JORDAN VALLEY WATER CONSERVANCY DISTRICT HEADQUARTERS CAMPUS SITE REPAIRS AND IMPROVEMENTS FOR UPPER CAMPUS

SITEWORK AND UTILITIES
CIVIL SPECIFICATIONS

March 3, 2021

SECTION 00 0001

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CIVIL

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TRAFFIC CONTROL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Traffic control requirements.

1.2 **REFERENCES**

A. ASTM D4956: Retroreflective Sheeting for Traffic Control.

B. ATSSA: American Traffic Safety Services Association, Inc.

C. Instructions to Flaggers. Publication of UDOT.

D. MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

E. Work Zone Traffic Control Guide: Publication of the Utah LTAP Center.

1.3 **SUBMITTALS**

A. Traffic control plan within 10 days of receiving the Notice of Intent to Award.

B. Flagger or traffic control technician certificates when requested by ENGINEER.

1.4 **TRAFFIC CONTROL PLAN**

A. Create a traffic control plan using the following resources. Resolve discrepancies between resources in descending order shown:

1. MUTCD.
2. Work Zone Traffic Control Guide.
3. ATSSA.

B. Include the following documentation as part of the traffic control plan.

1. Written description of phasing.
2. Drawing showing phasing (if required for clarity).
3. Drawing showing placement of traffic control devices.

C. Show how to move pedestrians through or around the Work site.

D. Show how to handle signalized intersections.

E. Meet grade, slope and protection requirement of the Americans with Disabilities Act (ADA).

1.5 **TRAFFIC CONTROL TECHNICIAN**

A. Certified by ATSSA or AGC.

1.6 **FLAGGER**

A. Certified by ATSSA, AGC or UDOT.

B. Equipment:
   1. 24” x 24” “Stop/Slow” sign.
   2. 6” to 8” long red wand for night flagging.
   3. Light plant for night flagging.

C. Clothing:
   1. Clothed; full length pants and long or short sleeved shirt.
   2. Hard toed shoes.
   3. Lime Green, orange, or red-orange hardhat and vest.
   4. Night clothing to be reflectorized.

PART 2 PRODUCTS

2.1 **PAVEMENT MARKINGS, SIGNS, BARRICADES**

A. MUTCD.

B. Channelizing Devices: Crash worthy plastic cones, drums and barricades.

C. Reflective Sheeting: ASTM D4956.

D. Pavement Markings: Section 32 17 23.

PART 3 EXECUTION

3.1 **FLAGGING**

A. MUTCD.

3.2 **TRAFFIC CONTROL DEVICES**

A. Install before work activities begin.

B. Maintain to ensure proper, continuous function.

C. Remove when no longer needed.

3.3 **TEMPORARY PAVEMENT MARKINGS**

A. Renew if stripes and markings have lost their original visual effectiveness.

END OF SECTION

SECTION 01 5700

TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Requirements for controlling surface and subsurface environmental conditions at the construction site, and related areas under the CONTRACTOR's responsibility.
B. Requirements for removal of physical evidence of temporary controls upon completion of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Temporary Materials: CONTRACTOR's choice.

PART 3 - EXECUTION

3.1 NOISE CONTROL
A. Use equipment that is equipped with noise attenuation devises. Comply with local Laws and Regulations.
B. Control construction noise in residential areas from 9:00 pm to 7:00 am.

3.2 DUST AND MUD CONTROL
A. Provide suitable equipment to control dust or air pollution caused by construction operations.
B. Provide suitable mud and dirt containment, so Work site, access roadways and properties adjacent to the Work site are kept clean.

3.3 SURFACE WATER CONTROL
A. Control all on-site surface water. Provide proper drainage so flooding of the site or adjacent property does not occur.
B. Provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the site.
C. Immediately prior to suspension of construction operations for any reason, provide proper and necessary drainage of Work site area.
D. Provide berms or channels as necessary to prevent flooding or saturation of Subgrade. Promptly remove all water collecting in depressions.
E. Dispose of water in a manner that will not cause damage to adjacent areas or facilities.

3.4 GROUND WATER CONTROL
A. Provide a dewatering system sufficient to maintain Excavations and foundations dry and free of water on a 24 hour basis.
B. Notify ENGINEER, in writing, if groundwater conditions differ from conditions shown in the Bidding Documents, or in any soil test data that has been supplied.
C. Remove all dewatering facilities when no longer required.
D. Dispose of water in a manner that will not cause damage to adjacent areas or facilities.

3.5 POLLUTION CONTROL
A. Soil: Prevent contamination of soil from discharge of noxious substances (including engine oils, fuels, lubricants, etc.) during construction operations. Excavate and legally dispose of any such contaminated soil off-site, and replace with acceptable compacted fill and topsoil.
B. Water: Prevent disposal of wastes, effluent, chemicals, or other such substances adjacent to or into streams, waterways, sanitary sewers, storm drains, or public waterways. Perform any emergency measures that may be required to contain any spillage.
C. Air: Control atmospheric pollutants.

3.6 EROSION CONTROL

A. Use measures such as berms, dikes, dams, sediment basins, fiber mat netting, gravel, mulches, slopes, drains and other erosion control devices or methods to prevent erosion and sedimentation.
B. Provide construction and earthwork methods which control surface drainage from cut, fill, borrow, and waste disposal areas, to prevent erosion and sedimentation.
C. Inspect earthwork during execution to detect any evidence of the start of erosion. Apply corrective measures as required.

END OF SECTION

SECTION 01 65 00

PRODUCT DELIVERY AND HANDLING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Basic requirements for product delivery and handling on site.

1.2 **DELIVERY**

A. Arrange for delivery of products in accordance with progress schedule to facilitate instruction before installation.

B. Coordinate deliveries to avoid conflict with work, conditions at site, and:

1. Work of separate contractors, or OWNER.
2. Limitations of storage space.
3. OWNER's use of premises.

C. Deliver products in undamaged condition in original containers or packaging, with identifying labels for handling, storing, unpacking, protecting and installing intact and legible.

D. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts, and to facilitate assembly.

E. Immediately upon delivery, inspect shipment to determine:

1. Product complies with requirements of Contract Document reviewed submittals.
2. Quantities are correct.
3. Containers and packages are intact, labels are legible.
4. Products are properly protected and undamaged.

1.3 **PRODUCT HANDLING**

A. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction space.

B. Coordinate delivery with installation time to ensure minimum holding time for items that are hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

C. Handle products to prevent bending or over-stressing.

D. Lift heavy components at designated lifting points.

E. Discard damaged products.

1.4 **ACCESS**

A. Identify access to CONTRACTOR's work and office area by use of signs so agents, delivery trucks, and other parties desiring contact with CONTRACTOR may do so.

B. In security zones, prevent unauthorized personnel from proceeding outside of CONTRACTOR's work and office areas.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Mobilization and demobilization requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**: Plan 412 Invert Cover.

1.3 **DEFINITIONS**

A. **Mobilization** includes bringing all necessary equipment to the site to do the Work. It includes all labor, materials, and equipment to set up temporary offices, buildings, facilities, signs, and utilities.

B. **Demobilization** includes removing all construction equipment and debris so site is left clean.

1.4 **TEMPORARY FACILITIES**

A. Field Office: CONTRACTOR's choice.

B. Utilities: Provide power, telephone, water, storm and sanitary facilities, and all other temporary utilities required.

C. Security and Protection: Construct and maintain temporary fencing for the protection of materials, tools, and equipment. Obtain prior approval for all fence locations.

D. Construction and Support: Set up and maintain in a neat and orderly manner temporary roads and paving, dewatering facilities, enclosures, identification signs and bulletin boards, waste disposal and temporary heat. Provide and maintain temporary all weather pedestrian walk ways and road detours.

E. Invert Cover: Install covers as shown in APWA Plan 412 or Drawings. Installation must be tight so no debris can by-pass the cover and enter the piping below.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Temporary Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 INSTALLATIONS

A. Relocate and modify temporary facilities as required.

B. Install temporary utility service or connect to existing service.

C. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access. Use of gasoline-burning, open flame, or salamander type heating units is prohibited.

D. Use local standards and codes for erection of adequate fences and barricades. Maintain all signing, barricades, fencing, drainage, and other items as required to protect public and private property from damage caused by construction operations.

E. Coordinate location of storage areas to avoid interference with drainage, traffic, or private property.

F. Provide and maintain all temporary signage required by the Work.

3.2 REMOVALS

A. Completely remove temporary materials and equipment:

1. When construction needs can be met beause of permanent installation, and
2. At completion of the Work.

B. Clean or repair damage caused by installation or use of temporary facilities.

C. Restore areas to original or to specified conditions at completion of the Work.

END OF SECTION

SECTION 01 7123

CONSTRUCTION LAYOUT

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Construction surveying requirements.

1.2 SUBMITTALS
A. Prior to contract closeout submit:
   1. Documentation to verify accuracy of survey work.
   2. When required by Laws and Regulations, submit a certificate signed by a licensed professional certifying that elevations and locations of improvements conform with the Contract Documents.
   3. All survey data, survey information showing dimensions, location angles and elevations of construction on contract Record Documents.

1.3 SURVEY REFERENCE POINTS
A. Known basic horizontal and vertical control points for the Project are indicated.
B. Locate and protect survey control points prior to starting site work, and preserve all permanent reference points during construction.
C. Notify ENGINEER in writing within 24 hours of any survey work changes or clarifications required for Project. Secure written authorization prior to making any changes or relocations.
D. Report in writing when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
E. Replace construction stakes damaged or destroyed by CONTRACTOR at no additional cost to OWNER.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION

3.1 PROJECT SURVEY REQUIREMENTS
A. Any work done without line and grade established by CONTRACTOR is at CONTRACTOR's own risk.
B. Locate and layout by instrumentation and similar appropriate means to include but not limited to:
   1. Pavement Subgrade and finish grade.
   2. Site improvements:
      a. Stakes for grading, fill and topsoil placement.
      b. Slope elevations.
      c. Utility locations and invert elevations.
   3. Batter boards for structures.
   4. Retaining wall locations and elevations.
   5. Curb and gutter alignment and grade.
   6. Building foundations, column locations and floor levels.
   7. Controlling lines and levels required for civil, mechanical, and electrical trades.

END OF SECTION

SECTION 01 7134

SURVEY REFERENCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of reference marks.

B. Making permanent records of marks set.

1.2 SUBMITTALS

A. Field notes in 8 1/2 inches x 11 inches format or in standard field book form. Before construction begins and after construction ends show the following:

1. All corners, points, or monuments which may be disturbed, damaged, moved, removed, covered, or destroyed by construction activity. Describe their kind, size, location, and any other data relating thereto.
2. All corners, points, or monuments which are replaced, established, or reestablished, lines of survey, bearings, basis of bearings, scale of drawing, structures containing reference marks, and picture drawings of each mark installed.
3. Found corners, points, or monuments, describing in detail the size, type, location and ownership.
4. A north arrow, length of lines, scale of drawing, weather, temperature, errors of closure, and method of adjustment.
5. Land surveyor's signature and seal on each tie-sheet record.

B. If any survey point, monument, or line is disturbed or destroyed before referencing (tie-out), reestablish that point, monument, or line at no additional cost to OWNER, and submit a record of survey plat to the governing agency to show how its location was reestablished.

C. “Corner File Report” that complies with applicable Laws and Regulations.

1.3 QUALITY ASSURANCE

A. Comply with all pertinent surveying codes, Laws and Regulations including but not limited to Utah State Code Title 17 Chapter 23 – County Surveyor.

PART 2 PRODUCTS

BRASS TAG

A. Imprinted with land surveyor's license number or business name fastened with a 1 inch long brad to:

1. a 3/8 inch diameter and 1-1/4 inch deep lead plug pounded into a hole drilled in a concrete structure, or
2. a cement water paste poured into the top of a two (2) inches diameter 24 inches long cast iron pipe driven into the ground.

B. Depress tag and brad a minimum of 1/8 inch below surface plane of concrete structure or end of pipe.

2.2 REBAR AND CAP

A. No. 5 deformed rebar at least 24 inches long.

B. Installed free from movement.

C. Cap bears the license number, business name, or government agency name.

2.3 **RECORD OF SURVEY**

A. Mylar sheet complying with applicable Laws and Regulations for providing plat survey control.

2.4 **OTHER MATERIALS**

A. Select all other materials, not specifically described but required for proper completion of work of this Section.

PART 3 EXECUTION

3.1 **REFERENCE MARKS**

A. Furnish and install reference marks set in concrete or mortar in sufficient number and durability to assure the perpetuation of facile replacement of any survey point, monument, or line.

B. Install reference marks where location of section corner or survey monuments are likely to be disturbed or destroyed, or where difficult terrain is encountered.

C. When specified or for new subdivision work, install reference marks for lot lines in concrete curbs or sidewalks. If not available, install witness monuments in approved locations.

3.2 **REFERENCE SURVEY MONUMENTS BEFORE DISTURBANCE**

A. Obtain local jurisdiction's monument permit not less than 72 hours before disturbing, damaging, moving, removing, covering, or destroying any existing survey monument.

B. Pay all costs and submit all pertinent data when replacing monuments not referenced.

3.3 REFERENCING SURVEY POINTS AND LINES

C. Reference all survey points and lines which may be disturbed or destroyed by construction operations using reference marks.

Locate reference marks on lines or extensions of lines that the survey points designate

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Cutting and patching to:

1. Fit several parts together, to integrate with other work.
2. Uncover work to install work done out of sequence.
3. Remove and replace defective and non-conforming work.
4. Remove Samples of installed work for testing.
5. Provide openings in non-structural elements for penetrations of mechanical and electrical work.

1.2 **SUBMITTALS**

A. Submit written request in advance of cutting and patching that affects:

1. Structural integrity of any element of Project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight-exposed elements.
5. Work of OWNER or separate contractor.

B. Include in request:

1. Identification of Project.
2. Location and description of affected work.
3. Necessity for cutting and patching.
4. Description of proposed work, and products to be used.
5. Alternatives to cutting and patching.
6. Effect on work of OWNER or separate contractor.
7. Written permission of affected separate contractor.
8. Date and time work will be executed.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Those required for original installation.

B. For any change in materials, submit request for substitution, Section 01 25 00 requirements.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions, including elements subject to damage or movement during modifications to completed work.

B. After uncovering, inspect conditions affecting performance of work.

C. Beginning of Modification work constitutes acceptance of existing conditions.

3.2 PREPARATION

A. Provide supports to assure structural integrity of surroundings, devices and methods to protect other portions of work from damage.

B. Provide protection from elements for areas which may be exposed by work.

3.3 PERFORMANCE

A. Execute work by methods to avoid damage to existing structures and other work, and which will provide proper surfaces to receive patching and finishing.

B. Employ original installer if possible to be responsible for modification work on weather-exposed and moisture-resistant elements, and exposed to view surfaces.

C. Restore Work with new products per requirements of Contract Documents.

D. Fit Work, to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

E. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 13

PROGRESS CLEANING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Cleaning and disposal of waste materials, debris, and rubbish.

B. Cleaning of Work before Final Inspection.

1.2 **SUBMITTALS**

A. Before Project Closeout: Certificate of disposal of Hazardous Waste if applicable.

1.3 **JOB CONDITIONS**

A. On Site Burning: Not permitted.

PART 2 PRODUCTS

2.1 **CLEANING MATERIALS**

A. Use only materials which will not create hazards to health or property, and which will not damage surfaces.

B. Use only cleaning materials recommended by manufacturer of item being cleaned.

PART 3 EXECUTION

3.1 **CLEANING DURING CONSTRUCTION**

A. Initiate and maintain a specific cleaning program to prevent accumulation of debris. Maintain areas under CONTRACTOR's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Provide covered containers for deposit of debris and rubbish.

C. Periodically clean interior areas to provide suitable conditions for finish work.

D. Remove debris and rubbish from closed or remote spaces before closing the space.

E. Broom clean interior areas before start of surface finishing, and continue cleaning on an as-needed basis.

F. Control cleaning operations so dust and other particulate will not adhere to wet or newly-coated surfaces.

3.2 DISPOSAL DURING CONSTRUCTION

A. Regularly remove and legally dispose of waste materials, debris, and rubbish from site.

B. Provide additional collections and disposal of debris whenever the periodic schedule is inadequate to prevent accumulation.

3.3 CLEANING BEFORE FINAL INSPECTION

A. Site:

Clean exposed-to-view surfaces.

Remove waste, debris, and surplus materials from site. Clean grounds; paved areas and sweep clean.

Rake clean other surfaces.

B. Building:

Clean interior and exterior exposed-to-view surfaces.

Remove temporary protection and labels not required to remain.

Clean finishes free of dust, stains, films and other foreign substances.

Clean transparent and glossy materials to a polished condition. Polish reflective surfaces to a clear shine.

Vacuum clean carpeted and similar soft surfaces. Clean resilient and hard-surface floors.

Clean surfaces of equipment; remove excess lubrication. Clean plumbing fixtures to sanitary condition.

Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.

Clean lighting fixtures and lamps. Continue cleaning until acceptance.

Remove waste and debris from roofs, gutters, area ways, and drainage systems.

END OF SECTION

SECTION 01 75 16

STARTUP PROCEDURES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Procedural requirements for start-up, testing, adjusting and balancing systems.

1.2 **COORDINATION**

A. Coordinate services with work of various trades to ensure rapid completion of services.

B. Report any deficiencies noted during performance of services to allow immediate corrective action.

1.3 **JOB CONDITIONS**

A. Before start of testing, adjusting and balancing, verify required job conditions:

1. Systems installation is complete and in full operation.
2. Conditions are within a reasonable range relative to design conditions.
3. Special equipment such as electronic equipment are in full operation.

B. Verify that special product or equipment requirements for preparation, testing and balancing have been met for elements of each of the systems that require testing.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Provide material required to perform start-up of each respective item of equipment and system before beginning of test, adjust and balance procedures.

2.2 **VERIFICATION OF PERFORMANCE**

A. Provide an independent certifying association to provide information and assistance required to adjust and balance system.

PART 3 EXECUTION

3.1 **START-UP**

A. Start up completed facility with appropriate personnel present.

B. Perform specified services and if necessary employ and pay for a manufacturer approved organization to perform specified services.

C. Provide appropriate utilities and instrumentation required for starting, testing, adjusting and balancing operations:

1. Make instruments available to ENGINEER to facilitate spot checks during testing.
2. Retain possession of instruments, remove from site at completion of services.

D. Comply fully with procedural standards of certifying association under whose standards service will be performed.

1. Execute each step of the prescribed procedure without omission.
2. Accurately record the required data.

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Requirements for collecting, maintaining, updating, and submitting Record Documents.

1.2 **DEFINITIONS**

A. **Record Documents**: Those documents maintained and annotated by CONTRACTOR during construction for recording "as built" condition of the Work.

1.3 **CONSTRUCTION PHOTOGRAPHS**

A. Provide electronic photographs when specified in the Contract Documents starting with a series of photographs before the start of any physical construction, and continuing for as long as the Work progresses:

1. Provide not less than 12 different subjects or angles of view each time from different locations in the Project area at intervals not exceeding one (1) month.
2. On each photograph indicate the date, job title, photograph identification, and direction the camera was facing.
3. With each request for payment.
4. Upon completion of the Work, submit all electronic pictures on disc. ENGINEER may request hard copies of the pictures.

B. Secure ENGINEER's approval if a video tape is to be substituted for the photograph prints.

1.4 **DOCUMENTS ON SITE**

A. Keep at job site 1 copy of each of the following, if issued for the Work:

1. Contract Drawings.
2. Project Manual.
3. Addenda.
4. Reviewed Shop Drawings, product data and Samples.
5. Modifications to the Contract Documents.
6. Field test records.
7. Inspection certificates.
8. Manufacturer's certificates.
9. Survey documentation.
10. Storm water pollution prevention plan (SWPPP).
11. All related permits.

B. Do not use record documents for construction purposes.

C. Store Record Documents in a location, apart from documents used for construction.

D. Maintain Record Documents in a clean, dry, legible condition.

E. Provide adequate files and racks for storage of Record Documents that will allow ready access for review and updating.

F. Make Record Documents available at all times for review and Inspection by ENGINEER.

1.5 **MARKING DEVICES**

A. Red colored waterproof for all marking unless requested otherwise.

1.6 **RECORDING**

A. Clearly and legibly label each document "PROJECT RECORD".

B. Number Record Documents in a manner which will allow ready retrieval of documents and allow indexing of documents for submittal to ENGINEER.

C. Update Record Documents as work occurs to show the current status of the Work.

D. Do not permanently cover or conceal any work until all required information has been recorded on the Record Documents.

E. Contract Drawings: Legibly mark contract Drawings to record following actual construction information:

1. Measured depths of various elements of foundation or finish grading in relation to finish floor datum or other permanent benchmark.
2. Measured horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
3. Measured location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of construction.
4. Field changes of dimension and detail.
5. Changes made by contract Modifications.
6. Details not contained in original contract Drawings.

F. Project Manual and Addenda: Legibly update each to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by contract Modifications.
3. Other technical matters and details included in the Work, but not originally specified.

G. Shop Drawings: Maintain reviewed Shop Drawings as Record Documents; legibly annotate drawings to record changes made to Shop Drawings.

H. Product Data and Samples: Maintain reviewed product data and Samples as Record Documents; update and document any variations

from the reviewed product data and Samples after acceptance.

1.7 **SUBMITTAL OF DOCUMENTS**

A. At the completion of the Work, submit all Record Documents.

B. Accompany the submittal with a transmittal letter, in duplicate, containing:

1. Submittal date.
2. Project title and number.
3. CONTRACTOR's name and address.
4. Title and number of each Record Document.
5. Certification that each document as submitted is complete and accurate.
6. Signature of CONTRACTOR, or CONTRACTOR's authorized representative.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 78 50

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Administrative provisions for Substantial Completion, acceptance of work, and Final Inspection.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 110 Arrow diagram for project close-out.

1.3 **SUBSTANTIAL COMPLETION**

A. When Work, or designated portion thereof, is substantially complete, submit written notice with list of any outstanding items to be completed or corrected.

B. After receipt of CONTRACTOR's certification of Work Completion, ENGINEER will make final inspection to determine status of completion.

C. Should Work not be substantially complete, remedy deficiencies and re- submit a written notice.

1.4 **ACCEPTANCE OF WORK**

A. Protect Work until it is accepted.

B. Neither ENGINEER's determination that Work is complete, nor acceptance thereof by the OWNER, shall operate as a bar to claim against the CONTRACTOR under the provisions of the contract documents.

1.5 **CLOSEOUT SUBMITTALS**

A. Record Documents: Section 01 78 39.

B. Operation and Maintenance Data; Section 01 78 23.

C. Evidence of payment to Subcontractors and Suppliers: Document 00 72 00, Final Application for Payment.

D. Final Summary Report of CONTRACTOR's Testing Agency: Section 01 45 00 requirements.

1.6 **CLOSEOUT SCHEDULE**

A. See APWA Plan 110 requirements.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 02 4113

PART 1 -

SELECTIVE SITE DEMOLITION

PART 1GENERAL

1.1 SECTION INCLUDES

A. Demolition of structural and utility items on site.
B. Salvage.

1.2 PAYMENT PROCEDURES

A. Payment for structures or obstructions which are not designated for removal and disposal in the Bidding Documents, and which cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for by Change Order.
B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

1.3 RELATED WORK

A. Demolition of Pavements, sidewalks, Driveway Approaches, curbs, gutters, Section 02 41 14.
B. Existing pipelines not to be salvaged are considered a part of excavation work, Section 31 23 16.
C. For use of explosives in the Work; Section 31 23 17.

1.4 SITE CONDITIONS

A. Protect structures to be removed and their contents from vandalism and theft.
B. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

PART 2PRODUCTS **-** Not Used

PART 3EXECUTION

3.1 PREPARATION

A. Review all work procedures with ENGINEER.
B. Locate and preserve all active utilities which are to remain in service.

3.2 PROTECTION

A. Avoid or minimize damage to tree roots. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property.
B. Provide certified arborist observation of root cuts larger than 4 inches diameter. Notify ENGINEER of such root cut.

3.3 STRUCTURE DEMOLITION

A. Remove structures and incidentals such as but not limited to foundations, sidewalks, Pavement slabs, fences and outbuildings.
B. Remove foundation walls at least 2 feet below the finished grade or 2 feet below the natural ground surface. Remove floor slab or break it into pieces no larger than 3 feet square.
C. Backfilling and compaction of Excavations for structures, Section 31 23 23.
D. Building components, Section 02 41 19.

3.4 PIPELINE DEMOLITION

A. Salvaging Pipe: Do not damage.
B. Plugs: Plug disconnected pipe lines near the right-of-way line with a water-tight concrete plug extending into the remaining pipe at least 2 feet.
C. Service Laterals: Excavate and shut off the corporation stop. Disconnect.

3.5 MISCELLANEOUS DEMOLITION

A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements.

1. Backfill is stable.
2. Burial does not interfere with construction.
3. Permission to do so is obtained from the ENGINEER.
4. No remaining portion is within 2 feet of the final ground surface contours.

3.6 SALVAGE

A. Salvage designated equipment and materials.

B. All other salvageable materials become the property of the CONTRACTOR unless such materials are not owned by OWNER.

END OF SECTION

SECTION 02 4114

PAVEMENT REMOVAL

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Removal of roadway Pavement.
B. Milling roadway Pavement.
C. Removal of curb, gutter, sidewalk, Driveway Approach, waterway, or similar flatwork.
D. Disposal of removed materials.

1.2 RELATED WORK
A. Demolition of structures and utilities.

1.3 DEFINITIONS
A. ADA: Americans with Disabilities Act.

1.4 SUBMITTALS
A. Traffic control plan, Section 01 55 26.

1.5 SITE CONDITIONS
A. Control dust, Section 01 57 00.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 PREPARATION
A. General
    1. Coordinate utility location, Section 01 31 13.
    2. Preserve all active utilities.
    3. Notify neighborhood of day and time of operation.
    4. Make sure invert covers are properly installed in storm drain and sanitary sewer systems, Section 01 71 13.
    5. Mark existing utilities on redline drawings.

B. Traffic Control: Provide worker and public safety, Section 01 55 26.

C. Tree Roots:
    1. Avoid or minimize damage to tree roots. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property.
    2. Provide certified arborist observation of root cuts larger than 4 inches diameter. Notify ENGINEER of such root cut.

A. Existing Surfaces:
    1. Do not damage adjacent concrete surfaces that are not scheduled for removal.
    2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
    3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

3.2 SAW-CUT PEDESTRIAN TRIP HAZARDS
A. Make saw cuts 1:8 slope measured to grade.
B. Eliminate trip hazards across the full width of the hazard.

3.3 SAW-CUT CURB HORIZONTALLY
A. Saw cut curbs for ADA ramps at 1:12 slope. No trip hazard at gutter flow line.

B. Saw cut curbs for flares:
    1. 1:4 slope measured to grade, or
    2. 1:12 slope measured horizontally when complying with ADA.

3.4 REMOVE PORTLAND CEMENT CONCRETE

A. Remove concrete to the nearest expansion joint or vertical saw cut.
B. Make concrete cuts straight, vertical to the surface, true, full depth.
C. DO NOT use machine mounted impact hammers.
D. Remove concrete pavement to neat vertical straight lines (saw-cut). Adjacent pavement surfaces must be protected during removal operations.

3.5 REMOVE ASPHALT CONCRETE

A. Saw cut full depth and remove Pavement.
B. When asphalt concrete overlays Portland cement concrete Pavements do not use a machine mounted impact hammer.
C. Remove asphalt pavement to neat vertical straight lines (saw-cut). Adjacent pavement surfaces must be protected during removal operations.

3.6 MILLING

A. Machine:
    1. Equipped to prevent air pollution.
    2. Equipped with a system to control slope of mill cut.
B. Tolerances:
    1. Milling Depth: As indicated plus or minus 10 percent not uniformly high or uniformly low.
    2. Striation Texture: Uniform, discontinuous, longitudinal, 3/16 inch deep maximum, 3/4 inch center to center.
    3. Smoothness: Plus or minus 5/16 inch in 25 feet.
    4. Cross Slope: Plus or minus 1/4 inch in 10 feet.
C. Performance:
    1. Lower utility frames, covers, and other Street Fixtures.
    2. Mill surfaces to the depth shown on the Drawings or indicated by ENGINEER. Do not disfigure adjacent work or existing surface improvements.
    3. If milling exposes smooth underlying Pavement surfaces, mill the smooth surfaces to make them rough.
    4. Mill off material if it ponds water or if it has been damaged by water.
    5. Where vehicles or pedestrians must pass over milled edges provide safe temporary ramps suitable to speed of user vehicles (or suitable for wheel chair user needs).
    6. Remove excess material and clean milled surfaces.
    7. If work equipment is removed from the milling site and milled surface awaits further work, provide appropriate traffic control and cleaning.

3.7 GRINDING

A. Machine:
    1. Cutting head 36 inches wide minimum.
    2. 50 to 60 diamond blades per foot of head.
B. Preparation:
    1. Control traffic.
    2. Provide water truck, waste truck, and other support machinery.
C. Mark areas to be ground. Tolerances:
    1. 1/4 inch lip transverse to the direction of vehicular travel. Potential for ponding not allowed.
    2. 1/8 inch lip (or dent) parallel to direction of vehicular travel.
    3. Taper ground areas from the lane/shoulder line into the shoulder area at 1/4 inch per foot.
D. Performance:

1. Skid resistance of final ground surface must be comparable to adjacent sections not requiring corrective work.
2. Surface treatment of ground areas.
    a. Asphalt Concrete: Asphalt tack coat and sand blotter, Section
    b. 32 12 14.
    c. Hydraulic Concrete: Water repellant, Section 07 19 00.
3. Waste grindings legally.
4. Protect downstream fish habitat.

3.8 CLEANING

A. Remove all debris and concrete dust. Clean surrounding rails, sidewalks, Driveways, landscaping and other objects in vicinity of work.

END OF SECTION

SECTION 02 41 15

CURB AND TRIP HAZARD REMOVAL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Saw cut and remove a curb.

B. Remove a trip hazard by saw cutting, grinding, or jacking.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 222 Saw cut driveway approach. Plan 235 Corner curb cut assembly. Plan 236 Tangent curb cut assembly. Plan 237 Island and median.

1.3 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

1.4 **SITE CONDITIONS**

A. Control dust, Section 01 57 00.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **PROTECTION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Do not damage abutting surfaces that are not scheduled for cutting or removal.

C. Protect plant and animal habitat. Follow federal, state or local protection requirements.

3.2 **CURB REMOVAL FOR NEW DRIVEWAY APPROACH**

A. Remove curb as shown in APWA Plan 222.

B. At the Apron: Saw off curb so surface of curb cut matches slope of apron. **Do not provide a lip at flow-line** unless indicated elsewhere.

C. At the Curb Flare: Saw off curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.
2. If the flare is NOT in a pedestrian walking area, make the length of the curb cut slope (parallel to the flow-line) three (3) feet minimum.

D. Remove blade marks on sawed surfaces by grinding.

3.3 **CURB REMOVAL FOR NEW CURB CUT ASSEMBLY**

A. For assembly types see APWA Plans 235, 236, and 237.

B. Curb Ramp or Blended Transition: Saw off curb to match the surface slope of the Curb Ramp or Blended Transition.

C Curb Flare: Saw off the curb perpendicular to the back of curb:

1. If the flare is in a pedestrian walking area, limit the curb cut slope (parallel to the flow-line) to 10 percent (1:10) maximum.
2. If the flare is NOT in a pedestrian walking area, typical horizontal length of the curb cut slope is two (2) feet.

D Remove blade marks on sawed surfaces by grinding.

3.4 **TRIP HAZARD REMOVAL**

A. **DO NOT cut or grind concrete structures** such as bridge decks, catch basins, manholes, concrete borders, culverts, etc. ENGINEER must determine other means of trip hazard removal.

B. Remove trip hazards greater than 1/4 inch high but less than 1 1/2 inches high. ENGINEER must determine acceptable means for removing trip hazards higher than 1 1/2 inches.

C. Make saw cut slopes, grinding slopes, and milled slopes not steeper than 10 percent (1:10) measured in direction of pedestrian travel. Grind sawed or milled surfaces to remove blade marks or to make smooth.

D. If flat work is jacked (Section 32 01 29), jack until displacement differential is less than 1/4 inch. Repair adjacent flat work elevations if adversely moved out of place because of the jacking process. Repair damaged form strip irrigation system or vegetation if growth is adversely affected.

3.5 **CLEANING AND REPAIR**

A. Remove debris and dust from work site.

B. Clean surrounding rails, concrete flat work, Driveways aprons, landscaping and other objects in vicinity of work.

C. Repair damage at no additional cost to OWNER.

END OF SECTION

SECTION 03 1100

SITE CONCRETE FORMING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Formwork for cast-in-place concrete.
B. Openings in formwork for other affected work.
C. Form accessories such as snap ties, bracing, etc.
D. Stripping formwork.

1.2 REFERENCES
A. ACI 347: Recommended Practice for Concrete Formwork.

1.3 DEFINITIONS
A. Shoring: The activity to support formwork.
B. Re-shoring: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.4 SUBMITTALS
A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.
B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.5 QUALITY ASSURANCE
A. Designer's Qualifications: Structural professional engineer who complies with Utah licensing law, has experience in concrete formwork, and is acceptable to the authority having jurisdiction.
B. Design Forms:
    1. With sufficient strength to maintain finished tolerances indicated in Section 03 35 00, to support loads, pressures, and allowable stresses as outlined in ACI 347 and for design considerations such
    2. as wind loads, allowable stresses, and other applicable requirements of local Laws and Regulations.
    3. To permit easy removal.
    4. For required finishes.
C. The design, engineering, and construction of formwork is CONTRACTOR's responsibility.

1.6 JOB CONDITIONS
A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.
B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.7 FIELD SAMPLES
A. Prepare field samples and submit per Section 01 33 00.
B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork to include vertical and horizontal form joints and typical rustication joints when required.
C. Size panel to indicate special treatment or finish required, including form release agent.

