRATIONS

A. Not Required.

END OF SECTION

SECTION 02115

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Clearing and grubbing.
2. Removing above-grade existing improvements to include utilities, as identified or interfering with proposed construction.
3. Removing below-grade existing improvements to include utilities, as identified or interfering with proposed construction.

B. Related Sections:

1. Earthwork: Section 02200.

C. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, to also include the following:
2. Geotechnical Engineering Report

D. The Contractor will remove, wholly or in part and satisfactorily dispose of all foundations, fences, old pavements, abandoned pipelines, and any other obstructions which are not designated or permitted to remain, except for utilities and for those items which other provisions have been made for removal. All salvable material will be clearly marked by the Project Manager and shall be removed, without necessary damage, in sections or pieces which may be readily transported and will be stored in locations approved by the Project Manager. These materials may include, but shall not be limited to, manhole frames and covers, inlet grates, fence material, culverts, walkway, roadway, and parking appurtenances and irrigation systems and appurtenances. The Contractor will be required to replace any materials lost from improper storage methods or damaged by negligence. Removal of sign panel will include all work necessary to remove the panel and its attachment hardware from the existing installation. Concrete adhering to sign posts will be removed; pedestals and bases will be removed to one foot (1') below the surrounding ground or subgrade.

E. Where portions of structures are to be removed, the remaining parts will prepared to fit new construction. The work will be done in accordance with plan details and in such a manner that materials to be left in place will be protected from damage. All damage to portions of structures which are to remain in place will be repaired by the Contractor at his expense. Reinforcing steel, projecting from the remaining structure, will be cleaned and aligned to provide bond with new extension. Dowels are to be securely grouted with approved grout. Depressions resulting from

the

removal of structures, footings, and other obstructions, shall be filled and compacted with clean fill materials so as to eliminate hazards of cave in, accumulation and ponding of water.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Permits: Obtain all required permits

1.03 PROJECT CONDITIONS

A. Construction Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities to include adjacent project areas under construction or temporary access. Do not close or obstruct public streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing

SECTION 02115

Improvements indicated to remain in place. Provide necessary fencing or barricades.

1. Protect all improvements on adjoining properties and on Owner's property.
 2. Restore damaged improvements to their original condition, as acceptable to property Owners, or Authorities having jurisdiction.
- C. Existing Bench Marks and Monuments: Carefully preserve and maintain existing benchmarks, horizontal/vertical control monuments, property line pipes and pins and other reference points. If disturbed or destroyed, restore or replace at no additional cost to Project Manager by Contractor.
- D. Environmental Requirements: Blasting is not permitted. Employ jack hammering and other loud noises and methods sparingly; comply with all applicable noise abatement ordinances or regulations. Onsite burning is not allowed.
- E. Excess Materials: Arrange for disposition of unsuitable materials, waste materials, and materials not allowed by specifications for fill, backfill, or site grading in accordance with local requirements. Location of dump, length of haul, and disposal expenses are Contractor's responsibility.
- F. Salvage Improvements: Carefully remove items indicated to be salvaged and store on Project Manager's premises where indicated or as directed by specifications, construction plans and/or by Project Manager.

PART 2 - PRODUCTS

Not Required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.02 SITE CLEARING

- A. General: Remove shrubs, grass, and other vegetation or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of existing sod and topsoil.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 2. Dispose of topsoil as specified for disposal of waste material at Contractor's expense.
- B. Clearing and Grubbing: Clear site except areas that are to be undisturbed of trees, shrubs, and other vegetation, as defined herein. The term clearing and grubbing means the scalping and removal of on-grade and below grade vegetable growth, organic materials, trash, rubbish and other obstructions, interfering with paving and fill areas.
- C. Completely remove stumps, roots, and other debris protruding through ground surface or conflicting with proposed construction. All areas with proposed appurtenances and utilities shall be cleared and grubbed to a minimum depth of 5' below existing ground surface.
- D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact each layer to a density equal to adjacent original ground, or as identified with referenced subsurface investigation report and specifications within.
- E. Removal of Existing Improvements: Remove existing above-grade and below-grade

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improvements and utilities as necessary to facilitate proposed construction or future construction within identified limits.

1. Abandonment and Removal: Removing all abandoned underground piping or conduits interfering with construction is included under this Section, abandonments to include plugging of conduit, shall meet specifications of governing agency having jurisdiction over utility.
- F. The Contractor shall notify all public utility companies and determine the location of all existing underground utilities prior to proceeding with construction. All work performed in the area of existing public utilities shall be performed according to the requirements of those agencies. The Contractor shall be responsible for locating any existing utility (including depth) which may conflict with the proposed construction. The Contractor shall protect, at his own expense, all existing utilities and be responsible for their repair if they are damaged during construction.
- G. All known existing utilities are shown in approximate locations on the plans. The actual location may vary from the plans, especially in the case of underground permanent and temporary utilities. This Contractor shall pothole and determine the horizontal and vertical location of utilities that may be critical to his operation. Whenever Contractor discovers a discrepancy in locations, he shall contact the Project Manager immediately.
- H. Contractor shall have lines identified prior to construction by utility company determining depth and horizontal location. Contractor shall be responsible for repair if damages occur during construction.
- 3.03 DISPOSAL OF WASTE MATERIALS
- A. Burning on Property: Burning is not permitted on property.
 - B. Removal to Project Manager's Storage Area: Transport excess and salvageable materials to location designated by Project Manager.
- 3.04 CLEANING
- A. Remove excess materials, debris, and equipment in accordance with General and Supplementary Conditions. Keep public or private ways, access roadways, streets and driveways used as access or egress to or from project site free from materials falling from trucks. Promptly clean streets, roadways, etc. to the satisfaction of the Project Manager and public or private Authorities having jurisdiction. A wheel wash area is to be used for removal of debris from vehicles, prior to leaving the site.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Provide excavation, rough grading, subgrade preparation, overlotting, filling, backfilling, compaction and disposal of spoil materials as shown on the Drawings to meet line and grade specified herein, or as specified to complete the Work. All spoil material shall be stockpiled or hauled and disposed as directed by the Project Manager.
2. Material excavated shall be defined as "unclassified excavation" and shall include all excavation performed under this item regardless of material encountered except for contaminated material requiring special handling and disposal.
3. All site work and excavation shall be completed as detailed on the accepted plans.

B. Related Sections:

1. Selective Clearing: Section 02115.
2. Trenching, Backfill, Compacting for Utilities: Section 02221.
3. Topsoil, Fine Grading & Soil Preparation: Section 02920.

C. Related Documents:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, to also include the following.
2. Survey Control Monumentation Record and Topography Survey, prepared by the Project Surveyor.
3. Geotechnical Engineering Report

1.02 REFERENCE STANDARDS

A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents to include specifications of the City of Denver for installation of storm sewers and other earthwork provisions.

1.03 DEFINITIONS

A. Excavation consists of removal of material encountered to subgrade or over-excavation elevations indicated and subsequent disposal or placement of materials removed.

B. Unauthorized excavation consists of inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of Project Manager. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation directed by Project Manager, shall be at Contractor's expense.

1. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Project Manager.
2. Unauthorized excavation, including deposition of additional excavated materials and other work resulting from slides, cave-ins or remedial work shall be at Contractor's expense.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Project Manager, who will make an inspection of conditions. If tests determine that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by testing firm or Contractor.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed pavement, slab on grade, slab gravel fill, topping materials or structure.

E. Structure: Buildings, foundations, slabs, tanks, tunnel, pavement, curbs, or other man-made

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stationary features occurring above or below ground surface.

- F. Structural Fill: The term "structural fill", as used herein, includes soil materials used for fill beneath and within 5'-0" of buildings, including fill used under fill supported slabs and the upper 3'-0" of fill under pavements.
 - G. Trench Backfill: The term "Trench Backfill", as used herein, includes soil materials used for backfilling utility or other trenches outside the building line.
 - H. Unclassified Excavation: The term "unclassified excavation", as used herein, includes the excavation of all materials required for the work obtained within construction limits of project, including bedrock, surface boulders, wasted sections of concrete, asphalt or other debris. The subsurface investigation and engineering analysis for the proposed Tivoli Revitalization describe the quality and physical characteristics of the soils within the limits of construction.
- 1.04 QUALITY ASSURANCE
- A. Codes and Standards: Comply with all applicable local, state and Federal rules, regulations and ordinances concerning sloping of excavation, trenching and safety of workers, including the latest OSHA requirements. The Contractor shall obtain all necessary permits as required in the General Condition and/or any permits required by Section 1000 prior to commencement of the work.
- 1.05 PROJECT CONDITIONS
- A. Site Information: Data in subsurface investigation reports was used for the basis of the design and is available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Contractor will be responsible for interpretations or conclusions drawn from this report.
 - 1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - B. Existing Utilities: The Contractor shall notify all public utility companies and determine the location of all existing underground utilities prior to proceeding with construction. All work performed in the area of public utilities shall be performed according to the requirements of these agencies. The Contractor shall be responsible for locating any existing utility (including depth) which may conflict with the proposed construction. The Contractor shall protect, at his own expense, all existing utilities and be responsible for their repair if they are damaged during construction.
 - 1. All known existing utilities are shown in approximate locations on the plans. The actual location may vary from the plans, especially in the case of underground utilities. Whenever Contractor discovers a discrepancy in locations, he shall notify the Project Manager immediately.
 - 2. Demolish and completely remove from site existing underground utilities indicated to be removed. Salvage items are identified on the Drawings and in these specifications. Coordinate with utility companies or agencies for shutoff of services if lines are active.
 - C. Use of Explosives: Use of explosives is not permitted.
 - D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction and Project Manager.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - E. Verification of Existing Conditions: Visit the site prior to submission of bids. Verify existing conditions, elevations, and contours. In the event of discrepancies between existing conditions and the requirements of the Contract Documents, contact the Project Manager for clarification.

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- F. Existing Bench Marks: Carefully preserve and maintain existing bench marks, vertical/horizontal control, monuments, property line pipes and pins, and other reference points. If disturbed or destroyed, restore or replace at no additional cost to the Project Manager.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: All fill material, regardless of intended use category, must be clean and free from organic matter, roots, brush or other vegetation, trash, brick, debris or other detrimental substances, and rocks or unbroken lumps larger 4". The Owner's Geotechnical Engineer should evaluate any fill used on the site. Fill used should be a non-expansive material similar to the site materials. Imported soils should meet the criteria as recommended in 3.10, F. this section.
1. The site soils are normal for the area and should be removable with normal heavy-duty equipment. Although not encountered during the Geotechnical Engineering study, it is possible on any site in a redeveloped area that hazardous substances may exist in the fill or underlying native materials. During the excavation phase of the project, it is recommended that a representative of the Geotechnical Engineer make frequent observations to verify the condition of the existing fill materials and to determine if there is reason to believe that any of these materials are hazardous.
 2. Structural Fill: Provide select, non-expansive, sandy fill with liquid limit, and gradation shown above. If sufficient materials meeting the above requirements are not available from on-site sources, provide additional material obtained from off-site sources and approved by the testing and inspections agency, at no additional cost to the Owner; it is assumed that on-site materials can be used as structural fill.
 3. Trench Backfill: The upper 3'-0" of trenches below pavement and fill supported slabs shall be structural fill as specified above. Material conforming to the requirements for overlot fill as specified above may be used for backfilling all other trenches.

2.02 SOURCE QUALITY CONTROL

- A. Fill and Backfill Materials: All fill and backfill should be approved by the Geotechnical Engineer, placed in uniform lifts with a thickness compatible with the type of compaction equipment being used, moisture conditioned to within 2% of optimum and compacted with the appropriate equipment. The following minimum percentages of the maximum dry density as determined by ASTM D698 (Standard Proctor) are recommended:
- | | |
|-------------------------|-----|
| 1. Below foundations | 98% |
| 2. Below floor slabs | 96% |
| 3. Below paved areas | 95% |
| 4. Landscaped area fill | 90% |
| 5. Retaining walls | 95% |
- B. Where relatively clean, free-draining non-proctorable sands or sand and gravel mixtures are used as fill, compact to at least 65% of Relative Density (ASTM D4253 and D4254).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Visit: Visit and inspect site and take into consideration known or reasonable inferable conditions affecting work. Failure to visit site will not relieve Contractor of furnishing materials or performing work required.
- B. Existing Utilities: Locate existing underground utilities in areas of the work. If utilities are to remain in place or be relocated later in construction, provide protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Project Manager immediately for direction. Cooperate with utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the appropriate utility company.

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3.02 SITE CLEARING AND SUBGRADE PREPARATION

- A. Strip and remove existing pavement materials, vegetation, debris, and other deleterious materials from proposed structure, pavement, ball field, and hockey rink areas. All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.
- B. If unexpected fills or underground facilities are encountered during site clearing, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction. All excavations should be observed by the geotechnical engineer prior to backfill placement.
- C. Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate exposed slopes after completion of grading operations. If it is necessary to dispose of organic materials on-site, they should be placed in non-structural areas and in fill sections not exceeding 5' in height.
- D. All exposed areas which will receive fill, floor slabs and/or pavement, once properly cleared should be scarified to a minimum depth of 12", conditioned to near optimum moisture content and compacted.

3.03 GENERAL PROCEDURES

- A. Removal: Demolish and completely remove from the project site all existing underground utilities indicated to be removed. Coordinate with utility companies for discontinuance of services if lines are active.
- B. Protection of Persons and Property: Provide all necessary measures to protect workmen and passerby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.
- C. Protect adjacent streets, roadways, and properties throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, sidewalks, pavements, and other improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3.04 EXCAVATION

- A. Excavation is all considered unclassified and includes excavation to subgrade or over-excavation elevations indicated, regardless of character of materials and obstructions encountered.
- B. It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.
- C. Depending upon depth of excavation and seasonal conditions, groundwater may be encountered in excavations on the site. Pumping from sumps may be utilized to control water within excavations.
- D. Use of lime, fly ash, kiln dust, cement or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction.

3.05 STABILITY OF EXCAVATIONS

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction to include the latest revision to OSHA standards. Safety is the sole responsibility of the Contractor.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

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- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.06 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to sediment basin to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collection in sediment basins. Do not use trench excavations as temporary drainage ditches. Discharge directly to storm sewer prior to removal of sediment shall not be permitted.

3.07 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill as indicated by Project Manager. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations.
 - 2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill as directed by Project Manager.

3.08 TRENCH EXCAVATION FOR PIPES AND CONDUIT

- A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9" of clearance on both sides of pipe or conduit.
- B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 - 1. For pipes and equipment 6" or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads ensure continuous bearing of pipe barrel on bearing surface.

3.09 COLD WEATHER PROTECTION

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F.
- B. Dust Control: Provide dust control as required to alleviate dust nuisance to the public, to adjacent properties and other work underway at the project site.
- C. Unanticipated Conditions: Notify the Project Manager immediately upon finding evidence of previous structures, filled materials which penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Project Manager instruction before proceeding with further work in such areas.
- D. Unsatisfactory Soils: Remove or otherwise correct unsanitary, sour, or otherwise unsatisfactory soil. Remove contaminated or unsuitable material from under building and paved areas.

3.10 BACKFILL AND FILL

- A. General: Place soil material in layers to required subgrade elevations, for each area classification

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listed below, using materials specified in this Section.

- B. Under grassed areas, use satisfactory excavated or borrow material, overlot fill.
- C. On-site granular and approved imported materials may be used as fill material for the following:
 - general site grading
 - foundation areas
 - floor slab areas
 - exterior slab areas
 - pavement areas
 - foundation backfill
- D. On-site existing clay and claystone are not recommended for use directly beneath proposed structures, unless a structural slab is used. However, these materials can be placed in pavement, non-structural areas and within deeper fill areas below the depths of removal and replacement as previously outlined.
- E. Frozen soils should not be used as fill or backfill.
- F. Imported soils (if required) should conform to the following or be approved by the Project Geotechnical Engineer:

<u>Gradation</u>	<u>Percent finer by weight (ASTM C136)</u>
6"100	
3"70-100	
No. 4 Sieve	50-80
No. 200 Sieve	35 (max)
• Liquid Limit.....	30 (max)
• Plasticity Index.....	15 (max)
• Maximum expansive potential (%)*.....	1.5

* Measured on a sample compacted to approximately 95% of the ASTM D698 maximum dry density at about 3% below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

1. Do not backfill trenches until tests or inspections have been made and backfilling is authorized by Project Manager. Use care in backfilling to avoid damage or displacement of pipe systems.