D. Remove formwork after casting concrete.

1.8 ACCEPTANCE

A. Secure ENGINEER's inspection of form layout for concrete flat work.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Faced with material which will produce smooth and uniform texture on concrete, unless indicated otherwise.
B. Arrange facing material orderly and symmetrical, keeping number of seams to a minimum.
C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.2 FORMWORK ACCESSORIES

A. Form Ties:
    1. Use ties constructed so that end fasteners can be removed without spalling concrete faces.
    2. After end fasteners of ties have been removed, embedded portion of ties are to terminate not less than 2 times the diameter or thickness of the fasteners from formed faces of concrete, but in no case greater than 3/4 inch.
    3. When the formed face on concrete is not exposed, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends or an approved equal for water retaining structures.
B. Pre-molded Expansion Joint Filler: Unless indicated otherwise, provide
C. Type F1, Section 32 13 73.
D. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, impair natural bonding or color characteristics of concrete. To prevent contamination, agents used on potable water structures are subject to review by ENGINEER prior to use.
E. Fillets for Chamfered Corners: Wood strips 1 inch x 1 inch size, maximum length possible.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 FORM CONSTRUCTION

A. All designs for forms must:
    1. Have the strength to withstand the pressure resulting from the placement of concrete and construction loads while maintaining the specified tolerances.
    2. Design forms to withstand support loads, lateral pressure, and allowable stresses outlined in ACI 347. Design for wind, allowable stresses, and other applicable requirements.
B. Form Materials:
    1. Smooth Forms: Use of smooth-faced, undamaged plywood or other panel type material of sufficient strength to provide continuous, straight, smooth as-cast surfaces.
    2. Architectural Concrete: Use of 3/4" min. "MDO" or "HDO" plywood.
    3. Embedded for accessories: Use of commercially manufactured items only.
    4. Form Ties: Use of Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent deflection and spalling of concrete surfaces upon removal only.
C. Form Construction:
    1. Construction is in accordance with ACI 347, to exact sizes, shapes, lines, and dimensions shown.

2. Shoring and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations.
3. Support of form facing materials by structural members spaced sufficiently close to prevent upward or lateral deflection during and after concrete placement.
4. Camber in the formwork as required for anticipated deflections is acceptable when specified.
5. At construction joints, overlap of forms over hardened concrete at least six inches.

D. Earth Forms: Side forms of footings may be omitted and concrete placed directly against excavation upon approval from Engineer. When earth forms are used, provide one inch minimum additional concrete on each side of the minimum design footing width.
E. Make forms sufficiently tight to prevent loss of concrete.
F. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.
G. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.
H. Provide positive means of adjustment using wedges, jacks, Shores, and struts to take up all settlement during concrete placing operation.
I. Provide temporary ports in formwork to facilitate cleaning and Inspection. Locate openings at bottom of forms to allow flushing water to drain.
J. At construction joints, overlap forms over hardened concrete at least 6 inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.
K. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.
L. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.
M. Anchor formwork to Shores, supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.
N. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.
O. Position expansion joint material and other embedded items accurately and support to prevent displacement.
P. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.
Q. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.
R. For underground concrete work, do not use soil walls for forming unless authorized by ENGINEER.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings for elements embedded in or passing through concrete.
B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
C. Install accessories per manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.
B. For As-cast Finishes:
    1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
    2. Where panel joints are recessed or otherwise emphasized, locate form ties within joints, not within panel areas.
    3. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.
C. Textured Finishes: As indicated.

3.5 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork per manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
B. Form coatings: Coating of forms is to occur prior to placement of reinforcing steel. Excess form coating material does not accumulate in forms or come into contact with surfaces which will be bonded to fresh concrete.

3.6 FORM REMOVAL

A. Removal of forms: Formwork not supporting concrete may be removed after curing for 24 hours at temperatures not less than 50 F unless removal is contingent upon concrete strength. Where a specified strength is required prior to removing forms, forms shall be removed when specified parameters have been satisfied.
B. Do not pry against face of concrete. Use only wooden wedges.
C. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.
D. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.
E. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.
F. Formwork for columns, walls, sides of beams, and other members not supporting the weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal.
G. Where no Re-shoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.
H. Where Re-shoring is planned, supporting formwork may be removed when concrete has reached 70 percent of specified strength, provided Re-shoring is installed immediately.
I. When Shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing Shores and supports, facing material may be removed at an earlier age as directed.

3.7 RESHORING

A. When Re-shoring is permitted or required, plan operations in advance and obtain approval.
B. During Re-shoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of Re-shoring.
C. Place Re-shores as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.
D. Tighten Re-shores to carry required loads without over-stressing.
E. Leave Re-shores in place until the concrete being supported has reached its specified strength.
F. For floors supporting Shores under newly placed concrete, level original supporting Shore or Re-shore.
    1. Re-shoring system shall have a capacity to resist anticipated loads in all cases equal to at least 1/2 the capacity of the Shoring system.
    2. Unless otherwise specified locate Re-shores directly under a Shore.
    3. In multistory buildings, extend Re-shoring through a sufficient number of stories to distribute the eight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and supporting Shores are not exceeded.
G. Design, engineering, and construction of Shoring and Re-shoring is the responsibility of the CONTRACTOR.

3.8 REMOVAL STRENGTH

A. When removal of formwork or Re-shoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions

has been met:

1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
2. When concrete has been cured per Section 03 39 00 for the same length of time as the site-cured cylinders that reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 deg. F. and concrete has been damp or sealed from evaporation and loss of moisture.

3.9 REUSE OF FORMS

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.
B. Thoroughly clean and properly coat forms before reuse.

3.10 FIELD QUALITY CONTROL

A. Before commencing a pour, verify connections, form alignment, ties, inserts and Shoring are placed and secure.
B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.
C. If during construction any weakness develops and false-work shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false-work.

END OF SECTION

SECTION 03 2000

SITE CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.
B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.2 REFERENCES

A. AASHTO M 254: Standard Specification for Corrosion Resistant Coated Dowel Bars.
B. ACI 301: Specifications for Structural Concrete for Buildings.
C. ACI 315: Details and Detailing of Concrete Reinforcement.
D. ASTM A 82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
E. ASTM A 185: Standard Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
F. ASTM A 615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
G. ASTM A 706: Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
H. ASTM C 1116: Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
I. ASTM D 3963: Standard Specification for Epoxy-Coated Reinforcing Steel.
J. AWS D1.1: Structural Welding Code Steel.
K. AWS D1.4: Structural Welding Code Reinforcing Steel.
L. CRSI Document: Manual of Standard Practice.

1.3 SUBMITTALS

A. Manufacturer's Certificate: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.
B. Welder's certification. C. Shop Drawings.
    1. Indicate sizes, spacing, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
    2. When required, prepare shop drawings by an engineer who complies with Utah licensing law and is acceptable to agency having jurisdiction.

1.4 QUALITY ASSURANCE

A. Perform concrete reinforcement work per CRSI Manual of Standard Practice.
B. Comply with ACI 301.
C. Welders: Certified to comply with AWS D1.1 or AWS D1.4 as applicable.

1.5 ACCEPTANCE

A. Unless specified otherwise, chairs for supporting reinforcement in flat slabs are spaced as follows.
    1. 3 feet maximum for No. 5 and smaller bars.
    2. 5 feet maximum for bars larger than No. 5.
B. Dowels are placed on dowel baskets and properly aligned.
C. Epoxy and galvanized coatings are not chipped or cut. Ends of cut bars are epoxy coated or galvanize painted prior to placement.
D. Minimum covering over reinforcement is as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fiber Reinforcement: ASTM C 1116 glass.
B. Reinforcing Steel: Deformed 60 ksi yield grade steel, ASTM A 615 and supplementary requirements S1 or ASTM A 706 for welding.
C. Welded Steel Wire Fabric: ASTM A 185 plain type in flat sheets or coiled rolls. Dimensions of the mesh 4"x 4" or as indicated.
D. Stirrups: ASTM A 82 steel.
E. Plain Dowel Bars for Expansion Joints: Smooth grade 60 ksi yield grade steel, ASTM A 615,
    1. Galvanized or epoxy coated in roadway Pavements.
    2. Provide metal dowel cap at one end of dowel to permit longitudinal movement of dowel within concrete section. Design caps with 1 end closed.
    3. Provide for movement equal to joint width plus 1/2 inch.
    4. For load transfer bars, paint with 1 coat of paint conforming to AASHTO M 254 and coat 1/2 with grease.
F. Coatings for Corrosion Protection:
    1. Epoxy coat, ASTM D 3963.
    2. Galvanized, Section 05 05 10.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or an acceptable patented system.
B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 FABRICATION

A. Fabricate reinforcement, ACI 315 providing for concrete cover.
B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.
C. Weld reinforcing bars; with AWS D1.4.

PART 3 - EXECUTION

3.1 PLACING

A. All designs shall be by a Professional Engineer, licensed in the State of Utah, and having experience in steel design. Shop drawing submittals are to include the professional engineer's seal and dated signature.
B. Shop drawings to be prepared in accordance with ACI 315.
C. Mill Certificates: Submit steel producer's certificates of mill analysis including physical and chemical analysis of reinforcing steel.
D. Materials:
    1. reinforcing bars: Conform to ASTM A 615, grade 60 (fy=60 ksi)
    2. Steel wire: Comply with ASTM A 82.
    3. Welded wire fabric: Comply with ASTM A 185 plain type.
    4. Stirrup steel: Conform to ASTM A 82.
    5. Smooth dowel bars for construction joints: ASTM A 29, Grade 60.
    6. Tie wire: Use minimum 16 gauge annealed type.
E. Fabrication:
    1. Fabrication of reinforcing bars to conform to required shapes and dimensions and in compliance with CRSI Manual and ACI 315. In the case of fabricating errors, do not allow

re-bending or straightening of reinforcing steel.

2. Reinforcement with any of the following defects will not be permitted in the work:
    a. Bar lengths, depths, and bends exceeding specified fabrication limits.
    b. Bends or kinks not indicated on drawings or final shop drawings.
    c. Bars with reduced cross-section due to excessive rusting or other cause.

F. Installation:
1. Cleaning of reinforcing steel required prior to installation.
2. Reinforcement bars are secured with wire ties at all points of intersection unless the spacing is less than 12 inches in each direction, in which case tie alternate points of intersection. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
3. Tack welding of reinforcing bars not allowed.
4. Overlapping of sheets of metal mesh acceptable one square plus six inches.

G. Splicing:
1. Reinforcement is furnished in the full lengths indicated on the plans. Splicing of bars is only permitted where shown on the plans. Stagger splices as far as possible.
2. The lap of bars thirty diameters minimum in making a splice is acceptable.

H. Do not bend reinforcing steel after embedding in hardened concrete, unless authorized by engineer.

I. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.

J. Place all reinforcement in the exact position indicated.

K. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

L. Overlap sheets of metal mesh one square plus 6 inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

M. Flat Slab Work:
1. Support reinforcing steel of formed flat slabs with metal chairs, precast concrete blocks or other slab bolsters.
2. Size chairs or bolsters to position the steel in the exact location indicated.
3. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 5 feet on centers in each direction. Plastic or epoxy coat that portion of the metal support in contact with the forms to prevent rust.
4. Tie down deck steel to beams or forms at regular intervals of not more than 5 feet on centers along the beams or forms to prevent movement of the steel during concrete placement.

3.2 SPLICING

A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without written approval. Stagger splices where possible.

B. Unless indicated otherwise, overlap reinforcing bars a minimum of 30 diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.

C. Do not use lap splices on bars greater in diameter than No. 11 unless approved.

D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.

E. Do not bend reinforcement after embedding in hardened concrete.

F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.3 PLACING EMBEDDED ITEMS

A. Place all sleeves, inserts, anchors and embedded items prior to concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.

B. Give all trades whose work is related to the concrete section ample notice and opportunity to introduce or furnish embedded items before concrete placement.

END OF SECTION

SECTION 03 3004

SITE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Material requirements.

1.2 REFERENCES
A. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
B. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
C. ACI 211.3: Standard Practice for Selecting Proportions for No-Slump Concrete.
D. ACI 214: Recommended Practice for Evaluation of Strength Test Results of Concrete.
E. ACI 301: Specifications for Structural Concrete for Buildings.
F. ACI 305: Hot Weather Concreting.
G. ACI 306: Cold Weather Concreting.
H. ACI 318: Building Code Requirements for Reinforced Concrete.
I. ASTM C 33: Standard Specification for Concrete Aggregates.
J. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
K. ASTM C 88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
L. ASTM C 94: Standard Specification for Ready-Mixed Concrete.
M. ASTM C 117: Standard Test Method for Material Finer than 75µ (No. 200) Sieve in Mineral Aggregates by Washing.
N. ASTM C 138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
O. ASTM C 143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
P. ASTM C 150: Standard Specification for Portland Cement.
Q. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete
R. ASTM C 227: Standard Test Method for Potential Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).
S. ASTM C 231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
T. ASTM C 260: Standard Specification for Air-Entraining Admixtures for Concrete.
U. ASTM C 289: Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
V. ASTM C 295: Standard Practice for Petrographic Examination of Aggregates for Concrete.
W. ASTM C 441: Standard Test Method for Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to The Alkali-Silica Reaction.
X. ASTM C 494: Standard Specification for Chemical Admixtures for Concrete.
Y. ASTM C 595: Standard Specification for Blended Hydraulic Cements.
Z. ASTM C 618: Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
AA. ASTM C 1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
BB. ASTM C 1116: Standard Specification for Fiber-Reinforced Concrete and Shot Crete.
CC. ASTM C 1157: Standard Performance Specification for Blended Hydraulic Cement.
DD. ASTM C 1240: Standard Specification for Use of Silica Fume as a Mineral Admixture in Hydraulic Cement Concrete, Mortar, and Grout.
EE. ASTM C 1260: Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

FF. ASTM C 1293: Standard Test Method for Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
GG. ASTM C 1567: Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
HH. ASTM C 1602: Standard Specification for Mixing Water Used in The Production of Hydraulic Cement Concrete.
II. II. ASTM D 1077: Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
JJ. ASTM STP 15-C: Manual on Quality Control of Materials.

1.3 SUBMITTALS

A. Quality Assurance: Submit names, certification levels, and years of experience of testing agency's laboratory and field technicians that are assigned to the Work. Verify laboratory complies with ASTM and ACI standards.
B. Mix Design: Submit.
    a. Date of mix design. If older than 365 days, recertify mix design.
    b. Cement source, type and chemical composition.
    c. Aggregate soundness and potential reactivity.
    d. Average Strength (f_{cr}), per quality control chart.
    e. Allowable range of slump and air content.
    f. Water cement ratio.
    g. Proportions of materials in the mix.
    h. Unit weight.
    i. Analysis of water if water is not potable.
    j. Mortar bar test results if a pozzolan is included in the mix.
    k. Technical data sheets for additives to be used at the plant and at the job site. Certify additives are compatible with each other.
C. Pre-approved mix design, submit name and address of Supplier.
D. Before changing mix design, submit a new design and give ENGINEER 10 days to evaluate the changes.
E. Source Quality Control Inspections and Testing Report: If requested, submit report describing CONTRACTOR's and Supplier's quality control activities and test results.

1.4 QUALITY ASSURANCE

A. Use a laboratory that follows and complies with ASTM D 1077.
B. Reject concrete that does not meet requirements of this section.
C. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures except as allowed by mix design.
D. Store bagged and bulk cement in weatherproof enclosures. Exclude moisture and contaminants.
E. Prevent segregation and contamination of aggregate stockpiles.
F. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.
G. Use of admixtures will not relax hot or cold weather placement requirements.

1.5 ACCEPTANCE

A. Materials:
    1. At the Source: Verify aggregate gradation. Determine percent of combined aggregate passing No. 200 sieve.
    2. At the Site: Verify mix identification, batch time, slump, air content, and temperature.
    3. At the Laboratory: Verify strength in 28 days.
B. Placement:
    1. Concrete in general, Section 03 30 10.

2. Pavement, Section 32 13 13 and 32 01 26.
3. Exterior flatwork, Section 32 16 13 or 32 16 14.

C. Defective Material:
1. Price adjustment, Section 01 29 00 and Section 03 30 10.
2. Dispute resolution, Section 01 35 10.

PART 2 - PRODUCTS

2.1 CEMENT

A. General:
1. Do not use air entraining cement except for hand mixed applications.
2. Do not use cement that contains lumps or is partially set.
3. Do not mix cement originating from different sources.

B. Standard Set Cement:
1. Type II cement per tables 1 and 3 in ASTM C 150, or Type V when necessary, or
2. Low-alkali cement per table 2 in ASTM C 150.

C. Rapid Set Cement: As above and as follows.
1. Initial set time: 15 minutes minimum.
2. Color: Acceptable to the ENGINEER.

D. Blended Hydraulic Cement: The following are the cement equivalencies when substituting blended cement for a Portland cement.

Table 1 – Cement Equivalencies		
ASTM C 150 (Low Alkali)	ASTM C 595	ASTM C 1157
Type I	IP	GU
Type II	IP (MS)	MS
Type III	--	HE
Type IV	--	--
Type V	--	HS

2.2 WATER

A. Clean, non-staining, non-detrimental per ASTM C 1602.
B. Screen out extraneous material.
C. Do not use alkali soil water.

2.3 AGGREGATES

A. Material: Clean, hard, durable, angular, and sound consisting of gravel, crushed gravel, crushed stone, crushed concrete, slag, sand or combination.
B. Source: Use the following requirements to determine suitability of aggregate source and not for project control.
1. Deleterious Substances and Physical Properties:
a. Coarse Aggregate: Class designation 4S in table 3 in ASTM C 33.
b. Fine Aggregate: Table 1 in ASTM C 33. Organic impurities producing a dark color concrete may cause rejection.
2. Reactivity:
a. Average prism length change in 12 months in an unmodified ASTM C 1293 test is less than 0.04 percent, or
b. Average mortar bar length change at 16 days in an unmodified ASTM C 1260 test is less than 0.10 percent, or
c. Historical data acceptable to ENGINEER, or d. Petrographic limits per ASTM C 295.
1) Optically strained, micro fractured, or microcrystalline quartz: 5.0% maximum.

2) Chert or chalcedony: 3.0% maximum.
3) Tridymite or cristobalite: 1.0% maximum.
4) Opal: 0.5% maximum.
5) Natural volcanic glass in volcanic rocks: 3.0% maximum.

2.4 ADMIXTURES

A. Calcium Chloride: Not allowed.
B. Air Entrainment: ASTM C 260. For extrusion enhancement use non-vinsal resin.
C. Set Enhancement and Water Reducing Agents: ASTM C 494.
   1. Type A: Water reducing.
   2. Type B: Set retarding.
   3. Type C: Set accelerating.
   4. Type D: Water reducing and set retarding.
   5. Type E: Water reducing and set accelerating.
   6. Type F: High range water reducing (super plasticizer). *
   7. Type G: High range water reducing and set retarding. *

   * Keep the relative durability factor of water reducing additives not less than 90 and the chlorides content (as Cl^-) not exceeding 1 percent by weight of the admixtures.

D. Pozzolan:
   1. Natural or fly ash per ASTM C 618.
   2. Silica fume per ASTM C 1240.
E. Special Admixtures: Allowed if mix design submittal is accepted.
   1. Lithium nitrate based solution for control of reactive aggregates.
   2. Calcium nitrite based solution for corrosion protection of reinforced structures subject to chloride-induced corrosion.
   3. Shrinkage reducer for controlling drying shrinkage in concrete.
   4. Viscosity modifier for enhancement of self-consolidating concrete or for workability.

2.5 MIX DESIGN

A. A. Selection of Cement: ASTM C 150 or C 1157.
   1. For sulfate resistance, use Type V Portland cement, or Type II with Class F fly ash. Class F fly ash may be used as an addition to Type V Portland cement.
   2. Do not use fly ash with Type IP(MS) or Type III Portland cement.
B. Selection of Aggregates.
   1. Maximum Particle Size:
      a. 1/5 of narrowest dimension between forms.
      b. 1/3 of depth of slab.
      c. 3/4 of minimum clear spacing between reinforcing bars.
   2. Gradation: ASTM C 33.
      a. Coarse Aggregate: Choose from the following grades. Gradations are based upon percent of material passing sieve by weight.

	Grade			
Sieve Size	357 (2”)	467 (1.5”)	57 (1”)	67 (3/4”)
2-1/2”	100	--	--	--
2 Inch	95 - 100	100	--	--
1-1/2”	--	95 – 100	100	--
1”	35 – 20	--	95 – 100	100
3/4"	--	35 – 70	--	90 – 100
1/2"	10 – 30	--	25- 60	--
3/8”	--	10 – 30	--	20 – 55
No. 4	0 – 5	0 – 5	0 – 10	0 – 10

b. Fine Aggregate:

Sieve Size	Percent Passing (by Weight)
3/8”	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

c. Silts and Clays: The amount of material smaller than the No. 200 sieve in any combined gradation sample is limited to the following percentages by weight of the combined sample.

1.1.75 percent maximum for concrete subject to abrasion.

2.3.0 percent maximum for all other concrete.

C. Selection of Pozzolan:
   1. General: If a blended aggregate passes an unmodified ASTM C 1293 test, use of a pozzolan is CONTRACTOR’s choice, otherwise select a pozzolan (or blended cement, or both) and determine the effective dosage to meet one of the following tests.
      a. ASTM C 1567. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.
      b. ASTM C 441. The expansion of a test mixture at 56 days is less than or equal to a control mixture prepared with cement with equivalent alkalis between 0.5 and 0.6 percent.
   2. Fly Ash (Class F): Allowed as a cement replacement under the following conditions.
      a. Before replacement is made, use the minimum cement content in the design formula to establish the water/cement ratio.
      b. Replace up to 20 percent of the cement by weight on a minimum basis of 1 part fly ash to 1 part cement.
      c. Submit to ENGINEER a quality history of the fly ash identifying a minimum of 20 of the most current ASTM C 618 analysis.
   3. Natural Pozzolan (Class N): Allowed as a cement replacement if the 14 day expansion test (ASTM C 1567) with job aggregates, job cement and natural pozzolan does not exceed the 14 day expansion test of job aggregates, job cement and Class F fly ash.
   4. Silica Fume: Allowed as a cement replacement if replacement of hydraulic cement on a 1 part silica fume to 1 part cement does not exceed 10 percent, and water/cement ratio is established before cement is replaced with silica fume.

D. Selection of Fiber Reinforcement: The basis for determining material proportions of fiber-reinforced concrete is the Supplier’s responsibility per ASTM C 1116 subject to mix property requirements of this Section. Unless specified otherwise provide synthetic fibers.

E. Selection of Mix Properties: Select and proportion mix to produce appropriate strength, durability and workability. Use ACI 211.1, 211.2, or 211.3, and meet the following properties and limitations.

Table 3 – Mix Properties and Limitations				
Properties	Test Method	Class		
		2000	3000	4000
Compressive Strength (fc') at 28 days, psi, minimum	ASTM C 39	2000	3000	4000
Compressive Strength at 7 days, psi, (for reference only)	ASTM C 39	1340	2010	2680
Average Strength, psi (fcr)	ACI 214	(a)	(a)	(a)
Cement content, bags,	--	4.5	5.5	6.5

Table 3 – Mix Properties and Limitations					
Properties		Test Method	Class		
			2000	3000	4000
Minimum (b)					
Water-cement ratio (by weight), maximum (d)		ACI 318	(c)	(c)	0.44
Entrained air, percent (based upon aggregate size) (e)	2" 1-1/2" 1" 3/4"	ASTM C 231	3.0 to 6.0 " " "	4.5 to 7.5 " " "	4.0 to 7.0 4.5 to 7.5 5.0 to 7.5 5.0 to 7.5
Slump		ASTM C 143	(c)	(c)	(c)

NOTES

The amount by which average strength (fcr) exceeds compressive strength (fc') is based upon statistical assurance that no more than 1 test in 100 tests will fall below compressive strength (fc').

(b) Unless allowed otherwise by ENGINEER.

(c) Specific to exposure conditions and finishing need.

(d) Before pozzolan substitution.

(e) Comply with ACI 211.1 if air content is changed.

(f) 1 bag of cement = 94 pounds.

1. Cold Weather: ACI 306. Unless allowed otherwise by ENGINEER, increase cement content in the mix design by 1 bag between October 1 and March 1, i.e. 5.5 becomes 6.5, or 6.5 becomes 7.5, etc.
2. Hot Weather: ACI 305. Reduce temperature of mix ingredients or use an admixture appropriate to job conditions when air temperature is over 75 deg. F.
3. Concrete Deposited Under Water: Increase cement content 1 bag per cubic yard greater than the design required for concrete placed above water or use viscosity modifying admixture.

2.6 SOURCE QUALITY CONTROL

A. Once selected, do not change source quality control sampling point.

B. Aggregate:
   1. Soundness, ASTM C 88.
   2. Alkali-silica Reactivity: ASTM C 289, C 1567, C 227 and C 1293.
   3. Petrographically examine fine and coarse aggregate sources once every 3 years per ASTM C 295.

C. Concrete Mix: Obtain samples per ASTM C 172 and run the following tests.
    1. Compressive strength, ASTM C 39.
    2. Unit weight, ASTM C 138.
    3. Slump, ASTM C 143
    4. Air, ASTM C 231.
    5. Temperature, ASTM C 1064.
D. Concrete Quality Charts: Comply with ACI 214 and ACI 301. Plot new results and identify trends on quality control charts that comply in form to ASTM STP 15-C. Show the Specified Strength (f_c'), the required Average Strength (f_{cr}), and the compressive strength versus date of Sample.
E. Equipment: Certify through the services of a professional engineer that trucks and plant equipment comply with the requirements of the National Ready Mixed Concrete Association. Do so at least every 2 years.
    1. Transit Trucks: Equip transit trucks with plates indicating total volume, agitating volume and mix volume.
    2. Weights and Measures: Comply with regulatory requirements of State of Utah.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Placement, Section 03 30 10.
B. Pavement restoration, Section 33 05 25.
C. Driveways, sidewalks, curb, gutter, Section 32 13 16. D. Roadway pavement, Section 32 13 13.

3.2 FIELD QUALITY CONTROL

A. Truck Mixed Concrete (Dry Batch): ASTM C 94.
    1. Truck Mixer: Fill drum no more than 63 percent of the gross drum volume and no less than 2 cubic yards. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm).
    2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).
B. Mixing Plant: ASTM C 94.
    1. Use option C and requirements in this section for preparing ready-mixed concrete.
    2. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
    3. Mixing time must exceed 80 seconds after adding air entrainment admixture.
C. Hand Mixing:
    1. Do not hand mix batches larger than 0.5 cubic yard.
    2. Hand mix only on a watertight platform.
    3. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency prior to adding water.

END OF SECTION

SECTION 03 3005

SITE CONCRETE TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Concrete sampling and testing requirements.

1.2 REFERENCES
A. ACI 318: Building Code Requirements for Reinforced Concrete.
B. ASTM C 31: Standard Practice for Making and Curing Concrete Test Specimens in the Field.
C. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
D. ASTM C 42: Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
E. ASTM C 78: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
F. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
G. ASTM C 138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
H. ASTM C 143: Standard Test Method for Slump of Portland Cement Concrete.
I. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.
J. ASTM C 173: Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
K. ASTM C 231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
L. ASTM C 567: Standard Test Method for Unit Weight of Structural Lightweight Concrete.
M. ASTM C 1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
N. ASTM D 1077: Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

1.3 SUBMITTALS
A. Concrete Supplier: If requested, submit reports and material certificates verifying concrete quality control.
B. Laboratory: Promptly submit test data results for 7 and 28 day breaks to Supplier, CONTRACTOR and ENGINEER.

1.4 QUALITY ASSURANCE
A. Provide an ASTM D 1077 compliant and ACI certified laboratory. B. Provide level I ACI certified field sampling technicians.

1.5 SITE CONDITIONS
A. Assist ENGINEER: Furnish labor to assist ENGINEER in obtaining and handling acceptance samples at site or sources.
B. Store and Cure Test Specimens: Safely store and cure concrete test specimens and acceptance test specimens for first 24 hours.
    1. Follow ASTM C 31 in making and curing cylinders or beams at site. Do not move the cylinders or beams for the initial 16 hour cure period. Provide initial cure temperature as follows.
        a. 60 to 80 deg. F. for Class 4,000 or less.
        b. 68 to 78 deg. F. for Class 5,000 or greater.
    2. Equip storage device with an automatic 24 hour temperature recorder with an accuracy of plus or minus 2 deg. F.

3. Use water containing hydrated lime if water is to be in contact with cylinders or beams.
4. Ensure the device(s) can accommodate the required number of test cylinders or beams. Lack of capacity will cause the placement of concrete to cease.
5. Have the storage devices available at the point of placement at least 24 hours before placement.
6. A 24 hour test run may be required.

1.6 ACCEPTANCE

A. At the Site:
   1. Sampling: ASTM C 172. Reject non-complying batches until 2 consecutive batches are compliant then proceed in random batch testing for acceptance.

Table 1 – Concrete Mix				
Rate of Placement (Cubic Yard / Day)	Temperature	Air	Slump	Strength
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction	1	1	1	1
NOTES Sampled at discharge chute prior to placement, or at pumper hose after priming grout has been wasted.				

   2. Temperature, ASTM C 1064.
   3. Air content, ASTM C 231 or ASTM C 173 if lightweight aggregate is used.
   4. Slump, ASTM C 143.

B. At the Laboratory:
   1. Compressive strength, ASTM C 31.
   2. Flexure strength, ASTM C 78.

PART 2 - PRODUCTS – Not Used

PART 3 --EXECUTION

3.1 PRECAST PRODUCTS

A. Obtain composite Samples from different portions of the batch.
B. Make and cure concrete test specimens for acceptance, ASTM C 31.
C. Cure all precast products with water vapor or water.
D. Do not damage precast products by stripping forms or handling before the concrete reaches its specified strength.

3.2 CAST-IN-PLACE PRODUCTS

A. Concrete testing shall be arranged for by the project manager and paid for by the OWNER. Any retesting due to test failure shall be paid for by the CONTRACTOR. Test results to be provided to the Architect/Engineer, the CONTRACTOR.
B. Evaluation of test results:
   1. Concrete strength is considered satisfactory if averages of all sets of two consecutive strength test results equal or exceed the specified strength (f'c) and no individual strength test result falls below specified strength (f'c) by more than 400 psi.
   2. Other items tested are considered satisfactory if the test result falls within the specified

parameters (i.e. if air entrainment is within 1-1/4% of 6-1/4%).

C. Concrete Testing Requirements: (Require the testing agency to do the following)
    1. Respond to the CONTRACTOR's requests for testing in a timely manner. Report all test and inspection results to the project manager and the CONTRACTOR immediately, especially when there appears to be a problem.
    2. Review and/or test materials for compliance with specifications.
    3. Secure production samples of materials at plants or stock-piles during course of work and test for compliance with specifications.
    4. Perform strength testing of concrete with one strength test for each 50 CY, or fraction thereof, of each mix design of concrete placed in any one day. Each test shall include four cylinders (one to be broken at 7 days and two at 28 days).
    5. Determine compliance with water/cement ratio requirements through use of the slump test on each batch of concrete delivered. Specify required slump and acceptable variance for each design mix.
    6. Determine compliance with air content requirements by testing each batch of concrete delivered.
    7. Determine concrete temperature compliance by taking temperature reading on each batch of concrete delivered.
    8. Identify the location of placement of tested concrete in testing report.

D. Duties:
    1. Provide necessary testing services for qualification of proposed materials and mix designs.
    2. Materials and mix design submittals.
    3. Facilitate testing by advising testing agency in advance of operations requiring testing. Furnish labor to assist the testing agency in obtaining and handling samples at job site or sources of materials. Provide and maintain adequate facilities for safe storage and proper curing of concrete test specimens on site for first 24 hours.
    4. Responsible for testing costs and remedial work required as a result of failed tests.

E. Acceptance: If any test is below the specified strength shown, the concrete may be accepted at a reduced price. The price reduction shall apply to the amount of concrete represented by the strength test as follows:

PSI Below Specified Strength Specifications	Pay Factor
1-100	0.98
101-200	0.94
201-300	0.88
301-400	0.80

*Concrete with compressive strength of more than 400 psi below the required strength shall be evaluated by the project manager. The project manager may accept this concrete at a pay factor of 0.50, or require that it be replaced with acceptable material.

F. Obtaining Samples:
    1. Batch samples, ASTM C 172.
    2. Core samples, ASTM C 42.

G. Identify location of tests on test reports.

H. Compressive strength , ASTM C 39.
    1. Mold 4 test specimens, ASTM C 31.
    2. For each strength test perform slump, air, unit weight, and temperature test.
    3. Break 1 cylinder at 7 days and 3 cylinders at 28 days. The average strength of 3 cylinder breaks shall be considered the test result.
    4. If any one cylinder in a 28 day test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the cylinder. The average strength of the remaining cylinders shall be considered the test result.
    5. Strength: Four cylinders every 50 cubic yards

I. Tensile (flexural) strength, ASTM C 78.

1. Mold 4 test specimens, ASTM C 31.
2. For strength test perform slump, air, unit weight, and temperature test.
3. Break 1 beam at 7 days and 3 beams at 28 days. The average strength of the 3 beam breaks shall be considered the test result.
4. If any one beam in a 28 day test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the beam. The average strength of the remaining beams shall be considered the test result.
5. Strength: Four cylinders every 50 cubic yards

J. Aggregate, ASTM C 136 for fine and coarse aggregate.
K. Slump test, ASTM C 143.
   1. Slump: Test on each truck load.
L. Air Test:
   1. Normal weight concrete, ASTM C 231.
   2. Light weight concrete, ASTM C 173.
   3. Air entrainment: Test on every truck load.
M. Unit Weight:
   1. Normal weight concrete, ASTM C 138.
   2. Light weight concrete, ASTM C 567.
N. When requested, test in-place concrete by impact hammer, sonoscope, or other non-destructive device:
   1. To determine relative strengths in various locations in Work.
   2. To aid in evaluating concrete strength.
   3. To select areas to be cored.
   4. To verify quality control in the absence of control testing.

3.3 RETESTING DEFECTIVE CONCRETE

A. Testing shall be coordinated by the project manager and paid for by the OWNER. Additional testing due to test failure shall be specified to be at the expense of the CONTRACTOR.
B. If CONTRACTOR desires to do a re-test; a request to ENGINEER for retesting must be made within 35 days from time of concrete placement. No coring or retesting shall be done after 40 days have elapsed from the time of placement.
   1. Choose 3 random test locations and verify choice with ENGINEER. Obtain retest samples per ASTM C 42 and test compressive strength per ASTM C 39 or flexure strength per ASTM C 78.
   2. Establish a chain of custody for all test samples.
   3. If concrete placed in the Work will be dry under service condition, air dry cores for 7 days before tests. Unless otherwise specified, use air temperature 60 to 80 deg. F. and relative humidity less than
   1. 60 percent.
   4. If concrete placed in the Work will be more than superficially wet under service conditions, test cores after moisture conditioning (liquid or vapor water cure).
   5. If more than 1 core shows evidence of having been damaged before testing provide replacement cores, otherwise evaluation will be done on 2 or more core samples.
   6. Evaluate cores in accordance with ACI 318 requirements.
   7. If core tests are inconclusive, or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be used and evaluated in accordance with ACI 318 requirements.
C. Coat sides of core hole with concrete epoxy resin adhesive. Fill core holes with non-shrink concrete mortar. Match color and texture of surrounding concrete.
D. Within 40 days from time of placement publish the chain of custody record and the results of retesting.

END OF SECTION

SECTION 03 3010

SITE CONCRETE PLACEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete placement for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.2 REFERENCES

A. ACI 301: Specifications for Structural Concrete for Buildings.
B. ACI 305: Hot Weather Concreting.
C. ACI 306: Cold Weather Concreting.
D. ACI 309: Standard Practice for Consolidation of Concrete.
E. ASTM C 881: Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
F. ASTM C 1059: Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

1.3 SUBMITTALS

A. Batch Delivery Ticket: For each batch delivered to site, identify.
    1. Date and Project description.
    2. Producer and plant.
    3. Name of contractor.
    4. Serial number of ticket.
    5. Mix identification.
    6. Truck number and time dispatched.
    7. Volume of concrete.
    8. Type and amount of cement.
    9. Total water and water/cement ratio.
    10. Water added for receiver of concrete and receiver's initials.
    11. Admixture types.
    12. Separate weights of fine and coarse aggregate.
    13. Statement of whether batch is pre-mixed at plant or mixed in transit.
B. Record of Placed Concrete: Identify record date, location of pour, quantity, air temperature, and CONTRACTOR's quality control test samples taken.
C. Bonding Compound: Identify product name, type, and chemical analysis.

1.4 QUALITY ASSURANCE

A. Provide ACI certified finishers.
B. Remove and replace any placed concrete suffering hot or cold weather damage.
C. For control testing follow Section 03 30 05 requirements.

1.5 ACCEPTANCE

A. General:
    1. Price adjustment, Section 01 29 00. CONTRACTOR may request ENGINEER determine appropriate Modifications or payment adjustments to correct Defective Work.
    2. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. Concrete work that fails to meet any of the following requirements will be considered defective. Replace any Defective Work at no additional cost to the OWNER.
    1. Placement:
        a. Reinforcing steel size, quantity, strength, position, damage, or arrangement is not as specified or does not comply with code.
        b. Formwork differs from required dimensions or location in such a manner as to

reduce concrete's strength or load carrying capacity or physical esthetics.
c. Workmanship likely to result in deficient strength.

2. Finishing:
   a. Concrete exposed to view has defects that adversely affect appearance.
   b. Slab tolerances of Section 03 35 00 are not met.
3. Protection:
   a. Method of curing is not as specified.
   b. Inadequate protection of concrete during early stages of hardening and strength development from
      1) temperature extremes.
      2) rapid moisture loss.
   c. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete, Section 03 30 04. Class as indicated.
   1. For roadway cuts, Section 33 05 25.
B. Bonding compound, ASTM C 1059. Either polyvinyl acetate base or acrylic base latex.
   1. Use type I in areas not subject to high humidity or immersion in water with minimum bond strength of 400 psi.
   2. Use type II in areas subject to high humidity or immersion in water with minimum bond strength of 1250 psi.
C. Vapor retarder, 10 mil thick clear polyethylene sheet. Type recommended for below grade application.
D. Forms, Section 03 11 00.
E. Reinforcement, Section 03 20 00.
F. Coverings and curing compound, Section 03 39 00.
G. Shinkage compensating grout, Section 03 61 00.
H. Epoxy adhesive, Section 03 61 00.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify ENGINEER minimum 24 hours prior to commencement of concrete placement operations.
B. Do not allow construction loads to exceed structural capacity.
C. Clean previously placed concrete. Apply bonding compound per manufacturer's instructions.
D. At locations where new concrete is dowelled to existing work, drill, remove dust, insert and pack steel dowels with shrink compensating grout.

3.2 EXAMINATION

A. Verify items to be cast into concrete are accurately placed and held securely.
B. Verify slump, air content range, mix identity, and batch time on delivery ticket matches mix design.
C. Verify slab steel mats are supported by steel chairs, precast concrete blocks, or other slab bolsters. Do not pour if absent.

3.3 DELIVERY

A. Slump and Air Content: Keep slump and air content within the allowable range.
B. Placement Time:

Air Temperature	Time After Initial Batching
Less than 90 deg. F.	1–1/2 hours
Greater than 90 deg. F.	1–hour (without retarder)
Greater than 90 deg. F.	1–1/2 hours (with retarder)

*To increase time past 1-1/2 hours, a hydration stabilizer that is acceptable to Supplier may be used.

C. Tempering:
   1. Water may be added if all following conditions are met.
      a. The mix design water/cement ratio is not exceeded.
      b. The delivery ticket allows for addition of water based upon water/cement ratio.
      c. The amount of water added is accurately measured to within 1 gallon of the design addition.
      d. Water addition is followed by 3 minutes of mixing at mixing speed prior to discharge.
      e. Supplier and CONTRACTOR mutually agree on who is authorized to add water.
   2. Do not add water after 1 cubic yard of concrete has discharged from the delivery vehicle.

D. Super-plasticizer: Comply with manufacturer's requirements. If none, then as follows.
   1. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing the admixture to the concrete. Prior to discharge, mix for a minimum of 5 minutes at a drum rate not less than 12 rpm or more than 15 rpm.
   2. If added at plant; do not deliver to site unless batch delivery ticket displays water/cement ratio prior to super-plasticizer addition.

3.4 CONCRETE PLACEMENT

A. Materials - Specific requirements:
   1. Portland Cement: Use Type II (moderate) cement conforming to ASTM C 150 Low alkali for all on grade or below grade installations. Type I may be used in above grade concrete work with approval from engineer.
   2. Admixtures: Calcium Chloride shall not be used as an admixture.
   3. Air Entrainment: Specify 6-1/4% plus or minus 1-1/4%.
   4. Pozzolans: Replacement allowed up to 15% of cement with a 1.5 to 1 replacement ratio. Specify loss of ignition at less than 1% and water requirement not to exceed 100%.
   5. Synthetic fibrous reinforcement: Specify collated, fibrillated polypropylene with a mix ratio of 1.5 pounds of fiber to 1.0 cubic yards of concrete. To be used in all concrete specified in Section 02528.
   6. Curing and Sealing: Specify a combination curing and sealing compound to be used on all exposed concrete flatwork complying with the requirements of ASTM C 309 and AASHTO M 148. The compound shall be acrylic based with a minimum of 18 percent solids and a moisture loss of 0.031 grams per cubic centimeter maximum after 72 hours. Specify a two coat application occurring immediately after surface water dissipation and concrete finishing and at approx. 28 day from placement.

B. Concrete Strength: Specify a minimum allowable compressive strength (at 28 days from placement) and minimum cement content (bags per cubic yard at 94 lbs. per bag) as follows:
   1. Footings: 3,000 psi and 5.5 bags.
   2. All other conditions: 4,000 psi and 6.0 bags.

C. Concrete proportioning and mixing:
   1. Specify use of only one type and brand of cement from same mill, and one source of coarse and fine aggregate.
   2. Require accurate measurement of all water added to the mix with means for verification.
   3. The maximum allowable time between charging of materials in the mixing drum and placement on site is 90 minutes.
   4. Ready Mix Concrete: Require a computerized ticket with each batch to be delivered to the project manager that includes the following information:
      a. Name of ready-mix batch plant.
      b. Serial number of ticket.

c. Date and number of truck.
d. Name of CONTRACTOR.
e. Specific designation of job (name and location).
f. Volume of concrete (number of cubic yards).
g. Time batch was dispensed to truck.
h. Reading of revolution counter at first addition of water.
i. Signature or initials of ready-mix representative.
j. Type and brand of cement.
k. Amount of cement (can be indicated by weight or quantity).
l. Total water content by producer (can be indicated by weight or quantity).
m. Water added by receiver of concrete and his initials (can be indicated by weight or quantity).
n. Admixtures and amount of same.
o. Maximum size of aggregate.
p. Weights of fine and coarse aggregates.
q. Indication that all ingredients are as previously certified or approved.

D. Concrete Replacement Procedures:
1. Cold Weather
a. All procedures of ACI 306 "Recommended Practice for Cold Weather Concreting" shall be followed for all concrete construction. A concrete temperature of 50º to 60º F is desirable.
b. Heating of the concrete aggregate must be approved by engineer.
c. If freezing may occur during curing period, the concrete shall be protected by means of an insulating covering and/or heating to prevent freezing for a period of not less than 10 days after placing.
d. Submittals shall clearly show procedures for protecting concrete and subsurface. Equipment requirements shall be clearly specified. No combustion heating shall be allowed during the first 24 hours unless precautions are taken to prevent exposure to exhaust gases.
2. Hot Weather
a. All procedures of ACI 305 "Recommended Practices of Hot Weather Concreting" shall be followed for all concrete construction.
b. A concrete temperature of 50º to 60ºF. is desirable. Special measures must be taken to maintain aggregate and water temperature below 90 degrees Fahrenheit.
c. Special procedures for wetting forms, reinforcing steel, and supporting earth immediately prior to placing concrete should be given.
d. If the combination of air temperature, relative humidity and wind velocity causes a rate of evaporation approaching 0.2 lb./square foot per hour, precautions against plastic shrinkage are necessary.
e. Sprinkling is acceptable to keep concrete form temperatures down before concrete is placed.
f. Measures should be taken to maintain both concrete strength and air entrainment at higher temperatures. If additional water is required to maintain consistency, additional cement and air entrainment admixture should be required as needed.
3. Curing of concrete: Curing can be accomplished by water ponding, covering with saturated burlap or cotton mats, continuous sprinkling or by using an approved curing and sealing compound.
4. Concrete protection: Protect the concrete from freezing, oil, grease, staining or defacement of any kind until it has set. If such protection is not provided, Removing and replacing the slab is at CONTRACTOR's expense.

E. Concrete Quality: Specify parameters for acceptance of concrete work and describe measures to be taken when concrete does not meet all parameters such as repair or removal and replacement. Such parameters should include appearance and strength requirements.

3.5 CAST-IN-PLACE CONCRETE

A. Job Conditions:

1. Do not place concrete on frozen ground.
2. Do not place concrete during rain, sleet or snow unless adequate protection has been provided and authorization has been received from engineer.
3. Do not allow rain water to increase mixing water or to damage the concrete finish.

B. Project manager inspections: Must receive project manager's approval of all dimensions, steel location, condition of forms, and placing equipment at least four (4) working hours prior to placing any concrete.

C. Adding water to concrete:
   1. Do not add water to concrete without the approval of the project manager.
   2. Account for all water added to the concrete mix.
   3. Do not add any water to ready-mix concrete drum unless the following conditions are satisfied:
      a. Water is added only while the concrete is mixing in the drum.
      b. The mixing truck is equipped with a revolution counter and a working water meter.
      c. The delivery ticket provides all information required so that the total amount of water added to the mix can be determined.

D. Joints and embedded items:
   1. Construction Joints:
      a. Locate joints so as to least impair the strength of the structure. Joints shall be perpendicular to main reinforcement. Continue all reinforcement across joints.
      b. Provide longitudinal keys at least 1-1/2 inch deep in all joints in walls and between walls and slabs or footings.
   2. Expansion Joints:
      a. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints (except dowels in floors bonded on only one side of joints).
      b. Refer to Section 02528 for expansion joint requirements in exterior flatwork.
   3. Other embedded items: All sleeves, inserts, anchors and embedded items required for adjoining work or for its support be placed prior to concreting.

E. Placing and finishing formed concrete:
   1. Preparation before placing:
      a. Sprinkle semi-porous subgrades sufficiently to eliminate suction of moisture from mix. Porous subgrades shall be sealed prior to concreting.
      b. Project manager review and approve formwork, reinforcement, etc. prior to commencement of concreting.
   2. Conveying:
      a. Conveying equipment conform to ASTM C 94.
      b. Handle the concrete from the mixer to the place of final deposit as rapidly as practicable.
   3. Placing Concrete:
      a. Place concrete continuously, or in layers (24 inches thick or less) such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.
      b. If a section cannot be placed continuously, construction joints shall be located as approved (30 foot on center max.).
   4. Segregation:
      a. Concrete shall not be allowed to free fall over six (6) feet.
      b. Concrete be deposited as near as possible to its final position to avoid segregation due to rehandling or flowing.
   5. Consolidation:
      a. All concrete shall be consolidated by vibration. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively.
      b. Use of vibrators to transport concrete within forms shall not be allowed.
      c. Vibrators shall be inserted and withdrawn at points approx. 18 inches apart. The duration at each insertion point shall be sufficient to consolidate concrete without

segregation (generally 5 to 15 seconds).
    d. A spare working vibrator shall be kept close at hand during all concrete placing operations.
    e. Do not vibrate forms of steel.
6. Bonding:
    a. Apply a bonding adhesive when necessary to enhance the bond between hardened concrete and new concrete if specified by ENGINEER.
    b. Clean and dampen hardened concrete surfaces to receive fresh concrete.
7. Perform the following operations:
    a. Repair of defective surface areas: Surface defects shall be repaired immediately after form removal.
    b. All honey-combed and other defective concrete shall be removed down to sound concrete. The edges of the repair area shall be perpendicular to the surface area and slightly undercut. No featheredge will be permitted.

F. Placing and finishing slabs:
1. Preparation of subgrade for slabs on grade: Keep subgrade moist but do not allow standing water, mud or soft spots. If temperature where concrete is to be placed is below 50 F, enclose and heat to maintain temperature above 50 F long enough to remove frost from subgrade.
2. Concrete mixing and placing with finishing: Spread and finish concrete before bleeding water has an opportunity to collect on the surface.
3. Locate joints in slabs as indicated: Schedule saw cutting with the set of the concrete to eliminate raveling during sawing and before shrinkage cracks develop.

G. Curing and Protection: Begin curing operations immediately after placement. Protect concrete from premature drying, excessively hot or cold temperatures, mechanical injury or vandalism.

H. Guarantee: CONTRACTOR shall furnish the University with a written two (2) year guarantee for concrete materials and workmanship, including material and labor for total removal and replacement. The CONTRACTOR shall immediately place in satisfactory condition in every particular, any such guaranteed work upon written notice from the project manager and make good all damage to the buildings and grounds caused by said work, without cost to the University. All guarantees shall start from the date of written substantial completion.

3.6 CONCRETE CLEANUP

A. Pay particular attention to project cleanup.

B. Daily cleanup, weekly cleanup and job completion cleanup responsibilities to remove garbage, rubbish and unused materials are required.

C. Project manager approval is required for final project cleanup.

D. Particular attention shall be placed on cleanup of areas subject to daily University activity. Construction activity shall be coordinated with project manager to reduce congestion or interruption of University activity.

3.7 CONCRETE RESURFACING

A. Resurfacing Requirements:
1. Density of 96% of adjacent soil.
2. Saw-cut all existing surfaces at excavations to an absolute minimum width necessary for construction activity.
3. Types of roadway surfaces shall be shown for gravel, bituminous and concrete surfaces. Gravel surfaces shall match existing gravel thickness. New asphalt thickness shall match existing thickness plus 1 inch, but must be a minimum of 3 inches and maximum of 6 inches. Concrete surfaces shall match existing thickness.

3.8 CONCRETE REHABILITATION

A. Requirements for repair of existing concrete, patching or repair of damaged concrete by use of epoxy resin or concrete ingredient compounds. Information shall include cleaning of concrete surfaces; application of bonding agent and cement paste filler; and application of epoxy adhesive and fillers.

B. Materials:
    1. Epoxy Resins: Bond Strength - 2700 psi - ASTM C882. Tensile Strength - 6600 psi - ASTM C638. Elongation - 2% at 7-day at 70 degrees F. - ASTM C638. Compressive Strength - 6500 psi - ASTM D695.
    2. Bonding Agent: Polyvinyl Acetate.
    3. Portland Cement: ASTM 150, Gray color.
    4. Sand: Clean, uniformly graded, ASTM C33 or ASTM C404.
    5. Cleaning agent: Commercial muriatic acid.

3.9 JOINTS AND JOINT SEALING
A. Steel edging and jointing tools are acceptable. Preferred are magnesium, aluminum or wood tools
B. Pavement joint sealing, Section 32 13 73.

3.10 CONSOLIDATION
A. Keep spare vibrator available during concrete placement operations, ACI 309.

3.11 FINISHING
A. Section 03 35 00 and as follows.

Table 1 – Finishes

Type of work	Type of finish
Sidewalks, garage floors, ramps, exterior concrete	Broom or belt finish
Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials	Non-slip finish
Surfaces intended to receive bonded applied cementitious applications	Scratched finish
Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces that are	Floated finish
Floors and roof surfaces that are floors intended as walking surfaces or to receive	Troweled
Unpainted concrete surfaces not exposed to public view	Rough as-cast form finish
Unpainted concrete surfaces exposed to public view	Smooth as-cast form finish
Concrete surfaces to receive paint or	Grout cleaned finish

3.12 CURING
A. Section 03 39 00. Use a membrane forming compound unless specified otherwise.

3.13 PROTECTION AND REPAIR
A. Protection: Section 01 66 00.
    1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, graffiti, and mechanical injury.
    2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
B. Repair:
    1. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
    2. Structural analysis and additional testing may be required at no additional cost to OWNER when the strength of a structure is considered potentially deficient.

3. To patch imperfections refer to Section 03 35 00 requirements.
4. Remove graffiti and mechanical injury.

END OF SECTION

SECTION 03 3500

SITE CONCRETE FINISHING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Finishing interior and exterior concrete surfaces.

1.2 REFERENCES
A. ACI 303: Guide to Cast-in-Place Architectural Concrete Practice.

1.3 SUBMITTALS
A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 PROJECT CONDITIONS
A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protection as required and remove from site at completion of Work.

PART 2- PRODUCTS

2.1 MATERIALS
A. Masonry Mortar and Grout: Section 04 05 16.
B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.
C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing materials. Use such compounds per manufacturer's recommendations.
D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than 2 pounds fluosilicate per gallon and does not interfere with adhesives and bonding.

PART 3- EXECUTION

3.1 PREPARATION
A. Examine the areas and conditions under which work of this section will be performed.
B. Correct conditions detrimental to timely and proper finishing. C. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISHING HORIZONTAL SLABS
A. Do not apply water (i.e. sprinkle) to any surface of concrete when finishing slabs.
B. Edges and Joints: Tools may be made out of steel. Preferred is wood, aluminum or magnesium.
C. Tolerances:
    1. Class A: 1 in 1000.
    2. Class B: 1 in 500.
    3. Class C: 1 in 250.
D. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating.
    1. Begin floating when water sheen has disappeared and surface has sufficient stiffness.
    2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at 2 or more different angles.
    3. Cut down high spots and fill low spots to the required tolerance.

4. Refloat slab immediately to a uniform sandy texture.

E. Trowel Finish:
   1. Do not use steel trowel or a power trowel on exterior concrete or on concrete that contains more than 3 percent air.
   2. First troweling shall produce smooth surface relatively free of defects but which may still show some trowel marks.
   3. Second troweling after surface has stiffened shall make finished surface essentially free of trowel marks, uniform in texture and appearance.
   4. On surfaces intended to support floor coverings, grind off defects that would show through floor covering.

F. Broom or Belt Finish: Sweep surface with brushes, rakes, tines or burlap belt before final set.

G. "Dry Shake" Finish: Give the surface a floated finish. Evenly apply approximately 2/3 of a blended unsegregated material.
   1. Begin floating immediately after application of first "dry shake".
   2. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.
   3. Make second application heavier in any areas not sufficiently covered by first application.
   4. Immediately follow with second floating.
   5. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.

H. Non-slip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

I. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone.
   1. Embed aggregate into surface by light tamping.
   2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.
   3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
   4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
   5. Continue until aggregate is uniformly exposed.
   6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.

J. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrices terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface per manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.3 FINISHING FORMED SURFACES

A. General:
   1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.
   2. Revise the finishes as needed to secure approval.

B. As-Cast Form Finish:
   1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.
   2. Smooth: Patch tie holes and defects and remove fins completely.
      a. When surface texture is impaired and form joints misaligned, grind, bush-hammer, or correct affected concrete.
      b. Slurry grout areas evidencing minor mortar Leakage to match adjacent concrete.
      c. Repair major mortar Leakage as a defective area.
      d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.

C. Rubbed Finish:
   1. Smooth Rubbed: Remove forms and perform necessary patching as soon after

placement as possible.
    a. Finish newly hardened concrete no later than 24 hours following form removal.
    b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.
2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible.
    a. Wet surface of concrete sufficiently to prevent absorption of water from grout.
    b. Apply grout uniformly.
    c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.
    d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.
    e. After surface whitens from drying, rub vigorously with clean burlap.
    f. Keep damp for at least 36 hours after final rubbing.
3. Cork Floated: Remove forms within 2 to 3 days of placement where possible.
    a. Remove ties.
    b. Remove all burrs and fins.
    c. Dampen wall surface.
    d. Apply mortar with firm rubber float or with trowel, filling all surface voids.
    e. Compress mortar into voids.
    f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
    g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish:
1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.
2. Float to texture that is reasonably consistent with formed surfaces.
3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.

E. Blasted Finish:
1. Perform abrasive blasting within 24 to 72 hours after casting.
2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.
3. Reapply curing protection after blast finishing

F. Architectural Finish: Refer to ACI 303.
1. Tooled Finish:
    a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.
    b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish:
1. Repair defective areas.
    a. Remove honeycomb and defective concrete to sound concrete.
    b. Make edges perpendicular to surface or slightly undercut.
    c. Featheredges are not permitted.
    d. Dampen area to be patched and at least 6 inches surrounding it to prevent absorption of patching mortar water.
    e. Prepare bonding grout.
    f. Mix to consistency of thick cream.
    g. Brush into surface.
2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.
3. Make any patches in concrete to closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry.
    a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.
    b. Use a minimum amount of mixing water.
    c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable

consistency.

d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.

4. After surface water has evaporated from patch area, brush bond coat into surface.
   a. When bond coat begins to lose water sheen, apply patching mortar.
   b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.
   c. Leave undisturbed for at least 1 hour before final finish.
   d. Keep patched area damp for 72 hours or apply curing compound.
   e. Do not use metal tools in finishing an exposed patch.
5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.
6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate.
   a. Outer 1 inch of patch shall contain same aggregates as surrounding concrete.
   b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.
   c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

END OF SECTION

SECTION 03 3900

SITE CONCRETE CURING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Concrete curing requirements.

1.2 REFERENCES
A. ACI 301: Specifications for Structural Concrete for Buildings
B. ACI 305: Hot Weather Concreting.
C. ACI 306: Cold Weather Concreting
D. ASTM C 171: Standard Specification for Sheet Materials for Curing Concrete.
E. ASTM C 1315: Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 SUBMITTALS
A. Curing agent data sheet.
B. Curing plan. Describe estimated cure quantity and procedure.
C. Manufacturer certificates, Section 01 33 00 that shows product meets performance criteria.
D. Manufacturer's recommended installation procedures which, when accepted by ENGINEER, will become the basis for accepting or rejecting installed product.

1.4 QUALITY ASSURANCE
A. Use workers knowledgeable of ACI 301, 305, 306.

1.5 PRODUCT HANDLING
A. Protect materials of this section before, during, and after installation.
B. Protect the work and materials of other trades.
C. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

1.6 WEATHER LIMITATIONS
A. Above 75 deg. F., ACI 305
B. Below 55 deg. F., ACI 306.

PART 2 - PRODUCTS

2.1 COVERS
A. Water or Fog-spay: Clean, non-staining and non-detrimental to concrete.
B. Sheet Coverings: White waterproof paper, polyethylene film, or polyethylene coated burlap sheet complying with ASTM C 171.
C. Mat Coverings: Clean roll goods of cotton or burlap fabric. D. Insulating Coverings: Non-staining curing blankets.

2.2 MEMBRANE FORMING COMPOUND
A. Material.
    1. Styrene-acrylic.
    2. Styrene-butadiene.
    3. Alpha- methylstyrene.
B. Performance Criteria: ASTM C 1315 compound.
    1. Type ID Class A (clear with fugitive dye), or
    2. Type II Class A or B (white pigmented).
C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not use membrane forming curing compound on surfaces that are to receive hardeners.
B. Commence curing operation within 20 minutes after finishing.
C. Do not allow vehicular traffic on newly paved areas until concrete has reached 90% of design concrete strength.

3.2 APPLICATION – COVERS

A. Water: Apply water-fog spray or ponding.
B. Absorptive Mat: Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers. Thoroughly saturate with water and keep continuously wet.
C. Moisture-Retaining Sheet: Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss. Repair any holes or tears during curing period.
D. Formed Surface Curing: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If forms are removed prior to curing completion, applying cure film or penetrant or use methods indicated above, as applicable.

3.3 APPLICATION – MEMBRANE FORMING COMPOUND

A. Apply coating continuously and uniformly. Follow manufacturer's recommendations
B. Protect continuity of film coatings and repair damage during cure period.
C. If forms are removed before expiration of cure period, apply coating to unprotected areas.

3.4 CONCRETE CURE TEMPERATURE

A. During cure period, eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete.

3.5 SCHEDULE

A. Concrete Exposed to Potable Water (as in Water Storage reservoirs):
    1. Moisture cover curing, or
    2. Acrylic cure, or
    3. Styreen acrylic silane co-polymer cure.

END OF SECTION

SECTION 03 40 00

PRECAST CONCRETE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Pre-cast concrete, complete with required connecting and supporting devices.

1.2 **REFERENCES**

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete. This reference standard includes ASTM material standards.

B. **ASTM Standards**:

A36: Structural Steel.

C478 Precast Reinforced Concrete Manhole Sections.

C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C858 Underground Precast Concrete Utility Structures. C891 Installation of Underground Precast Concrete Utility Structures.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

D. **PCI Standards**:

Design Handbook.

MNL-116 Quality Control and Assurance for Plant Production of Prestressed Concrete.

MNL-117 Quality Control and Assurance for Plant Production of Architectural Precast Concrete.

1.3 **DESIGN CRITERIA**

A. Design structural precast concrete units, ACI 318 and PCI design handbook.

B. Design utility precast units, ASTM C857 and C858.

C. Under direct supervision of a design professional who is fully experienced in design of units.

D. Design units to support required stripping and handling loads, and live, dead and construction loads.

E. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.4 **SHOP DRAWINGS**

A. Prepare Shop Drawings under seal of a licensed design professional.

B. Submit Shop Drawings, Section 01 33 00.

C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.

D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.5 **QUALITY ASSURANCE**

A. Manufacturer:
   1. Prestressed: PCI certified.
   2. Precast Concrete Units: PCI or NPCA certified
   3. Precast Utility Structures and Pipe: ACPA certified.

B. Transporter: Acceptable to manufacturer.

C. Erector:
   1. Prestressed: PCI certified.
   2. Precast: Has five (5) years minimum experience in erecting precast units.

D. Welders: Certified, AWS D1.1 and AWS D1.4.

1.6 **DELIVERY, STORAGE AND HANDLING**

A. Handle precast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.

C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, nonstaining, and will not inhibit uniform curing of exposed surfaces.

D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.

E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Above Ground: 5000 psi minimum, Section 03 30 04 and ACI 318.

B. Underground: Class 4000 minimum, Section 03 30 04 and ASTM C478 or ASTM C858.

2.2 **ACCESSORIES**

A. Connecting and Supporting Devices: Steel, ASTM A36.

B. Bolts, Nuts, and Washers: High-strength steel. Section 05 05 23.

C. Reinforcement: Grade 60 billet steel bars, Section 03 20 00 plain finish

2.3 **FABRICATION**

A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to ENGINEER.

B. Use molds which are rigid and constructed of material that will result in uniform finished products.

C. If self consolidating concrete is NOT used, vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.

D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts and accessories.

E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored and property located.

F. Ensure finished surfaces of precast structural units are uniform.

G. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

2.4 **DESIGN DEVIATIONS**

A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.

B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a licensed design professional.

2.5 **OPENINGS**

A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.6 **FINISHES**

A. General: Required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, provide Standard Finish.

B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spall are acceptable if approved. Major or unsightly imperfections, honeycomb or structural defects are not acceptable.

C. Commercial Finish: Produced in forms such as plywood or lumber that impart texture to concrete. Remove fins and large projections. Fill holes over 3/8 inch. Make faces true and well defined. Correct exposed ragged edges by rubbing or grinding.

D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.

E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch.

F. Special Finishes: Sandblasting, acid washing, retarders or form liners as approved by ENGINEER. Special finishes require submittal of two 12 x 12 inch Samples showing a representative color and texture to be used.

G. Painted Finishes: On concrete to be painted, use a form release agent acceptable to the paint manufacturer.

2.7 **REPAIR**

A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.8 **ALLOWABLE TOLERANCES**

A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as indicated.

B. End Squareness: 1/2 inch maximum.

C. Blockouts: 1 inch of centerline location indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Do not install precast units until concrete has attained its design compressive strength.

B. Install members plumb, level, and in alignment within PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.

C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

D. Install underground utility precast units per ASTM C891.

3.2 **PERFORMANCE REQUIREMENTS**

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. Rejection: Units may be rejected for any one of the following:
   1. Exceeding specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces which develops surface deficiencies.
   4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

END OF SECTION

SECTION 03 61 00

CEMENTITIOUS GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-mixed non-metallic shrinkage resistant grout, pre-mixed waterstop hydraulic cement grout, epoxy grout, and Portland cement grout:

1. Grout for leveling beds of structural steel plates.
2. Sealing of joints and gaps between piping and structures.
3. Sealing of joints between construction components.

1.2 REFERENCES

A. **ASTM Standards**:

C109 Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).

C144 Aggregate for Masonry Mortar. C150 Portland Cement.

C190 Tensile Strength of Hydraulic Cement Mortars. C207 Hydrated Lime for Masonry Purposes.

C472 Physical Testing of Gypsum Plasters and Gypsum Concrete.

C595 Blended Hydraulic Cements.

C881 Epoxy - Resin - Base Bonding Systems for Concrete.

C1090 Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.

C1107 Packaged Dry Hydraulic Cement (Non-Shrink). C1157 Blended Hydraulic Cement.

D570 Water Absorption of Plastics. D638 Tensile Properties of Plastics.

D695 Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Grout mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits Project requirements.

B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

A. Cement:
   1. Portland: Natural color Type II (normal) or Type IIA (air entrained), ASTM C150.
   2. Blended: ASTM C595 or C1157.

B. Lime: Type S, hydrated, ASTM C207.

C. Water: Clean, non-staining, non-detrimental.

D. Aggregate: Standard masonry type, ASTM C144.

2.2 PORTLAND CEMENT GROUT

A. Proportions by Volume: One part Portland cement, and sand equal to 2-1/2 to three times sum of volumes of cement and lime.

B. Mix thoroughly with water to form a stiff workable plastic putty.

C. Compressive Strength: 2800 psi in 28 days, ASTM C109.

2.3 GYPSUM PLASTER GROUT

A. Premixed, prepackaged, wood fiber gypsum plaster with an ASTM C472 minimum average dry compressive strength of 2000 psi in 28 days.

B. Mix with water per manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.4 CEMENT BASED SHRINKAGE RESISTANT GROUT

A. Grade B or Grade C: ASTM C1107. Premixed, non-metallic, non- gaseous product at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through flow cone after slight agitation, in temperatures of 40 deg F to 90 deg F

B. Bleeding: None.

C. Compressive Strength: 6500 to 9000 psi in 28 days, ASTM C109.

D. Non-shrink percentage: 0.5 percent, ASTM C1090.

2.5 EPOXY ADHESIVE GROUT

A. Two component material, ASTM C881. Suitable for use on dry or damp surfaces, 100 percent solids, high modulus, moisture insensitive:
   1. Tensile Strength: 5000 psi minimum in 14 days, ASTM D638.
   2. Tensile Elongation: Two (2) percent minimum, ASTM D638.
   3. Compressive Strength: 6500 psi minimum in 24 hours and 70 deg F, 12,500 psi in 28 days and 70 deg F , ASTM D695.
   4. Water Absorption: One percent maximum, ASTM D570.
   5. Bond Strength:

a. Direct Shear: 400 psi.

b. Direct Tension: 250 psi.

c. Beam Break: 800 psi.

6. Pot Life: Five minutes maximum at 70 deg F

2.6 **BONDING GROUT**

A. Of approximately one part cement to one part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.7 **PNEUMATICALLY PLACED PLASTER ("GUNITE" OR "SHOTCRETE")**

A. Materials: Portland cement, lime, water and sand.

B. Compressive Strength: 2800 psi in 28 days, ASTM C109.

C. Proportioning: One part cement to not more than five parts sand.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Fill joints, voids, and pockets, completely.