- G. Backfill excavations as promptly as work permits, but not until completion of the following:
 1. Acceptance of construction below finish grade including, where applicable, waterproofing, and perimeter insulation.
 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.11 PLACEMENT AND COMPACTION

- A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
 1. When existing ground surface after compaction process has a density less than that specified

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under compaction requirements; for a particular area classification, break up ground surface. Scarify existing subgrade to depth of 6" prior to compacting and placing fill. Moisture condition between 2% below and 2% above optimum moisture content, and recompact to at least 95% of maximum Standard Proctor density (ASTM D698).

B. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers, each layer to be compacted to meet requirements herein.

C. Compaction Requirements:

1. The following general compaction specifications should be observed on this project.
 - a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.
 - b. No fill should be placed over frozen ground.
 - c. Materials should be compacted to the following:

<u>Material</u>	<u>Minimum Percent</u> <u>(ASTM D698)</u>
Subgrade soils beneath fill areas	95
On-site soils or approved imported fill:	
Beneath foundations	98
Beneath slabs	95
Beneath pavements	95
Miscellaneous backfill	90

- d. Granular or imported soils should be compacted within a moisture content range of 3% below to 3% above optimum unless modified by the project geotechnical engineer.
- e. Clay soils should be compacted within a moisture content range of optimum to 2% above optimum.

D. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

E. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

F. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by testing agency if soil density tests indicate inadequate compaction.

1. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
3. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.12 SHRINKAGE

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- A. Shrinkage: For balancing grading plans, estimated shrink or swell of soils and bedrock when used as compacted fill following recommendations in this report are as follows:

<u>Material</u>	<u>Estimated Shrink(-) Swell (+) Based on ASTM D698</u>
On-site soils:	
Clays.....	-5 to -10%
Sands	-5 to -15%
On-site bedrock materials	
Claystone	+5 to +10%
Sandstone.....	-5 to -10%

3.13 GRADING

- A. General: Uniformly grade areas within project limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations or contours are indicated or between such points and existing grades.
- B. Finish surfaces free from irregular surface changes and as follows:
 - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
 - 2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
 - 3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 0.00 to 0.17 foot above required subgrade elevation.
- C. Grading Surface of Fill under Structural Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.05 foot when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.14 EROSION CONTROL

- A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction and erosion control plan submitted as part of the Construction Documents.

3.15 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Removal to designated areas on property: Transport acceptable excess excavated material to designated soil storage areas on property.

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- B. Removal from Property: Remove waste materials, including materials not allowed for fill, backfill or site grading as specified within, trash, and debris, and dispose of it off property at Contractor's expense.

END OF SECTION

SECTION 02270

TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided, to this Section.

1.2 SUMMARY

- A. Work Included. Furnish, install, maintain, and remove temporary erosion and sedimentation controls as shown on the drawings or specified herein, or as required to complete the work.
- B. Related Sections include the following:
 - 1. Division 2 Section "Site Clearing" site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 2. Division 2 Section "Subdrainage Systems" for drainage of slabs-on-grade and landscaped areas.
 - 3. Division 2 Section "Earthwork" for soil materials, site excavating, filling and grading.
 - 4. Division 2 Section "Trenching" for excavating and backfilling of utilities.
- B. Permits and Fees: Obtain and pay for all permits and fees required for the work of this section, including erosion and sediment control and water quality permits required by the authority having jurisdiction and the Colorado Department of Public Health and Environment, Water Quality Control Division.
- C. Erosion Control: The Erosion and Sedimentation Control Drawings included in the Contract Documents is the minimum requirement to be implemented. Provide additional control as necessary to meet applicable local and State criteria.

1.3 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Unclassified Excavation: Removal of all material of whatever character required for the work encountered above subgrade elevations and to lines and dimensions indicated, including boulders.
- C. Fill: Fill is all material placed to raise the grade of the site or to backfill excavation, upon which the Soils Engineer has made sufficient tests and observations to enable him to issue a written statement that, in his opinion, the fill has been placed and compacted in accordance with the requirements of these specifications.

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- D. **BMP: Best Management Practice.** Erosion and sediment control devices, which may consist of silt fence, crates, filter fabric, riprap, etc.
- E. **SWMP: Storm Water Management Plan.** Identifies BMPs, which are erosion and sediment control measures for the project.
- F. **Structures:** Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. **Subgrade:** Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. **Utilities:** Include on-site underground pipes, conduits, ducts, and cables, as well as underground services to buildings.

1.4 SUBMITTALS

- A. **Submittal Procedures:** All submittals are to be made to the Owner's Representative. If provided refer to Division 1 section "Submittals."
- B. **Product Data:** not required.

1.5 QUALITY ASSURANCE

- A. **Regulatory Requirements:** Comply with applicable local, State and Federal ordinances, rules and regulations concerning sedimentation control and storm water runoff.
- B. In case of conflict between the above codes, regulations, references and standards and these specifications, the more stringent requirements shall govern.
- C. **Preconstruction Conference:** Conduct conference at Project site as directed by Owner's Representative prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.6 PROJECT/SITE CONDITIONS

- A. **Existing Conditions:** Verify all existing conditions affecting the work of this section prior to submitting bids or proposals. Additional compensation will not be allowed for revisions or modification of work resulting from failure to verify existing conditions.

1.7 WARRANTY

- A. **Temporary Erosion and Sediment Control measures** shall be maintained until permanent measures are in place. All damaged, disturbed or devices filled with sediment, which may occur within the specified project warranty period, shall be corrected at no cost to the Owner. Any devices damaged by erosion or sediment shall be restored to their original condition by the Contractor, at no cost to the Owner.

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PART 2 - PRODUCTS

2.1 MATERIALS

- A. Erosion and Sedimentation Control Materials: Provide one or more of the following materials, as shown on the plans or as applicable for site conditions:
1. Sand bags.
 2. Clean, seed-free, certified, cereal hay or grain straw bales.
 3. Silt fences.
 4. Rock riprap.
 5. Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh.
 6. Biodegradable twisted jute or spun-coir mesh, 0.92 lb/sy minimum, with 50 to 65 percent open area.
 7. Drainage geotextile.
 8. Impervious fill.
 9. Other materials proposed for use on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
1. Determine the existing ground elevations, drainage patterns, and changes to such patterns during excavation in order to satisfactorily plan and provide materials for adequate erosion and sediment control devices.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and rights-of-way according to requirements of authorities having jurisdiction.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Secure grading permit from agency have jurisdiction prior to commencing grading operations, if required.

3.3 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.4 INSTALLATION

A. Erosion and Sedimentation Control Devices. Erosion and sedimentation control measures to be taken during construction include, but are not necessarily limited to the following:

1. Apply soil stabilization within 14 days to all disturbed areas that are to be dormant for a period longer than 30 calendar days after reaching grade. Stabilize soil with mulch anchored per criteria of authorities having jurisdiction. Temporarily revegetate areas that will remain in an interim condition for more than three months.
2. Roads and parking areas indicated to be paved may be covered with an appropriate aggregate base course in lieu of mulch. Temporary mulching or aggregate base course is not required if final pavement construction will take place within 30 days after grading to final contours.
3. Soils that will be stockpiled for more than 30 days must be mulched and seeded within 14 days after stockpile construction.
4. Prevent sediment from leaving the project site by installing a silt fence or other BMPs as indicated on the plans. Protect existing storm inlets adjacent to the site by an approved gravel filter.
5. Excavate the future detention/water quality pond and construct the outlet structure/storm sewer such that the pond may function as a temporary sediment basin during development of the site. Construct the sediment basin in accordance with authority having jurisdiction's criteria. Provide temporary swales to convey site runoff to the pond.
6. Locate stone stabilization pads at all points of vehicular ingress and egress to the construction site.
7. Provide temporary erosion controls consisting of berms at the top of slopes and interceptor ditches at ends of berms and at those locations which will eliminate or minimize erosion during construction, along with temporary seeding, temporary diversion, chutes, and down pipes and lining of water courses.
8. Temporary sedimentation controls shall consist of silt dams, traps, silt fence, barriers, and appurtenances at the top of spoil and borrow area slopes and where runoff water exits the site.
9. Maintain the available silt holding capacity of silt dams, fence traps and barriers until no longer needed. The sediment capacity of sediment retainage areas shall be at a minimum, the capacity shown on the plans in conformance with Urban Drainage Criteria Manual, Volume 3. Prior to removal, obtain concurrence of the Owner and Engineer.
10. Remove accumulated sediment and debris from a BMP when the sediment level reaches one-half the height of the BMP, or at any time the sediment or debris adversely impacts the functioning of the BMP.
11. Remove hay bales which have deteriorated and filter stone or cloth which has become dislodged. Place new hay bales and new filter and fence.
12. The erosion/sediment control plan shows the minimum required for the project. If it becomes apparent that additional controls are necessary, the Engineer shall be notified and with approval of the Owner's Representative additional controls shall be installed.

B. Chemicals and Pollutants:

1. Store construction materials and chemicals that could contribute pollutants to the runoff within an enclosure, container, or dike located around the perimeter of the storage area, to prevent discharge of these materials into runoff from the construction site.
2. Locate areas used for collection and temporary storage of solid and liquid waste away from the storm drainage system. Provide covering or fencing as required to prevent windblown materials; construct perimeter dike to contain liquid runoff. These measures may not be necessary if materials are immediately placed in covered waste containers.
3. Perform equipment maintenance in designated areas using measures such as drip pans to control petroleum products spillage.
4. Immediately clean up and properly dispose of spills of construction related materials such as paints, solvents, or other chemicals.

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C. Final Stabilization and Long-Term Management

1. Final stabilization shall be achieved through permanent vegetation and landscaping after construction of all buildings and paved surfaces.
2. Temporary erosion and sediment control measures may be removed within 30 days after final site stabilization is achieved or after temporary measures are no longer needed.

- B. Inspection and Maintenance: Inspect erosion and sediment control measures weekly during construction. In addition, inspect all facilities immediately after any significant runoff or snowmelt which results in runoff. Repair or otherwise mitigate any damage to the erosion and sediment control facilities at no additional cost to the Owner.

3.5 CLEANING

- A. Removal of Controls: Remove controls upon completion of that portion of the work for which controls were furnished. Leave the site and work area in a clean condition.

END OF SECTION

SECTION 02317

TRENCHING, BACKFILLING, COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This work shall consist of furnishing all labor, materials tools and equipment for trenching, bedding, backfill and compaction for all underground utilities as specified herein and shown on the accepted plans. The excavation shall be made to lines and grades shown on the accepted plans and as established by the Project Manager. Except where shown otherwise on the accepted plans and except where the Project Manager gives written permission to do otherwise, all trench excavation shall be made by open cut to the depth required to construct the pipelines as shown on the accepted plans. All excavation shall be unclassified.
2. Pavement removal and replacement as required.

B. Related Sections:

1. Earthwork: Section 02200.

C. Related Documents:

1. Geotechnical Engineering Report (not available)

1.02 QUALITY ASSURANCE:

A. Regulatory Requirements: Perform excavation work in conformance to the requirements of authorities having jurisdiction. Supply, install, and remove all shoring as may be required to comply with all safety regulations and to maintain earth banks until backfill is placed.

B. Testing and Inspection: Conform testing and inspection of backfill to the requirements of section 02200. Make in place density tests at intervals and locations as directed by the Project Manager.

1.03 PROJECT/SITE CONDITIONS;

A. Protection: Protect existing utilities, and utility excavations, in accordance with the requirements of Section 02200.

B. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Project Manager will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for the convenience of the Contractor.
2. Soil investigation and test reports are available for examination as set forth in Information Available to Bidders.
3. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Project Manager.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Fill Materials: Excavated earth, loam, sandy clay, sand and gravel, soft shale, or other acceptable materials, approved by the Owner's Geotechnical Engineer free from organic matter, frozen material and large clods of earth or stone, and of a proper moisture content which will facilitate backfilling.
- B. Foundation Materials: In those areas where undisturbed ground is not considered to provide adequate support, foundation material conforming to Section 02200, 3.10 F.
- C. Select Backfill:
 - 1. Job excavated material may be used for select backfill when the job excavated material is finely divided and free from debris, tin cans, frozen earth, rubbish, stumps, organic material, cinders or other corrosive material, stones larger than 12" in greatest dimension or masses of moist, stiff clay.
 - 2. Graded gravels meeting the Specification for Class 6 Aggregate Base Course may be used as select backfill material.
- D. Granular Bedding Materials: Granular bedding material shall be crushed rock or pea gravel with not less than 95% by weight passing 1/2" (95% by weight passing 3/4" for 30" and larger pipe) and not less than 95% retained on a #4 sieve. The Project Manager may accept other gradations if requested in writing. Excavated materials may be used for the upper portion of the bedding if accepted by the Project Manager.
- E. Unsuitable Material: Highly organic soil; ASTM D2487 Group PT, topsoil, roots, vegetable matter, trash and debris.

PART 3 - EXECUTION

3.01 EXECUTION

- A. General:
 - 1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 - 2. When rock is encountered in trench bottom, trench shall be over-excavated to a depth of not less than 6" below pipe. The over-excavated material shall be replaced with acceptable bedding material.
 - 3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- B. Excavation Classifications:
 - 1. All excavation is to be considered as "unclassified", except where rock is encountered.
- C. Shoring and Bracing:
 - 1. Provide materials for shoring and bracing, such as sheet piling, up rights, stringers and cross-braces, in good serviceable condition. Provide shoring as required for safety and by governing authorities.
 - 2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
 - 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Arrange shoring and bracing so as not to place stress on completed work.
 - 4. Exercise care in removal of shoring and bracing to prevent collapse or caving of excavation faces.
- D. Dewatering:

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1. Prevent surface water from flowing into excavations and from flooding project site and surrounding areas.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of trench bottoms, and soil changes detrimental to stability of subgrades and foundations.
3. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
4. Convey water removed from excavations and rain water to collecting or run off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure.
5. Do not use pipe trench excavations as temporary drainage ditches.

E. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

F. Material Storage:

1. Stockpile satisfactory excavated materials on site or where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
2. Locate and retain soil materials away from edge of excavations a distance equal to the depth of the excavation or more.

G. Trenching:

1. Excavate trenches through all materials encountered to depths shown on Drawings. Dispose of excavated materials not suitable for backfill off site.
2. Excavate for manholes, vaults and other appurtenances with clearances between 12" and 24" on all sides.
3. Do not excavate below required levels unless necessary due to wet trench conditions, as determined by the Owner's Soils Engineer. Backfill unnecessary excavation below the required level with granular bedding material as directed by the Owner's Soils Engineer and thoroughly tamp.

H. Bedding:

1. Bed pipe as shown in the bedding details. Provide Class "C" bedding except irrigation pipe add athletic field under drain system which shall be bedded in accordance with the irrigation and underdrain pipe bedding detail.