B. Comply with manufacturer's instructions and UBC Chapter 47.

C. Finish surfaces exposed to view smooth.

D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than 25 percent of the total sand in any batch.

END OF SECTION

SECTION 05 5600

METAL CASTINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Castings for grates, frames and covers for Manholes, catch basins, tree wells, monument boxes, water meters, etc.

1.2 REFERENCES
A. ASTM A 27: Standard Specification for Steel Castings, Carbon, for General Application.
B. ASTM A 48: Standard Specification for Gray Iron Castings.
C. ASTM A 148: Standard Specification for Steel Castings, High-Strength, for Structural Purposes.
D. ASTM B 22: Standard Specification for Bronze Castings For Bridges and Turntables.
E. ASTM B 584: Standard Specification for Copper Alloy Sand Castings For General Applications.
F. ASTM D 1187: Standard Specification for Asphalt-Base Emulsion for Use as Protective Coatings for Metal.
G. ASTM E 10: Standard Test Method for Brinell Hardness of Metallic Materials.

1.3 SUBMITTALS
A. Submit shop drawings; Section 01 33 00.
B. Submit manufacturer's affidavit certifying materials comply with Part 2 requirements. (X-ray certification mandatory).

1.4 QUALITY ASSURANCE
A. Make castings true to pattern in form and dimension and free from defects that would affect the service value of the casting.
B. Repair minor defects that do not impair the strength of a casting.
C. Reject castings that show injurious defects revealed by X-ray or machining operations.

1.5 PRODUCT DELIVERY, HANDLING AND STORAGE
A. Deliver and handle castings and gratings to prevent warping, rusting and damage.
B. Store all items on flexible surface and protect items from adverse environmental conditions.

PART 2 - PRODUCTS

2.1 STEEL CASTINGS
A. High Strength Steel Castings For Structural Purposes: ASTM A 148, Grade 80-50, except that the steel shall contain not less than 0.60 percent of manganese and not less than 0.20 percent silicon.
B. Mild-to-Medium Carbon Steel Castings For General Applications: ASTM A 27 Grade 65-35 with a minimum Brinell hardness number of 130 when tested in accordance with ASTM E 10.

2.2 GRAY IRON CASTINGS
A. All castings not specifically classified below shall conform to the requirements of ASTM A 48, Class 30.
    1. Grate, frame and cover castings sets; ASTM A 48, Class 35.
    2. Railings, railing posts and wheel guards; ASTM A 48, Class 40.
    3. Rockers, rocker plate bearings and bearing plates for bridges; ASTM A 48, Class 50.

2.3 BRONZE CASTINGS
A. Expansion and Bearing Plates: ASTM B 22, Alloy C.
B. Ornamental Tablets, Railings, Miscellaneous Ornaments and Fixtures: ASTM B 584, Alloy 1B.

PART 3 - EXECUTION

3.1 PREPARATION

A. Fit bearing surfaces of flush fitting machined castings together firmly without rocking. ENGINEER reserves the right to reject rocking sets.
B. Ensure castings are boldly filleted at angles and the arises are sharp and true. Unless indicated otherwise all letters shall be heavily raised and spaced to secure a uniform and balanced effect over the entire area of the panel.
C. Before castings are removed from the foundry, ensure they are cleaned and the parting lines, gates, and risers are ground flush.
D. Ensure sets are coated in quality ASTM D 1187 asphalt paint unless galvanized or bronze sets are specified or required.

3.2 INSTALLATION

A. Furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of castings.
B. Adjust Street Fixture elevation; Section 33 05 14.
C. Install countersunk flat head screw security bolts flush with top of grate.

3.3 CLEANING

A. Clean all castings free of grease, dirt, burrs, etc.

END OF SECTION

SECTION 31 0510

BOUNDARY MARKERS AND SURVEY MONUMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Materials and procedures for installing boundary markers and survey monuments.

1.2 PERFORMANCE REQUIREMENTS
A. Identify the land surveyor who set the marker plates and reference marks.
B. For vertical control datum use Mean Sea Level datum adjusted by United States Coast and Geodetic Survey for the location of survey.
C. Vertical Accuracy: 3rd order.
D. Make all individual tape measurements to the nearest 0.01 of a foot, with tape corrections for temperature, sag, suspension, etc. noted on all field notes requiring such measurements.
E. Horizontal Accuracy:
    1. 1:10,000 minimum for urban areas.
    2. 1:20,000 minimum for metropolitan areas.

1.3 SUBMITTALS
A. Survey notes and drawings showing:
    1. All monuments found, set, reset, or replaced, describing their kind, size, and location and giving other data relating thereto.
    2. Lines of survey, concrete structures containing reference marks, types of marks installed, distances and angles from monument referenced.
    3. Witness monuments, basis of bearings, bearings, length of lines to monuments or corners witnessed and scale of drawing.
    4. Errors of closure and method of adjustment.
    5. Memorandum of oaths and certificates.
    6. Narrative describing purpose of survey.
    7. Any other data necessary for the interpretation of the various items and locations of the points, lines, and areas shown.
B. Copies of plats filed with the County Recorder.

1.4 QUALITY ASSURANCE
A. Use a land surveyor who complies with Utah licensing law and who is acceptable to the OWNER to supervise the setting or resetting of monuments and boundary markers.
B. Make surveys in conformance with the accepted practice of land surveying and comply with all pertinent Laws and Regulations of land survey regulatory agencies and authority having jurisdiction.

PART 2 - PRODUCTS

2.1 MONUMENT
A. Monument Post: Minimum 3 feet long, precast or cast-in-place concrete. Make exposed surface of finished monument posts uniform, even texture, and free of holes, cracks, and chipped edges.
B. Marker Plate: Brass or bronze or as indicated.

2.2 FRAME AND COVER
A. Asphalt coated, heavy duty, cast iron, Section 05 56 00.

2.3 LOT LINE WITNESS MARKER
A. Brass surveyor's tag or brass nail set in a lead filled hole in concrete.

2.4 REBAR CORNER MARKER
A. No. 5 rebar, at least 18 inches long with the top fitted with a nonferrous survey cap and stamped with land surveyor's registration number.

2.5 PIPE CORNER MARKERS

A. 1 inch internal diameter galvanized steel pipe at least 18 inches long, or
B. 2 inches internal diameter galvanized steel pipe at least 36 inches long.
C. Fit pipe with concrete or mortar plug, tagged with surveyor's license number.
D. Fix tag in concrete or mortar plug with a 1 inch minimum long bent brass brad.

2.6 FIELD NOTE PAPER

A. 20 pound bond paper minimum with format of documents acceptable to OWNER.

2.7 CONCRETE

A. Cast-in-place: Class 4000 minimum, Section 03 30 04 or
B. Precast: Class 5000 minimum, Section 03 40 00.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify utility locations, Section 01 31 13.
B. Excavation, Section 31 23 16.

3.2 HORIZONTAL CONTROL

A. Set base horizontal ground control upon a minimum of 2 United States Coast and Geodetic Survey triangulation stations or equivalent, and tie to the Lambert Conformal Conic Projection for Establishment of the State Plane Coordinate System with Local Datum Adjustment within the Project area.

3.3 BEARING BASE

A. Refer all directional measurements to one "bearing base". Actual measurements may be equated to bearings and linear measurements shown on any record (i.e., plats, official maps, descriptions, or approved field notes of lines resurveyed that are shown on such records used in the survey).

3.4 TIE TO EXISTING MONUMENTS

A. Tie into a monument which has State Plane Coordinates if the monument is within 1/2 mile of the proposed survey site or at a selected location.

3.5 CORNER MARKERS

A. Site Boundary: Install pipe corner markers.
B. Lot Boundary: Install rebar corner markers for lot corners. Do not use rebar where pipe corner markers are installed as a boundary marker and a corner marker.

3.6 LOT LINE WITNESS MARKER

A. Witness all lot lines by installing 1/2 inch surveyor tags in sidewalk. If sidewalk does not exist, install tags in curb or mass concrete.

3.7 MONUMENTS

A. Locate monument post so reference point falls within 1 inch diameter circle in the center of marker plate. Install marker plate in survey monument post before the concrete has acquired its initial set.
B. Compact backfill soil; Section 33 05 05 to a Modified Proctor Density of 95 percent or greater.
C. Set top of frames and covers 1/4 inch lower than Pavement surface. Recess marker plate a minimum of 4 inches below cover.
D. Install monument so frame and cover does not contact monument or marker plate.

3.8 DAMAGED MONUMENTS

A. Replace survey control monuments which are disturbed or destroyed by CONTRACTOR.
B. If OWNER allows replacement of project survey control monuments which are lost or destroyed, use a licensed land surveyor to re-establish control monuments based upon original survey control.

3.9 REFERENCE MARKS

A. Section 01 17 24.

END OF SECTION

SECTION 31 0513

COMMON FILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Common fill materials.

1.2 REFERENCES

A. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D 1883: Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

C. ASTM D 2487: Standard Test Method for Classification of Soils for Engineering Purposes.

D. ASTM D 2844: Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.

E. ASTM D 3282: Standard Practice for Classification of Soils and Soil- Aggregate Mixtures for Highway Construction Purposes.

F. ASTM D 3740: Standard Recommended Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 SUBMITTALS

A. Prior to delivering material to site, identify.

1. Name of Supplier and source, And.
2. Gradation of common fill material.

B. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material prior to delivery to site.

1.4 QUALITY ASSURANCE

A. Use a laboratory that follows and complies with Section 01 45 00 and ASTM D 3740.

B. Reject common fill products that do not meet requirements of this section.

C. Remove any product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 ACCEPTANCE

A. General:

1. Acceptance is by Lot. One Lot is one day's production.
2. Dispute resolution; Section 01 35 10.

B. Roadway Backfill: Sub-lot size is 5,000 tons.

PART 2 - PRODUCTS

2.1 BORROW

A. Classifications A-1-a through A-4, ASTM D 3282.

2.2 GRANULAR BORROW

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D 3282.

B. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.3 GRANULAR BACKFILL BORROW

A. Classification A-1, ASTM D 3282.

B. Well graded.

C. Particle size; 2 inch maximum.

D. Material meets design CBR-value (ASTM D 1883) or R value (ASTM D 2844) for suitability of source, not for project control testing.

2.4 RECYCLED FILL

A. Material: Pulverized portland cement concrete, pulverized asphalt pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet the requirements of this Section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 NATIVE

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate Proctor data (see Section 33 05 05).

2.6 CLAY

A. Classification CL, CL-ML, or ML, ASTM D 2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious materials.

C. Homogeneous, relatively uniform.

2.7 SAND

A. Friable river or bank aggregate, free of loam and organic matter.

1. Graded as follows.

Sieve	Percent Passing by Weight
3/8	100
100	1 – 10

2.8 GRAVEL

A. Material: Rock, stone, or other high quality mineral particle or combination.

B. Gradation: ASTM D 448 narrow band.

1. Sewer Rock.

Nominal Size	ASTM Size No.
3.5 to 1.5”	1
2.5 to 1.5”	2
2 to 1”	3
1.5 to 3/4”	4
1 to 1/2"	5

2. Pea Gravel.

Nominal Size	ASTM Size No.
3/4 to 3/8”	6
1/2 to No. 4	7
3/8 to No. 8	8
No. 4 to No. 16	9
No. 4 (screenings)	10

2.9 TOPSOIL

A. Chemical Characteristics:
   1. Acidity/alkalinity range: pH 5.5 to 7.7
   2. Soluble Salts: Less than 2.0 mmhos/cm.
   3. Sodium Absorption Ratio (SAR): less than 3.0
   4. Nitrogen (NO3N): 48 ppm minimum
   5. Phosphorus (P): 11 ppm minimum
   6. Potash (K): 130 ppm minimum
   7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:
   1. Fertile, loose, friable.
   2. Containing more than 2 percent organic matter.
   3. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.
   4. Composition.

Material	Percent Passing
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30

2.10 SOURCE QUALITY CONTROL

A. Verify gradation, ASTM C 136.

B. Select Samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Trenches, Section 33 05 20.

B. Structures or landscaping, Section 31 23 23.

C. Pavements, Section 32 05 10.

END OF SECTION

SECTION 31 1100

SITE CLEARING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Removal of trees, stumps, roots, and tree debris.
B. Clearing site of plant life, root systems and shrubs.
C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 REFERENCES
A. NAA: Pruning Standards for Shade Trees.
B. Utah Shade Tree Pruning Standards.

1.3 QUALITY ASSURANCE
A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 SITE CONDITIONS
A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 PROTECTION
A. Protect roots and branches of trees to remain.
B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least 3 feet high.
C. When setting posts, avoid damaging tree roots.
D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.
E. Provide water and fertilizer to maintain existing trees.

PART 2 - PRODUCTS

2.1 STUMP TREATMENT SOLUTION
A. Formulated to kill existing vegetation.

PART 3 - EXECUTION

3.1 EXAMINATION
A. The Drawings do not purport to show all trees and shrubs existing on site.
B. Verify with ENGINEER which plantings are to be removed or to remain.
C. Tree root inspection:
    1. Assist ENGINEER by removing and replacing existing surface improvements.
    2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using Modification prices.

3.2 PREPARATION
A. Contact Blue Stakes prior to commencement of work for location of utilities.
B. All bench marks, structures, fences, roads, sidewalks, utilities, trees, shrubs, lawns, paving and curbs are to be protected. Above or below grade utilities which are to remain are to be located and safeguarded. Repair any damage work causes.

C. Upon discovery of unknown utilities or concealed conditions, discontinue affected work and immediately notify engineer.
D. Locate utilities. Preserve utilities that are to remain in service.
E. Review work procedures with ENGINEER.
F. Schedule work carefully with consideration for property owners and general public. Before starting, arrange for the disconnection of all utility services that are to be removed or which interfere with work.

3.3 SITE CLEARING

A. Remove all vegetation to outside Excavation, fill slope lines, and limits of slope rounding.
B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 CLEARING AND GRUBBING

A. Remove all existing objects (except those objects designated to remain) down to the subgrade from the construction site and University property in a neat, orderly and legal manner. Materials, excavation materials, garbage, residue, etc. which contains hazardous or regulated waste must be disposed of properly and in accordance with the laws of the State of Utah.
B. On-site burning is not permitted.
C. Re-usable top soil should be stripped and stored as directed by engineer Project manager for later use.
D. Trucks which haul dirt from one site to another via city streets are required to clean the truck tires before leaving the construction site to assure that dirt and debris does not fall on city streets during transit. This is a Salt Lake City adopted ordinance and the University requires that University projects abide by this ordinance.
E. Locate and protect all existing utilities, contact Blue Stakes for other utilities.
F. Clear the site of plant life, grass, root systems, and all surface debris as needed to provide a clean sub-base for the work.
G. Access areas to site must also be cleared for execution of the work as part of the bid.
H. Plant growth and features designated to remain as final landscaping on final drawings are to be safeguarded.
I. Protect all bench marks and existing survey work from damage or displacement. Maintenance and replacement of bench marks needs to be conducted by a Professional Licensed Surveyor with the State of Utah
J. Maintain all designated site access for vehicle and pedestrian traffic.

3.5 TREE REMOVAL

A. Remove branches, limbs, and debris.
B. Remove stumps and roots to 18 inches below proposed grade.
C. For stumps larger than 6 inches caliper remove and treat as follows:
    1. Remove chips and debris from around remaining stump.
    2. Apply stump treatment solution in accordance with manufacturer's recommendations.
    3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
    4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 2316

EXCAVATION FOR UTILITIES AND SITE GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Excavation and disposal of excavated materials.
B. Protection of existing facilities, utilities, and structures affected by excavation.

1.2 DEFINITIONS
A. Extra Excavation: Upper limit of Excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.
B. Classified Excavation: The excavation of specified materials.
C. Incidental Excavation: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of Excavation, slough, or over-break.
D. Unclassified Excavation: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or Rock fragments will not be sufficient cause to change classification of surrounding materials.

1.3 STORAGE AND HANDLING
A. Stockpile excavated material to cause a minimum of inconvenience to public and provide for emergency services as necessary.
B. Provide free access to all existing fire hydrants, water and gas valves, and meters.
C. Provide free flow of storm water in all gutters, conduits, and natural water courses.
D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.
E. Promptly remove other material from site.

1.4 SITE CONDITIONS
A. Prior to excavation, photograph existing surfaces along which work may take place in order to determine, after construction is completed, whether any damage to existing improvements occurred prior to construction operations. Refer to construction photograph requirements, Section 01 78 39.
B. Perform Incidental Excavation at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS FOR OVER EXCAVATED AREAS
A. Common fill, Section 31 05 13.
B. Crushed aggregate base, Section 32 11 23.
C. Stabilization fill, crushed aggregate base or common fill with maximum rectilinear particle size of 2 inches.
D. Stabilization fabric, Section 31 05 19.

PART 3 - EXECUTION

3.1 PREPARATION
A. Use white paint and mark the proposed Excavation.
B. Call the one-call center and wait the required amount of time. Color of one call center marks indicate the following.
    1. White: Proposed Excavation
    2. Pink: Temporary survey markings
    3. Red: Electric power lines, cables, conduit and lighting cables
    4. Yellow: Gas, oil, steam, Petroleum or gaseous materials
    5. Orange: Communications, alarm, signal, cables or conduits.
    6. Blue: Potable water.

7. Purple: Reclaimed Water, irrigation and slurry lines
8. Green: Sewer and storm drain lines

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.
B. Pothole, expose or otherwise locate utilities as necessary to give utility company at least 4 days notice to protect, preserve, or relocate a utility that interferes with or may be damaged by excavation work.
C. Where utilities or structures conflict with design grades, report conflict to the appropriate utility company and ENGINEER 14 days prior to the initiation of work within the conflict area.
D. For temporary controls, refer to Section 01 57 00.
E. Support and protect from damage any existing facility and structure that exists in, passes through, or passes under the site.
F. No Contract Time extension shall be granted and no additional compensation shall be made if CONTRACTOR fails to pothole and identify buried utilities or structures which conflict with the Work.

3.3 TOPSOIL

A. Excavate topsoil only to depth that will preserve topsoil quality.
B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.4 LANDSCAPE SPRINKLER SYSTEMS

A. Protect existing landscape sprinkler systems.
B. When disturbance of existing sprinkler system is required, interrupt and repair system so operation of system is maintained.

3.5 SHORING

A. Safe and shored trenching methods should be used for trenching, excavation and backfilling for utilities.
B. Protect excavations by shoring, bracing, sheet piling, underpinning or other methods required to prevent cave-in or loose soil from entering excavation.
C. Slope, shore, sheet, brace or otherwise support Excavations over 4 feet deep, Section 31 41 00.
D. When soil conditions are unstable, Excavations shallower than 4 feet deep must also be sloped, supported or shored.

3.6 DEWATERING

A. Keep Excavation free from surface and ground water.
B. If ground water table is in the intended construction operations, dewater Excavations.
C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.
D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.
E. Pay for damages and costs resulting from dewatering operations.
F. All dewatering systems be maintained and operated during the entire construction of the project.
G. Dewatering systems should be of the gravity underground type, but may be pumped or flow overland with approval from Provo City.

3.7 GENERAL EXCAVATION REQUIREMENTS

A. If extensive or difficult underpinning is specified by ENGINEER, a pre-construction or pre-bid survey by the CONTRACTOR to identify existing site conditions is required.
B. Excavate trench one-half utility diameter wider to facilitate proper backfill for backfill type required.
C. Excavate topsoil from areas to be re-landscaped or re-graded and other marked areas.
D. Excavate site to line and grade indicated.
E. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.
F. Where soil has been softened or eroded by flooding or hardened by drying during unfavorable weather, rework all damaged areas or replace with approved material at no additional cost to OWNER.
G. Notify ENGINEER of unexpected subsurface conditions.

H. Underpin adjacent structure, service utilities and pipe chases that may be damaged by Excavation work.
I. Protect Excavation walls as required. If conditions permit, slope Excavation Sides to maintain a safe and clean working area. Remove loose materials.
J. Where ENGINEER deems Subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.8 ROADWAY EXCAVATION

A. Control all drainage on all excavated areas to avoid erosion damage and flooding of adjacent property.
B. Proper sprinkling equipment to be provided at all times to abate any dust nuisance or air pollution that may arise due to construction operations.
C. Protect all above or below ground utilities.
D. In advance of setting line and grade stakes, clean Subgrade area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts that contain water.
E. Backfill and compact over excavation, Section 33 05 05.

3.9 STRUCTURAL AND LANDSCAPE EXCAVATION

A. Provide Shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.
B. For piling work, coordinate special requirements for piling. Protect Excavation walls.
C. If conditions permit, slope Excavation Sides as excavation progress. Maintain a safe and clean working area.
D. Support Excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.10 TRENCH EXCAVATION

A. Grade bottom of Trenches to provide uniform bearing surface.
B. If necessary, make bell holes and depressions required to complete joining of pipe or box.
C. Limit width of Trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.
D. In public thoroughfares and regardless of Trench depth, limit length of open Trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect Trenches over night.

3.11 EXTRA EXCAVATION

A. If unstable material is encountered at the bottom or face of any excavation, do not perform extra excavation without written consent.
B. Correct excavations beyond the specified lines and grades by filling and compacting the resulting voids with acceptable fill.
C. Volume of Excavation within any specified pay limit will be determined by the method of average-end-areas in the original position.

3.12 TOLERANCE

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 2323

BACKFILLING FOR UTILITY STRUCTURES AND SITE RETAINING WALLS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Structural backfill materials.
B. Structural backfilling requirements.

1.2 SUBMITTALS
A. Submit maximum laboratory dry density and optimum laboratory moisture content for:
    1. Subgrade material, and
    2. Each type of fill to be used.
B. Upon ENGINEER's request, submit a written quality control Inspections and testing report describing source and field quality control activities performed by CONTRACTOR and its Supplier.

1.3 QUALITY ASSURANCE
A. Do not change material sources, or aggregate without ENGINEER's knowledge.
B. Reject backfill material that does not comply with requirements specified in this section.

1.4 STORAGE
A. Safely stockpile backfill materials.
B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.
C. Avoid displacement of and injury to Work while compacting or operating equipment.
D. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.5 SITE CONDITIONS
A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.
B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.
C. Reshape and compact damaged structural section to required density.

1.6 ACCEPTANCE
A. General:
    1. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.
    2. For material acceptance refer to.
        a. Common fill, Section 31 05 13.
        b. Crushed aggregate base, Section 32 11 23.
        c. Cement treated fill, Section 31 05 15.
B. Structure Backfilling: One test per Lot.

Table 1 – Lot Size for Structural Backfilling Operations		
Structure Type	**Test Criteria**	**Lot Size**
Strip Footings	Standard (a)	Subgrade: 200 lineal feet
	Modified (a)	Crushed aggregate base: 200 lineal feet per lift.
Structure Footing excluding strip footings	Standard (a)	Subgrade: 225 square feet.
	Modified (a)	Crushed aggregate base: Each 225 square feet per lift
Embankments	Standard (a)	Fill: 625 square feet per lift
Miscellaneous small structures (e.g. Manholes, drainage boxes, etc.)	Standard (a)	Subgrade: Each footprint area Fill: Each lift
	Modified (a)	Crushed aggregate base: Each lift
NOTES (a) Proctor density, Section 33 05 05 (b) Lift thickness before compaction is 8 inches.		

1.7 WARRANTY

A. Restore incidentals damaged by settlement at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.
B. Crushed aggregate base, Section 32 11 23.
C. Cement treated fill, Section 31 05 15.

2.2 ACCESSORIES

A. Water:
   1. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.
   2. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify:
   1. Stockpiled fill meets gradation requirements.
   2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
   3. Ground surface is not frozen.
B. If subgrade is not readily compactable secure written authorization for extra excavation and backfill, Section 31 23 16.
C. Identify required line, levels, contours, and datum.

D. Stake and flag locations of underground utilities.
E. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter and other features.
B. Protect above or below grade utilities. Contact utility companies to repair damage to utilities. Pay all cost of repairs.
C. Protect Subgrade from desiccation, flooding and freezing.
D. Do not fill adjacent to structures until Excavation is checked by ENGINEER.
E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.
F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in Trenches.
G. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.
B. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 FOUNDATIONS AND SLABS ON GRADE

A. Place backfill materials in lifts not exceeding 8 inches before compaction.
B. Do not backfill against walls until concrete has obtained 14 day strength. Backfill against foundation walls simultaneously on each side.
C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.
D. Do not damage adjacent structures or service lines.
E. Where flowable fill is used, use fill that flows easily and vibration for compaction is not required.

3.5 MODIFIED BACKFILL LAYER METHOD

A. Refer to Section 33 05 20.

3.6 COMPACTION

A. Compact backfill; Section 31 23 26 to the following maximum dry densities.
    1. Under Footings: 95 percent.
    2. Interior Crawl Spaces: 90 percent.
    3. Interior Slab-On-Grade: 90 percent.
    4. Side of Foundation Walls and Retaining Walls:
        a. Exterior: 90-92 percent.
        b. Interior: 90-92 percent.
    5. Miscellaneous Structures: 95 percent.

3.7 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.
B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 31 2326

COMPACTION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Compaction of granular fill materials.

1.2 REFERENCES
A. ASTM D 698: Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN- m/m^3)).
B. ASTM D 1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
C. ASTM D 2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
D. ASTM D 2922: Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
E. ASTM D 3017: Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
F. ASTM D 3282: Standard Practice for Classification of Soils and Soil- Aggregate Mixtures for Highway Construction Purposes.
G. ASTM D 3740: Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS
A. A-1 Soil: Defined in ASTM D 3282.
B. Modified Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 1557 using procedure A, B or C as applicable.
C. Relative Density (or Relative Compaction): The ratio of field dry density to the maximum laboratory density expressed as a percentage.
D. Standard Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE
A. Use a laboratory that follows and complies with ASTM D 3740.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 COMPACTION
A. To the greatest degree possible, on-site materials need to be evaluated for suitability as structural backfill. The University is interested in using on-site materials to the greatest degree possible as long as there is no loss of quality or stability.
B. Any excavated soil identified for use as backfill shall be stored on the project site. Where this is not feasible, an alternate temporary storage site should be arranged with Architect/engineer. Such storage must be discussed with Architect/engineer early in the design process.
C. Any excavated soil not identified for use as backfill shall be removed and legally disposed of from the project site.

D. Backfill shall be properly laid and compacted in lifts to the following standards:
    1. In lawn and landscaped areas: 85% of maximum dry density, 12-inch layers.
    2. In sidewalks, roads, parking areas or under buildings: 95% maximum dry density, 8-inch layers.

    *NOTE: Where specific compaction recommendations are included in the soils report for the project, the soils report recommendations shall be followed in lieu of the above stated standards.
    *Compaction testing is required.

    Backfill:
    1. Backfill areas to contours and elevations shown on plans.
    2. Maintain optimum moisture content of backfill material to attain required compaction density.
    3. Cooperate with the testing firm hired for compaction testing. Note that first test will be provided by the University, but any retesting due to test failure will be at the expense of the CONTRACTOR.
E. It should be noted that failure of the architect and/or engineer to detect defective work or material does not prevent later rejection of the work nor obligate the architect and/or engineer for final acceptance when such defective work or material is discovered.
F. A test schedule for all improvements shall include:
    1. Curb and gutter with grade less than 0.5%: one random test per lift per 200 lineal feet.
    2. Curb and gutter with grade greater than 0.5%: one random test per lift per 400 lineal feet.
    3. Sidewalk: one random test per lift per 400 lineal feet.
    4. Trenches: one random test per lift per 200 lineal feet.
    5. Roadways: one random test per lift per 1000 square yards.
    6. Landscape Areas: No specific requirements.
G. The University will pay for the original test only. Additional testing requirements due to test failure will be at the expense of the CONTRACTOR.
H. Protect all above and below grade utilities. Include protection of excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from entering the excavation.
I. Notify architect/engineer before commencement of any excavation. Also, notify public utility companies when excavation is close to their lines before excavation.
J. Moisten or dewater backfill material to obtain optimum moisture for compaction.
K. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.
L. When no density compactive effort is specified, compact the entire area to eliminate unstable zones.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform control testing of materials. Perform additional testing at no additional cost to OWNER.
    1. Because of changes in source of materials or proportions requested by CONTRACTOR.
    2. Because of Failure of materials to meet specification requirements.
    3. For other testing services needed or required by CONTRACTOR.
B. Report: For each material tested, record the following.
    1. Vertical and horizontal location of the test.
    2. Optimum laboratory moisture content.
    3. Field moisture content.
    4. Maximum laboratory dry density.
    5. Field density.
    6. Percent compaction results.
    7. Certification of test results by testing agency.
C. Optimum Soil Density: Use ASTM D 2216 and the following industry standards.
    1. For A-1 Soils: Use test method C of ASTM D 1557 (Modified Proctor)
    2. For All Other Soils: Use test method C of ASTM D 698 (Standard Proctor).

D. Field Density:
    1. Use ASTM D 3017 and test method C of ASTM D 2922 for shallow depth nuclear testing.
    2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

END OF SECTION

SECTION 31 2500

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Erosion control and slope protection facilities including blankets or mulches.
B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

A. Submit prior to using:
    1. Sample of blanket or geotextile materials.
    2. Mulch formula.
    3. Grass mixture listing.
    4. Plant list.
    5. Geotextile manufacturer's certification.
B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.
B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.
C. Deliver blanket in original wrapping showing name of manufacturer and product weight.
D. Deliver plant materials immediately prior to placement.
E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced prior to planting.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Riprap: Rock, Section 31 37 00.
B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.
C. Geotextiles: Refer to fabric in Section 31 05 19.
D. Erosion Control Vegetation Mats: Permanent three dimensional mats which allow for re-vegetation where high water flows are expected.
E. Fiber Mulches: Straw, hay, wood or paper free from weeds or foreign matter detrimental to plant life.
F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.
G. Topsoil and Fertilizer: Refer to Section 31 05 13 and Section 32 92 00.
H. Delivery of seed materials be in original containers with certified germination test results and showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove foreign materials, roots, rocks, and debris.

B. Grade to eliminate rough spots, and ponding areas.
C. Grade soil to drain perimeter water away from protected areas.
D. As applicable.
    1. Temporary controls, Section 01 57 00.
    2. Grass, Section 32 92 00.

3.2 SLOPE PROTECTION BLANKET

A. Cover seeded slopes where grade is greater than 3 horizontal to 1 vertical with blanket. Roll down over slopes carefully and loosely without stretching or pulling.
B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow Trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.
C. Toe-in top end of each section in narrow Trench at least 12 inches deep. Toe-wrap fabric at bottom of slope.
D. Staple loosely the outside edges and overlaps.
E. In ditches, lay matting in upstream direction. Overlap and staple ends6 inches with upstream section on top.
F. If natural drainage water traverses protected or controlled area;
    1. construct a channel or riprap according to Drawings and Section 31 3700.
G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.
H. Present alternative methods of protection for approval prior to starting any work.

3.3 GEOTEXTILE

A. Placement, Section 31 05 19.

3.4 MULCHES

A. Apply mulches at the rate indicated.
B. When installed with a tackifier, apply at the rate recommended by the tackifier Supplier.

3.5 SURFACE COVER

A. Grass, Section 32 92 00.
B. Ground cover, Section 32 93 13.

3.6 MAINTENANCE

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.
B. Protect and repair geotextiles, Section 31 05 19.
C. Keep surface of soil damp only as necessary for seed germination.
D. Apply water slowly so surface of soil will not puddle and crust.
E. Replant damaged grass areas showing root growth Failure, deterioration, bare or thin spots, and eroded areas.
F. Re-fertilize 60 days after planting.
G. Remove weeds that are over 3 inches high.

END OF SECTION

SECTION 31 37 00

RIPRAP OR ROCK LINING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Placement of loose riprap, hand-placed riprap, or grouted riprap.

1.2 **REFERENCES**

A. **ASTM Standards**:

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 **SUBMITTALS**

A. Submit before use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

PART 2 PRODUCTS

2.1 **AGGREGATE**

A. Durable, angular, hard stone free from seams and cracks.

B. Graded in size to produce a reasonably dense mass.

C. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.

D. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.

E. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.

F. At least 95 percent of the stones shall have at least two (2) fractured or clean angular faces.

2.2 **ACCESSORIES**

A. Portland cement grout, Section 03 61 00.

B. Geotextile fabric, Section 31 05 19.

C. Grout, Section 04 05 16.

2.3 **SOURCE QUALITY CONTROL**

A. Aggregate: Wear not greater than 40 percent when tested, ASTM C535.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval before backfilling.

B. Install required geotextile in accordance with Section 31 05 19.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

3.4 GROUTED RIPRAP

A. After placement and wetting the stones, sweep sand or fine gravel into the interstices to fill to within four (4) inches of the outer surface of the riprap.

C. Fill the remaining volume of the interstices flush with a well-mixed grout.

D. Keep grout wet by sprinkling or covering with wet material for at least three (3) days. Protect grout from stream water or any other disturbance during this cure period.

E. Do not place grout in freezing weather.

END OF SECTION

SECTION 31 4100

SHORINGFOR UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shoring for open Excavations requiring a Protective System.
B. Underpinning to stabilize adjacent structure.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. In trenching, two Protective Systems are required if each Side of the Trench is to be shored. The use of a Trench Box shall be classified as one Protective System.
B. Payment covers the cost of the Protective System to a depth of 3 feet below the Excavation elevations indicated. Allowance for extra cost may be made, based upon the actual cost to the CONTRACTOR of constructing, extending or reconstructing any Protective System that may be necessary to carry the excavation to the required depth which is greater than 3 feet below the Excavation elevations indicated. The extra cost will be paid for by **Change Order**.
C. Excavation in Lieu of Protective System: When Protective Systems are indicated and with the written approval of the ENGINEER the actual installation of the Protective Systems are not made, the CONTRACTOR will be paid in full for the Protective System bid item, which includes all extra excavation, extra backfill, backfill compaction, or other incidental work performed by CONTRACTOR in lieu of constructing the Shoring or underpinning.