3.02 CONTROLLED FILL

- A. After pipe bedding has been completed in accordance with applicable pipeline Sections, carefully backfill trenches using approved excavated materials. Carefully hand tamp around the pipe and up to 12" above the top of the pipe, in lifts not to exceed 6" loose thickness.
- B. Use care to place and tamp this course without disturbing joints, alignment, or grade of the piping. Fill remainder of trench in layers not exceeding 8" loose depth where pneumatic, vibratory or other tamping equipment is used.
- C. Where crane operated or hydraulic drop hammers are used to compact the remainder of the backfill, limit loose depth of each lift to 3'.
- D. Use care in backfilling and compacting operations to avoid disturbing pipe. Replace misaligned, crushed or otherwise disturbed main piping.
- E. Exercise extreme care in removing cribbing, shoring or sheeting so as not to disturb foundation, bedding and initial backfill. Where necessary to drive sheet piling or shoring below top of pipe, cut off sheet piling or shoring 12" above top of pipe and leave in place.
- F. Where groundwater or wet trench conditions occur, provide additional bedding below and over the pipe consisting of granular bedding material, as defined in pipe line sections, to a depth as

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required. If used, payment for the bedding materials shall be only for the additional amount in excess of the standard bedding requirements specified.

- G. Re-open trenches improperly backfilled or where settlement occurs, to the depth required for proper compacting, then refill and compact, restoring the surface to the required grade, compaction, and smoothness.
- H. Pooling or water flooding for consolidating the backfill will not be permitted, and the addition of water is limited to that needed for obtaining the desired moisture content specified.

3.03 PAVEMENT REMOVAL AND REPLACEMENT

- A. Saw cut to create clean break line. Remove and dispose of existing surface and aggregate base course. Leave 6" undisturbed subgrade lip on each side of trench. After trench has been backfilled and properly compacted, place aggregate base course in accordance with existing thickness. Compact aggregate base course to 95% AASHTO T180. Replace pavement in accordance with permit requirements or minimum thickness specified. Compact asphalt to 95% ASTM D1559.
- B. Replace sections (between joints) of concrete work. Remove and dispose of waste material. Compact and prepare subgrade for concrete in accordance with Section 02200.

3.04 QUALITY CONTROL

- A. Soil Compaction Tests:
 - 1. Determine maximum density and optimum moisture content of backfill material in accordance with ASTM D698.
 - 2. Moisture Content: Adjust and maintain moisture content of the soil within $\pm 2\%$ of optimum moisture content.
- B. Compaction Requirements:
 - 1. Compact backfill in utility trenches to not less than 95% maximum density from the top of the granular bedding to the top of the trench.
 - 2. Replace disturbed surface materials with material matching existing and adjacent materials.

END OF SECTION

SECTION 02521

CONCRETE CURBS, SIDEWALKS AND DRIVEWAYS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete curb and gutter.
2. Concrete sidewalks.
3. Concrete plazas and drives.
4. Concrete grass/drain pans.
5. Concrete walls.
6. Concrete testing requirements

B. Related Sections:

1. Earthwork: Section 02200.
2. Asphaltic Pavement: Section 02510.
3. Concrete Formwork: Section 03100.
4. Concrete Reinforcement: Section 03200.
5. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

A. Reference Standards:

1. Concrete Work: Follow recommendations of ACI 301.

1.03 SUBMITTALS.

A. Quality Control Submittals:

1. Mix Designs: Prior to pouring any concrete, submit concrete mixes for approval in accordance with Section 01300. Separate mix designs shall be submitted for each type of concrete to be used in the project. Submittals shall include all information used in designing the mixes. See Section 03300 for design procedures.
2. Test Reports: Reports of control tests, special tests or core tests specified under Section 01400 Quality Control shall be distributed by the testing laboratory.
3. Record of Work: A record shall be kept by the Contractor listing the time and date of placement of all concrete. Such record shall be kept until the completion of the project and shall be available to the Project Manager for examination at any time.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with design standards of applicable local codes and Ordinances.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator or other transportation device within 1 1/2 hours after the mixing water has been added.

B. Extra Water:

1. Deliver concrete to the job in exact quantities required by the design mix.
2. If extra water is required before depositing concrete, the Contractor's superintendent shall have sole authority to authorize the addition of water.
3. Additional water added to the mix after leaving the batch plant shall be indicated on the truck ticket and signed by the person responsible.
4. When extra water is added to the concrete, mix thoroughly for 40 revolutions of the drum or 3-1/2 minutes at mixing speed, whichever is greater.

1.06 PROJECT CONDITIONS

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A. Environmental Requirements:

1. Cold Weather Placement: When depositing concrete after the first frost or when the mean daily temperatures are below 40° F. follow recommendations of ACI 306. Maintain concrete temperature at a minimum of 50° F. for not less than 72 hours after depositing. The concrete may not contain calcium chloride. Maintain forms in place for a minimum of 72 hours after depositing concrete, subject to approval of the Project Manager. Place no concrete without approval of the Project Manager on days when the temperature at 9:00 AM is below 30° F. until, in the opinion of the Project Manager, the Contractor has taken all necessary precautions and supplied all the necessary equipment to prevent the concrete from freezing.
2. Hot Weather Placement: When depositing concrete in hot weather, follow recommendations of ACI 605. The optimum temperature of concrete at time of placement shall not exceed 85° F. Protect to prevent rapid drying. Start finishing and curing as soon as possible. When the air temperatures are expected to exceed 90° F. the Contractor shall obtain approval from the Project Manager on the procedures to be used in protecting, depositing, finishing and curing of concrete. Pozzolih Retarder, as manufactured by Master Builders Company, Cleveland, Ohio or approved equal, may be used upon approval of the Project Manager. The use of continuous fog sprays may be required by the Project Manager for 24 hours especially in times of low humidity.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. General: Use ready mixed concrete conforming with ASTM C94-84. No on job mixed concrete will be allowed. See Section 03300 for materials.
- B. Cement:
 1. All cement used in concrete work shall be Portland Cement conforming to the requirements of ASTM C-150, Type I or Type II. In general, cement meeting the requirements of ASTM C-150 Type II cement shall be used in concrete which will be in contact with the soil, unless otherwise allowed or directed by the Project Manager. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.
 2. The Contractor will be responsible for the proper storage of all cement until it is used. When requested by the Project Manager, the Contractor will, at his own cost and expense, furnish the Project Manager with a certificate from the manufacturer or an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work.
- C. Aggregate:
 1. Fine Aggregate: Will be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate will be well graded from course to fine and when tested by means of laboratory sieves will meet the requirements of ASTM C 33.

Sieve Size	Percent Passing
3/8"	100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10

2. Coarse Aggregate: The coarse aggregate will consist of broken stone or gravel composed of clean, hard, tough and durable stone and will be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, vegetable, or other deleterious matter.

Coarse aggregate will be well graded and when tested by means of laboratory sieves will meet the requirements of ASTM C 33

Sieve Size	Percent Passing
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
#4	0 - 5

- D. Air Entraining Agent: Conform to ASTM C260.
- E. Admixtures: The Contractor will use air-entraining admixtures for all surfaces of exposed concrete. Air-entraining admixtures shall meet ASTM C 260. All other chemical admixtures shall meet ASTM C 494.
- F. Fly Ash:
1. Fly ash may be utilized in the design mix when allowed by the Project Manager. Fly ash shall conform to the requirements of ASTM C 618 for Class C or Class F. The pozzolanic index shall be eighty-five (85) for Class C and Class F fly ash. Class C fly ash will not be permitted where sulfate resistant cement is required.
 2. The Contractor shall notify the Project Manager of the source of the fly ash for review prior to use in the project. The fly ash to be used on any project shall have been tested by the Contractor for compliance with these specifications. The results of this testing shall be submitted to the Project Manager prior to its use on the project.
 3. When required by the Project Manager, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions.

2.02 MISCELLANEOUS MATERIALS

- A. Curing Compound - Vertical Surfaces: Conform to ASTM C309-81.
- B. Curing Compound - Horizontal Surfaces: Conform to ASTM C309-81.
- C. Reinforcing: See Section 03200 Concrete Reinforcement.

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2.03 CONCRETE

- A. All concrete shall conform to the following requirements:
 - 1. Design: 28 day compressive strength of 3,500 psi or as specified in drawings and details. Concrete shall be manufactured and delivered in accordance with ASTM C94, standard specification for ready-mixed concrete.
- B. Air Entrainment: All concrete work shall contain an air entraining agent.
 - 1. Concrete for walks, sidewalks, and curbs shall have an air content of 7% + 1%.
 - 2. The entrained air content of all other concrete shall be controlled at 6% + 2% for 3/4" aggregate concrete and 4-1/2% + 1-1/2% for 1-1/2" aggregate concrete.
- C. Admixtures: No admixtures will be allowed except as specified herein, unless authorized by the Project Manager. All requests for approval or substitution must be made by the Contractor and be accompanied by sufficient information and test data for evaluation.

2.04 MIXING

- A. Mixing:
 - 1. Add aggregate and approximately two-thirds of the required water to the mixer first and mix a minimum of seventy (70) revolutions at mixing speed to insure wetting of all the aggregate particles. Add cement, air entraining agent and remaining water and mix a minimum of thirty (30) revolutions at mixing speed. When the mean ambient temperatures are below 40° F. all concrete shall have a minimum temperature of 70° F. at time of depositing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Forms and Reinforcement: Provide ample notice to the Project Manager to allow him to examine all forms and reinforcement just before concrete is deposited and to observe the placing of all concrete. Do not begin placement until approval of Project Manager is obtained.

3.02 PREPARATION

- A. Subgrade: Perform minor cut and fill required to bring the grade to the correct level to receive concrete work. Recompact to comply with Section 02200.
- B. Concrete Work Preparation: Comply with Section 03300.
- C. Existing Asphalt: Where new curb and gutter abuts existing asphalt paving, cut asphalt to a straight line and pour toe of gutter against asphalt to avoid necessity of patching asphalt. Cut existing concrete with a masonry saw.
- D. Protection: Comply with Section 03300.

3.03 SUBGRADE

- A. Work by Earthwork Contractor: Earthwork contractor will perform all cut and fill necessary to bring the subgrade to within $\pm 1/2$ " of bottom surface of sidewalks, curb and gutter and other concrete work under this Section.
- B. Work by Concrete Curbs, Sidewalks and Driveway Contractor: Cut or fill and finish grade as required to bottom of sidewalk or curb and gutter within a tolerance of 1/4". If fill is required use on-site material or Class 6 road base material compacted to at least 95% of Standard Proctor Density, ASTM D698.

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3.04 PLACEMENT

A. Placement:

1. Deposit concrete in approximately uniform horizontal layers not over 24" in height.
2. Piling up of the concrete in the forms or chuting in a manner that separates the aggregates will not be permitted.
3. Follow the recommendations of ACI 614 for depositing concrete into forms. No concrete shall be dropped over 5'-0".
4. Prevent accumulations of water on the surface of the concrete due to water gain, segregation, or other causes, during placement or compacting as far as possible by adjusting the mixture. Make provision for removal of such water as may accumulate so that under no circumstances will concrete be placed in such accumulation.

B. Compaction: Compact concrete during and immediately after depositing, by means of mechanical vibrators. Supplement by hand spading at corners and angles of the forms, around embedded fixtures and in other difficult areas.

3.05 SIDEWALKS, CURBS AND DRIVEWAYS

A. General: Construct sidewalks and curbs in accordance with details on the Drawings and in strict conformity with the ordinances of city governing such work.

B. Finish: Broom and belt finish as indicated. Final surface finish as directed by the Project Manager. Finish edges with a slightly rounded edging tool.

C. Thickness: Total thickness of all sidewalks shall be full 4" unless indicated otherwise.

D. Joints:

1. Joint materials will conform to AASHTO Specifications according to type as follows:

Concrete joint sealer, hot-poured elastic	M 173
Preformed expansion joint filler (Bituminous Type)	M 33
Preformed sponge rubber and cork expansion joint fillers	M 153
Preformed expansion joint fillers - non-extruding & resilient bitum.	M 213

2. Non-bituminous types shall be placed in widths shown on the accepted plans or three-eighths inch (3/8") when not specified. Bituminous type shall be used for concrete paving and structural construction where joint sealers are not called for.
3. Expansion joint material will be provided at the following locations and will be in place prior to the placing of concrete:
 - a. at each end of curb return;
 - b. at both edges of driveway;
 - c. between back of sidewalk and driveway slab or service walk;
 - d. between new concrete and existing masonry buildings;
 - e. as shown on the Drawings;
 - f. as directed by the Project Manager;
 - g. between new and existing concrete; and
 - h. every one hundred fifty feet (150') in sidewalk.
4. Transverse joints will be placed at maximum intervals of ten feet (10') to control random cracking; joints will be formed, sawed, or tooled to a minimum depth of one-third (1/3) of the total thickness (no less than 2"). If divider plates are used, the maximum depth of plates will not be greater than one-half (1/2) depth at the finished surface and will be no less than fifteen-sixteenths inch (15/16") thick.

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5. Tool joints will be spaced as follows:
 - a. not more than ten feet (10') nor less than five feet (5') apart in curb and gutter and combination curb-walk.
 - b. as shown on the Drawings

3.06 CURING

- A. General: Do not remove forms until such time as specified and remove carefully so as not to injure the concrete surface.
- B. Vertical Surfaces: Clean all surfaces of loose sand, mortar, debris and grout; spray lightly with water and coat with a clear or translucent curing compound as soon as possible after removing forms. Apply curing compound in all cases the same working day that the forms are removed.
- C. Horizontal Surfaces: As soon as possible after placing concrete, coat all exposed horizontal surfaces with curing compound as specified. Give special attention to obtaining adequate curing of slab edges.
- D. Exposed faces of curbs and sidewalks will be finished to true-line and grade as shown on the plans. Surface will be floated to a smooth but not slippery finish. Sidewalk and curb will be broomed or combed and edged, unless otherwise indicated by the Project Manager. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms will be tooled with an edger having a three-eighths inch (3/8") radius.
- E. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.
- F. Immediately following the removal of the forms, all fins and irregular projections will be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface will be left sound, smooth, even, and uniform in color. Mortar used in pointing will not be more than thirty (30) minutes old. All construction and expansion joints in the completed work will be left carefully tooled and free of all mortar and concrete. The joint filler will be left exposed for its full length with clean and true edges.
- G. Fresh concrete will be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Project Manager. The selected curing process will be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is recommended. The following curing procedures may be used subject to the approval of the Project Manager:
 1. ponding (for slabs or footings)
 2. spraying
 3. wet burlap, earth, or cotton mats
 4. waterproof paper or polyethylene plastic cover
- H. Membrane curing compound will not be used when the concrete surface will be painted. The type of membrane curing compound chosen will not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process will be carefully adhered to as follows:
 1. Surfaces being wetted by ponding, spraying, or wetted material will be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule will be followed whereby the concrete is wetted on a schedule approved by the Project Manager.
 2. Surfaces being protected by waterproof paper or polyethylene plastic cover will receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Project Manager may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient

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moisture for curing. After the first seventy-two (72) hours the cover will be kept tightly in place for the remainder of the curing period.

3.07 MISCELLANEOUS CONCRETE REQUIREMENTS

- A. Provide all other site concrete flatwork indicated on the Drawings even though not specifically mentioned herein to complete the work, including the following:
1. Anchors and Sleeves: Install anchors, posts and sleeves furnished under other Sections in accordance with shop drawings.

3.08 BACKFILLING

- A. Backfilling: Backfill against all work following removal of forms. Fill level with surrounding area and compact as directed by the Project Manager. Final grade tolerance $\pm 1"$.

3.09 TESTING

- A. General:
1. The requirements of this section will apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.
 2. Concrete materials and operations will be tested as directed by the Project Manager and as herein stipulated. The required testing services will be performed by a designated testing agency acceptable to the Project Manager and all testing agencies will meet the requirements of ASTM E329. Concrete testing shall be performed by the designated testing agency at the expense of the Contractor.
 3. A representative of the testing agency will inspect, sample, and test material and production of concrete as required by the Project Manager. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Project Manager and the Contractor.
 4. The testing agency will report all test and inspection results to the Project Manager and Contractor immediately after they are performed. All test reports will include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test will include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).
- B. Tests Provided by the Contractor:
1. The following services shall be performed by the designated testing agency at the expense of the Contractor:
 - a. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141; mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be forty-five (45) minutes. If they cannot be returned to the laboratory and cast within the forth-five (45) minutes, they will be cast in the field and transported to the laboratory in twelve (12) to twenty-four (24) hours. One test series will be taken per fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the Project Manager.
 - 1) Field cured test series: Four (4) cylinders: two (2) to be broken at seven (7) days; two (2) to be broken at fourteen (14) days or as directed by the Project Manager.
 - 2) Lab cured test series: Six (6) cylinders; Two (2) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days*; two (2) to be broken at forty-five days.
- * If the specified strength is not obtained at twenty-eight (28) days, two (2) cylinders are to be broken at forty-five (45) days.
- b. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Project Manager, in accordance with AASHTO T119.

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- c. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- d. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
- e. When required by the Project Manager, the Contractor will provide concrete mix designs, the results of which will be immediately reported to the Project Manager. When pumped concrete is to be used, a separate mix design will be required. Mix designs will be in accordance with ACI 211 and 304, as applicable.
- f. Additional testing and inspection required because of changes in materials or proportions.
- g. When the work fails to pass inspection or previous tests fail to meet specifications, additional tests will be taken as directed by the Project Manager.
- h. Core samples will be obtained and tested when samples of fresh concrete were not obtained and tested. Obtaining and testing cores will be in accordance with ASTM C42. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least eighty-five percent (85%) of the specified strength f_c , and if no single core is less than seventy-five percent (75%) of the specified strength. Core holes will be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.
- i. Failure of the Contractor to furnish testing as herein described will be sufficient cause for rejection of the work in question.

C. Responsibility and Duties of the Contractor.

1. The Contractor will provide the testing agency with the following:
 - a. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.
 - b. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.
2. The use of testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance.

3.10 PROTECTION

- A. General: Protect all exposed surfaces of concrete from premature drying and frost. Protect freshly placed concrete against rain damage. Protect all concrete surfaces from staining, cracking, chipping and other damage during progress of work, and leave in good condition upon completion.
- B. Vandalism: Vandalized concrete is not acceptable and will be ordered removed and replaced at Contractor's expense.

END OF SECTION

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HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving overlay.
 - 4. Asphalt surface treatments.
 - 5. Cold milling of existing hot-mix asphalt pavement.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for soil materials, excavating, backfilling and site grading.
 - 2. Division 2 Section "Pavement Markings" for pavement striping and symbols.
- C. References:
 - 1. City and County of Denver Standard Specifications for Design and Construction, latest edition.
 - 2. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. CDOT: State of Colorado Department of Transportation.
- C. CDOT Specifications: Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.

1.4 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt paving in accordance with Section 401 of the CDOT Specifications.
 - 1. Standard Specification: CDOT Specifications.
 - 2. Measurement and payment provisions and safety program submittals included in CDOT Specifications do not apply to this Project.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include technical data and tested physical and performance properties.

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- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Material Test Reports: For each paving material.
- D. Material Certificates: For each paving material, signed by providers.

1.6 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications:
 - 1. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
 - 2. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Testing Agency:
 - 1. All testing and inspections required herein will be performed by an independent testing and inspection agency employed by the Owner.
 - 2. Notify the testing and inspection agency not less than 48 hours in advance of all work requiring testing or inspection services.
- C. Testing Requirements: Asphalt Paving shall be tested for gradation, asphalt content and in-place density in accordance with CDOT Specifications, the current edition of CDOT Field Materials Manual, and local Regulatory Agency requirements, whichever are the most stringent.
- D. Preconstruction Conference: Conduct conference at Project site as directed by Owner's Representative. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Tack Coats: Minimum surface or air temperature in the shade of 60 deg F (15 deg C).
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface or air temperature in the shade of 40 deg F and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface or air temperature in the shade of 50 deg F and rising at time of placement.
- B. Coordination and Scheduling:
 - 1. Cooperate with other trades and arrange scheduling to avoid damage to other work, including grading, site utilities and piping, exterior concrete, landscaping and irrigation systems.
 - 2. Before commencing pavement operations, ascertain that utility lines, site lighting and wiring, piping, curb and gutter work, general grading and heavy trucking is complete so that such operations will not damage paving work.
 - 3. Mask off and protect exposed building surfaces and abutting concrete from damage or staining by tack coat and paving operations.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations meeting the requirements of the CDOT Specifications.
- B. Asphalt Concrete Aggregate: Clean, hard, durable particles of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the requirements of Subsection 703.04 of the CDOT Specifications, and Grading SX and S (Table 703-4).
- C. Mineral Filler: Rock dust, slag dust, hydrated lime, hydraulic cement, or other suitable mineral material conforming to the requirements of Subsection 703.06 of the CDOT Specifications.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: The asphalt cement to be used on this project shall be PG 64-22 conforming to the requirements of Subsection 702.01 of the CDOT Specifications.
- B. Tack Coat: AASHTO M 140, emulsified asphalt or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- C. Fog Seal: AASHTO M 140, emulsified asphalt or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted at the factory in water, of suitable grade and consistency for application.
- D. Water: Potable.

2.3 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes. Furnish job-mix formulas for each pavement type, conforming to the requirements of Subsection 401.02 of the CDOT Specifications. Mix aggregates and bituminous materials in accordance with the requirements of Subsection 401.15 of the CDOT Specifications. Use approved job mix formulas. Mix to comply with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: Grading S.
 - 3. Surface Course: Grading SX.
- B. Emulsified-Asphalt: Shall conform to AASHTO M140 or M208 in accordance with Subsection 702.03 of the CDOT Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is unfrozen, free of water, snow, and ice otherwise in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction. Scarify, regrade and recompact surface of subgrade that is pumping or deforming as required to provide true levels, uniform slopes and proper total thickness of paving as required in Division 2 Section "Earthwork."

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- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to a depth of a minimum 1 ½-inches or as indicated on the plans.
 2. Mill to a uniform finished surface free of gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Transport milled hot-mix asphalt to asphalt recycling facility.
 7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.2 gal./sq. yd. (0.2 to 0.8 L/sq. m).
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than ¼ inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than ¼ inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

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1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.20 gal./sq. yd. (0.2 to 0.8 L/sq. m).
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

- A. Apply asphalt binder uniformly to existing pavement surfaces at a rate of 0.25 gal./sq. yd. (1.0 L/sq. m) per in accordance with Subsection 420.04 of the CDOT Specifications.
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).
 1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.7 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated on the plans or as directed by Geotechnical Report. Maximum lift thickness shall be 3-inches. Minimum lift thickness shall be 1½-inches for Grading SX and 2-inches for Grading S.
 2. Place hot-mix asphalt surface course in single lift. Maximum lift thickness shall be 2-inches.
 3. Spread mix at minimum temperature of 235 deg F (113 deg C) per in accordance with Subsection 401.15 of the CDOT Specifications, Table 401-5.
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150mm).
 - 3. Offset transverse joints, in successive courses, 6 to 12 inches (150-300 mm).
 - 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. When paving surface temperature falls below 185 deg F (85 deg C) no further compaction effort will be permitted unless approved.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density in accordance with Subsection 401.17 of the CDOT Specifications.
 - 1. Pavement shall be compacted to a density of 92% to 96% of the maximum theoretical density, determined according to Colorado procedure 51. Field density determination will be in accordance with Colorado Procedure 44 or 81.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

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1. Base Course: Plus or minus $\frac{1}{4}$ inch (6 mm).
2. Surface Course: Plus $\frac{1}{4}$ inch (6 mm), no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: $\frac{1}{4}$ inch (6 mm).
2. Surface Course: $\frac{3}{16}$ inch (5 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is $\frac{1}{4}$ inch (6 mm).

3.11 MANHOLE FRAME ADJUSTMENTS

- A. Set frames for manholes and other such units within areas to be paved to $\frac{1}{4}$ -inch minimum to $\frac{1}{2}$ -inch maximum below final grade as part of this work. Include existing frames or new frames furnished under other sections of these specifications.
- B. Set cover frames to $\frac{1}{4}$ -inch minimum and $\frac{1}{2}$ -inch maximum below surface of adjacent pavement. Surround frames set to grade with a ring of compacted asphaltic concrete base prior to paving. Place asphaltic concrete mixture up to 1-inch below top of frame, slope to grade, and compact with hand tamping. Adjust frames as required for paving.
- C. Provide temporary closures over openings until completion of rolling operations. Remove closures at completion of work.

3.12 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).
 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.13 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With a fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

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1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 350 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Asphalt Content and Gradation. Testing agency will take sample of uncompacted paving mixtures at a minimum frequency of every 1,000 tons according to Colorado Procedure – Laboratory CPL-5120 and Colorado Procedure CP-31.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements. Conforming to the specified requirements will be in according with Subsection 105.03 of the CDOT Specifications.

3.15 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 02741

INTERLOCKING BLOCK RETAINING WALL - KEYSTONE

PART 1: GENERAL

1.01 Description

- A. Work shall consist of designing, furnishing and construction of a KEYSTONE Compac III Unit Retaining Wall System in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans. No alternate wall systems will be considered.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

1.02 Related Sections

- A. Section 31 00 00 - Earthwork

1.03 Reference Documents

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C140 Sampling and Testing Concrete Masonry Units
 - 2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
 - 3. ASTM D422 Particle-Size Analysis of Soils
 - 4. ASTM D698 Laboratory Compaction Characteristics of Soil -Standard Effort
 - 5. ASTM D1557 Laboratory Compaction Characteristics of Soil -Modified Effort
 - 6. ASTM D3034 Polyvinyl Chloride Pipe (PVC)
 - 7. ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
 - 8. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
 - 9. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
 - 10. ASTM D4595 Tensile Properties of Geotextiles - Wide Width Strip
 - 11. ASTM D5262 Unconfined Tension Creep Behavior of Geosynthetics
 - 12. ASTM D5818 Evaluate Installation Damage of Geosynthetics
 - 13. ASTM D6637 Tensile Properties of Geogrids – Single or Multi-Rib
 - 14. ASTM D6638 Connection Strength - Reinforcement/Segmental Units
 - 15. ASTM D6706 Geosynthetic Pullout Resistance in Soil
 - 16. ASTM D6916 Shear Strength Between Segmental Concrete Units
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M 252 Corrugated Polyethylene Drainage Pipe
 - 2. AASHTO M 288 Geotextile Specification for Highway Applications
- C. National Concrete Masonry Association (NCMA)
 - 1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
 - 2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

1.04 Submittals/Certification

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.
- B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the state of the project. The engineering designs, techniques, and material evaluations shall be in accordance with the Keystone Design Manual.

1.05 Quality Assurance

- A. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the Compac retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.
- B. Contractor shall provide evidence that the design engineer has a minimum of five years of documental experience in the design for reinforced soil structures. The design engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than \$2,000,000.
- C. Owner shall/may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide all quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.06 Delivery, Storage and Handling

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Definitions

- A. Compac III Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates, manufactured by a licensed manufacturer of Keystone.
- B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- C. Unit Drainage Fill - drainage aggregate that is placed within and immediately behind the Keystone concrete units.

- D. Reinforced Backfill - compacted soil that is placed within the reinforced soil volume as outlined on the plans.

2.02 Keystone Concrete Retaining Wall Units

- A. Keystone concrete units shall conform to the following architectural requirements:
 - 1. Face color - concrete gray, unless otherwise specified. The Owner may specify standard manufacturers' color.
 - 2. Face finish - hard split in angular tri-plane or straight face configuration. Other face finishes will not be allowed without written approval of Owner.
 - 3. Bond configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
 - 4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet (3 m) under diffused lighting.
- B. Keystone concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.
- C. Keystone concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:
 - 1. Compressive strength: ≥ 3000 psi (21 MPa);
 - 2. Absorption: ≤ 8 % for standard weight aggregates;
 - 3. Dimensional tolerances: $\pm 1/8$ " (3 mm) from nominal unit dimensions not including rough split face;
 - 4. Unit size: 8" (203 mm) (H) x 18" (457 mm)(W) x 12" (304 mm)(D) minimum;
 - 5. Unit weight: 67 -lbs/unit (30 kg/unit) minimum for standard weight aggregates.
- D. Keystone concrete units shall conform to the following performance testing:
 - 1. Inter-unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 600-plf (8 kN/m) minimum at 2-psi (13 kPa) normal pressure;
 - 2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 500-plf (7 kN/m) minimum at 2-psi (13 kPa) normal force.
- E. Keystone concrete units shall conform to the following constructability requirements:
 - 1. Vertical setback: $1/8$ " (3 mm) \pm per course (near vertical) or 1" (25 mm) + per course per the design;
 - 2. Alignment and grid positioning mechanism - fiberglass pins, two per unit;
 - 3. Maximum horizontal gap between erected units shall be $\leq 1/2$ inch (13 mm).

2.03 Shear and Reinforcement Pin Connectors

- A. Shear and reinforcement pin connectors shall be 1/2-inch (12 mm) diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods to provide connection between vertically and horizontally adjacent units and geosynthetic reinforcement, with the following requirements:

1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;
 2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.
- B. Shear and reinforcement pin connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.04 Base Leveling Pad Material

- A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.05 Unit Drainage Fill

- A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4 (4.75mm)	0 - 10
No. 50 (300um)	0 - 5

- B. Drainage fill shall be placed within the cores of, between, and behind the units as indicated on the design drawings. Not less than 1.3 cubic foot (0.036 m³), of drainage fill shall be used for each square foot (0.093 m²) of wall face unless otherwise specified.

2.06 Reinforced Backfill

- A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch (50 mm)	100
3/4-inch (19 mm)	100-75
No. 40 (425um)	0-60
No. 200 (75um)	0-35

Plasticity Index (PI) <15 and Liquid Limit <40 per ASTM D-4318.

- B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless installation damage tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.
- D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.07 Geogrid Soil Reinforcement

A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene. Polyester geogrid shall be made from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.

B. T_a , Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

$$T_a = T_{ult} / (RF_{cr} * RF_d * RF_{id} * FS)$$

T_a shall be evaluated based on a 75-year design life.

1. T_{ult} , Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637.
 T_{ult} is based on the minimum average roll values (MARV).
2. RF_{cr} , Reduction Factor for Long Term Tension Creep
 RF_{cr} shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.
3. RF_d , Reduction Factor for Durability
 RF_d shall be determined from polymer specific durability testing covering the range of expected soil environments. $RF_d = 1.10$ minimum.
4. RF_{id} , Reduction Factor for Installation Damage
 RF_{id} shall be determined from product specific construction damage testing performed in accordance with ASTM D5818. Test results shall be provided for each product to be used with project specific or more severe soil type. $RF_{id} = 1.05$ minimum.
5. FS , Overall Design Factor of Safety
 FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.

C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).

D. Soil Interaction Coefficient, C_i
 C_i values shall be determined per ASTM D6706 at a maximum 0.75-inch (19 mm) displacement.

E. Manufacturing Quality Control
The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.

The QC testing shall include:

- Tensile Strength Testing
- Melt Flow Index (HDPE)
- Molecular Weight (Polyester)

2.08 Drainage Pipe

- A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 Geotextile Filter Fabric

- A. When required, geotextile filter fabric shall be a needlepunched, nonwoven fabric that meets the requirements of AASHTO M288.

PART 3: EXECUTION

3.01 Excavation

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's or Contractor's QA/QC representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.
- B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the Keystone wall unit.
- B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.
- C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Keystone Unit Installation

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Install shear/connecting devices per manufacturer's recommendations.
- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

- E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.
- C. The geogrid shall be laid horizontally on compacted backfill and attached to the Keystone wall pins and within 1 inch of the face of the units. Place the next course of Keystone concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.
- D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps greater than 2 inches between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction is used, or 8 - 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.
- C. Reinforced backfill shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.
- D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1 m) from the tail of the Keystone concrete unit.
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.
- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

- A. Cap units shall be glued to underlying units with an all-weather concrete construction adhesive.