1.3 DEFINITIONS

A. Accepted Engineering Practices: Those requirements or practices that are compatible with standards required by a duly licensed or recognized authority.
B. Benching: A method of protecting persons and property against cave-ins by excavating the Sides of an Excavation to form one or a series of horizontal levels or steps, usually with vertical or near vertical surfaces between levels.
C. Excavation: Any man-made cut, cavity, or depression in an earth surface, including Trenches, formed by earth removal and producing unsupported earth conditions (Sides). If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a Trench.
D. Failure: The permanent deformation or breakage of a structural member or connection; or the collapse of all or part of an Excavation.
E. Protective System: Any recognized method of protecting persons and property against cave-ins, the collapse of adjacent structures, or material that may fall or roll from an Excavation Side or into an Excavation. Protective systems include Support Systems, Sloping and Benching systems and Shield systems.
F. Shield: A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect persons and property within the structure without preventing a cave-in. Shields may be permanent structures or may be designed to be portable and moved along as work progresses. Portable Shields used in Trenches are usually referred to as "trench boxes" or "trench shields".
G. Shoring: A structure that supports the Sides of an Excavation and thereby protects persons and property by preventing cave-ins.
H. Side: Vertical or inclined earth surface formed at the outer edges of an excavation.
I. Sloping: A method of protecting persons and property against cave-ins by excavating to form Sides that are inclined away from the Excavation, the angle of incline being of such a degree for the conditions of exposure that a cave-in will not occur.
J. Support System: A structure that protects persons and property by providing support to an adjacent structure, underground installation, or the Sides of an Excavation.
K. Trench: A narrow Excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15 feet.
L. Trench Box: See Shield.
M. Un-fractured Rock: Rock that can be excavated with vertical Sides and remain intact while exposed. Fractured Rock is considered equivalent to un-fractured Rock when the material on

the Side or Sides of the Excavation is secured against cave-in or movement by Rock bolts, netting, or other means approved by a professional engineer.

1.4 DESIGN OF PROTECTIVE SYSTEMS

A. Design Support Systems, Shield systems, and the structural components of these systems, and Sloping and Benching systems to resist all loads that are intended to be imposed or transmitted to them.

B. Design system for any hydrostatic pressure in the Sides of an excavation.

1.5 SUBMITTALS

A. Submit a Protective System plan when requested.

PART 2 - PRODUCTS

2.1 MATERIALS

A. CONTRACTOR's choice.

PART 3 - EXECUTION

3.1 PREPARATION

A. Make safe or remove trees, surface encumbrances which are hazardous to Shoring operations.

B. Provide adequate ventilation of Excavations.

C. Control dust and groundwater.

3.2 STABILITY OF ADJACENT STRUCTURES

A. Support adjoining buildings, walls, sidewalks, Pavements, or other structures endangered by excavation operations.

B. Excavation below level of base of footing of any structural foundation or wall shall not be permitted except as follows:

1. Underpinning or other Support Systems is provided to ensure stability of structure, or
2. Excavation is in Un-fractured Rock, or
3. A professional engineer determines in writing that such work will in no way pose a hazard to persons and property or the integrity of the structure.

3.3 PROTECTION OF PERSONS AND PROPERTY

A. Shoring and/or bracing is to be used, wherever required, to protect existing buildings and structures, utilities, other improvements, or to maintain life safety.

B. Protect from cave-ins. Install a Support System, by Sloping, by Benching, by use of a Shield system, or by use of a combination of these methods.

C. Scale to remove loose material. Use Rock bolting, wire mesh, installation of protective barricades, or provide equivalent protection.

D. Stairway, Ladder, Ramp: Comply with OSHA.

E. Protect against cave-ins from vibratory loads adjacent to excavation operations.

3.4 INSPECTIONS

A. Inspect Excavations daily for evidence of possible cave-ins, indications of Failure of Protective Systems, or other hazardous conditions.

B. Upon discovery of hazardous conditions, cease all work in the Excavations until additional precautions have been taken to ensure persons and property safety.

3.5 SHIELD SYSTEMS

A. Minimize the time the Sides of the Excavation remain unsupported.

B. Do not subject Shield systems to loads other than those considered for in their design.

C. Remove persons and property from Excavation when portable Shields are being relocated.

3.6 INSTALLATION AND REMOVAL OF SUPPORT SYSTEMS

A. Do not overload Support Systems.

B. Install additional members to carry the loads imposed upon the Support System when temporary removal of individual members is necessary.

C. When removing the Support System, release member by member slowly to avoid Failure of the remaining members or cave-ins.
D. Coordinate backfilling to minimize time an unsupported Excavation remains open.

END OF SECTION

SECTION 32 01 05

INFORMATION, REGULATORY, AND WARNING SIGNS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Information, regulatory, and warning signs but not street name signs or construction signs.

1.2 **REFERENCES**

A. **ASTM Standards**:

B209: Aluminum and Aluminum - Alloy Sheet and Plate.

B. **FS Standards**:

L-P 380: Plastic Molding Material Methacrylate.

L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

C. **National Bureau of Standards**:

PS 1: Construction and Industrial Plywood.

D. **DOT Standards**:

MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 **DEFINITIONS**

A. For definition purposes, the various types of signs are identified by a combination of letter and number. The letter represents the type of sign panel construction and the number represents the type of lettering and symbols to be used as follows:

1. Panel Type:
   a. Type A: Reflectorized sheeting on sheet aluminum.
   b. Type B: Reflectorized sheeting on plywood.
2. Letter Type:
   a. Type 1: Reflectorized demountable cutout letters, symbols, and borders with prismatic reflectors.
   b. Type 2: Opaque legend and borders.
   c. Type 3: Reflectorized permanently attached cutout letters, symbols, and borders or reflectorized screen processed letters, symbols, and borders.

1.4 **SUBMITTALS**

A. Submit Shop Drawings of support structures before fabrication.

B. Submit sample of each color of reflective sheeting including manufacturer's name and product number.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Sign Blank:

1. Aluminum Sheet: 0.1 inch thick ASTM B209 alloy 6061-T6.
2. Aluminum Extrusion: 0.1 inch thick ASTM B209 alloy 6063-T5 and 6063-T6.
3. Softwood Plywood: PS 1 Group 1 with each panel bearing initials DFPA Grade - Trademark of the American Plywood Association; painted to ENGINEER's choice of color unless indicated.

B. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8 inch diameter mounting holes.

C. Fabricated Supports: Galvanized steel, Sections 05 05 10 and 05 12 00.

D. Sheeting:

1. Reflective: FS L-S-300 with 2,200 hours minimum durability.
2. Nonreflective: Nonchalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.

E. Prismatic Reflectors: Methyl methacrylate lens meeting FS L-P-380 requirements with aluminum frame.

F. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

G. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

2.2 **COLORS AND FORMAT**

A. Sign Colors and Format: MUTCD.

B. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 **INSTALLATION**

A. Do not remove a sign that is being replaced until the new sign is placed and uncovered. Provide temporary covering. Maintain covering until removal.

B. Unless indicated otherwise use clearance and locations shown in MUTCD. Install posts plumb and in proper alignment. Construct sign

post foundations with concrete. Finish foundations flush with or below natural ground.

C. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

D. Construct overhead support structures where indicated with signs horizontal and perpendicular to roadway. Minimum allowable vertical clearance from high point of pavement is 16.5 feet.

3.3 **WORKMANSHIP**

A. Carefully fabricate and erect signs. Damage signs will be rejected.

B. Make all vertical joints and cuts flat and true.

C. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

D. Lay out and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

E. Wash all sign faces before final inspection, Section 01 74 13.

END OF SECTION

SECTION 32 01 10

RELOCATE FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reset existing fences and gates in new locations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nails, Spikes and Staples: Galvanized steel for exterior, high humidity locations, and treated wood. Size and type to suit applications.

B. Chain Link Fences and Gates: Section 32 31 13.

C. Wire Fences and Gates: Section 32 31 16.

D. Concrete: Class 3000 minimum, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate locating utilities, Section 01 31 13.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Completely remove all existing posts, footings, wires, gates, and other items used in fencing.

B. Remove concrete on posts. Reuse posts, wire, and gates from existing fence.

C. Replace any fencing materials and gates that are damaged, lost, or broken during fence and gate relocations. Provide new materials as required which meets Specifications, for fence and gates of the same type.

D. Set relocated fences and gates straight and true.

E. Fill in old post holes unless they become part of new construction.

F. Reset posts in concrete, eight (8) inches in diameter to depth indicated or two (2) feet minimum.

END OF SECTION

SECTION 32 05 10

BACKFILLING ROADWAYS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Roadway backfill materials.

B. Roadway backfilling requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 245 Subgrade stabilization.

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 **DEFINITIONS**

A. **Embankment**: A raised earthen structure.

B. **Pavement**: A surface or covering, as of Portland cement concrete, bituminous concrete, brick, concrete paver, etc., specifically a paved street, sidewalk, curb, gutter, curb cut assembly, ramp, apron, Driveway, etc.

C. **Subgrade**: A surface of native earth or Rock leveled off as to receive backfill materials.

1.4 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material.
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight, and aggregate classification or Supplier's identification code.

1.5 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this section.

C. If requested, submit a quality control Inspection and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural roadway section to required density.

D. Soil Cement: Do not spread soil cement mixture when air temperature is less than 40 deg F in the shade.

E. Drainage: Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of work area.

1.8 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per Lot.

D. Compaction: One test per Lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot size as follows:

Table 1 – Compaction Standard and Lot Sizes		
Material	**Proctor**	**Lot Size**
Subgrad	Standar	1000 square yards
Comm on Fill	Standar d	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per
Aggreg ate base course	Modified	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift
NOTES (a) Standard proctor, ASTM D698. (b) Modified proctor, ASTM D1557.		

E. Flowable Fill Strength: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.9 **WARRANTY**

A. Repair incidental settlement or settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13: Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23: Untreated base course.

C. Cement treated fill, Section 31 05 15: Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE**

A. Stabilization separation fabric, Section 31 05 19: Woven, high MARV.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Areas to be backfilled are free of debris, snow, ice or water.
3. Bearing surfaces are not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **SUBGRADE**

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the Subgrade:

1. Excavation for Subgrade stabilization is incidental work. Section 31 23 16.

2. Place geotextile fabric per APWA Plan 245. Place acceptable fill in lifts over the geotextile, compact and wrap.

3.5 **EMBANKMENTS**

A. Place backfill material in lifts not exceeding equipment compaction capability.

B. Build shoulders to a grade higher than that of adjacent fills. Provide surface runoff at all times.

C. Commence compaction along edge of area to be compacted and gradually advance toward center.

D. Operate compaction equipment along lines parallel or concentric with the center-line of the embankment being constructed.

E. Do not damage subsurface structures or utilities.

3.6 **BASE COURSES**

A. Place backfill material in lifts not exceeding eight (8) inches before compaction.

B. Maintain moisture content in compaction operations.

C. Avoid segregation when spreading backfill. Keep surfaces free from pockets of coarse and fine aggregate.

D. Rework fills that do not conform to compaction requirements until requirements are met.

E. Protect cement treated fill against freezing and traffic for seven (7) days.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.

2. Six (6) inches when using handheld compaction equipment.

3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days. Maximum is 90 psi in 28 days.

3.9 FIELD QUALITY CONTROL

A. Test roadway backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

B. Proof Rolling Test:

1. Before placing fill material for roadbed backfills, proof roll subgrade using gross weight of 18,000 pounds/tandem axle, with a tire pressure at least 90 psi.
2. All proof roll passes will traverse the subgrade parallel to the roadbed centerline. All subsequent passes will be offset 1/2 the vehicle width until the entire subgrade is tested.
3. ENGINEER will analyze, determine, designate and measure the areas, if any, requiring additional compaction or reconstruction.
4. Once subgrade passes the proof rolling test, protect the surface from construction operations and traffic damage. Repair all cuts, ruts, and breaks. Keep surface in a satisfactory condition until geotextile fabric or base course has been placed.

3.10 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Treated and untreated base course production and placement.

1.2 **REFERENCES**

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.

C136 Sieve Analysis of Fine and Coarse Aggregates. D75 Sampling Aggregates.

D448 Sizes of Aggregate for Road and Bridge Construction.

D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D2419 Sand Equivalent Value of Soils and Fine Aggregate. D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3665 Random Sampling of Construction Materials. D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils. D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 **DEFINITIONS**

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP**: Acronym for reclaimed asphalt pavement. See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 **SUBMITTALS**

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.
3. Target gradation for each sieve size,
4. Percent composition of reclaimed asphalt or concrete included in the mix.
5. Unit weight, CBR, relative density, and relative moisture content.
6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 **QUALITY ASSURANCE**

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 **ACCEPTANCE**

A. **General:**

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. **Gradation**: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors

Criteria	Pay Factor	Mean of Deviations of Acceptance Tests From the Target Grading Curve				
		1 Sampl	2 Samples	3 Sample	4 Sample	5 or More
1/2" and Larger	1.00 0.95 0.90 0.80 0.70	0 – 15 16 – 17 18 – 19	0.0 – 12.1 12.2 – 13.9 14.0 –	0.0 – 10.8 10.9 – 12.4 12.5 –	0.0 – 10.0 10.1 – 11.5 11.6 –	0.0 – 9.5 9.6 – 11. 11.1 – 11.9 12. –
3/8" Sieve	1.00 0.95 0.90 0.80 0.70	0 – 15 16 – 17 18 – 19	0.0 – 11.5 11.6 – 13.2 13.3 –	0.0 – 9.8 9.9 – 11.3 11.4 –	0.0 – 8.8 8.9 – 10.1 10.2 –	0.0 – 8.0 8.1 – 9.2 9.3 – 10.0 10.1 –
No. 4 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 14 15 – 17 18 19 – 20 21 – 22	0.0 – 10.5 10.6 – 12.1 12.2 –	0.0 – 8.8 8.9 – 10.1 10.2 –	0.0 – 7.8 7.9 – 9.0 9.1 –	0.0 – 7.0 7.1 – 8.0 8.1 – 8.7 8.8 – 10.0
No. 16 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 11 12 – 13 14 15 – 16 17	0.0 – 8.2 8.3 – 9.4 9.5 –	0.0 – 6.9 7.0 – 7.9 8.0 –	0.0 – 6.2 6.3 – 7.1 7.2 –	0.0 – 5.6 5.7 – 6.4 6.5 – 7.0 7.1 – 8.0 8.1 – 8.7

No. 200 Sieve	1.00 0.95 0.90 0.80 0.70	0 – 4.5 4.6 – 5.2 5.3 –	0.0 – 3.4 3.5 – 3.9 4.0 –	0.0 – 2.9 3.0 – 3.3 3.4 –	0.0 – 2.5 2.6 – 2.9 3.0 –	0.0 – 2.3 2.4 – 2.6 2.7 – 2.9 3.0 – 3.3 3.5 – 3.6
NOTES (a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.						

C. **Relative Density**: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. **Field Density**: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 - Placement Type, Location, Sub-lot Size

Typ	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with	1,000 square
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non- load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. **Material**: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties				
	ASTMs	Aggregate Class		
		A	B	C
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D5821	50	–	–
Wear (toughness or hardness), max., percent	C131	50		
Fine aggregate				
Liquid Limit, max.	D4318	25		
Plastic Index, max.	D4318	0	0	6
Sand Equivalent, min., percent	D24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C29	75		
CBR, min., percent	D1883	70	55	--

NOTES

(a) Faces: Retained on No. 4 sieve.

(b) Wear: Retained on No. 12 sieve after 500 revolutions.

(c) Liquid limit and plastic index: Passing No. 40 sieve.

(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.

(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. **Gradation**: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Target Grading Curve must lie within the selected aggregate grade in table 4. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Master Grading Bands

Sieve	Aggregate Grade			Target Tolerance
	Grade 1-1/2	Grade 1	Grade 3/4	
1-1/2"	100	–	–	(Pay factor 1.00 in Table 1)
1 "	–	100	–	
3/4 "	70 –	–	100	
1/2 "	85	79 –	–	
3/8 "	–	91	78 –	
No. 4	55 –	–	92	
No. 16	75	49 –	55 – 67	
No. 200	40 – 65	61	28 – 38	
	25 – 40	27 – 35	7 – 11	
	7 – 11	7 – 11		

NOTES

(a) It is assumed fine and course aggregate have same bulk specific gravity.

(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1” sieve in Grade 1 is not applicable.

(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

C. **Changing Source**: A new material properties report is required.

2.2 **TREATED BASE COURSE**

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:
   a. Sand equivalent and fractured face measured after asphalt residue is burned off.
   b. Plasticity and wear requirements apply to virgin aggregate portion only.
   c. Allowable asphalt content is controlled by allowable CBR.
2. Remove debris from crushed RAP aggregate by screening.
3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:
   a. Cement with its chemical components is allowed.
   b. Wear test and fractured face test not required.

2.3 **SOURCE QUALITY CONTROL**

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

C. Testing Protocol: Gradation, ASTM C136. Maximum density, ASTM D1557. Optimum moisture content, ASTM D2216.

PART 3 EXECUTION

3.1 **SUB-BASE PREPARATION**

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 **PLACEMENT**

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.
2. Maintain optimum moisture content plus or minus two (2) percent.

3. Use appropriate compaction equipment.
4. Do not place additional material on any unaccepted layer or on any frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 - Placement Type, Location, Aggregate Class

Type	Location	Aggregate Class		
		A	B	C
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement)	X		
II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	X	X	
III	Landscape (includes non-structural, non-load bearing areas.	X	X	X

NOTES:
(a) **X** indicates where placement is allowed.

C. Compaction:
1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 **FIELD QUALITY CONTROL**

A. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

B. Testing Protocol: Gradation, ASTM C136. Field density, ASTM D2922. Moisture content, ASTM D3017.

3.4 **REPAIR OR REMOVAL**

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 32 1203

PAVING ASPHALTS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Performance graded asphalt, asphalt cement, cutback asphalt, emulsified asphalt, recycle asphalt, and crack patch asphalt.
B. Requirements for accepting non-complying paving asphalts.

1.2 REFERENCES
A. ASTM D 113: Standard Test Method for Ductility of Bituminous Materials.
B. ASTM D 977: Standard Specification for Emulsified Asphalt.
C. ASTM D 2026: Standard Specification for Cutback Asphalt (Slow- Curing Type).
D. ASTM D 2027: Standard Specification for Cutback Asphalt (Medium- Curing Type).
E. ASTM D 2028: Standard Specification for Cutback Asphalt (Rapid- Curing type).
F. ASTM D 2397: Standard Specification for Cationic Emulsified Asphalt.
G. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
H. ASTM D 4552: Standard Practice for Classifying Hot-Mix Recycling Agents.
I. ASTM D 5710: Standard Specification for Trinidad Lake Modified Asphalt.
J. ASTM D 6373: Standard Specification for Performance Graded Asphalt Binder.

1.3 SUBMITTALS
A. Submit bill of lading for each shipment of paving asphalt from vendor. Identify the following.
    1. Source of product (manufacturer);
    2. Type and grade of asphalt, And
    3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE
A. Reject paving asphalts which are not uniform in appearance and consistency or which foam when heated to mixing temperature.
B. Do not use storage containers contaminated with other types or grades of Petroleum products.
C. Do not use Petroleum product that does not comply with contract requirements.
D. Asphalt pavement shall be placed only when the air temperature is above 40ºF and rising.
E. Asphalt Testing will be coordinated Project Manager and paid for by the OWNER for the first test. Additional testing due to test failure shall be specified at the expense of the CONTRACTOR.
F. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric conditions.

1.5 ACCEPTANCE
A. General:
    1. Acceptance is by Lot. One Lot is one day's production.
    2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00
    3. Dispute resolution, Section 01 35 10.
B. Performance Graded Asphalt Binder (PGAB): Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly from oil storage unit.
    1. Refer to limits identified in Section 209 of UDOT's "Manual of Instruction Part 8 Materials". Pay factors are as follows.
        a. If none of the critical properties are outside rejection limit a composite price adjustment of 25 percent or less is allowed.
        b. If one or more of the critical properties falls outside the rejection limit or if a composite price adjustment is more than 25 percent, paving asphalt will be rejected.
C. Asphalt Cement (AC) Binder: Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly

from oil storage unit.

1. Ductility: Meet this Section's requirements, or
2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials".
    a. Lot may be accepted using the published graphics. If price adjustment exceeds 30 percent, reject paving asphalt, or
    b. If allowed to remain after placement, price adjustment will be 50 percent.

D. Cut-back Binder: Meet this Section's requirements for ductility.

E. Trinidad Lake Modified Asphalt: Supplier's certificate for ASTM compliance.

F. Emulsified Asphalt: Supplier's certificate for ASTM compliance.

G. Recycle Asphalt: Identity of source (asphalt cement or tar products). H. Crack Patch: Meet material requirements in Section 32 01 17.

PART 2 - PRODUCTS

2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

A. Petroleum asphalt that complies with ASTM D 6373. Blending the paving asphalt with polymers or natural asphalts is CONTRACTOR's choice.

2.2 ASPHALT CEMENT (AC)

A. Petroleum asphalt that complies with Table 2 of ASTM D 3381 except as follows:

1. Replace ductility at 77 deg. F. (25 deg. C.) with ductility at 39.2 deg. F. (4 deg. C.). Use the following values.

    - AC-5: greater than 25.
    - AC-10: greater than 15.
    - AC-20: greater than 5.

2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".

B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low- temperature copolymer consisting of 2 percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

A. Petroleum asphalt that complies with ASTM D 5710 (a blend of natural asphalts).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

A. Petroleum asphalt that complies with ASTM D 2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

A. Petroleum asphalt that complies with ASTM D 2027 (fluxed or blended with a kerosene-type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg. F. (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

A. Petroleum that complies with ASTM D 2028 asphalt (fluxed or blended with a naphtha-solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted.

1. Anionic, ASTM D 977 (breaks by evaporation).
2. Cationic, ASTM D 2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

A. Petroleum asphalt that complies with ASTM D 4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar

products to make Pavements resistant to fuel spillage.

1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP when less than 30 percent virgin aggregate is added.
2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to the RAP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prime coat, Section 32 12 13.
B. Tack coat, Section 32 12 14.
C. Plant mix paving, Section 32 12 17.
D. Road mix paving, Section 32 12 17.
E. Seal coating, Section 32 01 13.
F. Crack patch, Section 32 01 17.

END OF SECTION

SECTION 32 1205

ASPHALT CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Composition of asphalt - aggregate mix.
B. This specification does not apply to polymer modified asphalt concrete. Refer to Section 32 12 06.

1.2 REFERENCES

A. AI Manual Series No. 2: Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
B. AASHTO T 324: Hamburg Wheel-track Testing of Compacted Hot- Mix Asphalt (HMA).
C. ASTM C 29: Standard Test Method for Unit Weight and Voids in Aggregate.
D. ASTM C 88: Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
E. ASTM C 117: Standard Test Method for Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.
F. ASTM C 131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
G. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregate.
H. ASTM C 142: Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
I. ASTM D 75: Standard Practice for Sampling Aggregates.
J. ASTM D 140: Standard Practice for Sampling Bituminous Materials.
K. ASTM D 242: Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
L. ASTM D 979: Standard Methods for Sampling Bituminous Paving Mixtures.
M. ASTM D 2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
N. ASTM D 3203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
O. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
P. ASTM D 3515: Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
Q. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials.
R. ASTM D 3666: Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
S. ASTM D 4318: Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
T. T ASTM D 4552: Standard Practice for Classifying Hot-Mix Recycling Agents.
U. ASTM D 4791: Standard Test Method for Flat or Elongated Particles in Coarse Aggregate.
V. ASTM D 4867: Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.
W. ASTM D 5444: Standard Test Method for Mechanical Size Analysis of Extracted Aggregate.
X. ASTM D 5581: Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6-jnch_Diameter Specimen)
Y. ASTM D 5821: Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
Z. ASTM D 6307: Standard Test Method for Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.
AA. ASTM D 6373: Standard Specification for Performance Graded Asphalt Binder.

1.3 DEFINITIONS

A. Asphalt-Aggregate Designator: Alpha-numeric code that indicates type and grade of asphalt, and type and grade of aggregate in an asphalt-aggregate mix. For example;
    1. "*AC-20-DM-3/4*" means asphalt-aggregate mix shall be composed of AC-20 type and grade asphalt cement and DM-3/4 type and grade aggregate.
    2. "*RA-1-DM-1*" means asphalt-aggregate mix shall be composed of RA-1 type and grade

asphalt recycling agent and DM-1 type and grade aggregate.
3. "*RS-1-SS-II*" means asphalt-aggregate mix shall be composed of RS-1 type and grade asphalt emulsion and SS-II type and grade aggregate.

B. Mean of Deviations: Defined in Section 32 11 23.

1.4 SUBMITTALS

A. Quality Assurance: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM standards.

B. Mix Design: Submit.
1. Date of mix design. If older than 365 days, recertify mix design.
2. Asphalt cement source, type and chemical composition.
3. Aggregate gradation target.
4. Asphalt cement target, dust to asphalt ratio, moisture sensitivity (tensile strength) stability, flow and voids in the bituminous mix.
5. Paving asphalt grade if RAP is used in the mix.
6. RAP, mineral filler, anti-strip, and recycle agent percentages.

C. Pre-approved mix design, submit name and address of Supplier.

D. Before changing mix design, submit a new design and give ENGINEER 10 days to evaluate the changes.

E. Source Quality Control Inspections and Testing Report: If requested, submit report describing CONTRACTOR's and Supplier's quality control activities and test results.

1.5 QUALITY ASSURANCE

A. Use a laboratory that follows and complies with ASTM D 3666.

B. Do not change aggregate source or paving asphalt source without ENGINEER's written approval.

C. Do not use non-complying sources.

1.6 ACCEPTANCE

A. General:
1. Acceptance is by Lot. One Lot is one day's production.
2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10.

B. Installation: Accepted as specified in Section 32 12 16.

C. Materials:
1. At the Source:
   a. Aggregate: Verify gradation. Collect sample from conveyor belt or stockpile if belt is not accessible.
   b. Paving Asphalt: See Section 32 12 03 provisions. c. Mix: 325 deg. F. maximum in transport vehicle.
2. At the Site:
   a. One sub-lot is 500 tons.
   b. Sampling: Two random samples per sub-lot. Location as follows.
      1) Behind paver before compaction, or
      2) Where sub-lot exhibits non-uniform appearance.
3. At the Laboratory:
   a. Air Voids:
      1) Basis of evaluation is laboratory compacted samples (not field compacted samples).
      2) If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to ENGINEER.
   b. Dust to asphalt ratio.
   c. Asphalt Content, Aggregate Gradation: Lot is acceptable if test deviations are

within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than pay factor 0.85 limits may stay in place at 50 percent cost.

Table 1 – Pay Factors for Non-complying Materials

Criteria	Pay Factor	Range of Mean of Deviations of Tests Results from the Design Mix Target in Percentage Points				
		500 Tons	1,000 Tons	1,500 Tons	2,000 Tons	≥2,500 Tons
Asphalt Content	1.00 0.975 0.95 0.90 0.85	0.00–0.70 0.71–0.80 0.81–0.90 0.91–1.00 1.01–1.10	0.00–0.54 0.55–0.61 0.62–0.68 0.69–0.75 0.76–0.82	0.00–0.46 0.47–0.52 0.53–0.58 0.59–0.64 0.65–0.69	0.00–0.41 0.42–0.46 0.47–0.52 0.53–0.56 0.57–0.61	0.00–0.38 0.39–0.43 0.44–0.47 0.48–0.52 0.53–0.56
1/2" and larger Sieve	1.00 0.975 0.95 0.90 0.85	0.0–10.9 11.0–12.9 13.0–13.9 14.0–14.9 15.0–16.0	0.0–7.3 7.4–8.3 8.4–9.3 9.4– 10.3 10.4–11.3	0.0–6.5 6.4–7.1 7.2–7.9 8.0–8.7 8.8–9.5	0.0–5.6 5.7–6.3 6.4–7.0 7.1–7.7 7.8–8.4	0.0–5.2 5.3–5.8 5.9–6.4 6.5–7.1 7.2–7.7
3/8" Sieve	1.00 0.975 0.95 0.90 0.85	0.0–9.9 10.0–10.9 11.0–11.9 12.0–13.9 14.0–15.0	0.0–6.9 7.0–7.8 7.9–8.7 8.8–9.6 9.7–10.5	0.0–5.9 6.0–6.6 6.7–7.3 7.4–8.0 8.1–8.9	0.0–5.3 5.4–6.9 6.0–6.6 6.7–7.2 7.3–7.9	0.0–4.9 5.0–5.5 5.6–6.1 6.2–6.6 6.7–7.2
No. 4 Sieve	1.00 0.975 0.95 0.90 0.85	0.0–9.9 10.0–11.0 11.1–11.9 12.0–12.9 13.0-14.0	0.0–6.7 6.8–7.6 7.7–8.5 8.6–9.4 9.5–10.2	0.0–5.7 5.8–6.3 6.4–6.9 7.0–7.5 7.6–8.0	0.0–5.2 5.3–5.8 5.9–6.4 6.5–7.0 7.1–7.6	0.0–4.8 4.9–5.4 5.5–5.9 6.0–6.5 6.6–7.0
No. 8 Sieve	1.00 0.975 0.95 0.90 0.85	0.0–7.9 8.0–8.9 9.0–9.9 10.0–10.9 11.0–12.0	0.0–5.6 5.7–6.3 6.4–7.0 7.1–7.7 7.8–8.5	0.0–4.8 4.9–5.4 5.5–6.0 6.1–6.6 6.7–7.2	0.0–4.3 4.4–4.8 4.9–5.3 5.4–5.8 5.9–6.4	0.0–4.0 4.1–4.5 4.6–4.9 5.0–5.4 5.5–5.8
No. 16 Sieve	1.00 0.975 0.95 0.90 0.85	0.0–7.9 8.0–8.9 9.0–9.9 10.0–10.9 11.0–12.0	0.0–5.2 5.3–5.8 5.9–6.4 6.5–7.0 7.1–7.6	0.0–4.6 4.7–5.1 5.2–5.6 5.7–6.1 6.2–6.6	0.0–4.2 4.3–4.6 4.7–5.1 5.2–5.5 5.6–5.9	0.0–3.9 4.0–4.3 4.4–4.7 4.8–5.1 5.2–5.4
No. 50 Sieve	1.00 0.975 0.95 0.90 0.85	0.0–6.9 7.0–7.9 8.0–8.9 9.0–9.9 10.0–11.0	0.0–4.3 4.4–4.8 4.9–5.3 5.4–5.8 5.9–6.4	0.0–3.8 3.9–4.1 4.2–4.5 4.6–4.9 5.0–5.5	0.0–3.4 3.5–3.8 3.9–4.1 4.2–4.4 4.5–4.9	0.0–3.2 3.3–3.5 3.6–3.8 3.9–4.1 4.2–4.5
No. 200 Sieve	1.00 0.975 0.95 0.90 0.85	0.0–3.0 3.1–3.5 3.6–4.0 4.1–4.5 4.6–5.0	0.0–2.4 2.5–2.7 2.8–3.0 3.1–3.3 3.4–3.6	0.0–2.0 2.1–2.2 2.3–2.4 2.5–2.7 2.8–3.0	0.0–1.8 1.9–2.0 2.1–2.2 2.3–2.4 2.5–2.6	0.0–1.7 1.8–1.9 2.0–2.1 2.2–2.3 2.4–2.5

NOTES
(a) Test paving asphalt content using a burn-off oven, ASTM D 6307.
(b) Determine aggregate gradation be extraction, ASTM D 5444.

PART 2 - PRODUCTS

2.1 PAVING ASPHALT

A. Asphalt Cement: Section 32 12 03. Substitutes for asphalt cement are as follows.

ASTM D 3381	ASTM D 6373
AC 10	PG 64-22 or PG 70-28
AC 20	PG 70-28

B. Recycle Asphalt: Section 32 12 03.

2.2 AGGREGATE

A. Material: Clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.
B. Source: Use the following requirements to determine suitability of aggregate source and not for project control.
   1. Coarse Aggregate:
      a. Angularity (fractured faces), ASTM D 5821: 50 percent maximum by weight of particles with at least 2 fractured faces.
      b. Hardness (toughness), ASTM C 131: 40 percent minimum wear of aggregate retained above the No. 4 sieve unless specific aggregates having higher values are known to be satisfactory.
      c. Flat or Elongated Particles, ASTM D 4791: 20 percent maximum retained above 3/8 inch sieve has a 3:1 length to width ratio.
   2. Fine Aggregate:
      a. Friable Particles, ASTM C 142: 2 percent maximum passing No. 4 sieve.
      b. Plasticity, ASTM D 4318: Aggregate passing No. 40 sieve is non-plastic even when filler material is added to the aggregate.
         1) Liquid limit: Less than 25.
         2) Plastic limit: Less than 6.

2.3 ADMIXTURES

A. Reclaimed Asphalt Pavement (RAP) Aggregate: Restrictions include.
   1. 15 percent by weight maximum providing grading and voids in the bituminous mix are met.
   2. Greater than 15 percent requires separate mix design.
B. Mineral Filler: ASTM D 242.
C. Recycle Agent: ASTM D 4552.
D. Antistrip: Heat stable cement slurry or lime slurry.

2.4 MIX DESIGN

A. Selection of Materials:
   1. Paving Asphalt, Section 32 12 03:
      a. AC-10 or AC-20: Light traffic pavement.
      b. AC-20: Medium traffic pavement.
      c. RA: For hot-laid recycled asphalt pavement. Choice by CONTRACTOR.
   2. Aggregate: This Section Article 2.2.
B. Selection of Design Aggregate Structure:
   1. Gradation: Maximum particle size is 1/2 compacted lift thickness.
      a. Target Gradation Curve must lie within one of the Master Grading Bands in the following table, or
      b. If acceptable to ENGINEER, use fractionated proportioning to select or adjust

gradation.