3.07 As-built Construction Tolerances

- A. Vertical alignment: $\pm 1.5"$ (40 mm) over any 10' (3 m) distance.
- B. Wall Batter: within 2 degrees of design batter.
- C. Horizontal alignment: $\pm 1.5"$ (40 mm) over any 10' (3 m) distance.
Corners, bends & curves: ± 1 foot (300 mm) to theoretical location.
- D. Maximum horizontal gap between erected units shall be $\leq 1/2$ inch (13 mm).

3.08 Field Quality Control

- A. Quality Assurance - The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.
- B. Quality Assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications. *(Quality Assurance is usually best performed by the site geotechnical engineer.)*
- C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.
- D. Quality Control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.

END OF SECTION

**RENAISSANCE SHELTER
STANDARD SPECIFICATIONS**

SECTION A: GENERAL

1.1 Scope of Work

A. Furnish and install prefabricated shelter(s). Shelter(s) are to be constructed and installed in accordance with specifications contained under SECTION B: PRODUCTS, and SECTION C: INSTALLATION. All parts, components, and materials used in the manufacturing of these shelters are to be manufactured and supplied by one shelter manufacturer with a minimum 5 years experience in manufacturing pre-engineered buildings. No matching of materials from different suppliers will be allowed. All structures shall be provided by a single manufacturer.

1.2 Related Work

A. Concrete. General Contractor shall block out openings in concrete slab at each column and/or refer to style of base connection detail chosen.

B. Paint. Refer to paint specifications for finish coat.

1.3 References

ASTM A 500-501: Specifications for Structural Tubing.

ASTM a 446, GRADE A: Specifications for Steel Sheet.

ASTM A 36: Specifications for Structural Steel.

ASTM A 307: Specifications for Unfinished Bolts and Nuts.

1.4 System Design

A. Design of Shelter System shall be in accordance with applicable Building Codes and certified by a Registered Engineer. Footing designs will require a Soils Sample provided by the Owner.

1.5 Quality Assurance

A. Manufacturer shall have a minimum of five years experience in the manufacture and supply of pre-engineered steel shelter systems. Manufacturer shall be active members of *The American Institute of Steel Construction*. Manufacturer shall have demonstrated experience in **AISC certified Category II and III construction**. Manufacturer shall have a Certified Welding Inspector on staff.

B. Installation shall be in accordance with manufacturer's shop drawings and directions.

1.6 Submittals

A. Submit shop drawings and product data.

B. Submit color chart for roof and, when necessary, submit color chart for steel structure.

1.7 Delivery and storage

A. Deliver materials to site undamaged. Store and protect materials onsite so that they will not be damaged. Materials will be placed prior to erection so that water will drain and not accumulate.

B. Contractor and/or Owner is responsible for providing adequate space for unloading and storage. Contractor and/or Owner must provide good access to the site and conditions adequate for off-loading and erection by crane.

1.8 Warranty

A. Provide one year warranty that shelter structure and roof will not fail structurally due to defects in materials or design.

1.9 Engineering Data

A. Wind load: Shelter(s) shall withstand a wind load of up to 90 mph.

B. Snow load: Shelter(s) shall support a snow load of 30 lbs. Psf.

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SECTION B: PRODUCTS

2.1 *Acceptable Manufacturers*

A. SKYLARK SHELTER SYSTEMS, manufactured by Central Denver Ironworks, Inc., Denver, Colorado 80216 (303) 549-3920.

B. Any equal alternates must be approved 10 days before the bid date.

2.2 *Materials*

A. Columns, Beams, and Purlins shall meet ASTM Specification A 500. All other structural steel shall conform to ASTM Specification A 36. All structural steel shall be primed and/or finish coated as specified under SECTION D: PAINTING. Bolts, unless otherwise specified, shall conform to ASTM Specification A 307. Field connections shall be bolted except at purlins. Bolt heads shall be hidden from view where necessary. Purlins are to fit into pre-fabricated saddles.

B. All member shall be sized by the manufacturer prior to its submittal of the bid. All main members shall be tubular steel in shapes and sizes required by the structural design.

C. The inclusion of wood, aluminum flashing, light gauge framing and sheet metal judged to be excessive by the Owner's Representative shall not be allowed. **Stitch-welded "C" studs used for rafters and purlins will not be allowed.**

D. All welds at column collars and other exposed welds shall be ground and sanded smooth.

Onsite welding only at purlins and covers will be allowed.

Central Denver IronWorks, Inc.

"Skylark shelter Systems"

4245 Fox Street

Denver, CO 80216

(303) 549-3920

F. Roof system shall be provided, complete with flashing, trim, and fasteners as required. Roofing panels shall be fabricated from 20 gauge galvanized steel sheet, with "DENVER" profile. **No wood or light metal flashing will be allowed with steel roof package.**

SECTION C: EXECUTION

3.1 *Inspection*

A. Contractor shall verify that shelter is installed straight and true.

3.2 *Installation*

A. Install shelter(s) in accordance with manufacturer's drawings and specifications.

3.3 *Tolerances*

A. Maximum variation from plan and drawings at embedded base plate: 3/16 of an inch radial variation from centerline of column.

B. Maximum offset from true alignment between adjacent members butting or in line: None.

3.4 *Clean up*

A. Installer shall clean up site and remove excess materials.

3.5 *Protection*

A. Contractor shall protect finished installation from damage due to other trades or accidents.

SECTION D: PAINTING

4.1 *Steel Frame*

A. Primer Paint: Carboline Zinc or equal

B. Finish Coat: Carboline *Carbothane Urethane* system or equal

C. Preparation: Clean and prepare surfaces consistent with SSPC SP10 near-White Blast.

4.2 *DENVER Roof System*

A. Galvanize.

**SECTION 02910
TOPSOIL, FINE GRADING AND SOIL PREPARATION**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Salvaging Existing Topsoil for Re-distribution.
 - 2. Ripping/disking.
 - 3. Spreading stockpiled Topsoil.
 - 4. Soil Conditioner – Not Required.
 - 5. Fine Grading.

- B. Related Sections:
 - 1. Earthwork: Section 02300.
 - 2. Seeding: Section 02921.

1.02 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal and other inspection certificates shall accompany invoice for materials showing source or origin. Submit to Architect prior to acceptance of material.

1.03 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Section 01600.

- B. Soil Amendments: Not Required

1.04 PROJECT/SITE CONDITIONS

- A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.

- B. Vehicular accessibility on site shall be as required. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Topsoil:
 - 1. Existing Topsoil: This material is considered adequate for reuse as topsoil. Four (4) inches of existing topsoil shall be stripped and stockpiled for reuse and spreading.

- B. Soil Conditioner: Not required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General: Verify that existing site conditions are as specified and indicated before beginning work under this Section.

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1. Grades: Inspect to verify rough grading is within +/- 1.25" of grades indicated and specified.
2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete water, mortar, lime water or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Architect. All access roadways or compacted soil shall be ripped to loosen.

B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Architect.

C. Acceptance: Beginning of installation means acceptance of existing conditions by Contractor.

3.02 PREPARATION

A. Protection:

1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
2. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this Section.
3. Pay for repairs made by Contractor(s) designated by Owner.

B. Weed Control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide one (1) week before soil preparation and as needed, but no sooner than three (3) months after emergence. Contractor to keep a log of all herbicide application rates throughout the duration of the project detailing its application and submit to Owner at the completion of project as required.

C. Surface Grade: Remove existing grass, weeds, debris and rocks larger than one-half inch (1/2") in all areas designated to receive new bluegrass sod or bluegrass seed. Verify that all rough grades have been established in accordance with specified earthwork grade tolerances and other provisions.

D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water to run off the grounds as is intended by the grades.

E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion (see Section 02921), blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

3.03 INSTALLATION

A. Ripping and Tilling: Rip/till to minimum of eight inches (8"), with agricultural sub-soiler, in all areas to receive bluegrass sod with four (4) passes in at least two (2) directions. Rip/till to minimum of four inches (4"), with agricultural sub-soiler in native seed areas, with four (4) passes in at least two (2) directions. In areas where extremely stiff material or debris is encountered during ripping, re-adjust equipment to avoid bringing up chunks of un-tillable material.

B. Topsoil:

1. Apply four inches (4") deep (when compacted to eighty percent (80%) density with two percent (2%) at optimum moisture content) of stockpiled topsoil over entire disturbed area to receive landscaping.
2. Imported topsoil not required unless existing is deemed to be unusable.

SECTION 02910

- C. Soil Conditioner: Not required.
 - D. Fertilizer:
 - 1. See Part 2, C. of this Section.
 - E. Fine Grading in seeded areas:
 - 1. Do fine grading for areas prior to native seeding.
 - 2. For ground surface areas surrounding buildings, maintain required positive drainage away from buildings as required by Soils Engineer/Report.
 - 3. Noxious weeds or parts thereof shall not be present in the surface grade prior to seeding.
 - 4. Prior to acceptance of grades, hand rake to smooth, even surface free of debris, clods, rocks and vegetable matter greater than one-half inch (1/2").
- 3.04 NOTIFICATION AND INSPECTION
- A. Inspection: Provide notice to Architect requesting inspection at least seven (7) days prior to anticipated date of completion.
 - B. Deficiencies: Architect will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Architect for final inspection.
- 3.05 CLEANING
- A. General: Remove debris and excess materials from site. Clean out drainage inlet structures as required. Clean paved and finished surfaces soiled as a result of work under this Section, in accordance with direction given by Architect.
- 3.06 PROTECTION
- A. General: Provide and install barriers as required and as directed by Architect to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by Owner. Contractor is responsible for malicious destruction caused by others.

END OF SECTION

**SECTION 02921
SEEDING**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. 'NativeSeed Mix.
2. Hydromulch.
3. Erosion Control Matting.
4. Maintenance.

B. Related Sections:

1. Topsoil, Fine Grading and Soil Preparation: Section 02910.
2. Sodding: Section 02923.
3. Trees, Shrubs and Groundcover: Section 02930.

1.02 REFERENCES

- A. Reference Standards: Comply with U. S. Department of Agriculture Rules and Regulations under Federal Seed Act and be equal in quality to standards for Certified Seed.

1.03 SUBMITTALS

A. Quality Control Submittals:

1. Certificates: State, federal or other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Architect prior to acceptance of the material.
2. A sample of the soil retention blanket shall be submitted at least two (2) weeks in advance of its use on the project for approval by the Architect.

B. Contract Closeout Submittals:

1. Operating and Maintenance Data: At completion of work, submit three (3) copies. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.

- C. Warranty: At completion of work, furnish written warranty to Architect based upon requirements as specified.

1.04 QUALITY ASSURANCE

A. Source Quality Control:

1. Seed Materials: Subject to inspection and acceptance. Architect reserves the right to reject at any time or place prior to acceptance, any work and seed which in Architect's opinion fails to meet Specification requirements.
2. Inspection: Primarily for quality, however, other requirements are not waived even though visual inspection results in acceptance.
3. Inspection can be made periodically during seeding, at completion and at end of warranty period by Architect.

- B. Testing Requirements: Seed and seed labels shall conform to current State and Federal regulations and be subject to testing provisions of the Association of Official Seed Analysis.

SECTION 02921

1.05 DELIVERY, STORAGE AND HANDLING

- A. Seed: Deliver seed in sealed standard containers stating correct name and composition on the outside of the container. Seed damaged in transit or storage will not be accepted.
- B. Notification: Verify material arrivals at project site with Architect. Immediately remove unacceptable material from job site.

1.06 PROJECT/SITE CONDITIONS

- A. Existing Conditions:
 - 1. Vehicular accessibility onsite shall be as directed by Architect. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Owner.
- B. Environmental Conditions: Do not drill or sow seed during windy weather or when ground is frozen or otherwise un-tillable.

1.07 WARRANTY

- A. Warranty for 'Low Grow' Seed Areas: Warrant areas in seed to be in a healthy, vigorous growing condition and for consistency of coverage for a period of one (1) year from date of acceptance. After time of seed germination, re-seed any spots where seed has not germinated within the total seeding area. Continue this procedure until a successful stand of grass is growing and accepted by the Architect and Owner.

1.08 MAINTENANCE

- A. General: The maintenance period shall begin immediately after each area is seeded and continue until final acceptance of entire project. During this time, be responsible for all work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material and equipment to maintain seeded areas.
- B. Materials: Conform to Specifications or otherwise be acceptable to the Architect.
- C. Watering: Not required for native seed areas.
- D. Weed Control: As required, using selective herbicides approved by Architect and adhering to local environmental laws.
- E. Insect and Disease Control: As required, apply insecticide and fungicide approved by Architect and adhering to local environmental laws.
- F. Reseeding: In areas larger than two (2) sq. ft. in which no stand of grass is established. Reseed and water until stand of grass is successfully established.
- G. Mowing and Trimming:
 - 1. Mow non-irrigated, native grasses only as required. Cut back to six inches (6"). This shall occur no more than three (3) times only during the first year. Remove clippings from adjacent gravel, pavement or irrigated turf areas.
- H. Fertilization:
 - 1. 'Low Grow' Seed - None required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seed Mixtures:

1. Seed Mixture for Seeding Areas as Indicated:

Sow the following seed mixture(s) for pure live seed at the following rate(s):

a. Native Seed Mix – Use mix on plans.

B. Water: Free of substances harmful to plant growth. Owner is responsible for watering seeded areas for one (1) full year from date of seeding.

C. Fertilizer: Apply in accordance with Section 02910 – Topsoil, Fine Grading and Soil Preparation.

D. Mulch:

1. Seeded Areas: Hydromulch with Conweb 200/Matfiber and Tackifier or accepted substitute.

a. Wood cellulose fiber: Must be thermally produced, air dried and conforming to the following:

Percent Moisture Content: 12.0% ± 3.0%.

Percent Organic Matter: 99.3% minimum.

Percent Ash: 0.8% ± 0.2%.

pH Range: 4.8% ± 0.5%.

Percent Water Holding Capacity: 100 gms. H2O/100 gms. Fiber.

Water Soluble Dye: Green.

b. Mulch Material: Supply in packages having gross weight not over one-hundred pounds (100 lbs.) and marked by Manufacturer to show air dry weight content.

c. Tackifier: Hydromulch fiber may contain tackifier or tackifier may be added at time of mulching.

d. Suppliers: Certify that laboratory and field testing of product has been accomplished and that it meets all of foregoing requirements for wood cellulose fiber mulch. Inorganic tackifier and asphaltic material will not be permitted. The organic tackifier shall be a free-flowing, non-corrosive powder produced from natural plant gum of *Plantago Insulares* (Indian Wheat) and applied at a minimum rate of one-hundred pounds (100 lbs.) per acre.

E. Erosion Control: Shall be a machine produced mat consisting of seventy percent (70%) agricultural straw and thirty percent (30%) coconut fiber. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate 16 mm x 16 mm mesh and on the bottom with polypropylene netting with an approximate 6 mm x 6 mm to 13 mm x 13 mm mesh. The blanket shall be sown together with cotton, biodegradable or photodegradable thread.

F. Staples: No. 11 gauge steel wire formed into a "U" shape six inch (6") long.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions are as specified and indicated before beginning work under this Section.
 - 1. Layout: Verify layout of seeding areas as indicated prior to starting seeding operations.
 - 2. Grades: Verify intent of Drainage Channels and relationship of adjacent grades, modified grades and desired clean-up and drainage results.
- B. Acceptance: Beginning of installation means acceptance of existing conditions by Contractor.

3.02 PREPARATION

- A. Protection:
 - 1. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this Section.
 - 2. Pay for repairs made by Contractor(s) designated by Architect.
 - 3. Identify prepared seeding areas requiring protection and erect barriers for proper protection and traffic control maintained throughout germination/development period.
- B. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work. Erosion damage is the Contractor's responsibility once site disruption begins.
- C. Drainage Channels: Entire channel flow lines, banks and adjacent terrain within fifteen feet (15') of channel center lines are to be cleared and re-vegetated with seed.
- D. Seeded Areas: Remove weeds, debris and rocks larger than one half inch ($\frac{1}{2}$ ") which may hinder seeding or subsequent operations. Dispose of accumulated debris at direction of Architect.
- E. Fine Grading: Perform as required to maintain positive drainage, prevent ponding while directing run-off into catch basins, drainage structures, etc. and as required to provide smooth uniform, well-contoured surface prior to proceeding. Tolerance: \pm one half inch ($\frac{1}{2}$ ").

3.03 SEEDING

- A. General: Seed in manner such that after surface is raked and rolled, seed shall have one-quarter inch ($\frac{1}{4}$ ") of cover.
- B. Hydraulic Seeding/Mulching Equipment: Include pump capable of being operated at one-hundred (100) gallons per minute and at one-hundred pounds (100 lbs.) per square inch pressure, unless otherwise directed.
 - 1. Equipment: Nozzle adaptable to hydraulic seeding requirements.
 - 2. Storage Tanks: Means of estimating volume used or remaining in tank.

SECTION 02921

- C. Drainage Channels: Seed all drainage channels and other areas of potentially high flows at two (2) times the specified rate.

3.04 MULCHING

A. Hydromulching:

1. Mixing: Add cellulose fiber mulch after proportionate quantities of water and other accepted material have been placed in slurry tank. Mix ingredients to form homogeneous slurry.
2. Spraying: Spray apply slurry mulch uniformly over designated seed areas using color of mulch as metering agent.
 - a. Apply at rate of two thousand pounds (2,000 lbs.) per acre plus tackifier at rate of one-hundred pounds (100 lbs.) per acre.
3. Hydromulching: Do not apply in presence of free surface water resulting from rain, melting snow or other causes.

- B. Timing: Mulch seeded areas within twenty four (24) hours after seeding. Areas not mulched within twenty four (24) hours after seeding shall be re-seeded with the specified seed mix prior to mulching.

- C. Hay Mulching: Not required.

- D. Quality Control: Repair and re-mulch areas improperly mulched or damaged by Contractor's negligence, in specified manner. Mulch removed by circumstances beyond the Contractor's control shall be repaired and re-mulched as ordered with payment for this corrective work, when ordered, at the contract prices.

3.05 EROSION CONTROL **(to be utilized on all slopes steeper than 4:1)**

- A. Soil Retention Blankets: The area to be covered with Soil Retention Blanket shall be properly prepared and seeded before the blanket is placed. When the blanket is unrolled, the heavyweight polypropylene netting shall be on top and the lightweight polypropylene netting shall be in contact with the soil. In ditches and on slopes, blankets shall be unrolled in the direction of the flow of water. Installation shall be in accordance with the Manufacturer's recommendations. A representative of the Manufacturer can be present to give instruction during the installation of the soil retention blanket.

1. The blanket shall be placed smoothly but loosely on the soil surface without stretching.
2. The upslope end shall be buried in a trench six inches (6") wide by six inches (6") deep beyond the crest of the slope to avoid undercutting. For slope applications, there shall be a six inches (6") overlap wherever one (1) roll of blanket ends and another begins with the uphill blanket placed on top of the blanket on the downhill side.
3. There shall be a four inch (4") overlap whenever two (2) widths of blanket are applied side to side.
4. Insert staples in a pattern according to the Manufacturer's recommendation at approximately two (2) staples per square meter.
5. At terminal ends and every twenty-five feet (25'). Soil Retention Blanket placed in ditches shall be buried in a trench approximately 6" deep by 6" wide. Before backfilling, staples shall be placed across the width of the trench spaced at 6" on center in a zigzag pattern. The trench shall then be backfilled to grade and compacted by foot tamping.

SECTION 02921

B. Drainage Channels:

1. Grade and smooth channel. Apply seed prior to installing blankets.
2. Anchor blankets at top of channel. Backfill with check slot material. For culvert outfalls, place blanket at least twelve inches (12") upstream from pipe opening.
3. Install a blanket in the center of the channel, in the direction of water flow. Additional blankets are installed at the edges of this center blanket.
4. Construct check slots with soil, gravel, or stone, in the middle and end of each blanket.
5. Overlap side channel blanket edges a minimum of three inches (3") over the center channel blanket and staple. Overlap end and beginning blanket edges a minimum of six inches (6") and staple.
6. Anchor the top edge of side channel blankets.
7. Anchor the terminal ends of blankets in a check slot.

C. Stapling: Staple overlaps which run parallel to direction of flow in channel bottoms on two foot (2') intervals. Staple outside edges, centers and overlaps on banks on two foot (2') intervals.

1. Each Width of Cloth: Install row of staples down center as well as along each side.
2. Staple check slots and junctions of new rolls across channel on six inch (6") intervals.
3. On soft or sandy soil or in windy areas, apply staples in alternate slanting position and space at eighteen inch (18") intervals.
4. For extra hard soil or shale areas, use sharp hardened steel three inch (3") fence type staples.

3.06 NOTIFICATION AND INSPECTION

- A. Inspection: Provide notice to Architect requesting inspection at least seven (7) days prior to anticipated date of completion. All planting must be alive and healthy in order to be considered complete.
- B. Deficiencies: Architect will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Architect for final inspection.

3.07 CLEANING

- A. Remove debris and excess materials from site. Clean paved and finished areas soiled as a result of work under this Section, in accordance with direction given by Architect. Clean out drainage inlet structures as required.
- B. Remove mulch immediately from trees, shrubs and sod to prevent damage to same.

3.08 PROTECTION

- A. Provide and install barriers as required and as directed by Architect to protect seeded areas from damage from pedestrian and vehicular traffic. Contractor is responsible for malicious destruction of seeding caused by others.

END OF SECTION

**SECTION 03100
CONCRETE FORMWORK**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Formwork for Cast-In-Place Concrete.
 - 2. Formwork Accessories.

- B. General: Whenever necessary, forms will be used to confine the concrete and shape it to the required lines. Forms will have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms will be constructed so that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the accepted plans. Any form which is not clean and has had the surface prepared with a commercial form oil that will effectively prevent bonding and that will not stain or soften concrete surfaces will not be used.

- C. Related Sections:
 - 1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
 - 3. Concrete Reinforcement: Section 03200.
 - 4. Fibrous Reinforcement: Section 03240.
 - 5. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. Reference Standards: See Section 01091. Comply with the following:
 - 1. ACI 301-89 Specifications for Structural Concrete for Buildings.
 - 2. ACI 347-78 Recommended Practice for Concrete Formwork.

- B. Comply with listed reference standards except as modified by supplemental requirements on the Drawings or by these Specifications.

1.03 QUALITY ASSURANCE

- A. Design Criteria:
 - 1. Safety: Assume responsibility for safety of formwork and provide necessary design, construction, materials and maintenance to produce required concrete work safety.

PART 2 - PRODUCTS

2.01 FORMWORK AND ACCESSORIES

- A. Plywood forms, plastic coated plywood forms, or steel forms will be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

- B. Form Ties: Adjustable in length to permit tightening of forms and of type to leave no metal closer than 1" of surface nor holes or depressions larger than 7/8" in diameter.

- C. Clamps, Brackets, Braces, Washers, Wedges, Walers, Etc.: Contractor's option.

- D. Chamfer Strips: 3/4" 45° job cut wood or 3/4" 45° PVC for unexposed surfaces. Use PVC for exposed surfaces.

- E. Shoring System: Contractor's option.

SECTION 03100

2.02 MISCELLANEOUS MATERIALS

- A. Form Oil: Non-staining. Contractor's option.
- B. Expansion Joint Filler: Bituminous fiber type complying with ASTM D1751-83. Sizes as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Foundation Bearing Surfaces: Inspected and approved by Owner's Geotechnical Engineer prior to start of formwork.
- B. Formwork: Provide ample notice to Project Manager to allow for review of formwork surfaces that will provide finish surface of exposed concrete.

3.02 PREPARATION

- A. Underslab Surfaces: Fine grade to smooth, level surface prior to installation of slab forms.

3.03 ERECTION

- A. General: Maintain formwork tolerances complying with ACI 301.
- B. Footings:
 - 1. Use of earth as form not allowed.
 - 2. Lap forming with dressed lumber or plywood not allowed.
 - 3. Butt form material end to end conforming to shape, lines and dimensions indicated on Drawings.
 - 4. Properly brace or tie to maintain position. Install forms sufficiently tight to prevent excess leakage of mortar.
- C. Construction Joints:
 - 1. Use construction joints at temporary stopping of concrete placement or as indicated on Drawings.
 - 2. Submit locations of joints desired for construction to Project Manager for acceptance.
 - 3. Leave joints in reinforced structural members rough and provide longitudinal or vertical keys at least 1-1/2" deep.
- D. Slabs on Grade:
 - 1. Where concrete slabs are deposited on earth, take care to obtain smooth level surface so slabs will be of uniform thickness as required throughout.

3.04 FORM COATING

- A. Coating:
 - 1. Coat surface of formwork prior to each pour.
 - 2. Apply in accordance with Manufacturer's recommendations.
 - 3. Apply coating prior to placing of reinforcement.
 - 4. Promptly remove excess coating material.
 - 5. Remove coatings of dust from contact surfaces of forms prior to depositing concrete.

3.05 REMOVAL

- A. Forms will not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms after placing concrete will be one (1) day for footings and Class "B" concrete and two (2) days for all other concrete except in curbs, gutters, and sidewalks.

SECTION 03100

3.06 REUSE

- A. Forms: Clean form material suitable for reuse before erection.

END OF SECTION

**SECTION 03200
CONCRETE REINFORCEMENT**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Reinforcing Bars for Cast-In-Place Concrete.

- B. Related Section:
 - 1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
 - 2. Concrete Formwork: Section 03100.
 - 3. Fibrous Reinforcement: Section 03240.
 - 4. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. Reference Standards: See Section 01091. Comply with the following:
 - 1. ACI 301-89 - Specifications for Structural Concrete for Buildings.
 - 2. ACI 315-88 (SP-66) - ACI Detailing Manual.
 - 3. ACI 318-89 - Building Code requirements for Reinforced Concrete.

- B. Comply with listed reference standards except as modified by supplemental requirements on the Drawings or by these Specifications.

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01300.
 - 1. Contractor will submit to the Project Manager shop drawings of the reinforcement for his review and acceptance. The Project Manager's acceptance of shop drawings and bar schedules will not relieve the Contractor of fulfilling his responsibilities as outlined in the plans and specifications of the contract.
 - 2. Indicate size, configuration, pertinent dimensions, number, exact position, and spacing of reinforcement and exact location of openings, framing, and special conditions affecting work.
 - 3. All shop drawings shall be original drawings produced by the subcontractor or supplier and shall not be reproductions of the contract documents.

1.04 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Section 01600.
 - 1. Unload and store reinforcing bars to keep clean. Store on timber skids while awaiting use.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The placing, fastening, splicing and supporting of reinforcing steel and wire mesh or bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". Before being positioned, all reinforcing steel will be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement will be reinspected and, if necessary, cleaned.

2.02 MATERIALS

- A. Reinforcing Bars: ASTM A615-87, Grade 60 unless otherwise indicated.

- B. Bar supports and Spacers: Contractor's option.

- C. Tie Wire: No. 14 or No. 16 gage, black, soft iron wire.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Reinforcement: Provide ample notice to Project Manager to allow for review of completed concrete reinforcement before placing concrete.

3.02 PLACEMENT

- A. Reinforcement will be carefully formed to the dimensions indicated on the accepted plans by the cold bending method. Cold bends will be made so that the inside diameter of the bend measured on the inside of the bar shall be as follows:

Bar Size	Grade 60
#3 through #8	6 bar dia.
#9, #10, and #11	8 bar dia.
#14 and #18	10 bar dia.

The inside diameter of bend for stirrups and ties shall not be less than four (4) bar diameters for sizes #5 and smaller, and five (5) bar diameters for #6 and #8 inclusive. Reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used. Heating of reinforcement will not be permitted.

- B. Reinforcing steel will be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel will be supported by metal chairs or spacers, precast mortar blocks, or metal hangers. Splicing of bars, except where shown on the plans, will not be permitted without approval of the Project Manager.
- C. Welded wire fabric for concrete reinforcement will be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and will comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-185) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).
- D. Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel will be the following, which is specified in ACI 301, Sec. 5.5:

Bottom bars on soil bearing foundations & slabs	3 inches
Bars adjacent to surfaces exposed to weather on earth backfill:	
For bars more than $\frac{3}{4}$ " in diameter	2 inches
For bars $\frac{3}{4}$ " or less in diameter	1- $\frac{1}{2}$ inches
Interior Surfaces: slabs, wall, joints with 1- $\frac{3}{8}$ " diameter or smaller	$\frac{3}{4}$ inches

3.03 CLEANING

- A. Reinforcement: Clean prior to placing concrete to remove scale, oil, ice or other coatings that will destroy or reduce bond, including mortar from previous concrete pours.

END OF SECTION

**SECTION 03240
FIBROUS REINFORCING**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Incorporation of synthetic fibrous concrete reinforcement in site flatwork.

B. Related Sections:

1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
2. Concrete Formwork: Section 03100.
3. Concrete Reinforcement: Section 03200.
4. Cast-In-Place Concrete: Section 03300.

1.02 QUALITY ASSURANCE

- A. Record of Work: Comply with requirements of Section 03300. Batch trip tickets shall show, in addition to the information specified in Section 03300, the amount of fibrous concrete reinforcement material added to the batch.

- B. Comply with requirements of Section 03300 Cast-In-Place Concrete as supplemented herein.

- C. The fibrous concrete reinforcement supplier shall provide the services of a qualified technical representative to instruct the concrete supplier and Contractor in proper batching, mixing, testing, placing and finishing of materials to be provided under this Section.

- D. Work provided under this Section shall produce concrete conforming to the requirements for each type and class of concrete specified when tested in accordance with specified methods.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Comply with applicable requirements of Section 03300.

PART 2 - PRODUCTS

2.01 GENERAL

- A. When shown on the accepted plans or approved by the Project Manager fibrous reinforcing may be utilized. Fibrous concrete reinforcement shall be one hundred percent (100%) virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. The fibers shall have the following physical characteristics:

1. Specific gravity - 0.91.
2. Tensile strength - 70,000 to 110,000 psi.
3. Fiber length - per Manufacturer's recommendation for specific use ($\frac{3}{4}$ " for sidewalks).

2.02 MANUFACTURERS

A. Acceptable Products:

1. Fibermesh; Fibermesh, Inc.
2. Forta-CFP; Forta Corp.
3. Approved Substitute.

- B. Material: Virgin polypropylene collated, fibrillated fibers containing no reprocessed olefin materials and have tensile strength of not less than 70,000 psi.

PART 3 - EXECUTION

3.01 GENERAL

SECTION 03240

- A. Comply with applicable provisions of Section 03300 for which fibrous concrete reinforcement will be supplied.

3.02 BATCHING AND MIXING

- A. Add fibrous concrete reinforcement to concrete materials at the time the concrete is batched in the amounts recommended by the Manufacturer (1.5 lb./s.y. for sidewalks) or as indicated on the accepted plans.
- B. Concrete shall be mixed in strict accordance with fibrous concrete reinforcement Manufacturer's instructions and recommendations to assure uniform and complete dispersion.

3.03 PLACING AND FINISHING

- A. Place and finish concrete in accordance with the fibrous concrete reinforcement Manufacturer's instructions.
- B. Quality and tolerance of finish for fiber reinforced concrete shall comply with the requirements of Section 03300.

END OF SECTION

**SECTION 03300
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

- A. Section Includes:
 - 1. Formed Cast-In-Place Concrete.
 - 2. Concrete Curbs and Flatwork.
 - 3. Miscellaneous Concrete.

- B. Related Requirements:
 - 1. Testing: Section 01400.
 - 2. Quality Control: Section 01400.

- C. Related Sections:
 - 1. Concrete Curbs, Sidewalks and Driveway: Section 02521.
 - 2. Concrete Formwork: Section 03100.
 - 3. Concrete Reinforcement: Section 03200.
 - 4. Fibrous Reinforcement: Section 03240.