Table 2 – Master Grading Bands

Sieve Size	Dense				Open	Friction	
	DM-1	DM-3/4N	DM-3/4	DM-1/2	OM-1/2	FM-1	FM-2
1 inch	100						
3/4 inch		100	100			100	
1/2 inch	75 – 91	74 – 99		100	100	90 –100	100
3/8 inch		69 – 91	75 – 91		93 – 100	60 – 100	90 – 100
No. 4	47 – 61	49 – 65	46 – 62	60 – 80	36 – 44	15 – 40	30 – 50
No. 8		33 – 47			14 – 21	4 – 12	5 – 15
No. 16	23 – 33		22 – 34	28 – 42			
No. 50	12 – 22	21 – 35	11 – 23	11 – 23			2 – 5
No.200	3 – 7	6 – 18	3 – 7	3 – 7	2 – 4	2 – 5	
		2 – 6					

NOTES
(a) Gradation expressed in percent passing by weight, ASTM C 136.
(b) It is assumed fine and coarse aggregate have same bulk specific gravity.
(c) Friction Mixture: See ASTM D 3515.
(d) DM -3/4N is 100% crushed.
(e) Percentage of fines passing No. 200 sieve determined by washing, ASTM C 117.

2. Aggregate Blend:
   a. Dry-rodded Unit Weight, ASTM C 29: 75 pounds per cubic foot minimum.
   b. Weight Loss (soundness), ASTM C 88: 16 percent maximum using sodium sulfate.
   c. Clay Content (cleanliness), ASTM D 2419: Sand equivalent value after going through the dryer or prior to the drum mixer.
      1) 45 percent minimum if Medium Traffic Classification.
      2) 60 percent minimum if Heavy Traffic Classification. The sand equivalent requirement is waived for the RAP aggregate but applies to the remainder of the aggregate blend.

C. Selection of Admixture: CONTRACTOR's choice.
   1. RAP: Adjust paving asphalt grade to account for RAP binder viscosity.
   2. Cement or Hydrated Lime: Add if mix is moisture sensitive.

D. Selection of Mix Properties: Use AI Manual Series No. 2 procedure for stability, flow and voids.
   1. Stability, Flow Voids: If traffic classification is not specified elsewhere, use Medium Traffic Classification.

Table 3 – Stability, Flow, Voids Limits

Criteria	Traffic Classifications		
	Light	Medium	Heavy
Number of compaction blows each end of specimen	50	75	112
Stability, lbs., minimum	750	1200	1800
Flow, in 0.01 inch units	10 – 18	10 – 18	10 – 18
Voids in Mineral Aggregate (VMA), percent minimum 1" nominal maximum particle size 3/4" nominal maximum particle size 1/2" nominal maximum particle size 3/8" nominal maximum particle size	 13 14 15 16.5	 13 14 15 16.5	 13 14 15 16.5
Voids in Bituminous Mix, percent	3 – 5	3 – 5	3 – 5

NOTES
(a) Traffic Classifications:

Light: (ESAL $<10^4$ per year)
Class I: Parking lots, Driveways, light traffic residential streets, light traffic farm roads.

Medium: (ESAL between 10^4 and 10^6 per year)
Class II: Residential streets, rural farm and residential roads. Class III: Urban minor collector streets, rural minor collector roads.

Heavy: (ESAL $>10^6$ per year)
Class IV: Urban minor arterial and light industrial and light industrial streets, rural major collector and minor arterial highways.
Class V: Urban major arterial and heavy industrial streets, freeways, expressways, arterial highways, rural interstate and other principal arterial highways.
(a) Stability, Flow, Voids: ASTM D 5581.
(b) VMA: ASTM D 3203
(c) Nominal maximum particle size is the largest sieve size listed in this Section upon which any material is retained.

2. Dust to Asphalt Ratio: 0.8 to 1.6.
3. Moisture Sensitivity, ASTM D 4867: Tensile strength ratio less than 0.80 using freeze-thaw conditioning. Test specimen shall be 150 mm in diameter and 95 mm in height and compacted at 7 percent plus or minus 1 percent air voids)
4. Rut Susceptibility, AASHTO T 324: Maximum rut depth is 10 mm at 20,000 passes.

2.5 SOURCE QUALITY CONTROL

A. General: Collect samples, ASTM D 3665. Do not change sampling points.
   1. Aggregate sampling, ASTM D 75.
   2. Paving asphalt sampling, ASTM D 140. Test for viscosity and penetration.

B. Asphalt-Aggregate Mix: Sample, ASTM D 979. Test for the following.
   1. Air voids, ASTM D 3203 or ASTM D 5581.
   2. Paving asphalt content, ASTM D 6307.
   3. Aggregate gradation, ASTM D 5444.
   4. Tensile strength of bitumen-aggregate mixtures, ASTM D 4867.

C. Mixing Plant: ASTM D 3515.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roadway paving, Section 32 12 17.

B. Patching, Section 33 05 25.

END OF SECTION

SECTION 32 1214

TACK COAT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Application of asphaltic material to existing asphalt concrete or Portland cement concrete surfaces preparatory to placing an asphalt concrete Pavement.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03.
   1. Identify water/asphalt dilution ratio.
   2. Identify tack coat application rate.
B. Identify asphalt material recommended by fabric manufacturer.

1.3 WEATHER

A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg. F. The temperature restrictions may be waived only upon written authorization from ENGINEER.
B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

1.4 NOTICE

A. Send written notice to residents or business owners 24 hours prior to applying coat.

PART 2 – PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following.
   1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
   2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
   3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

PART 3 – EXECUTION

3.1 PREPARATION

A. Select and advise ENGINEER of the type of tack material to be used.
B. Clean the surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.
C. Provide surface for pedestrian access across tack coat.
D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

3.2 APPLICATION

A. General:
   1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
   2. Apply tack only to area covered with asphalt concrete in the same day.
B. Application rate: Typically as follows.
   1. Emulsions, 0.05 to 0.15 gallons per square yard.
   2. Cutback, CONTRACTOR's choice.
C. Tack Substrate for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows:
   1. Dry Pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce the application rate to no less than 0.20 gallons per square yard.
   2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

3.3 PROTECTION

A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.
B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.
B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.
C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION

SECTION 32 1313

CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete base course and concrete surface course.

B. Concrete product is not specified in this Section. Refer to Section 03 30 04.

1.2 REFERENCES

A. ACI 305: Hot Weather Concreting.

B. ACI 306: Cold Weather Concreting.

C. APWA Plan No. 261: Manual of Standard Plans for Concrete Pavement Joints.

D. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

E. ASTM C 39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

F. ASTM C 78: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

G. ASTM C 150: Standard Specification for Portland Cement.

H. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.

I. ASTM D 3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

J. ASTM D 5249: Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

K. ASTM E 950: Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

L. ASTM E 1274: Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

1.3 SUBMITTALS

A. Before delivery.

1. Traffic control plan, Section 01 55 26.
2. Joint layout plan.
3. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of the concrete. Refer to ACI 305.
4. Proof of finisher's ACI certification.
5. Make and model name of paving machine.
6. Concrete mix design and number, Section 03 30 04.
7. Proof of profilograph calibration and profilograph operator certification.
8. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

B. At Delivery: Batch ticket, Section 03 30 10. C. After delivery.

1. Profile deviation report.
2. Ride index report.
3. Upon ENGINEER's request, submit a written quality control inspections and testing report describing source and field quality control activities and test results performed by CONTRACTOR and CONTRACTOR's Supplier.

1.4 QUALITY ASSURANCE

A. Do not change concrete Supplier until ENGINEER accepts new source and new mix design.

B. Reject product that does not meet requirements of Section 03 30 04.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

1.5 WEATHER

A. Hot weather, ACI 305.

B. Cold weather, ACI 306.

1.6 NOTICE

A. Send written notice to residents and businesses within affected area at least 3 days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 ACCEPTANCE

A. General:

1. Acceptance is by Lot. Lot size is specified below.
2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.
4. Opening a paved surface to traffic does not constitute acceptance.

B. Concrete Mix:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C 172.
2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non- complying batches until 2 consecutive batches are compliant then continue in random batch testing for acceptance.
3. Strength: Lot is acceptable if strength test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with a sub-lot test deviation greater than Reject may stay in place at 50 percent cost.
    a. Compression: ASTM C 39. Lot size is 500 square yards.

Pay Factor	PSI Below 28 day Compressive Strength
1.00	0
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

b. Flexural: ASTM C 78. Lot size is 750 square yard.

Pay Factor	PSI Below 28 day Flexure Strength
1.00	0
0.95	1 to 29
0.85	30 to 60
Reject	Greater than 60

C. Installation:

1. Placement, finishing and protection, Section 03 30 10.
    a. Verify grade, cross slope, finish and dimensions.
    b. No standing water in curb and gutter.
2. Thickness. Lot size is 1,000 square yards.
    a. Thickness will be determined on ASTM D 3549 cored or sawed specimens. Acceptance will be based on the average of all Lot thickness tests.

D. Tolerance

Pay Factors	(inches less than specified thickness)
1.00	0.00 to 0.25
0.90	0.26 to 0.50
0.70	0.51 to 0.75
0.50	0.76 to 1.00

b. When any thickness measurement is less than specified by more than 1 inch, the actual thickness of the Pavement will be determined by taking additional cores at intervals less than 10 feet parallel to the centerline in each direction from the affected location, until in each direction a core is found which is not deficient by more than 1 inch. Exploratory cores for deficient thickness will not be used in averages for price adjustments.

c. Payment may be made for areas deficient in thickness by more than 1 inch at 50 percent. If not, remove and replace.

d. Price adjustments and Pavement removal will be applied only to those areas showing the deficient thickness which is defined by an additional set of cores taken at the 100 percent pay point as determined in a straight line basis between the original cores. If the second set of cores is deficient, the area will be defined on a straight-line basis using all scores for the different pay factors.

3. Roughness: “Must grind” bumps are removed and tolerance for profile roughness index is not exceeded.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Compression Design:

1. Cast-in-place: Class 4000, Section 03 30 04.
2. Slump per accepted mix design.

B. Flexure Design.

1. Tensile Strength: 650 psi per ASTM C 78.
2. Cement Content: 6.5 bags.
3. Water Cement Ratio: 0.44 maximum by weight (prior to pozzolan exchange), ACI 318.
4. Entrained Air: 5 to 7 percent, ASTM C 231 (pressure).

5. Slump per accepted mix design

2.2 MISCELLANEOUS MATERIALS

A. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00.
B. Hook Bolts: Steel, ASTM A 307 Grade A nuts and bolts, internally and externally threaded.
C. Expansion Joint Filler: F1 sheet, Section 32 13 73.
D. Contraction Joint Filler (Backer Rod): Type 1 round, closed cell, ASTM D 5249.
E. Contraction Joint Sealant: HAS1, HAS4, or CAS6, Section 32 13 73.
F. Curing Compound: Liquid membrane, Section 03 39 00.
G. Bond Breaker: Wax based compound.
H. Grout: Epoxy adhesive, Section 03 61 00.
I. Evaporative Reducer: Water-based mono-molecular polymer liquid at application rates recommended by the manufacturer. Not to be used as a finishing aid.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
    1. Coordinate utility location, Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
    2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
    3. Coat surface of Street Fixtures with oil to prevent bond with concrete Pavement.
    4. Remove sand, leaves and other objectionable materials prior to placing the paving course.
    5. Notify ENGINEER minimum 24 hours prior to commencement of concreting operations.
B. Trees, Plants, Ground Cover:
    1. Protect trees, plants and other ground cover from damage.
    2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to the OWNER.
C. Traffic Control:
    1. Provide worker and public safety, Section 01 55 26.
    2. Apply temporary traffic and lane marking tape or paint after placement layout has been verified with ENGINEER.
D. Base Course:
    1. Follow Section 31 25 00 for herbicide treatment.
    2. Verify base course is placed to grade, compacted and dampened.
    3. If indicated, apply prime coat, Section 32 12 13.
E. Cement Treated or Lean Concrete Base: Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course. Moisten the surface but do not place concrete over puddled water. Apply a double coat of bond breaker prior to placing surface concrete.

3.2 FORM CONSTRUCTION

A. Section 03 11 00.
B. Check formwork for grade and alignment variance from the following tolerances:
    1. Top of forms not more than 1/4 inch from true grade.
    2. Vertical face on longitudinal axis not more than 1/4 inch from true line.
C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.3 REINFORCEMENT PLACEMENT

A. Section 03 20 00.

B. Interrupt reinforcement at expansion joints.

C. Use load transfer bars on longitudinal construction and transverse construction joints.

D. Use smooth dowel in expansion joints.

E. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.

F. Position mats on bar chair supports and properly tie before any concrete is poured. Keep mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide a minimum of 2 inch overlap to adjacent mats.

3.4 JOINTS

A. General:

1. Review joint layout with ENGINEER.
2. Follow Section 32 13 73 requirements.
3. Follow joint requirements in APWA Plan No. 261.

B. Construction Joint: Construction joints (contact joints) (cold joints) are those made by placing concrete against cured concrete.

1. The contact joint between separately laid lanes cannot deviate from a true line by more than 1/4 inch in any direction at any point.
2. Tie both sides of longitudinal and transverse construction joints together with tie bars or key-way. Before placing concrete in adjoining slab, straighten tie bars to 0.1 feet of straight position.
3. Do not cause edge slump when placing tie-bars or by over-working edge of slab.

C. Contraction Joints: Contraction joints (crack control joints) are scorelines made to force crack joint locations in concrete. Keep a minimum of 3 working power saws on the Project when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.

1. Joint spacing measured in feet = twice the slab thickness measured in inches or a maximum of 15 feet.
2. Joint Depth = T/3.
3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
4. Longitudinal Joints: Make longitudinal joints the same dimension as transverse joints.
5. Make transverse joints across width of the Pavement full length and meet curb and gutter joints.
6. Leave forms in place until paving operations are resumed on the other side of the joint.

D. Volunteer Crack Joint:

1. If a volunteer crack joints falls within 5 feet of the location of proposed contraction joint, omit the contraction joint.
2. Rout volunteer crack joints to a 1-1/4 inch depth by 3/8 inch width. Clean and fill crack joint with backer rod and joint sealant.
3. When crack joints occur within 2 feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.

E. Expansion Joints:

1. If a deformed rebar is used in an expansion joint, provide sleeve for movement.
2. Secure fillers to prevent movement. When butted together, do not leave voids or gaps between filler units.
3. Set joint fillers full depth if no joint sealant is specified.
4. Recess joint fillers if backer rods and joint sealant are specified or provide a plastic cap.

F. Joint Sealing: Section 32 13 73.

G. If CONTRACTOR chooses to open the roadway to construction or public traffic prior to final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

3.5 CONCRETE PLACEMENT

A. Section 03 30 10.

B. At the beginning of concrete placement, test slump and air. If corrections are necessary, placement may proceed after 2 subsequent and consecutive batches pass testing.

C. Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping placement work.

D. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around Manholes or other structures until they are at required finish elevation and cross-slope.

E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained an ASTM C 78 flexural strength (modulus of rupture) of 450 psi.

G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint.

H. Place the concrete to the full width of the Pavement in a single construction operation unless indicated otherwise.

3.6 FINISHING

A. Final finished grade tolerance shall be within plus or minus 0.04 feet of final grades on the drawings.

B. Section 03 35 00.

C. Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct the difficulties.

D. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

E. After floating, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities. Refloat repaired areas to provide a continuous smooth finish.

F. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.

G. Surface Texture: After floating when excess moisture or surface sheen has disappeared.

1. For speed less than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.

2. For speed greater than 45 mph: 1/8 inch deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2 inches.

H. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.7 CURING

A. Section 03 39 00.

B. Type II Class A or B (white pigmented) membrane forming compound applied in two directions for total white coverage on all exposed surfaces after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air

temperature.

3.8 TOLERANCES

A. Grade: 1/8 inch in 10 feet parallel to centerline.

B. Cross Slope: 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.

C. Thickness: Not less than 1/4 inch deficient.

D. Roughness

Table 1 – Roughness Tolerance						
Speed and Traffic Class		Profile Roughness Index, (PRI) Inches / Mile				Profile Deviation Inches/25 feet Maximum
		IRI		PI		
		Min	Max	Min	Max	
0 to 29 mph	I or II	–	–	–	–	0.4
	III or IV	129	177	46	66	0.4
30 to 44 mph	I or II	90	115	35	50	0.4
	III or IV	70	90	21	35	0.4
45 mph +	All Classes	–	70	–	21	0.3
NOTES (a) Use a zero blanking band. (b) As a minimum, trace right wheel path in direction of travel (c) Traffic class defined in Table 3, Article 32 12 05. (d) IRI (International Roughness Index), ASTM E 950 (e) PI (Profile Index), ASTM E 1274 .						

1. Profile Deviation: Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas exceeding profile deviation tolerance are “must grind” areas.
2. Profile Roughness Index: (PRI)
    a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding Lot. Treat partial segments longer than 250 feet as a Lot.
    b. Exclude from the Lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than 8 percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

3.9 OPENING TO TRAFFIC

A. Not less than 3,000 psi compressive or 400 psi flexure strength.

3.10 PROTECTION AND REPAIR

A. General: All expenses are at no cost to OWNER. B. Protection: Section 03 30 10 and as follows.

1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either
    a. Maturity meter.
    b. Concrete cylinders.
2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and spillage of materials as they occur.

3. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

B. Repair: Section 03 30 10.

1. Corrective Action for “Must Grinds”: Grinding per Section 02 41 14 is acceptable after concrete cure.
2. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance.
3. Corrective Action for Cracks: Consider repair options published in Guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with Portland cement concrete bonded to Pavement with epoxy adhesive.

END OF SECTION

SECTION 32 1373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Joints and joint sealants in horizontal traffic surfaces for concrete sidewalks, curb, gutter and Pavement slabs.

1.2 REFERENCES

A. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
B. ASTM D 545: Standard Methods of Testing Preformed Expansion Joint Fillers for Concrete Construction (Non-extruding and Resilient Types).
C. ASTM D 994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
D. ASTM D 1190: Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type.
E. ASTM D 1191: Standard Method for Testing Concrete Joint Sealers.
F. ASTM D 1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
G. ASTM D 1752: Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
H. ASTM D 1850: Standard Specification for Concrete Joint Sealer, Cold-Application Type.
I. ASTM D 1851: Standard Methods of Testing Concrete Joint Sealers, Cold-Application Type.
J. ASTM D 2240: Standard Test Method for Rubber Property - Durometer Hardness.
K. ASTM D 2628: Standard Specification for Preformed Poly-chloroprene Elastomeric Joint Seals for Concrete Pavements.
L. ASTM D 3405: Standard Specification for Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.
M. ASTM D 3406: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.
N. ASTM D 3407: Standard Methods of Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.
O. ASTM D 3408: Standard Methods of Testing Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.
P. ASTM D 3542: Standard Specification for Preformed Poly-chloroprene Elastomeric Joint Seals for Bridges.
Q. ASTM D 3569: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.
R. ASTM D 3575: Standard Test Method for Flexible Cellular Materials Made from Olefin Polymers.
S. ASTM D 3581: Standard Specification for Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.
T. ASTM D 3582: Standard Methods for Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.
U. ASTM D 3583: Standard Methods of Testing Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type, for Portland Cement Concrete Pavements.
V. ASTM D 5249: Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.
W. ASTM D 5893: Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
X. FS SS-S-200: Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 SYSTEM PERFORMANCES

A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.
B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

A. Manufacturer's certification that product was manufactured, tested and supplied per source quality control requirements specified herein, together with a report of the test results and the date each test was completed.
B. Manufacturer's instruction for joint preparation, type of cleaning and installation.
C. Manufacturer's Product Data and Samples for each joint sealant product required.
D. Safety data sheets.

1.5 QUALITY ASSURANCE

A. Installation of joint systems are to follow manufacturer's published directions.
B. For cold applied joint sealant installation, use installers approved by the joint sealant Supplier.
C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for multi-component materials.
B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 GENERAL

A. Compatibility: Provide joint fillers, sealant backings, sealants, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.2 JOINT VOID - FORMER

A. Plastic with a water stop.
B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

A. F-1: Bituminous (asphalt or tar) mastic, ASTM D 994. Formed and encased between 2 layers of bituminous saturated felt or 2 layers of glass-fiber felt.
B. F-2: Cane or other cellulosic fiber, ASTM D 1751. Saturated with asphalt.
C. F-3: Granulated cork, ASTM D 1751. In an asphalt binder; encased between 2 layers of asphalt saturated felt or 2 layers of glass-fiber felt.
D. F-4: Sponge rubber fully compressible, ASTM C 1752. With resiliency recovery rate of 90 percent minimum.
E. F-5: Cork, ASTM C 1752. Impregnated and bound with asphalt, compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.
F. F-6: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 lb/ft^3 density maximum, And of size and shape to control sealant depth and performance.

2.4 JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE

A. Backer material, ASTM D 5249 for cold- and hot-applied joint sealant in Portland cement concrete or asphalt Pavements joints.
    1. Type 1: Round rods.
    2. Type 2: Sheets or strips, laminated or skived.
    3. Type 3: Poured fills which completely fill Pavement joint.

2.5 JOINT SEALANT - GENERAL

A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 JOINT SEALANT - HOT-APPLIED

A. HAS-1: Asphalt base type, ASTM D 3405.

B. HAS-2: Thermoplastic type, ASTM D 3581. Jet-fuel resistant without rubber unless indicated otherwise.
C. HAS-3: Elastic type, ASTM D 1190.
D. HAS-4: Elastomeric type, ASTM D 3406. One component, for Portland cement concrete Pavements.
E. HAS-5: Elastomeric type, ASTM D 3569. One component, jet-fuel resistant, for Portland cement concrete Pavements.

2.7 JOINT SEALANT - COLD-APPLIED

A. CAS-1: Elastomeric type, ASTM C 920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield Pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O.
   1. Self leveling.
   2. Shore A Hardness: 40 ∀ 5 ASTM D 2240.
   3. Final cure: 4 days maximum.
   4. Service range: -10 to 150 deg. F.
B. CAS-2: Mastic type, ASTM D 1850. Single or multiple component; for joints having a minimum width of 1/2 inch.
C. CAS-3: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.
D. CAS-4: Elastomeric preformed poly-chloroprene type with lubricant adhesive and indicated movement ratio.
   1. For concrete Pavement seal, ASTM D 2628.
   2. For concrete bridge seals, ASTM D 3542.
E. CAS-5: Silicone type, ASTM D 5893. Single component, non-sag or self leveling, chemically curing sealant based on polymers of poly-siloxane structure intended for use in Portland cement concrete Pavements.
F. CAS-6: Asphalt base meeting ASTM D 3405.
G. CAS-7: Olefin polymer, ASTM D 3575 as follows.
   1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
   2. Tensile strength 115 psi minimum, Suffix T
   3. Density 2.9 plus or minus 3 lbs/cf, Suffix W, Method A
   4. Water Absorption 0.025 lbs/sf maximum, Suffix L.

2.8 SOURCE QUALITY CONTROL

A. Preformed Expansion Joint Fillers: Non-extruding and resilient types, ASTM D 545.
B. Hot-Applied Joint Sealants:
   1. Elastic type used in concrete Pavements, bridges, other structures, ASTM D 1191.
   2. Bituminous type for hydraulic and asphaltic concrete Pavements, ASTM D 3407.
   3. Elastomeric type for hydraulic concrete Pavement, ASTM D 3408.
C. Jet-Fuel-Resistant Joint Sealant: Hot-applied, ASTM D 3582 and ASTM D 3583.
D. Cold-Applied Mastic Joint Sealant: Cold-applied, ASTM D 1851.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus 5 degrees.
B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.
C. Remove frost and moisture in concrete joint substrates before commencing sealing.
D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 JOINT SEALING

A. General:
   1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.

2. Except as otherwise indicated, fill sealant rabbet flush with surface.
3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:
   1. For sidewalks, Pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
   2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
   3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.

C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.

D. Heating: Do not use overheated hot-applied sealants.

E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of Substantial Completion.

B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

SECTION 32 1613

DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete flatwork such as but not limited to waterways, waterway transition structures, sidewalks, curbs, gutters, Driveway Approaches.

1.2 REFERENCES

A. American Public Works Association (Utah Chapter).
   1. Plan 205: Curb and Gutter.
   2. Plan 209: Curbs.
   3. Plan 211: Waterway.
   4. Plan 213: Waterway Transition Structure.
   5. Plan 215: Dip Driveway Approach.
   6. Plan 216: Mountable curb driveway approach.
   7. Plan 221: Flare Driveway Approach.
   8. Plan 225: Open Driveway Approach.
   9. Plan 229: Pipe Driveway Approach.
   10. Plan 231: Concrete Sidewalk.

B. ASTM A 36: Standard Specifications for Structural Steel.

C. ASTM C 39. Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

D. ASTM C 172: Standard Method of Sampling Freshly Mixed Concrete.

1.3 DEFINITIONS

A. Driveway: A paved or unpaved vehicular thoroughfare outside of, but connected to a public road right-of-way or highway right-of-way.

B. Driveway Approach: (1) A vehicular thoroughfare connecting a public road or highway to a driveway. (2) A concrete structure composed of sidewalk, apron and any curb and gutter abutting the apron. When an apron is built as a bridge over curb and gutter, the bridge is included in this definition.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Concrete mix design, Section 03 30 04.

C. Batch ticket, Section 03 30 10.

D. Quality Control Inspections and Testing Report: Upon ENGINEER's request, submit a report describing source and field quality control activities and test results performed by CONTRACTOR and CONTRACTOR's Suppliers.

1.5 NOTICE

A. Send written notice to residents and businesses within affected area at least 3 days before work starts.

B. Indicate when concrete work will take place and when driveway approach can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.6 ACCEPTANCE

A. General:
   1. Acceptance is by Lot. One Lot is one day's production.
   2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00.
   3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. Concrete Mix:
    1. Testing Frequency: Section 03 30 05. Sample per ASTM C 172.Temperature, Slump, Air: Lot size is 1 random batch. Reject non- complying batches until 2 consecutive batches are compliant then proceed in random batch testing for acceptance.
    2. Strength: ASTM C 39. Lot size is 50 cubic yards. At ENGINEER's discretion, a Lot with sub-lot test deviations greater than Reject may stay in place at 50 percent cost.

Pay Factor	PSI Below 28 day Compressive Strength
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

C. Placement, finishing and protection, Section 03 30 10
    1. Verify line, grade, cross slope and finish.
    2. No standing water in curb and gutter.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Concrete Mix.:
    1. Cast-in-place: Class 4000, Section 03 30 04.
    2. Maximum slump per mix design.
B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel per Section 03 20 00.
C. Expansion Joint Filler: F1 sheet 1/2 inch thick per Section 32 13 73.
D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round Section 32 13 73.
E. Contraction Joint Sealer: HAS1 or HAS4 hot applied per Section 32 13 73.
F. Curing Compound: Membrane forming compound per Section 03 39 00.
G. Plate Steel: ASTM A 36 galvanized per Section 05 05 10.

PART 3 - EXECUTION

3.1 CONSTRUCTION EQUIPMENT
A. Slip Form Machines.
    1. Placement must produce required cross-section, lines, grades, finish, and jointing as specified for formed concrete.
    2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION
A. Control pedestrian and vehicular traffic, Section 01 55 26.
B. Examine surfaces scheduled to receive concrete formwork for defects.
C. Do not start work until defects are corrected.
D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 LAYOUT
A. Provide 6" base course min. (1" gradation) under all flatwork. Compact to 96% of maximum dry density.
B. Testing is required for compaction of base course material before concrete is placed.
C. Plans shall be of sufficient engineering quality to ensure good grade control with no interval greater than 50 feet. Curves shall have grade control on 25-foot intervals.
D. All grades shall be set within 0.01 feet of true grade at any given spot.
E. Concrete forms shall be of sufficient rigidity to support construction or may be slip form equipment

for construction of curb and gutter where long, straight portion are involved.

F. Three tests for compressive strength shall be made: (1) 7 day; and (2) 28-day strength. Each truck load is to be tested for slump and air entrainment and temperature. Tests for strength are to taken every 50 cubic yards of material (three (3)cylinders). Testing will be arranged for by the project manager at the OWNER's expense. Any additional testing due to test failure shall be specified to be at the CONTRACTOR's expense.
G. Fibrous Reinforcement shall be specified for all exterior flatwork.
H. Expansion Joints shall be no more than 1/2" wide asphalt impregnated premolded fiber complying with ASTM D 1751. Install expansion joints at intervals not to exceed 40 linear feet in any direction. Control joints shall be installed at intervals not to exceed 10 linear feet in any direction. Control joints shall be 1/4th thickness of the slab and shall be cleanly inscribed by trowel or by saw-cutting.
I. Joint Sealant shall be a one part non-priming polyurethane sealant, gray in color. The Sealant shall conform to federal specification TT-S-00230c, Type II, Class A.
J. Field Tolerances:
    1. Curb or Curb and Gutter: Line - Less than 1/2" in 10 feet and not more than 1" from true line at any location. Grade - No more than 1/4 inch from true grade at any point.
    2. Sidewalk: Line - Less than 1/2" in ten feet and not more than 1" from true line at any location. Grade - Not more than 1/4" plus or minus deviation from a 10 foot straightedge. Ponding - Less than 1/4" at any location. Cross Slope - Plus or minus 1/2" percent from shown on plans provided that adequate cross drainage is provided.
K. Curb, Gutter, Curb and Gutter: Plan 205, 209, 211, 213.
    1. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
    2. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final cure has been reached. Remove and replace any area where ponding is found.
L. Sidewalk: Plan 231.
    1. Cross slope 2 percent.
    2. Landing slope 2 percent maximum in any direction.
    3. Ramp slope, Section 32 16 14.
M. Driveway Approaches: Plan 215, 216, 221, 225, 229.

3.4 CONCRETE PLACEMENT

A. Section 03 30 10.
B. Make sure base course is uniformly damp at time of concrete placement.
C. Obtain ENGINEER's review of base course and forms before placing concrete.
D. Do not use methods that segregate the mix.
E. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.
F. Consolidate concrete with vibrator or other acceptable method. Do not use mechanical vibrators. Prevent dislocation of inserts.

3.5 CONTRACTION JOINTS

A. Geometrics:
    1. Tooled Joints (Score Lines):
        - Depth = T/4. T is the depth of the concrete slab in inches.
        - Top radius = 1/2 inch.
    2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.
    3. Template Joints: 1/8 to 3/16 inch wide 1/4-depth of slab.
B. Sidewalks.
    1. At intervals equal to the width of the sidewalk and transverse to the line of walk.
    2. Radial at curbs and walk returns.
    3. Place longitudinal joints in walks when width of walk in feet is greater than 2 times the walk thickness in inches. (e.g. maximum width of a 4 inch thick walk before placement of a longitudinal contraction joint is 8 feet). Make longitudinal joints parallel to, or

concentric with, the lines of the walk.
4. In walk returns make 1 joint radially midway between the beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with the adjacent walks.

C. Curb, Gutter, Waterway.
1. Place joints at intervals not exceeding 12 feet.
2. At curb radius and walk returns make the joints radial.
3. Where integral curb and gutter is adjacent to concrete Pavement, align the joints with the Pavement joints where practical.

D. Additional Contraction Joint Requirements: Section 32 13 73.

3.6 EXPANSION JOINTS

A. Expansion Joints shall be no more than 1/2" wide asphalt impregnated premolded fiber complying with ASTM D 1751. Install expansion joints at intervals not to exceed 40 linear feet in any direction. Control joints shall be installed at intervals not to exceed 10 linear feet in any direction. Control joints shall be 1/4th thickness of the slab and shall be cleanly inscribed by trowel or by saw-cutting.

B. Sidewalks, Sidewalk Ramps.
1. Place expansion joints to separate sidewalk from utility poles, hydrants, Manhole frames, buildings and abutting sidewalks.
2. Place expansion joints between the sidewalk and the back of curb returns and between the sidewalk and sidewalk ramps.
3. Do not place expansion joints in sidewalk ramp surfaces.
4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.

C. Curb, Gutter, Waterway.
1. Do not place longitudinal joints in drain gutter flow-lines.
2. Where drain gutter transitions extend beyond the curb return, place expansion joints at the ends of the drain gutter transition.
3. Place expansion joints at beginning of curb radius (BCR) and end of curb radius (ECR).

D. Slip Form Work: Expansion joints are not required except at BCR or ECR.

E. Driveway Approach: Do not place expansion joints in curb returns.

F. Street Intersection Corner: Place expansion joints at BCR and ECR.

G. Additional Expansion Joint Requirements: Section 32 13 73.

3.7 FINISH

A. Section 03 35 00.

B. Round edges exposed to public view to a 1/2 inch radius.

C. Apply broom finish longitudinal to curb and gutter flowline.

D. Apply broom finish transverse to sidewalk centerline as follows.
1. Fine hair finish where grades are less than 6 percent.
2. Rough hair finish where grades exceed 6 percent.

E. Remove form marks or irregularities from finish surfaces.

3.8 CURING

A. Section 03 39 00.

B. Type ID Class A (clear with fugitive dye) membrane forming compound. Apply total coverage in 2 directions after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.9 PROTECTION AND REPAIRS

A. General: All expenses are at no cost to OWNER.

B. Protection: Section 03 30 10.
1. Protect concrete work from deicing chemicals during the 28 day cure period.
2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C. Repair: Section 03 30 10.

1. Correct all humps or depressions.
2. Secure ENGINEER's acceptance of method of correction.

END OF SECTION

SECTION 32 16 14

CURB CUT ASSEMBLY

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Concrete flat work for public right-of-way accessibility.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 235 Corner curb cut assembly. Plan 236 Tangent curb cut assembly. Plan 237 Islands and median.

Plan 238 Detectable warning surface.

1.3 **DEFINITIONS**

A. **Approach**: An Element in a pedestrian access route that connects a sidewalk to a Blended Transition or a Turning Space. It has a Running Slope of 8.33 percent (1:12) maximum, a Cross Slope of five (5) percent (1:20) maximum, and a Running Length to be determined by the ENGINEER.

B. **Blended Transition**: An Element in a pedestrian access route that connects a sidewalk or an Approach to a Crosswalk. It is 4 feet wide minimum and has a Running Slope of 5 percent (1:20) or less. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

C. **Clear Space**: An Element in a pedestrian access route that is located beyond the foot of a Curb Ramp, Turning Space, or Blended Transition and is within the width of the Crosswalk. Its dimensions are 4 feet minimum by 4 feet minimum with a Running Slope of 5 percent (1:20) maximum. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

D. **Counter Slope**: Running Slope of the roadway surface in a Crosswalk (including the pan of the gutter).

E. **Cross Slope**: Grade perpendicular to the direction of pedestrian travel usually expressed in percent.

F. **Cross Width**: Distance perpendicular to the direction of pedestrian travel usually expressed in linear measure.

G. **Crosswalk (or Pedestrian Street Crossing)**:

1. Unmarked: That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the roadway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway. In the absence of a sidewalk on one side of the roadway, that part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line;
2. Marked: Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color.

H. **Curb Ramp**: An Element in a pedestrian access route that is 4 feet wide minimum, has a Running Slope from 5 percent (1:20) to 8.33 percent (1:12) maximum and is not required to be more than 15 feet long. Curb ramps are perpendicular to or parallel with a curb. A perpendicular curb ramp abuts or cuts through the curb and its Turning Space is at the top of the ramp. A parallel curb ramp abuts the curb and its Turning Space abuts or cuts through the curb. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

I. **Detectable Warning Surface**: A surface feature of truncated dome material built into the walking surface to advise a pedestrian of an upcoming change from pedestrian to vehicular way.

J. **Element**: An architectural or mechanical component of a building, facility, space, site, or public right-of-way.

K. **Grade Break**: The line where two surface planes with different grades meet flush.

L. **Running Length**: Distance parallel to the direction of pedestrian travel usually expressed in linear measure.

M. **Running Slope**: Grade parallel to the direction of pedestrian travel usually expressed in percent.

N **Turning Space (or Landing)**: An element in a pedestrian access route that connects an Approach or a sidewalk to a Curb Ramp, a Blended Transition or a Clear Space. It is 4 feet minimum by 4 feet minimum. If constrained on 2 sides, it must be 5 feet minimum in the direction of the Curb Ramp or Blended Transition. It's Running Slope and Cross Slope is 2 percent (1:50) maximum. At midblock Crosswalks without stop control, the Cross Slope is permitted to equal the street or highway grade.

1.4 **SUBMITTALS**

A. Field quality control 'pass-fail' checklist data.
B. Traffic control plan, Section 01 55 26.
C. Concrete mix design, Section 03 30 04.
D. Batch ticket, Section 03 30 10.
E. Detectable warning surface product data sheet.

1.5 **OWNER'S INSTRUCTIONS**

A. **Alteration**s: If the direction of water flow in an existing curb and gutter system is not apparent, proceed as follows:
   1. Flood curb and gutter system to determine extent of replacement.
   2. Flood curb and gutter system after installation to verify drainage.
B. **Steep Slopes**: Prior to placing concrete, allow ENGINEER time to check slopes and dimensions of construction forms.

1.6 **ACCEPTANCE**

A. Clear Space: Located within Crosswalk, Running Slope, Cross Slope.
B. Flow-line: No standing water, no trip hazard.
C. Detectable Warning Surface:
   1. Color contrast, dome geometry, joints between units.
   2. Cross Width, Running Length.
D. Curb Cut: Cross Width (appropriate to number of crosswalks served).
E. Turning Space: Running Slope, Cross Slope, dimensions.
F. Curb Ramp: Running Slope, Cross Slope, Cross Width.
G. Blended Transition: Running slope, Cross Slope, Cross Width.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Class 4000, Section 03 30 04.

2.2 **DETECTABLE WARNING SURFACE**

A. Concrete paver, ribbed composite panel, or tile.
B. Properties:
   1. Homogenous color.
   2. High shear strength domes.
   3. Slip resistant, freeze thaw resistant, UV resistant.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles.

B. Assist visually impaired and wheel chair users.

C. Provide continuous access to fire hydrants.

D. Keep passage ways free of construction materials, trash and debris.

E. Remove graffiti immediately.

3.2 **INSTALLATION**

A. Layout, APWA Plans 235, 236, 237, and 238.

B. Place concrete, Section 03 30 10.

C. Install Detectable Warning Surface full width of curb cut.

3.3 **FIELD QUALITY CONTROL**

A. Use the 'pass-fail' checklist in Table 1 to verify that the curb cut assembly complies with layout requirements.

3.4 **CLEANING AND REPAIR**

A. Remove all debris and concrete dust.

B. Clean surrounding handrails, sidewalks, driveways approaches, landscaping, and other objects in vicinity of work.

C. Repair surfaces damaged by saw cutting, grinding, or removal operations at no additional cost to OWNER.

END OF SECTION

Table 1 – Field Quality Control Checklist

Date:_____Time:_____(am) (pm) Job No. _____
Job Title: _____
Indicate the intersection corner or adjacent street address number:
Intersection:_____, NE NW SE SW
Street Address Number:

	Criterion	Pass	Fail
Clear Space			
Located in the width of the Crosswalk	Yes		
Running Slope	≤ 5%		
Proper Crosswalk striping	Yes or NA		
Gutter			
Slope (midblock)	Street grade		
Slope (corner without yield or stop control)	≤ 5%		
Slope (corner with yield or stop control)	≤ 2%		
Slope (adjacent to a Turning Space)	≤ 2%		
Counter Slope (flow-line to pan lip)	≤ 5%		
Trip hazard at flow-line	No		
Trip hazard at roadway/pan joint	No		
Curb Ramp			
Running Slope	≤ 8.33%		
Blended Transition			
Running Slope	≤ 5%		
Turning Space			
Running Slope (midblock)	Street grade		
Running Slope (corner)	≤ 2%		
Cross Slope	≤ 2%		
Approach			
Running Slope	≤ 8.33%		
Cross Slope	≤ 5%		
Detectable Warning Surface			
Spans curb cut in pedestrian access route	Yes		
Running Length	≥ 24"		
Color contrast	Yes		
Dome dimension and orientation	Yes		
Flare			
Slope (if in pedestrian access route)	≤ 10%		

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Words, striping, and other pavement markings.

B. One-way or two-way prismatic reflectors.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.

M247 Glass Beads Used in Traffic Paint.

M248 Ready-Mixed White and Yellow Traffic Paints. M249 White and Yellow Reflective Thermoplastic Striping Material (Solid Form).

B. **ASTM Standards**:

D638 Tensile Properties of Plastics.

E303 Measuring Surface Frictional Properties Using the British Pendulum Tester.

E1710 Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer.

C. **DOT Standards**:

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 **DEFINITIONS**

A. **Retroreflective**: Majority of reflected light is directed back to the light source.

1.4 **SUBMITTALS**

A. Product data for primer to be used for tape applications.

B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.

C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degrees observation angle.

D. Manufacturer's recommendation for type of adhesive to be used.

E. Samples of each thermoplastic or preformed plastic pavement markings along with manufacturer's instructions of how the materials are to be applied.

1.5 **QUALITY ASSURANCE**

A. At the end of the correction period, pavement markings, when applied according to the recommendations of the manufacturer, show a neat, durable marking with no flow or distortion due to temperature if the pavement surface remained stable. The tape shows no appreciable fading, lifting or shrinkage, and no significant tearing, roll back or other sign of poor adhesion.

1.6 **WEATHER**

A. Apply pavement striping and markings only when pavement surface is dry and air temperature is above 40 deg F during daylight hours.

B. Do not apply pavement striping and markings when rain is anticipated within 12 hours.

PART 2 PRODUCTS

2.1 **GLASS BEADS**

A. AASHTO M247.

2.2 **FILM AND ADHESIVE**

A. **Film**: A pliant polymer with retroreflective glass beads distributed throughout its cross-sectional area and bonded to its top surface. The film is selected and blended to conform to standard white or yellow highway colors and has a minimum thickness of 0.06 inches at pattern height.

1. Skid Resistance: 35 BPN minimum, ASTM E303.
2. Tensile Strength: ASTM D638. Using a Sample size 6 x 1 inch, a temperature between 70 and 80 deg F, and a test jaw speed of 10 to 12 inches per minute, the film has an elongation of 75 percent maximum at break and a strength as follows.
   a. Type 1: 150 pounds minimum tensile strength per square inch of cross-section area.
   b. Type 2: 40 pounds minimum tensile strength per square inch of cross-section area.
3. Reflectivity: Meet film reflectivity in the following table.

Table 1 - Film Reflectivity

Application	Tensile Strength	Color	
		White	Yellow
Non-residential	Type 1	500	350
Residential	Type 2	300	250

NOTES

(a) Follow ASTM E1710 procedures using 30 meter test distance, an entrance angle of 88.76 degrees, and an observation angle of 1.05

degrees. (b) Reflectivity is measured in millicandelas per square foot per footcandle (mcd/sf/fc).

B. **Adhesive**:

1. Class 1: Without pre-coated adhesive for applications with surface preparation adhesive recommended by the manufacturer at temperatures of 40 deg F or above and moderate humidity.
2. Class 2: With pre-coated pressure sensitive adhesive with minimum adhesion value of 1.1 pounds per inch width, AASHTO M237

2.3 **PAINT**

A. Alkyd type F (fast dry) ready-mix, AASHTO M248.

B. Thermoplastic, AASHTO M249.

2.4 **PRISMATIC REFLECTORS**

A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated:

1. With a cast iron housing and acrylic prismatic reflector.
2. With an overall size not less than nine (9) inches long, five (5) inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above its base.
3. With a minimum reflective area of 1.6 square inches per face.

B. Reflector Specific Intensity: Meet intensity in the following table.

Table 2 - Intensity

Color	Entrance Angle	
	0 Degrees	**20 Degrees**
White Yellow	3.0 1.8	1.2 0.72
NOTES (a) Intensity measured at 0.2 degree observation angle.		

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Use equipment manufactured for pavement marking. Use workers experienced in operating such equipment.

B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of six (6) inches over that cycle.

C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

D. For thermoplastic paint materials, use equipment that is designed to

agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

A. **General**: DO NOT begin pavement painting and marking operations without ENGINEER's knowledge of such activity.

B. **Repair of Receiving Surface**: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
2. Crack sealing and crack repairing, Section 32 01 17.
3. Pushing or shoving pavement repair.
    a. Mill damaged area at least three (3) inches below required surface elevation.
    b. Install and compact three (3) inches of bituminous concrete, Section 32 12 16.13. ENGINEER to determine Mix Designator.

C. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.
2. Grind off confusing pavement markings and lane stripes.

D. **Cleaning**: Broom or flush the surface to remove dirt, loose stones, or other foreign material. For better adhesion results clean the surface using high velocity compressed air.

E. **Mark Roadway**: Mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

F. **Markings**: Markings that adhere to bituminous concrete or Portland cement concrete by either a pressure sensitive pre-coated adhesive or an epoxy cement shall mold to the pavement contours by traffic action at normal pavement temperatures and shall be ready for traffic immediately after application.

3.3 INSTALLATION - ALKYD RESIN PAINT STRIPING

A. Adjust pavement striping machine to apply paint at rate recommended by paint manufacturer. Provide two (2) applications over new pavement (pavement correction period has not expired)

B. Glass Bead Application Rate (Final Application): 5.9 to 6.1 pounds per gallon of paint.

C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.4 **INSTALLATION - THERMOPLASTIC PAINT STRIPING**

A. Clean off dirt, glaze, and grease before pre-striping.

B. Pre-stripe the application area with a binder material that will form, when sprayed, a continuous film over pavement surface, and will dry rapidly and mechanically adhere to pavement surface. Install material in varying widths if indicated.

C. At a temperature recommended by the equipment manufacturer, extrude thermoplastic material from equipment that is proven to produce a line 1/8 inch to 3/16 inch thick, continuous, uniform in shape and has clean and sharp dimensions.

D. Do not use material that produces fumes that are toxic, obnoxious, or injurious to persons or property.

E. Apply so finished lines have well-defined edges free of waviness.

F. Glass Bead Application Rate: Six (6) pounds of glass beads to every 100 square feet of marking.

3.5 **INSTALLATION - TAPE STRIPING**

A. Apply pavement marking tape as indicated or directed. ENGINEER will establish control points.

B. Apply tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.

C. Maintain the line on established control points. Apply intermittent pavement marking tape 24 inches long, spaced approximately 100 feet on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

D. Press down tape immediately after application until it adheres and conforms to pavement surface.

E. Completely remove all tape on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.

3.6 **INSTALLATION PAVEMENT MARKING FILMS**

A. Apply before traffic is allowed on freshly paved surface.

B. Unless indicated otherwise, provide Type 1, Class 2, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.

C. When indicated, inlay markings in fresh bituminous concrete pavement with a compaction roller during the paving operation.

D. Apply all markings in accordance with manufacturer's recommendations.

3.7 **INSTALLATION - PRISMATIC REFLECTORS**

A. Install reflectors by cutting pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.

B. Install markers so that housing top surface and edges are flush with pavement surface.

3.8 **INSTALLATION - WORDS, SYMBOLS AND OTHER MARKINGS**

A. Wet sandblast existing or temporary pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.

B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.9 **REPAIR**

A. Before the end of the correction period, renew stripes and markings if original visual effectiveness is reduced by 50 percent.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Chain link fabric, posts, braces, anchorage, gates, miscellaneous hardware and appurtenances.

1.2 **REFERENCES**

A. **ASTM Standards**:

A53 Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless.

A121 Zinc Coated (Galvanized) Steel Barbed Wire. A392 Zinc Coated Steel Chain-Link Fence Fabric.

A491 Aluminum Coated Steel Chain-Link Fence Fabric. A585 Aluminum Coated Steel Barbed Wire.

A641 Zinc Coated (Galvanized) Carbon Steel Wire. F567 Installation of Chain-Link Fence.

F573 Residential Zinc Coated Steel Chain-Link Fence Fabric.

F626 Fence Fittings.

F654 Residential Chain-Link Fence Gates.

F668 Poly(Vinyl Chloride) (PVC) Coated Steel Chain-Link Fence Fabric.

F1043 Strength and Protective Coatings on Steel Industrial Chain Link Fence and Framework.

B. **CLFMI Standards**:

Manual for Chain Link Fence Installation.

1.3 **SUBMITTALS**

A. Drawings: Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.

B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.

C. Submit sample of fence fabric and typical accessories.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Galvanizing: Class 3, ASTM A121.

B. Aluminizing: Class 2, ASTM A585.

C. Polyvinyl Chloride (PVC): For PVC coated materials, paint all posts, fittings, hardware and accessories to match PVC color.

D. Steel Post: Schedule 40, ASTM A53.

E. Concrete: Class 3000 minimum cast-in-place, Section 03 30 04.

2.2 **CHAIN LINK FABRIC**

A. Steel wire fabric, 11 gage for all fences less than 60 inches in height and nine (9) gage for fences over 60 inches coated as follows:

1. Zinc coating, ASTM A392.
2. Aluminum coating, ASTM A491.
3. Polyvinyl chloride coating, ASTM F668. The fabric shall be hot dipped galvanized steel wire complying with ASTM A392 and coated with a continuous PVC bonding process (minimum 15 mil thickness). Color of PVC coating as indicated and applied free of voids, cracks, tears and to have a smooth and lustrous surface.

B. For residential fabric, provide zinc coated fabric, ASTM F573.

C. Unless indicated otherwise use chain link fabric that has approximately two (2) inches square mesh and coated after fabrication.

D. Knuckle finish top edge and twist and barb bottom edge on fabric less than 60 inches wide. For wider fabric, twist and barb finish on both edges. Provide fabric with barbing done by cutting the wire on bias.

E. If indicated, insert slats in fabric.

2.3 **BARBED WIRE**

A. Two strand, 12-1/2 gage wire with 14 gage, four (4) point round barbs spaced approximately five (5) inches on center.

2.4 **TENSION WIRES AND FABRIC TIES**

A. Tension Wires: Seven (7) gage galvanized coil spring steel wire, ASTM A641.

B. Fabric Fasteners: None (9) gage galvanized or six (6) gage aluminum wire, or approved non-corrosive metal bands, for ties to fasten fabric to posts, rails, and gate frames. Fasten fabric to bottom tension wire spaced 24 inches on center.

2.5 **TRUSS OR TENSION BARS**

A. Galvanized steel rod 3/8 inch diameter for truss or tension bars used in trussing gate frames and line posts adjacent in end, corner, slope, or gate posts. When used in trussing line posts, provide adjustment by means of galvanized turnbuckles or other suitable tightening devices.

B. Tension Bars:

1. Galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch for tensions bars to fasten fabric to end and corner posts and gate frames. Provide 1 tension bar for each end post and two (2) for

each corner and pull post per section of fabric.

2. Use tension bar bands made from heavy pressed galvanized steel spaced on 15 inch centers to secure tension bars to posts.

2.6 **POSTS, CAPS, RAILS, COUPLINGS**

A. Posts, Frames, Stiffeners, Rails: ASTM F1043.

Table 1 – Posts, Frames, Stiffeners, Rails	
Proposed Use	**Nominal Type and Size**
End, corner, slope and gate posts for single gates 6 feet or less in width and double gate 12 feet or less in width for 1. Fence less than 72 in. high 2. Fence 72 inches or higher	 2" pipe 2-1/2" pipe
Gate posts for single swing gates over 6 feet, but not over 13 feet in width and double swing gates over 12 feet, but not over 26 feet in width or for all slide gates with leaves larger than 6 feet	3-1/2" pipe
Gate posts for single swing gates over 13 feet, but not over 18 feet in width and double swing gates over 26 feet, but not over 36 feet in width	6" pipe
Gate posts for single swing gates over 18 feet in width and double swing gates over 36 feet in width	8" pipe
Frame for gates	1-1/2" pipe
Stiffeners for gates	1-1/4" pipe
Line posts for fence 72 in. or higher	2" pipe
Line posts for fences less than 72 in. high	1-1/2" pipe, or 1-1/8" x 1-5/8" H
Top rail	1-1/4" pipe, or 1-1/2" x 1-1/4" H
Bottom rail	6-gage, coiled spring steel tension wire

B. Posts: Galvanized steel, at indicated length.

C. Caps: Pressed galvanized steel or malleable iron designed to fit securely over post ends forming a weather tight closure. Where top rail is used, provide cap to permit passage of top rail. "H" section posts do not require caps.

D. Top, Intermediate and Bottom Rails: Galvanized steel, in required lengths. Provide joint couplings to connect rails securely. Provide means for attaching top rail securely to each end, corner, line, slope and gate posts.

E. Joint Coupling: Galvanized steel, six (6) inches long minimum for each joint. 1 coupling in five (5) shall have expansion spring. Couplings shall be outside sleeve type with bore of sleeve true to maintain adjacent lengths of rail in alignment.

2.7 **FITTINGS AND HARDWARE**

A. Galvanize fittings and hardware.

B. Rivets: Galvanized steel.

2.8 **SUPPORT OR EXTENSION ARM**

A. Use support or extension arms for barbed wire that are of a type that can be attached to tops of the posts and carry number of wires indicated.

B. Use only support arms that are capable of supporting a 250 pound vertical load at the end of the arm without causing permanent deflection.

C. Single support arms are to be integral with a top post weather cap and have a hole for passage of the top rail when required.

2.9 **GATES**

A. Residential Gates: ASTM F654.

B. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.

C. Assemble gate frames and attach hardware by welding or by using fittings and rivets to make rigid connections. Use same fabric as for fence. Install fabric with stretcher bars to gate frame at not more than 15 inch on center.

D. Provide diagonal cross-bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to prevent frame from sagging or twisting.

2.10 **GATE HARDWARE**

A. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide minimum of one pair of hinges for each leaf.

B. Latch: Forked steel type or plunger-bar steel type to permit operation from either side of gate. Provide locking device and padlock eye as integral part of latch.

C. Keeper: Provide keeper for all vehicle gates which automatically engages the gate leaf and holds it in the open position until manually released.

D. Gate Stops: Mushroom type or flush plate with anchors set in concrete to engage the center drop rod or plunger bar.

E. Sliding Gates: Manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, steel wheel or rubber wheel, and accessories as required.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

C. Review to ASTM F567 and CLFMI products manual for chain link fence installation.

D. Protect roots and branches of trees and plants to remain.

E. Limit amount of clearing and grading along fence line to permit proper installation.

3.2 LAYOUT OF WORK

A. Accurately locate and stake locations and points necessary for installation of fence and gates.

B. General arrangements and location of fence and gates are indicated. Install except for minor changes required by unforeseen conflicts with work of other trades.

3.3 INSTALLATION OF POSTS

A. Space line posts as follows:

1. Tangent sections to 500 feet radius: 10 feet maximum.
2. 200 feet radius to under 500 feet radius: Eight (8) feet maximum.
3. 100 feet radius to under 200 feet radius: Six (6) feet maximum.
4. Under 100 feet radius: Five (5) feet maximum.

B. Provide pull posts at 500 feet maximum intervals. Changes in line of 30 degrees or more are considered corners.

C. Set all posts to true line and grade in concrete bases or in approved pipe sleeves or sockets. Check for vertical and horizontal alignment.

D. Construct concrete bases for posts at least 10 inches in diameter. Place a minimum of six (6) inches concrete below each post. Depth of post in concrete as follows:

1. Line Posts: 18 inches.
2. End, Pull, Corner and Gate Posts Less Than six (6) inches Diameter: 24 inches
3. Gate Posts: 30 inches.

E. Where posts are required to be set in concrete walls or masonry, set sockets for posts to a depth of at least 18 inches. Use sockets that consist of lengths of 0.048 inch galvanized metal pipe sleeves, with an inside diameter sufficient to allow the posts to fit loosely. Coat inside of socket and outside of posts with bituminous paint. Caulk posts securely in place with lead wool.

3.4 INSTALLATION OF BRACE ASSEMBLIES

A. Attached brace rail from end, pull, corner or gate posts to first ensuing line post. Install braces so posts are plumb when diagonal truss rod is under proper tension.

3.5 **INSTALLATION OF RAILS**

A. Install rails level and plumb with grade between posts and attached to posts before stretching fabric. Top rails shall form continuous brace from end-to-end of each run of fence.

3.6 **INSTALLATION OF FENCE FABRIC**

A. Place fence fabric on security side of posts unless otherwise specified. Place fabric approximately 1 inch above the ground. Maintain a straight grade between posts by excavating ground high points. Filling depressions with soil.

B. Stretch fabric taut and securely fasten to posts. Fasten to end, gate, corner, and pull posts. Secure stretcher bars with metal bands spaced at 15 inch intervals. Cut the fabric and fasten each span independently at all pull and corner posts. Fasten to line posts with tie wire, metal bands, or other at 15 inches intervals. Attach the top edge of fabric to the top rail or tension cable at approximately 24 inches intervals. Attach bottom tension wire to fabric with tie wires at 24 inches intervals and secure to end of pull posts with brace bands.

C. Draw barbed wire to assure minimum sag at high temperature and no breakage at low temperature. Connect wires and arms by means of 0.142 gauge galvanized wire stays.

3.7 **INSTALLATION OF GATES**

A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation.

3.8 **REPAIR DAMAGED COATING**

A. Grind smooth and wire brush all welds made after galvanizing to remove loose or burned zinc coating, after which neatly coat the areas with 50-50 solder or as otherwise directed by ENGINEER. Make repairs to abraded or otherwise damaged zinc coating in a similar manner. Replace PVC coating.

END OF SECTION

SECTION 32 84 23

UNDERGROUND IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Underground irrigation system complete with heads, valves, controls, and accessories.

1.2 **REFERENCES**

A. **ASSE Standards**:

1013 Reduced Pressure Principle Backflow Preventers.

B. **ASTM Standards**:

B88 Copper Pipe.

B687 Brass, Copper, and Chromium-Plated Pipe Nipples. D1785 Poly (Vinyl Chloride)

PVC Plastic Pipe, Schedules 40, 80, and 120.

D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 80.

D2466 Poly (Vinyl Chloride)(PVC), Plastic Pipe Fittings; Schedule 40.

D2672 Joints for IPS PVC Pipe Using Solvent Cement.

F656 Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

C. **NFPA Standards**:

70 National Electric Code.

1.3 **DEFINITIONS**

A. **Irrigation System**: The arrangement of valves, controls, heads and accessories including lateral and mainline pipe systems.

B. **Mainline Pipe**: Pipe that carries water from point of connection at supply system to the valves.

C. **Lateral Pipe**: Pipe that carries water from the valves to the sprinkler heads or emitters.

1.4 **PERFORMANCE REQUIREMENTS**

A. Design Pressure: As indicated at the heads.

B. Location of Heads: Design location is approximate. Make adjustments as necessary to avoid plantings and other obstructions.

C. Water Coverage: Turf and other planting areas, 100 percent. Modify layout to obtain coverage and rate of application and to suit manufacturer's standard heads. Do not decrease number of heads indicated unless acceptable to ENGINEER.

D. Pipe Testing Schedule: Section 33 08 00.

E. Flush pipe clean before head placement.

F. Leave system dry if work is Substantially Complete after October 15 unless otherwise acceptable to ENGINEER.

1.5 **SUBMITTALS**

A. Product Data: Manufacturer's technical data and installation instructions.

B. Layout drawings and details illustrating piping layout to water supply location and type and coverage of heads, valves, piping circuits, controls, landscaping features, list of fittings and accessories.

C. Pipeline test report: Section 33 08 00.

D. Operation and Maintenance Data: Section 01 78 23:

1. Submit instructions covering full operation, care, and maintenance of system (and controls) and manufacturers parts catalog.
2. Include year-to-year schedule showing length of time each valve is to be open to provide determined amount of water, drain procedures, cleanout features, etc.
3. Instruct OWNER's maintenance personnel how to operate controller and adjust sprinkler heads

E. Manual Valve Key Operator:

1. Gate valve key.
2. Stop and waste valve key, rigid stee, with"T" handle, standing three (3) feet above ground when used and key end to fit stop and waste valve nut.

PART 2 PRODUCTS

2.1 **PIPE, FITTINGS, OTHER**

A. Mainline Pipe, Lateral Pipe: PVC, Schedule 40 up to 2-1/2 inch diameter, then Class 200 for larger diameters, ASTM D1785:

1. Smaller than three (3) inches diameter, solvent welded, ASTM D2672.
2. 3 inches and larger diameter, threaded or mechanical joint.

B. Fittings: Solvent welded or threaded.

C. Sleeves, PVC: Four (4) inch minimum.

D. Riser:

1. Threaded schedule 80 PVC pipe 1/2 inch diameter. Length as required.
2. Half inch barbed swing pipe adapter.

E. Valve Fittings: PVC: Schedule 80 threaded.

F. Copper Pipe: Type K, ASTM B88.

G. Copper Fittings: Wrought or cast, ASTM B687.

2.2 VALVES

A. Manual Control Valve: Gate type with cast bonze body, resilient integral taper seat, non-rising stem, and fitted for key operation.

B. Manual Drain Valve: Ball type, 3/4 inch bronze body, with replaceable seat disc.

C Automatic Control Valve:

1. Globe type, normally closed, fitted for manual flow adjustment.
2. Totally encapsulated low power replaceable solenoid.
3. High-strength rubber or synthetic rubber diaphragm.
4. Pressure regulating (set for site conditions).

D. Automatic Drain Valve: Designed to open for drainage when line pressure drops below three (3) psi. (NOT for use on mainline pipe.)

2.3 DRAIN SUMP

A. Sewer rock or pea gravel, Section 31 05 13.

2.4 BACKFLOW PREVENTER

A. Manufacturer's standard, State or OWNER approved, to suit sprinkler system and the following:

1. Reduced Pressure Principle Device: Above ground type, ASSE 1013.
2. Capable of being tested and serviced without removal from pipe line.
3. Body and caps constructed of bronze with wear and corrosion resistant internal parts complete with bronze quarter turn ball valves.
4. When underground irrigation system is designed for liquid fertilizer, provide a reduced pressure backflow prevention device. The drain to daylight must be a minimum of 12 inches below the bottom of the release valve for devices four (4) inches in diameter and smaller, or 12 inches plus the nominal diameter of the devices over four (4) inches in diameter.

2.5 SPRINKLER HEADS

A. In General: Heads are placed to provide uniform coverage over entire area of spray indicated at available water pressure.

B. Pop-up Spray Head:

1. Fixed pattern with screw type flow adjustment and stainless steel retraction spring.
2. Pop-up of 4, 6, and 12 inches.
3. Side and bottom inlets on six (6) and 12 inch heads.

C. Rotary Head:
   1. Gear driven, high-impact plastic construction full circle and part circle design.
   2. Built-in check valve.

D. Pop-up Impact Head:
   1. High-impact plastic construction, full circle, part circle, with plastic clapper, and heavy duty steel retraction spring.
   2. Side or bottom inlet.
   3. Built-in check valve required when used with more than three (3) feet of elevation change on the lateral line.
   4. Plastic sprinkler nozzles, interchangeable.

E. Above-ground Impact:
   1. Brass construction with stainless steel clapper.
   2. Mounted above ground with no pop-up features.
   3. Brass sprinker nozzles interchangeable.

2.6 **NOZZLES**

A. Fixed Spray:
   1. Radius pattern and gal/min as required.
   2. Matched precipitation rates.
   3. Stainless steel adjustment screw.
   4. Threaded to match riser.
   5. Pressure regulating: (Required when the psi at the sprinkler does not fall within the range recommended for its use). See manufacturer's specifications.
   6. Filter Screen.

B. Bubbler:
   1. Made of high-impact plastic.
   2. Pressure compensating with adjustable flow and radius as required.
   3. Threaded to match riser.
   4. Attached to fixed riser or pop-up spray.
   5. Filter screen.

2.7 **VALVE BOX**

A. Precast concrete or plastic with adequate hand room to operate small tools and provisions for locking cover to frame.

B. For drain pockets, ASTM size no. 2 gravel (2-1/2 inch) Section 31 05 13.

2.8 **DRIP TUBING**

A. Self cleaning, pressure compensating, polyethylene dripper line.

B. Dripper discharge: 0.6 to 0.9 gal/hr and choice of 12, 18 or 24 inch spacing.

C. Pressure compensation range from eight (8) to 60 psi.

2.9 **LINE FLUSHING VALVE**

A. Automatic cleaning, high impact, 1/2 inch diameter, plastic.

B. Maximum flow rate per flush valve: 15 gal/min.

C. Can be disassembled allowing for winterization blow-out.

2.10 **AIR/VACUUM RELIEF VALVE**

A. Brass body and cap and rated to 200 psi.

B. Temperature resistant silicone disc seat.

2.11 **FILTER**

A. Disk:

1. Corosion resistant thermoplastic, threaded.
2. Multiple disk filter design: 120 mesh.
3. Shut-off valve.
4. Constructed of durable, non-corrosive components and equipped with O-ring seals.

B. "Y":

1. Threaded inlet and outlet.
2. Polyester 0.01 mesh filter screen.
3. Durable, non-corrosive components and equipped with an O-ring seal.
4. Operating flow range of 1 to 15 gal/min with a pressure range of 10 to 150 psi.
5. Easy removable cap and screen.

2.12 **SWING PIPE**

A. Pipe: Polyethylene, flexible, rated for 80 psi.

B. Elbow: Barbed plastic suiting pipe diameter.

2.13 **QUICK COUPLER**

A. Heavy duty brass, one-piece body design.

B. Operating flow range of five (5) to 125 gal/min with a pressure range of 125 psi.

C. Brass key to match valve type and size.

D. Stainless steel spring.

2.14 **JOINT PRIMER AND SOLVENT CEMENT**

A. Refer to ASTM F656, and ASTM D2672 requirements.

2.15 **VALVE BOX**

A. Two inch diameter, Schedule 40 PVC with removable cap, length as required.

2.16 **TEFLON TAPE**

A. For use on threaded joints. Quality grade, 0.004 inch.

2.17 **AUTOMATIC CONTROL SYSTEM**

A. General: Furnish low voltage system manufactured expressly for control of automatic circuit valves of underground irrigation systems. Provide unit of capacity to suit number of circuits.

B. Control Enclosure - External Applications: Manufacturer's standard weatherproof enclosure with locking cover, complying with NFPA 70.

C. Control Enclosure - Internal Applications: Manufacturer's standard with locking cover, complying with NFPA 70.

D. Wire:

1. Provide wire for connecting remote control valves to automatic controllers that is Type "UF", 600 volt, stranded or solid copper, single conductor wire with PVC insulation and bearing UL approval for direct underground burial feeder cable. Make all connections with UL approved type seal to make a waterproof connection. Bury wires in the same trench as the pipe where possible.
2. Provide wire with 4/64 inch insulation, minimum covering of ICC- 100 compound for positive weatherproofing protection. For wire sizes 14, 12, 10, and 8 use a single conductor solid copper wire, and for sizes 6 and 4 use stranded copper wire. Make control or "hot" wires red and all common or "ground" wires white.
3. Verify wire types and installation procedures conform to local codes.

Table 1 – Valve Wire Sizing Chart

Voltage at Controller	Wire Control Common	Maximum Allowable Length in Feet from Controller to Valves			
		No. of Valves (Solenoids)			
		1	2	3	4
14	14	2765	1309	846	549
14	12	3393	1608	1039	673
14	10	3962	1877	1213	783
12	12	4394	2082	1346	6872
12	10	5397	2557	1652	1071
12	8	6364	3018	1949	1263
10	10	6986	3311	2140	1387

E. Transformer: To convert service voltage to control voltage and in accordance with manufacturer's recommendations.

F. Circuit Control: Each circuit variable from approximately five (5) to 60 minutes. Include switch for manual or automatic operation of each circuit.

G. Timing Device: Adjustable, 24 hours and 14 days clocks to operate any time of day and skip any day in a 14 day period. Allow for manual or semiautomatic operation without disturbing preset mechanical operation.