1.02 REFERENCES

- A. Reference Standards: Comply with following except as modified by supplementary requirements of this project Specification.
 - 1. ACI 117-90: Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301-89: Specifications for Structural Concrete for Buildings.
 - 3. ACI 305R-91: Hot Weather Concreting.
 - 4. ACI 309R-87: Guide for Consolidation of Concrete.
 - 5. ACI 318-89 (Revised 1992): Building Code Requirements for Reinforced Concrete, Parts 2 and 3.
 - 6. ACI 503.2-92: Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
 - 7. ASTM C94-90b: Standard Specification for Ready-Mixed Concrete.
 - 8. ASTM C494-86: Standard Specification for Chemical Admixtures for Concrete.
 - 9. ACI 306.1-90: Standard Specifications for Cold Weather Concreting.
 - 10. ACI 308-92: Standard Practice for Curing Concrete.

- B. Field References: Keep at least one (1) copy of ACI 301 on site at all times. Other reference standards listed above shall be kept on site when directed by Project Manager.

1.03 SUBMITTALS:

- A. Mix Designs: Not less than two (2) weeks prior to placing any concrete. Submit mixes for acceptance in accordance with Product Data provisions of Section 01300.
 - 1. Submit Manufacturer's data and/or certifications verifying conformance of mix materials including admixtures with specified requirements.
 - 2. Submit separate mix design for each concrete mix type to be used in project. Include following:
 - a. Mix identification designation.
 - b. Statement of intended use for mix.
 - c. Mix proportions, including admixtures.
 - d. Wet and dry unit weight.
 - e. Entrained air content.
 - f. Design slump.
 - g. Design compressive strength.
 - h. Strength qualification data.
 - i. Water/cementitious materials ratio.
 - 3. Strength Qualification Data:

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- a. Submit required average strength qualification data and documentation per ACI 301 3.9.1, 3.9.2 and 3.9.3.
- b. If trial batches are used to qualify average strength, mix design shall be prepared by an independent testing laboratory and shall achieve average compression strength a minimum of 1200 psi greater than specified strength with slump within 1" of maximum permitted and air content within 0.5% of maximum allowable.
- c. If field test data is used to qualify average strength, submit separate qualification data for each production facility which will supply concrete to project, including copies of concrete testing agency's reports from which data was compiled.

- B. Test Reports: Reports of control tests, special tests and core tests specified under Field Quality Control in Part 3 shall be distributed by independent testing laboratory in accordance with Section 01400 if required.

1.04 QUALITY ASSURANCE

- A. Testing Agency: All testing will be conducted by approved testing laboratory. See Field Quality Control - Part 3 and Section 01400.
- B. Source Quality Control: Project Manager shall be offered uninterrupted access to ready-mix batching plant while work is in progress.
- C. Record of Work: Keep record listing time, location and date of placement of concrete for structure. Keep such record until completion of project and make available to Project Manager for examination at any time.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Hauling Time: Discharge concrete transmitted in truck mixer, agitator or other transportation device within 1-1/2 hours after mixing water has been added.
- C. Extra Water:
1. Deliver concrete to site in exact quantities required by design mix.
 2. Should extra water be required for workability before depositing concrete and water/cement ratio of accepted mix design has not been exceeded, General Contractor's superintendent shall have sole authority to authorize addition of water. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.
 3. Where extra water is added to concrete it shall be mixed thoroughly for 50 revolutions of drum before depositing.
 4. Water may be added at the site only once for each batch.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Cold Weather Placement:
 - a. When for three (3) successive days prior to concrete placement the average daily outdoor temperature drops below 40° F or when the average outdoor temperature is expected to drop below 40° F on the day of concrete placement, preparation, protection and curing of concrete shall comply with ACI 306.1.
 - b. Minimum temperature of concrete upon delivery shall conform to ACI 301 Table 7.6.1.1. Concrete temperature at placement shall conform to minimum values of ACI 306.1 Table 3.2.1, and shall not exceed minimum values by more than 20° F.
 - c. Subject to acceptance of Project Manager, an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures will not be allowed.
 - d. Subject to acceptance of Project Manager, Contractor may substitute cement for equal weight of fly ash in design mix.

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- e. Comply with concrete protection temperature requirements of ACI 306.1. Record concrete temperatures during specified protection period at intervals not to exceed sixteen (16) hours and no less than twice during any 24 hour period.
 - f. Submittal of detailed procedures, means, and methods for production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather is not required.
2. Hot Weather Placement:
- a. When depositing concrete in hot weather, follow recommendations of ACI 305R.
 - b. Temperature of concrete at time of placement shall not exceed 85° F.
 - c. When air temperatures on day of placement are expected to exceed 90° F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during placement.
 - d. Approved substitute in accordance with Section 01600. Calcium chloride and admixtures containing more than 0.10 percent chloride ions or sodium thiocyanates not allowed.
3. Water-Reducing, Retarding Admixture:
- a. ASTM C494, Type D:
 - 1. Cormix PSI-R Plus.
 - 2. Euclid Eucon Retarder 75.
 - 3. W.R. Grace Daratard-17.
 - 4. Sika Plastocrete 161R.
 - 5. Approved substitute in accordance with Section 01600.
- B. Miscellaneous Materials:
- 1. Curing Compound - Vertical Surfaces: ASTM C309-81.
 - 2. Curing and Sealing Compound - Exterior Concrete: Minimum 30% solids content, maximum moisture loss of 0.030 grams per square centimeter (300 square feet per gallon coverage):
 - a. Euclid Super Rex Seal or Super Pliocure.
 - b. Master Builders Masterseal.
 - c. Approved substitute in accordance with Section 01600. Comply with requirements of floor finish manufacturers.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete will be composed of Portland Cement, aggregate, and water, and shall be reinforced with steel bars or steel wire fabric where required. Admixtures other than air-entraining agents require written permission of the Project Manager.
- B. ACI 301: Provide materials in accordance with ACI 301, paragraphs as listed, unless amended or superseded by requirements of this Section or general notes on Drawings.
- C. Concrete Materials (ACI 301 Chapter 2):
- 1. General: Ready-mixed Concrete: ASTM C94-90b. On-site mixed concrete not allowed.
 - 2. Cement:
 - a. All cement used in concrete work shall be Portland Cement conforming to the requirements of ASTM C-150, Type I or Type II. In general, cement meeting the requirements of ASTM C 150 Type II cement shall be used in concrete which will be in contact with the soil, unless otherwise allowed or directed by the Project Manager. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.
 - b. The Contractor will be responsible for the proper storage of all cement until it is used. When requested by the Project Manager, the Contractor will, at his own cost and expense, furnish the Project Manager with a certificate from the Manufacturer or an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work.
 - 3. Fly Ash:

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- a. Fly ash may be utilized in the design mix when allowed by the Project Manager. Fly ash shall conform to the requirements of ASTM C 618 for Class C or Class F. The pozzolanic index shall be eighty-five (85) for Class C and Class F fly ash. Class C fly ash will not be permitted where sulfate resistant cement is required.
- b. The Contractor shall notify the Project Manager of the source of the fly ash for review prior to use in the project. The fly ash to be used on any project shall have been tested by the Contractor for compliance with these Specifications. The results of this testing shall be submitted to the Project Manager prior to its use on the project.
- c. When required by the Project Manager, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions.
- 4. Aggregate: ASTM C33-86, obtained from same source throughout project:
 - a. Fine Aggregate: Fine aggregate will be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate will be well graded from course to fine and when tested by means of laboratory sieves will meet the requirements of ASTM C33.

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10

- b. Coarse Aggregate: The coarse aggregate will consist of broken stone or gravel composed of clean, hard, tough and durable stone and will be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, vegetable, or other deleterious matter. Coarse aggregate will be well graded and when tested by means of laboratory sieves will meet the requirements of ASTM C33.

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
#4	0 - 5

- 5. Non-Corrosive. Non-Chloride Accelerator: ASTM C494-86. Type C or E, containing not more chloride ions than present in municipal drinking water and with long term test data from independent testing laboratory providing non-corrosive effect on reinforcing steel:
 - a. Euclid Accelguard 80.
 - b. W.R. Grace Daraset.
 - c. Sika Plastocrete 161 FL.
 - d. Master Builders Pozzutec 20.
 - e. Gilco Accelerator.
 - f. Approved substitute in accordance with Section 01600.
- 6. Water-Reducing, Retarding Admixture: ASTM C494, Type D:
 - a. Cormix PSI-R Plus.
 - b. Euclid Eucon Retarder 75.
 - c. W.R. Grace Daratard-17.
 - d. Master Builders Pozzoloth R.
 - e. Prokrete Industries Protard.

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- f. Sika Plastiment.
- g. Approved substitute in accordance with Section 01600.

D. Miscellaneous Materials:

- 1. Curing Compound - Vertical Surfaces: ASTM C309-81.
- 2. Curing and Sealing Compound - Exterior Concrete: Minimum 30% solids content, maximum moisture loss of 0.030 grams per square centimeter (300 sq. ft. per gallon coverage):
 - a. Euclid Super Rex Seal or Super Pliocure.
 - b. Master Builders Masterseal.
 - c. Approved substitute in accordance with Section 01600. Comply with requirements of floor finish manufacturers.

2.02 ADHESIVES AND BONDING COMPOUNDS

- A. Epoxy Adhesives for Use in All Structural Repairs: Two component. 100% solids, 100% reactive compound suitable for use on dry or damp surfaces and comply with ASTM C881.
 - 1. Euclid Euco Epoxy 452 or 620.
 - 2. Sika Sidadur Hi-Mod.
 - 3. Approved substitute in accordance with Section 01600. Where epoxy injection procedures are used, use low viscosity epoxy made by one of the above manufacturers.
- B. Epoxy Joint Filler: Three component. 100% solids compound with minimum shore D hardness of 50:
 - 1. Euclid Euco Epoxy 600 or 700.
 - 2. Sika Sikadur 51.
 - 3. Approved substitute in accordance with Section 01600.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Reference Standard: ACI 301 Chapter 3.
- B. Design: Conform to general notes on the Drawings. Proportion ingredients for mixes in accordance with ACI 301 3.9.
 - 1. Should Contractor require special mix due to structural requirements, weather or materials, submit samples of cement and aggregate to be used to approved testing laboratory. Testing laboratory will make analysis of materials and design proper mix to be used.
- C. Durability: Conform to ACI 301 3.4 as modified herein.
 - 1. Concrete Exposed to weather or Freeze-Thaw Including Paving, Site Work and Exterior Slabs: Meet requirements of ACI 301 3.4.1 except that concrete shall have a water-cement ratio not exceeding 0.45.
- D. Slump: Design water-cementitious material ratio to provide slumps indicated under mix type.
 - 1. Concrete Containing High Range Water Reducing Admixture (Superplasticizer): Slump of 2-3" upon arrival at site, maximum slump of 8" after addition of superplasticizer.
 - 2. Other Concrete: Maximum 4".
 - 3. Design slump of fiber reinforced concrete shall be the slump prior to addition of fibers.
- E. Water/Cementitious Material Ratio: Provide concrete with following water/cementitious material ratios:
 - 1. Concrete Subject to Freezing/Thawing: Maximum 0.50.
 - 2. Fiber Reinforced Concrete: Maximum 0.55. Water includes free surface moisture on aggregates and liquid admixture.
- F. Selection of Proportions:
 - 1. Mix Design: Cost of concrete mix design by concrete contractor.
 - 2. Selection of Proportions: Use method of ACI 301 3.9. Proportioning based on method of ACI 301 3.10 not allowed.

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- a. Field test records used for documentation of the average strength produced by a proposed mix in accordance with ACI 301 3.9.3.2 shall, in addition to the requirements there listed, comply with the following:
 - 1. The test record shall represent production concrete from a single design mix, produced during the past year, and may be composed of thirty (30) or more consecutive tests.
 - 2. The test record shall represent concrete made with identical materials and proportions (including admixtures) to the proposed mix.
 - 3. The test record shall represent concrete proportioned to produce the maximum slump allowed by these Specifications and for air entrained concrete within $\pm 0.5\%$ of the maximum air content allowed.
- b. Mixes proportioned on the basis of trial mixtures shall meet the provisions of ACI 301 3.9.3.3.

G. Admixtures:

- 1. General: No admixtures will be allowed except as specified herein unless authorized by the Project Manager. All requests for approval or substitution must be made by the General Contractor and be accompanied by sufficient information and test data for evaluation. All admixtures shall be chemically compatible with cementitious materials and all other admixtures used in the mix. All admixtures shall be chloride free. No calcium chloride shall be added to concrete.
- 2. The Contractor will use air-entraining admixtures for all surfaces of exposed concrete. Air entraining admixtures shall meet ASTM C 260. All other chemical admixtures shall meet ASTM C 494.

H. Chloride Ions: Maximum water soluble chloride ion concentration in concrete mix shall not exceed following percentages by weight of cementitious materials.

- a. All Concrete: 0.15%.

I. Mixing: All concrete will be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum will be operated at the speed specified by the Manufacturer of the equipment. The entire contents of the mixer will be discharged before recharge, and the mixer will be cleaned frequently. The concrete will be mixed only in such quantities that are required for immediate use. No retempering of concrete will be permitted. Hand-mixed concrete will not be permitted except by written approval of the Project Manager, and then in only very small quantities or in case of an emergency.

2.04 CONCRETE MIX TYPES

A. General: Concrete mix information shall be prepared and submitted in accordance with ACI 301 Section 4.2. Proportions shall be submitted to the Project Manager, along with at least two (2) sets of certified twenty-eight (28) day test results, for review and acceptance. No concrete will be incorporated into the work until the proportions have been accepted by the Project Manager.

B. Concrete will be made in two (2) classes, "A" and "B", conforming to the following:

	<u>Class A</u>	<u>Class B</u>
Minimum compressive strength - 28 days *	4000 psi	3,000 psi
Minimum cement - sacks/cubic yard	6	5
Maximum water/cement ratio - by weight	0.50	0.63
Slump - inches	1-4	2-4
Air entrainment - % by volume	4-8	4-8

* When tested in accordance with ASTM C-31.

C. The fine aggregate in both classes of concrete shall be between thirty-four percent (34%) and thirty-eight percent (38%) by volume of the total aggregates.

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- D. Admixtures:
 - 1. Non-Corrosive, Non-Chloride Accelerator: Use at all concrete slabs placed at air temperature below 50° F.
 - 2. Air Entraining Agent: Use at all concrete required to be air entrained.
 - 3. Superplasticizer: Contractor's option at:
 - a. All pumped concrete.
 - b. Concrete with water/cement ratio below 0.50.
- E. Mix Designs: Identified by mix identification letter. Submit new mix designs indicating slump, air content and admixtures for all mixes designated to receive fibrous reinforcing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Project Manager's Review: Provide minimum of twenty-four (24) hour notice to Project Manager to allow him to review forms and reinforcement just before concrete is placed and to observe placing of concrete.
- B. Contractor's Review: Contractor shall inspect forms and reinforcing prior to concrete placement to assure accurate placement of embedded items.

3.02 GENERAL

- A. Install concrete work in accordance with ACI 301, paragraphs as listed unless amended or superseded by this Section or notes on the Drawings.
- B. The use of ready-mixed concrete will in no way relieve the Contractor of the responsibility for proportion, mix, delivery, or placement of concrete; all concrete must conform to all requirements ASTM C-94. The information included on the delivery system should be in accordance with ASTM C-94 section 16.
- C. Concrete will be continuously mixed or agitated from the time the water is added until the time of use and will be completely discharged from the truck mixer or truck agitator within one and one-half (1½) hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete will not be allowed.
- D. The Project Manager will have free access to the mixing plant at all times. The organization supplying the concrete will have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. (The Contractor will collect delivery, or batch, tickets from the driver for all concrete used on the project and deliver them to the Project Manager.) Batch tickets will provide the following information in accordance with ASTM C-94:
 - 1. Name of ready-mix batch plant.
 - 2. Serial number of ticket.
 - 3. Date.
 - 4. Truck number.
 - 5. Name of purchaser.
 - 6. Specific designation of job (name and location).
 - 7. Specific class or designation of the concrete in conformance with that employed in job specifications.
 - 8. Amount of concrete in cubic yards.
 - 9. Time loaded or of first mixing of cement and aggregates.
 - 10. Water added by receiver of concrete and his initials.
 - 11. Weights of fine and coarse aggregates.
 - 12. Type, brand, and amount of cement.
 - 13. Type, brand and amount of admixtures.
 - 14. Weight (in gallons) of water including surface water on aggregates.

3.03 PREPARATION

- A. Do not begin concrete work until operations are complete enough to allow placement to be carried on as continuous operation for entire section that is to be placed. Clean equipment for mixing and transporting concrete.
 - 1. Forms: Cleaned of debris and ice, wetted (except in freezing weather), and coated as specified under Section 03100.
 - 2. If water accumulates in forms, pump out before concrete is deposited.
 - 3. Clearly mark finish top surface of vertical members on form walls.
- B. Protection: Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to placing of slabs, sidewalks or floors above.

3.04 PLACEMENT

- A. General: Comply with ACI 301, Chapter 8.
- B. Placement: Before depositing concrete, debris will be removed from the space to be occupied by the concrete and the forms, including any existing concrete surfaces, will be thoroughly wetted. Concrete will not be placed until all forms and reinforcing steel have been inspected and accepted by the Project Manager. Concrete will be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of ingredients. The concrete will be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It will be deposited in continuous layers, the thickness of which generally will not exceed twelve inches (12"). Concrete will be placed in a manner that will avoid segregation and will not be dropped freely more than five feet (5'). If segregation occurs, the Project Manager may require the concrete to be removed and replaced at the Contractor's expense. Concrete will be placed in one (1) continuous operation, except where keyed construction joints are shown on the plans or as approved by the Project Manager. Delays in excess of thirty (30) minutes may require removal and replacement of that pour, as determined by the Project Manager.
- C. Water: Prevent accumulations of water on surface of concrete due to water gain, segregation, or other causes, during placement or compacting. Make provision for removal of water as may accumulate so that concrete not be placed in such accumulation.
- D. Consolidation: Consolidate concrete during and immediately after depositing by means of mechanical vibrators. Supplement by hand spading at corners and angles of forms, around embedded fixtures and in other difficult areas.
 - 1. Mechanical Vibrator: Concrete will be thoroughly compacted or vibrated. All concrete will be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, will be either tamped or vibrated. Care will be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration will stop before any segregation of the concrete occurs. Mechanical vibrators will be an approved type as specified in ACI Publication 309, Chapter 5. Vibrators will not be used to move or spread the concrete.
 - 2. Any evidence of lack of consolidation or overconsolidation will be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor will be responsible for any defects in the quality and appearance of the completed work.
 - 3. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

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- E. The consistency of concrete will be kept uniform for each class of work and will be checked by means of slump tests or Kelly ball tests. The workability of the concrete will be varied as directed by the Project Manager. At all times concrete will have a consistency such that it can be worked into corners and angles of the forms and around joints, dowels and tie-bars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or laitance on the surface. If, through accident, intention, or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete will not be incorporated in the work but will be discarded off the project site as waste material at the Contractor's expense. NO WATER MAY BE ADDED AT THE JOB SITE WITHOUT PERMISSION OF THE PROJECT MANAGER. If approval is obtained and water is added at the job site, slump tests will be run and test cylinders cast following the addition of the water. Any expense incurred in excess of ordinary tests will be borne by the Contractor.
- F. Finishing:
1. Where tops of cast-in-place concrete walls will form finished surface, immediately finish concrete in form by skilled cement finisher. Walls or surfaces not finished to level subject to removal and replacement.
 2. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.
- G. Immediately following the removal of the forms, all fins and irregular projections will be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface will be left sound, smooth, even, and uniform in color. Mortar used in pointing will not be more than thirty (30) minutes old. All construction and expansion joints in the completed work will be left carefully tooled and free of all mortar and concrete. The joint filler will be left exposed for its full length with clean and true edges.

3.05 CONSTRUCTION JOINTS OF STRUCTURAL MEMBERS

- A. Not required.

3.06 REPAIR OF SURFACE DEFECTS

- A. Reference Standard: ACI 301 9.1.
- B. Inspection: Allow Project Manager to inspect concrete surfaces immediately upon removal of forms.
- C. Repair:
1. Modify or replace concrete not conforming to required lines, details, and elevations.
 2. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, repair or replace exposed architectural finished concrete except upon express direction of Project Manager.
 3. Patch holes and defects.

3.07 TREATMENT OF FORMED SURFACES

- A. Reference Standard: ACI 301 Chapter 10.
- B. Form Removal: Finish and cure concrete surfaces covered by formwork immediately after forms have been removed. Do not expose more surface area than can be finished and cured in one working day.
- C. Patching:

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1. Patch voids, honeycombs or damaged areas in accordance with repair of surface defects above.
 2. Add white cement to patching grout as required to match color of existing concrete where patches are exposed to view.
 3. Patch all tie holes.
 4. Use specified bonding compound and epoxy adhesive.
- D. Laitance: Remove deposits of laitance occurring on top of concrete surfaces as soon as concrete has hardened sufficiently to prevent injury to concrete. Repair areas where laitance is removed as specified for patching.
- E. Unexposed Concrete Surfaces: Treat surfaces of concrete wall, slabs, beams, and columns, which are to be covered by subsequent work, as specified under Patching.
- F. Unpainted Exposed Concrete Surfaces:
1. Carefully protect from damage and soiling concrete surfaces, both interior and exterior, to remain exposed but unpainted.
 2. Patch where required as specified under Patching. Upon completion of work, reclean damaged or soiled surface as required to make clean, smooth and finished in every respect.
- ### 3.08 CURING AND PROTECTION
- A. Reference Standard: ACI Chapter 12.
- B. Finishing: Exposed faces of curbs and sidewalks will be finished to true-line and grade as shown on the plans. Surface will be floated to a smooth but not slippery finish. Sidewalk and curb will be broomed or combed and edged, unless otherwise indicated by the Project Manager. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms will be tooled with an edger having a three-eighths inch (3/8") radius.
- C. Protection: Protect exposed surfaces of concrete from premature drying and frost. Protect freshly placed concrete from rain damage. Protect finished slabs from mortar leakage from pouring of slabs above.
- D. Form Removal: Do not remove forms until times as specified. Remove carefully to not injure concrete surface. Protect edges and corners to prevent cracking, chipping or other damage and premature drying.
- E. Vertical Surfaces: Clean surfaces of loose sand, mortar, debris and grout; spray lightly with water and coat with clear or translucent curing compound as soon as possible after removing forms. Apply curing compound same working day that forms are removed.
- F. Horizontal Surfaces:
1. As soon as possible after placing concrete, coat exposed horizontal surfaces with curing compound in accordance with Manufacturer's recommendations and cover with white polyethylene sheeting of minimum of six (6) mil nominal thickness. Give special attention to providing adequate curing of slab edges.
 2. Provide polyethylene sheeting as wide as practical, edges lapped minimum of six inches (6"), weighted to prevent blowing, and sealed to prevent loss of moisture. Keep sheeting in place a minimum of seven (7) days.
- G. Protection/Completion: Protect concrete surfaces from staining, cracking, chipping, and other damage during progress of the work, and leave in good condition upon completion. The exposed surfaces of the concrete will be thoroughly cleaned upon completion of the work.
- H. Fresh concrete will be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Project

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Manager. The selected curing process will be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is recommended. The following curing procedures may be used subject to the approval of the Project Manager.

1. Ponding (for slabs or footings).
 2. Spraying.
 3. Wet burlap, earth, or cotton mats.
 4. Waterproof paper or polyethylene plastic cover.
- I. Membrane curing compound will not be used when the concrete surface will be painted. The type of membrane curing compound chosen will not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process will be carefully adhered to as follows:
1. Surfaces being wetted by ponding, spraying, or wetted material will be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule will be followed whereby the concrete is wetted on a schedule approved by the Project Manager.
 2. Surfaces being protected by waterproof paper or polyethylene plastic cover will receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Project Manager may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient moisture for curing. After the first seventy-two (72) hours the cover will be kept tightly in place for the remainder of the curing period.

3.09 BACKFILLING

- A. When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete will be promptly backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill will be level with the top of the concrete for at least two feet (2') and then sloped as shown on the accepted plans or as directed by the Project Manager. Existing pavement which is damaged during construction will be repaired by the Contractor at his expense. The first two feet (2') of patching to match existing asphalt or concrete will be the Contractor's responsibility.

3.10 FIELD QUALITY CONTROL

- A. Reference Standard: ACI Chapters 16 and 17.
- B. General: Testing will be conducted by a designated testing agency. See Section 01400. The requirements of this section will apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.
- C. Test Priority: Control tests shall be used to determine concrete quality throughout project; however, special tests shall have precedence over control tests, and core tests shall have precedence over all previous tests.
- D. Tests: Cooperate fully with those making tests. Following tests and procedures are subject to change during construction at discretion of Project Manager:
1. Concrete materials and operations will be tested as directed by the Project Manager and as herein stipulated. The required testing services will be performed by a designated testing agency acceptable to the Project Manager and all testing agencies will meet the requirements of ASTM E329.
 2. A representative of the testing agency will inspect, sample, and test material and production of concrete as required by the Project Manager. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Project Manager and the Contractor.
 3. The testing agency will report all test and inspection results to the Project Manager and Contractor immediately after they are performed. All test reports will include the exact location of the work at which the batch represented by a test was deposited. The report of the strength

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test will include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).

4. The testing agency or its representative is not authorized to revoke, alter, relax, enlarge or release any requirements set forth in these specifications.

E. Tests Provided by the Contractor:

1. The following services shall be performed by the designated testing agency at the expense of the Contractor:

- a. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141; mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be forty-five (45) minutes. If they cannot be returned to the laboratory and cast within the forty-five (45) minutes, they will be cast in the field and transported to the laboratory in twelve (12) to twenty-four (24) hours. One test series will be taken per fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the Project Manager.

1. Field cured test series: Four (4) cylinders; two (2) to be broken at seven (7) days; two (2) to be broken at fourteen (14) days or as directed by the Project Manager.
2. Lab cured test series: Six (6) cylinders; two (2) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days; two (2) to be broken at forty-five (45) days.

* If the specified strength is not obtained at twenty-eight (28) days, two (2) cylinders are to be broken at forty-five (45) days.

- b. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Project Manager, in accordance with AASHTO T119.
- c. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- d. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
- e. When required by the Project Manager, the Contractor will provide concrete mix designs, the results of which will be immediately reported to the Project Manager. When pumped concrete is to be used, a separate mix design will be required. Mix designs will be in accordance with ACI 211 and 304, as applicable.
- f. Additional testing and inspection required because of changes in materials or proportions.
- g. When the work fails to pass inspection or previous tests fail to meet Specifications, additional tests will be taken as directed by the Project Manager.
- h. Core samples will be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions set forth in these specifications. Obtaining and testing cores will be in accordance with ASTM C42. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least eighty-five percent (85%) of the specified strength f_c , and if no single core is less than seventy-five percent (75%) of the specified strength. Core holes will be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.
- i. Failure of the Contractor to furnish testing as herein described will be sufficient cause for rejection of the work in question.

F. Responsibility and Duties of the Contractor:

1. The Contractor will provide the testing agency with the following:
 - a. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.

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- b. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.
2. The use of testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance with the standards set forth in these specifications.

END OF SECTION

**SECTION 07900
JOINT SEALERS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Providing all caulking and sealant indicated on Drawings, specified herein, and not specified under other sections. In general, seal all openings indicated on Drawings and at other locations requiring sealant to seal visually and against infiltration from air and water, including but not limited to following:
 - 1. Expansion joints in concrete slabs.
 - 2. Isolation joints, between structure and other elements.

1.02 QUALITY ASSURANCE

- A. Installer: Company specializing in sealant application.
 - 1. Experience: Continuously installed sealants in State of Colorado for five (5) years.

1.03 PROJECT CONDITIONS

- A. Environmental Conditions: Do not apply exterior sealants during wet weather or when outside temperature is below 40° F or apply interior sealants when inside temperature is below 60° F.

PART 2 - PRODUCTS

2.01 JOINT BACKING MATERIAL

- A. General: Size joint backing material for minimum 30% compression when inserted in joint. Material: Round rod or semi-circular type.
- B. Manufacturers:
 - 1. Dow Chemical Company, Ethafoam.
 - 2. Sonneborn, Sonofoam.
 - 3. Accepted Substitute in accordance with Section 01600.

2.02 SEALANT MATERIAL

- A. Acceptable Materials:
 - 1. Interior and Under Thresholds: Not required.
 - 2. Exterior: Two (2) component polyurethane, FS TT-S-00227E, Type II, Class A, non-sag.
 - 3. Primer: As recommended by sealant manufacturer.
 - 4. Sealant at Concrete Pads: Two (2) component self-leveling polyurethane, FS TT-S-00227E, Type I, Class A, pourable type.
 - 5. Colors: As selected by Project Manager from standard colors.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01600:
 - 1. Inspect joints to be sealed to application of any work under this section.
 - 2. Notification: Notify General Contractor of any joints which cannot be put into proper condition to receive sealants in writing with copy to Project Manager.
- B. Acceptance: Beginning of work means acceptance of existing conditions by installer.

3.02 PREPARATION

A. Preparation of Surfaces:

1. Clean surfaces in accordance with manufacturer's recommendations.
2. Mask edges, if required, to protect adjoining surfaces and produce a straight finish line.
3. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.

B. Joint Backing:

1. Joints: Depth necessary to provide for specified allowable thickness of sealant and also required backing where and as specified. Provide backing of extent and type a specified and required to provide for allowable depth of sealant.
2. Back-up Materials for Sealants: Non-staining, compatible with sealant and primer, resilient nature, and as recommended by manufacturer of sealant.
 - a. Size and Shape: As required by width of joint and specified.
 - b. Do not use materials impregnated with oil, solvents or bituminous materials.
3. Compress backing material minimum of 30% when inserted in joint. Backing material for upper portion of joints shall be round rod or semi-circular in cross-section where in contact with sealant.

3.03 APPLICATION

A. Exterior Thresholds: Not required.

B. Seal Joints:

1. Apply sealants in continuous beads without open joints, voids or air pockets, using ratchet hand gun or mechanical powered gun.
2. Confine sealants to joint areas with masking tapes or other precautions. Apply compounds in concealed compression joints accurately so that excess compound will not extrude from joints.
3. Remove excess compound or sealant promptly as work progresses, and clean adjoining surfaces.
4. In rough surfaces or joints of uneven widths, install sealant well back into joint. Recess equal to width of joint, or 3/8" minimum at masonry.
5. Use anti-tack agent where necessary to protect freshly applied sealant from public traffic and dirt.
6. Comply with manufacturer's specifications and recommendations.

C. Workmanship: Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.

1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces.
2. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.

D. Joint Sizes: Install sealants to depths as indicated or, as recommended by sealant manufacturer but within following general limitations:

1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to depth equal to 50% of joint width, but not more than 1/2" deep or less than 1/4" deep.
2. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to depth in range of 75% to 125% of joint width.

- E. Spillage:
 - 1. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.
 - 2. Remove excess and spillage of compounds promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage. Do not damage adjoining surfaces or finishes.

- 3.04 CURING, PROTECTION AND CLEANING
 - A. Curing: Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

 - B. Protection:
 - 1. Advise General Contractor of procedures required for protection of sealants during construction period, so that they will be without deterioration or damage (other than normal weathering) at time of acceptance.
 - 2. Protect surfaces from damage. Clean soiled surfaces immediately. Replace any damaged material which cannot be cleaned with new material.

END OF SECTION