PART 3 EXECUTION

3.1 EXCAVATION

A. Section 31 23 16.

B. Excavate trenches for sprinkler system pipe to provide 18 inches of cover over Mainline Pipe and 10 inches over Lateral Pipe. Before excavating, establish location of all underground utilities and obstructions.

C. Trench for sprinkler system to ensure proper grades and slopes to drain points.

D. Barricade trenches within the right of way and along pedestrian routes that are left open overnight or that may be a hazard during construction, Section 01 55 26.

3.2 INSTALLATION

A. General: Plans are diagrammatic. Proceed with installation in accordance with the following:

1. Run all Lateral and Mainline pipe as required. Within planting areas avoid conflict with trees. Where trenching is required in proximity to trees which are to remain, do not damage roots.
2. Install stop and waste valves, isolation valves, vacuum breakers, pressure reduction valves, and other equipment required by local authorities according to Laws and Regulations in order to make system complete.
3. Slope Lateral Pipe to drain.
4. After completion of grading, seeding or sodding, and rolling of grass areas, adjust heads to be flush with finished grades.

B. Piping:

1. Assemble all Lateral and Mainline Pipe in accordance with manufacturer's recommendations. Assure positive drainage.
2. At wall penetrations, pack opening around pipe with Section 03 61 00 non-shrink grout. At exterior face, fill perimeter slot with backer rod and sealant. Repair below grade waterproofing and make penetration watertight.
3. Install PVC pipe in dry weather above 40 deg F Allow joint to cure a minimum of eight (8) hours before testing.

C. Sleeves:

1. Install sleeves before concrete work.
2. Under roadway, install PVC sleeve if cover over sleeve exceeds two (2) feet, otherwise use cast iron or ductile iron sleeve.

D. Control Valves:

1. Install remote control valves to manufacturer's recommendation.
2. Use Schedule 80 PVC pipe for nipples on valve header, length as necessary. Install valves one per each plastic valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.

E. Automatic Drains: Install per manufacturer's recommendations at low point of Lateral Pipes and Mainline Pipes.

F. Manual Drains:

1. Install per manufacturer's recommendations on upstream and downstream side of backflow preventers and at lowest point along Mainline Pipe.
2. Install by teeing down to 3/4 inch drain valve. Provide a drainage sump sized to receive volume of drain water.
3. Make manual drain valves accessible by installing an adjustable pipe sleeve to meet finished grade with locking valve marker lid flush with finish grade.

G. Quick-Coupling Valves: Install using 3/4 inch flexible lateral with galvanized elbow and riser. Locations as indicated.

H. Backflow Preventers:

1. Install assembly complete for sprinkler systems with two (2) drain valves and two (2) shut off valves per local Laws and Regulations, and manufacturer's requirements.
2. In below grade installations install assemblies with drain valves. Provide open box floor with gravel drain sump.

I. Valve Access Boxes:

1. Install over all remote control valves, manual control valves, zone shutoff valves, gate valves or globe valves. Valves to be installed using valve markers will not require access boxes.
2. Install boxes on level subgrade to proper grade and proper drainage.
3. Provide boxes with proper length and size extensions.

J. Automatic Controller:

1. Mount the panel enclosure so adjustments can be conveniently made by the operator.
2. Ground controller per local Laws and Regulations.
3. Make all control wire connections to automatic controllers.
4. Coordinate controller installation with electrical work.

K. Wire and Electrical Work:Use electrical control and ground wire suitable

for sprinkler control cable of size indicated.

L. Sprinkler Heads, Emitters, Bubblers, Small Rotators (less than 10 gallons per minute):
   1. Install with flexible lateral and spiral barbed PVC elbows and riser (length as required).
   2. Install shrub spray heads a minimum of 12 inches above finished grade of plantings.
   3. Install tree bubblers 1/2 inch below crown of tree roots.
   4. Flush Lateral Pipe thoroughly. Remove all foreign materials prior sprinkler head installation.

M. Large Rotator Heads (10 gallons per minute or more): Install pressurized swings joints with O-ring seals.

N. Swivel Hose Elbows: Install brass swivel hose elbows, accurately machined pipe with hose threads and "O" ring seals.

3.3 FLUSHING AND TESTING

A. Mainline Pipe: Section 33 08 00. Test at design pressure:
   1. Flush pipe clean before pressure testing.
   2. Pressure test in sections to expedite backfilling.
   3. Notify ENGINEER 24 hours in advance of pressure testing pipe. Before backfilling and after air pockets have been vented from the lines, pressure test for three consecutive hours. Repair all leaks.

B. Lateral Pipe: Section 33 08 00. Test at design pressure:
   1. Pressure test in sections to expedite backfilling is permitted.
   2. Flush pipe clean before head placement.
   3. Provide one hundred (100) percent precipitation coverage.

3.4 BACKFILLING

A. Section 33 05 20.

B. Backfill above pipe with soil free of rocks over 1 inch diameter, debris, or organic matter. Backfill final four (4) inches with soil of like quality to adjacent areas.

C. Compact Trench backfill thoroughly to prevent settling damage to grades or plant materials. Repair at no additional cost to OWNER.

3.5 SURFACE FINISHING

A. Protect existing landscaping.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.
   1. Section 32 92 00 for turf and grasses.
   2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.6 **FIELD QUALITY CONTROL**

A. Piping may be tested in sections to expedite backfilling.

B. Notify ENGINEER to schedule final inspection after irrigation system is completely installed and fully functional.

C. Make required field adjustment before inspection and changes after inspection as required by OWNER and ENGINEER.

END OF SECTION

SECTION 32 91 19

LANDSCAPE GRADING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Landscape grading requirements.

B. Backfill materials.

1.2 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.3 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during the backfilling process. Work closely with ENGINEER particularly when grading and construction berms, channels, or other aesthetic considerations.

D. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.4 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

C. Avoid displacement of and injury to Work while compacting or operating equipment.

D. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.5 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.6 **ACCEPTANCE**

A. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Crushed aggregate base, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

1.7 **WARRANTY**

A. Any settlement noted in landscaped surfaces will be considered to be caused by improper compaction methods and shall be corrected at no additional cost to the OWNER.

B. Restore incidentals damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13.

B. Cement treated fill, Section 31 05 15.

C. Crushed aggregate base, Section 32 11 23.

D. Structural soil mix, Section 32 91 13.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

E. Verify stockpiled fill meets gradation requirements, areas to be backfilled are free of debris, snow, ice or water, and ground surface is not frozen.

F. If subgrade is not readily compactable secure written authorization for

stabilization excavation and backfill. Refer to Section 31 23 16.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Protect subgrade from desiccation, flooding and freezing.

D. Do not fill adjacent to structures until Excavation is checked by ENGINEER.

E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches.

G. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

B. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **BACKFILLING**

A. General: Conduct work in an orderly manner. Do not create a nuisance. Do not permit soil accumulation on streets or sidewalks. Do not allow soil to be washed into sewers and storm drains.

B. Grading Intent: Spot elevations and contours indicated are based on the best available data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference in elevation between points change, then the minimum percentage of slope as a result of field adjustment of specific spot elevations is as follows:

1. Pavement Areas: 1 percent.
2. Concrete or Brick Areas: 0.30 percent.
3. Lawn or Planted Area: 0.75 percent.

C. Planted Surfaces:

1. Place backfill to a finished grade.
2. Grade slopes to provide adequate drainage after compaction. Do not create water pockets or ridges. Prevent erosion of freshly graded areas during construction until surfaces have been constructed and landscaping areas have taken hold.
3. Remove surface stones greater than 1 inch from finished grading.

D. Hard Surfaces: Place structural soil to depth specified.

3.5 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.6 **COMPACTION**

A. Ninety-two (92) percent relative to a standard proctor density, Section 31 23 26, unless indicated elsewhere.

3.7 **SURFACE FINISHING**

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surfaces to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

1. Backfill areas to contours and elevations required. Do not use frozen materials.
2. Make smooth changes in grade. Blend slopes into level areas.
3. Remove surplus backfill materials from site.
4. Leave stockpile areas completely free of excess fill materials.
5. Slope grade away from building at a minimum of five (5) percent for ten (10) feet unless indicated otherwise.

3.8 **CLEANING**

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 92 00

TURF AND GRASS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Seed and sod requirements.

B. Soil preparation and fertilizers.

1.2 **REFERENCES**

A. **FS Standards**:

OF 241 Fertilizers, Mixed, Commercial.

B. **ASPA Standards**:

Guideline Specifications for Sodding.

1.3 **SUBMITTALS**

A. Submit name of sod supplier or location.

B. Submit laboratory analysis of top soil, if requested by ENGINEER.

1.4 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date and location of packaging. Damaged packages are not acceptable.

B. Strip sod no more than 24 hours before laying.

C. Deliver fertilizer in containers showing weight, chemical analysis, and name of manufacturer. Store fertilizer in a weatherproof location.

PART 2 PRODUCTS

2.1 **SEED**

A. Furnish grass seed that is fresh, clean, and new crop composed of varieties indicated and tested to have minimum of 90 percent purity and minimum of 80 percent germination.

B. Use seed that conforms to applicable Laws and Regulations.

C. Do not use wet, moldy or otherwise damaged seed.

2.2 **SOD**

A. Obtain all shipments of sod from approved sources.

B. Mowed regularly and carefully maintained from planting to harvest to assure reasonable quality and uniformity.

C. Free of grassy and broadleaf weeds, and bare or burned spots.

D. Clean, strongly rooted sod of variety indicated.

E. Cut sod in pieces not exceeding 1 square yard. Limit depth of cut to 1/2 inch minimum and 1 inch maximum.

2.3 **TOP SOIL**

A. Section 31 05 13.

2.4 **ACCESSORIES**

A. Fertilizer: Uniform in composition, dry and free flowing. Comply with FS O-F-241. Provide nutrients required by soil analysis.

B. Mulching Material: Wood or wood cellulose fiber free of growth or germination inhibiting ingredients.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Protect existing underground improvements from damage.

B. Do not place turf and grasses until existing weeds have been removed and soil has been prepared.

C. Do not sow immediately following rain, when ground is too dry, too hard, or during windy periods without first loosening the surface.

3.2 **GRADING**

A. Establish finished grades after settling to provide adequate drainage so no water pockets or ridges will be created.

B. Till soil to a depth of four (4) inches and remove rocks and debris over two (2) inches diameter and any vegetation and weeds. Fine grade entire site to a smooth, loose, and uniform surface. Use native or approved imported topsoil and plant after proper preparation.

C. When subgrade has been established, roll areas to remove ridges and depressions so surface is parallel with finished grade. Limit weight of rolling equipment to 110 pounds minimum or 250 pounds maximum per square foot.

D. Site tolerances:

1. Total topsoil depth for lawns or grasses: Five (5) inches.
2. Elevation of topsoil relative to walks, hard surfaces or edges:
   a. Seed Areas: 1/2 inch below.
   b. Sod Areas: 1-1/2 inches below.
3. Slope away from building five (5) percent for 10 feet minimum. Fill low spots and pockets. High point of finish grade shall be at least six (6) inches below finish floor level.

3.3 **FERTILIZING**

A. Apply fertilizer in formulation and quantity required by soil analysis.

B. Apply after fine grading and mix thoroughly into upper two (2) inches of topsoil.

C. Do not apply grass seed and fertilizer at same time in same machine unless one step hydro seeding is used.

D. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.4 **SEEDING**

A. Unless indicated otherwise, apply seed at a rate of five (5) pounds per 1,000 square feet evenly in two (2) intersecting directions. Rake in lightly.

B. Apply fine spray water immediately after each area has been sown.

3.5 **ONE STEP HYDRO SEEDING**

A. Unless indicated otherwise, on lawn areas apply seed at the rate of five (5) pounds per 1,000 square feet and fertilizer at the rate of 15 pounds per 1,000 square feet of area.

B. Mix seed and fertilizer with a specially prepared dyed wood cellulose fiber and water to form a slurry.

C. Mix slurry in tanks having continuous agitation so that a homogenous mixture is discharged hydraulically on area to be seeded.

D. Apply wood fiber mulch in suspension at a rate of 2,000 pounds per acre or as indicated otherwise.

3.6 **TWO STEP HYDRO SEEDING**

A. Make soil surface smooth, loose and uniformly fine texture before seeding. Do not prepare more ground than can be seeded in a work day period.

B. Mix fertilizer at a rate of 15 pounds per 1,000 square feet, with wood fiber mulch and water to form a slurry.

C. Maintain a well mixed fertilizer slurry in the mix tank.

D. Spray the fertilizer mixture at the rate of 2,000 pounds per acre.

E. Sow seed on fertilized areas at the rate of five (5) pounds per 1,000 square feet of area, in two (2) directions with a cyclone or other type mechanical seeder.

3.7 **SEED PROTECTION ON SLOPES**

A. Blankets: Section 31 25 00.

3.8 **LAYING SOD**

A. Maintain the sod moist, live, and in good condition to encourage immediate growth.

B. Comply with ASPA guidelines for sodding.

C. Lay sod on smooth, moist topsoil, working off planks if required. Rake to loosen and level before placing each course of sod. Ensure sod is not stretched or overlapped and all joints are butted tight. Place sod to break joints on ends. Keep length seams in a straight line.

D. Roll sod immediately after placing. Thoroughly water with a fine spray to a depth sufficient that the underside of the new sod and soil immediately below the sod are thoroughly wet.

E. On slopes two (2) horizontal to one (1) vertical and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at 2 feet maximum on center. Drive pegs flush with soil portion of sod.

3.9 **RESTORATION**

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surface is to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

3.10 **CLEANING AND MAINTENANCE**

A. Remove from site foreign materials collected during cultivation.

B. Dispose of cleanings.

C. Grass maintenance, Section 32 01 90.

END OF SECTION

SECTION 32 93 13

GROUND COVER

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Plants and ground cover requirements.

B. Bedding, topsoil, and temporary support.

1.2 **REFERENCES**

A. **AAN Standards**:

B. **ANSI Standards**:

Z60.1 American Standard for Nursery Stock.

C. **FS Standard**:

OF 241 Fertilizers, Mixed, Commercial.

1.3 **QUALITY ASSURANCE**

A. Perform work in conformity with applicable requirements of AAN.

B. Obtain nursery stock and other plant materials from acceptable sources.

C. Provide plants free of disease and insects.

1.4 **SUBMITTALS**

A. Submit samples of fertilizers and a complete listing of all plantings, origins and sizes.

B. All necessary inspection certificates for each shipment of plants as required by Laws and Regulations.

C. Schedule of planting times.

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. Exercise care in digging, transporting, handling, and packing of all plants.

B. Handle plants so roots are protected at all times. If delivery is in open vehicles, cover entire load without causing over heating.

C. Deliver plant materials immediately before placement. Keep plant materials moist.

D. Protect balls from sun and wind by covering with soil or other suitable material if not planted immediately on delivery.

E. Store fertilizer in a weatherproof location such so its effectiveness will not be impaired.

1.6 **ACCEPTANCE**

A. Ball of earth surrounding roots has not been cracked or broken.

B. Burlap, staves, and ropes required in connection with transplanting are installed.

C. Heeled in stock from cold storage not accepted.

1.7 **WARRANTY**

A. Warrant plantings through one year plus one continuous growing season. Replace any unsatisfactory or dead plantings within 10 days of written notice. Make corrections at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Provide plants of normal growth and uniform height, according to species, with straight canes and well developed leaders, roots, and tops.

B. Provide plants of sizes indicated, Size stated in each case being interpreted to mean dimensions of plant as to stands in its natural position in nursery without straightening of any branches or leaders.

C. Provide legible labels attached to all plants, specimens, bundles, boxes, bales, or other containers indicating botanical genus, species, and size of each.

D. Plants cut back from larger sizes to meet Specifications shall be rejected.

E. Container growth deciduous shrubs will be acceptable in lieu of bailed and burlapped deciduous shrubs subject to limitations for container grown stock.

2.2 **NATIVE GRASSES AND WILDFLOWERS**

A. Unless indicated otherwise, provide the following mixture: 77 percent Festuca ovina duriuscula (Hard Fescue) and 23% Wildflower seeds of equal proportioned quantities of the following, Aster alpinus (Alpine Aster), Campanual carpatica 'Jacqueline' (Bluebells), Coreopsis grandiflora 'Sunray' (Dwarf Coreopsis), Eschschlzia californica (California Poppy), linum Lewisii (Blue Flax), Primula (While Primrose), Tagetes (Marigold), Viguiera Multiflora (Showy golden eye).

B. Purity of all seed types: 90 percent.

C. Germination of all seed types: 90 percent.

2.3 **ORGANIC MULCH**

A. Horticultural grade Class A decomposed plant material, elastic and homogeneous, free of decomposed colloidal residue, wood sulphur, and iron.

B. pH value of 5.5 to 7.5.

C. 60 percent organic matter by weight, moisture content not exceeding 15 percent, and water absorption capacity of not less than 300 percent by

weight on oven dry basis.

2.4 **ACCESSORIES**

A. Fertilizer, FS O-F-241: Uniform in composition, dry and free flowing. Provide nutrients required by soil analysis.

B. Wrapping Materials: Quality burlap tightly tied around plant root system.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Plan to install materials during normal planting seasons for each type of landscape work required. Correlate planting time with maintenance periods and warranty.

B. Verify area to receive plants is to grade, all work is completed in the area, and topsoil has been placed. Follow Section 31 23 23 grading requirements.

C. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Examine grade, verify elevations, observe conditions under which work is to be performed, and notify ENGINEER of unsatisfactory conditions.

3.2 **GRADING**

A. Site tolerances:

1. 12 inches minimum total topsoil depth.
2. 2 inches below walks, hard surfaces or edges.

B. Do not expose or damage existing shrub or tree roots.

C. Slope away from building five (5) percent for 10 feet minimum. Fill low spots and pockets. High point of finish grade shall be at least six (6) inches below finish floor level.

3.3 **FERTILIZING SEEDED AREAS**

A. Apply fertilizer in formulation and quantity required by soil analysis.

B. Apply after fine grading and mix thoroughly into upper two (2) inches of topsoil.

C. Do not apply seed and fertilizer at same time in same machine unless one step hydro seeding is used.

D. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.4 **INSTALLATION**

A. Place plant materials for orientation approval by ENGINEER before installation.

B. Set all shrubs slightly lower than finished grade. Use plant mix consisting of three (3) parts topsoil and 1 part organic mulch. Do not fill around stems. Carefully place and tamp plant mix soil to fill all voids.

C. Spread excess soil from excavated plant pits in surrounding planting beds.

D. Sow seed at the rate of 78 pounds per acre. Rake seed into soil and top-dress all seeded areas with 1/4 inch topsoil. Do not let seed installation be subject to damage by climatic conditions.

E. Restore pavements, grassed areas, planted areas, and other improvements damaged to a condition equal to original conditions.

3.5 **CLEANING AND MAINTENANCE**

A. Remove from site foreign materials collected during cultivation.

B. Dispose of cleanings.

C. Trees, plants, and ground cover maintenance, Section 32 01 90.

END OF SECTION

SECTION 32 93 43

TREE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Supply and install tree.

B. Site preparation and backfill requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**: Plan 681 Tree

B. **ANSI Standards**:

A300 Tree, Shrub and Other Woody Plant Maintenance Practices. Z60.1 American Standard for Nursery Stock.

C. **International Society of Arboriculture (ISA) Standards**.

1.3 **SUBMITTALS**

A. Copy of CONTRACTOR's notice to property owner. Format to be substantially as follows:

NOTICE TO PROPERTY OWNER

Your new tree is a:____ (*Name of tree*)

How to take care of your new tree.

- Water thoroughly once every 7 to 10 days during the spring, summer and fall for at least two (2) years. Put your hose by the base of the tree and run water gently for about 20 minutes. Then as tree matures, water at the drip line (straight down under the tips of the branches) every three (3) to four (4) weeks.
- Do not fertilize until second year and only then if needed.
- Do not use weed killer near new trees.
- Protect new tree from damage by cars, lawn mowers, grass trimmers, bikes, vandals, etc.
- Maintain a mulch cover at the base of the new tree.

1.4 **QUALITY ASSURANCE**

A. Provide an ISA certified arborist to observe tree planting. Upon ENGINEER's request, provide a copy of the arborist's ISA certificate and registration number on file with the State Division of Commercial Code.

B. Nursery: Use a company specializing in growing and cultivating trees with minimum three (3) years experience.

C. Installer: Use a company specializing in installing and planting tree.

D. Planting Plan: Correlate planting time with maintenance periods and warranty.

E. Rejection: Reject any tree upon the following basis:

1. Tree has cracked or broken ball of earth surrounding roots before or during process of planting.
2. Tree was cut back from a larger plant to meet Specifications.
3. Tree is not specified size.
4. Tree has been pruned improperly.
5. Tree has disease or insect infestations.
6. Tree was damaged during transplant.

1.5 **ACCEPTANCE**

A. Tree will be accepted not less than 60 days after planting, watering and successful growth.

1.6 **WARRANTY**

A. Vegetation establishment priod, Section 32 98 00.

B. Include coverage of trees from death, unhealthy conditions, or if tree dies from poor planting practice. Replace any unsatisfactory or dead tree within 10 days of written notice.

C. Replacements: Provide tree of same size and species, planted in the next growing season, with a new warranty commencing on date of planting.

D. Additional Cost: All corrective work will be at no additional cost to OWNER.

1.7 **MAINTENANCE**

A. Period is until acceptance.

B. Maintain tree health immediately after placement.

C. Notify property owner of tree watering practice.

D. Trim off dead or broken branches. Remove clippings and dead branches from site.

E. Control disease.

PART 2 PRODUCTS

2.1 **TREE MATERIALS**

A. Species and size specified, grown in climatic conditions similar to those in locality of Work with branching configuration and cane requirements required in ANSI Z60.1.

B. Provide tree of normal growth and uniform height, according to species,

with straight trunk and well developed leaders, laterals and roots. Heeled in stock from cold storage not accepted.

C. Provide tree size indicated, (size being interpreted to mean dimension of tree as its stand in its natural position in nursery without straightening of any branches or leaders).

D. Provide legible labels attached to tree indicating botanical genus, species, and size.

2.2 **SOILS**

A. Backfill of Root Ball Pit: Native soil if not excessively rocky, compactable or clayey; otherwise amend at a rate of two (2) parts native soil to 1 part topsoil. Mix together thoroughly.

B. Topsoil: Section 31 05 13.

2.3 **ORGANIC MULCH**

A. Horticultural grade class A decomposed plant material, elastic and monogenous, free of decomposed colloidal residue, wood sulphur, and iron.

B. pH value of 5.5 to 7.5.

C. 60 percent organic matter by weight, moisture content not exceeding 15 percent, and water absorption capacity of not less than 300 percent by weight on oven dry basis.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Plan to install materials during normal planting season.

B. Notify ENGINEER of unsatisfactory conditions.

3.2 **EXCAVATION**

A. Excavate only for depth of root ball.

B. In park strips adjacent to paved thoroughfares, the traditional round hole barely big enough to accommodate the root ball is not permitted. Excavate the site in the shape of a rectangle. Make excavated area width at least two (2) times diameter of tree root ball and length at least three (3) times its' diameter:

1. Compact both sides of root ball parallel to street.
2. Loosen sides of planting site that are perpendicular to street.

C. In other landscaped areas, excavated area for tree planting at least three (3) times diameter of root ball.

D. Place plant materials for final orientation review by ENGINEER before backfilling root ball.

3.3 **INSTALLATION**

A. APWA Plan 681.

B. Remove wire baskets and twine from around root ball. If possible, remove all burlap material, or remove top 1/3 from root ball.

C. Maintain plant in vertical position. Eliminate voids and air pockets.

D. Remove all cardboard and twine from tree trunks.

E. Follow arborist's instructions.

3.4 **PRUNING**

A. Comply with ANSI A300 and directions of arborist.

3.5 **PROTECTION**

A. Do not touch directly or indirectly any overhead wire, cable, or power line.

B. Shelter the root ball. Do not let the root ball dry out.

C. Do not damage any irrigation line or emitter system.

D. Do not lift or maneuver the tree by the trunk.

E. Do no add gravel to the bottom of the hole.

F. Do not stake the tree unless carefully monitored by ENGINEER.

G. Do not compact the backfill.

H. Do not use grass clippings as mulch.

I. Do not over water, under water, over prune, paint or wrap the trunk, or fertilize during planting.

J. Do not forget to watch for people using the street or sidewalk while planting.

K. Do not over prune.

L. Do not allow grass, flowers, or vines to grow next to the trunk.

M. Protect roots and branches of existing trees.

N. Do not permit heavy equipment or stockpiling of materials or debris within the drip line. Do not permit earth surface within the drip line to be changed in any way except as required.

O. Replace existing trees damaged by construction operations at no additional cost to OWNER.

END OF SECTION

SECTION 33 05 07

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping. D2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 **DEFINITIONS**

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

1.4 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 **PRESSURE PIPE SYSTEM**

A. Pipe: AWWA C900, C905, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, ASTM C110.

2.2 **GRAVITY PIPE SYSTEM**

A. Pipe:

1. Solid smooth wall:
   a. 4 to 15 inch diameter, ASTM D3034.
   b. 18 to 27 inch diameter, ASTM F679.
2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F949.

B. Fittings: ASTM D1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when 730

flattened to 60 percent deflection, ASTM D2412.

2.3 **PERFORATED PIPE SYSTEM**

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D2729.

C. Joints: Push-on, solvent weld or other.

2.4 **SOLVENT WELDS**

A. Primer, ASTM F656.

B. Glue, ASTM D2564.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
    a. Water distribution and transmission, Section 33 11 00, AWWA C900, C905, and C909.
    b. Underground irrigation, Section 32 84 23, and ASTM D2855.
2. Gravity Systems:
    a. Sanitary sewers, Section 33 31 00.
    b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 08

PRE-STRESSED CONCRETE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete cylinder pipe in sizes 12 inches through 72 inches composed of a welded steel cylinder, steel joint rings welded to the cylinder, a centrifugally spun cement-mortar lining, a pretensioned rod wrapping helically wound around the steel cylinder under measured tension, and an exterior cement-mortar coating.

B. Couplings, fittings, and joint materials.

1.2 REFERENCES

A. **AISI Standards**:

No. 1012: Standard Nonsilverized Carbon Steel.

B. **ASTM Standards**:

A283 Low and Intermediate Tensile Strength Carbon Steel Plates.

A370 Test Methods and Definitions for Mechanical Testing of Steel Products.

A569 Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

A611 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality. A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C33 Concrete Aggregates. C150 Portland Cement.

C. **AWWA Standards**:

C200 Steel Water Pipe 6 In. and Larger.

C208 Dimensions for Fabricated Steel Water Pipe Fittings. C303 Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids.

1.3 SUBMITTALS

A. Design Summary: Before fabrication, submit a design summary for each size and class of pipe together with line layout drawings or line schedules that show the location of each section of pipe and each special fitting to be furnished.

1.4 **DELIVERY, STORAGE AND HANDLING**

A. Attach end covers to pipe stored either in the yard or in the field. Reject injurious drying out of concrete.

B. Stalls: Remain in place during storage.

C. Gaskets: Store in cool, well ventilated place and protect from direct sunlight.

PART 2 PRODUCTS

2.1 **STEEL CYLINDER**

A. Fabricated from either:

1. Hot-rolled carbon steel sheets: ASTM A570, Grade C, or ASTM A611, or ASTM A569 except that the maximum carbon content may be 0.25 percent and a minimum yield strength of 33,000 psi.

2. Plates: ASTM A283, Grade D.

3. Gauge of cylinder steel.

Pipe Size	Gauge	Pipe Size	Gauge
12” to 16”	16	54” to 57”	11
18” to 21”	15	60” to 63”	10
24” to 33”	14	66” to 69”	9
36” to 51”	12	72”	8

B. Seams: Fabricate sheets or plates into cylinders with longitudinal or helical seams. Where longitudinal seams are used, fabricate in courses, which may consist of two or more sheets or plates. Produce welds with a tensile strength at least equal to the specified minimum tensile strength of the sheet or plate. Cut test specimens from the cylinder and test per ASTM A370 when required.

C. Specified Diameter: The inside diameter of the concrete section.

D. Circumference of Steel Cylinders: Not to deviate from the design value by more than +3/16 inch for pipe sizes 16 inches and smaller or more than +1/4 inch for larger sizes.

2.2 **STEEL CYLINDER AND ROD AREA**

A. Total Cross-Section Area (cylinder plus rod reinforcement): Computed on the basis of a maximum stress of 16,500 psi, in the steel at the design pressure with no allowance for tensile strength of the concrete.

B. Rod Wrap: Not less than 7/32 inch diameter.

C. Maximum Center to Center Spacing Between Rods: No greater than 1-1/2 inches with cylinder thickness less than 14 gage nor greater than two (2) inches with cylinder thickness 14 gage and heavier.

D. Minimum Cross-Section Area of Rod Reinforcement per Lineal Foot of Pipe: Numerically equal to at least 1 percent of the nominal inside diameter of the pipe in inches.

E. Minimum Center to Center Spacing Between Rods: No closer than two

(2) rod diameters.

F. Cross-Sectional Area of the Rod Reinforcement: Not to exceed 60 percent of the total required area of steel.

2.3 **ROD WRAPPINGS**

A. Rod Reinforcement: Steele grade 40, ASTM A615 except:

1. Bars: Plain round bars except the requirements of ASTM A615, Sec. 6, 7 and 14.3 shall not apply.
2. Intermediate Diameter Bars: Meet the requirements for the next smaller bar number designation.
3. Bars of Diameter Less Than No. 3: Meet the requirements for No. 3 bar.

B. Helically wind rods and space equally along the length of the cylinder and continue over the cylindrical portion of the bell ring.

C. Use a suitable device for stressing, measuring, and visibly indicating the tension in the rod during the winding operation. Hold the tension within 110 to 125 percent of the difference between the specified minimum yield strengths of the cylinder and rod. Continue the rod wrapping from end to end of the cylinder and weld to the joint rings. Lap weld the welded splices in the rod for a distance of four (4) rod diameters or butt weld in such a manner that the joint develops a tensile strength at least equal to the specified minimum strength of the rod. Test each butt welding to the stress of 25,000 psi tension.

2.4 **JOINTS**

A. Steel Joint Rings: Bell and spigot rubber gasket type, self-centering without the gasket supporting the weight of the pipe and the steel conforming to the requirements of AISI Steel Designation No. 1012.

B. Spigot Rings: Fabricated from a specially rolled section which includes a gasket groove. Proportion the groove that, upon proper closure of the joint, the gasket will be suitable compressed and will effect a watertight seal which provides for expansion, contraction and deflection.

C. Bell Ring Thickness Plus Rod Reinforcement Over the Bell: Provide a total cross-sectional area not less than 1/3 greater than that furnished for an equivalent length along the barrel of the pipe.

D. Sizing: Size both the bell and spigot rings to the same design diameter by expanding the rings beyond the elastic limit of the steel.

E. Tolerances:

1. Minimum bell ring thickness: U.S. standard 10 gage for pipe sizes 12 inches through 16 inches and 3/16 inch for larger sizes.
2. Circumference of the inside bell ring contact surface: Not to exceed the circumference of the outside spigot ring contact surface by more than 3/16 inch.

2.5 **TESTING STEEL CYLINDERS**

A. After each cylinder is completed, but before lining or coating, test hydrostatically to a minimum hydrostatic pressure which develops a circumferential tensile stress of not less than 20,000 psi and not more than 25,000 psi. Reweld cylinders that show any leakage under test at the points of leakage and subject them to another hydrostatic test. Continue procedure until completely watertight under the required test pressure.

2.6 **RUBBER GASKETS**

A. Shape: Circular cross-section.

B. Gasket Compounds: Conform to the requirements of AWWA C200 consisting of first grade natural rubber, synthetic rubber, or a suitable combination thereof. Form and cure in such a manner as to be dense and homogenous with a smooth surface free from blisters, pits, and other imperfections.

2.7 **CEMENT**

A. Cement: Type II, ASTM C150 unless indicated otherwise.

2.8 **AGGREGATES**

A. Sand for Cement-Mortar: "Fine Aggregate", ASTM C33, except that the gradation may be modified to provide a lining of optimum density.

2.9 **CEMENT-MORTAR LINING**

A. Cement-Mortar: One part cement to not more than three (3) parts fine aggregate by weight. Control water content to obtain dense, workable, durable mortar.

B. Spin the lining in the cylinder to obtain a nominal thickness of 1/2 inch for pipe sizes 12 inches through 16 inches and to a nominal thickness of 3/4 inch for pipe sizes 18 inches and larger. Use gage rings at the ends of the pipe to control the thickness. Take adequate measures to limit the deviation from the mean diameter of the cylinder, at any section, to a maximum of 1/2 percent of the mean diameter. Where required, place external roundup rings around the cylinder before the spinning to ensure roundness of the cylinder and uniformity of lining thickness. After the mortar has been placed in the cylinder, revolve at a speed that will cause the cement-mortar to level out to a uniform thickness throughout the cylinder. Continue the spinning until the lining is thoroughly compacted and surplus water removed, and the finished lining is smooth and uniform throughout.

C. Moist cure the lining for a minimum period of 24 hours after spinning before wrapping the cylinder with rod. This may be accomplished by tightly sealing the ends of the cylinder with a waterproof membrane to retain the moisture in the mortar. Vapor curing may be used in lieu of or in combination with moist curing on a time ratio basis of one (1) hour vapor curing to four (4) hours moist curing. Transport, support, and cure in a manner to prevent damage to the lining.

D. Lining Thickness Tolerance: Not more than plus or minus 25 percent from the specified nominal thickness.

2.10 **EXTERIOR COATING**

A. Cement-Mortar for Coating: Ratio of 1 part of cement to not more than three (3) parts of fine aggregate, by weight. Control the water content to obtain a dense, workable, durable mortar. Rebound may be reclaimed and used as aggregate.

B. Apply by mechanical means producing a dense, uniform finished coating adhering tightly to the pipe. Provide a minimum nominal coating applied over the cylinder of 3/4 inch over the rod wrap.

C. Cement Slurry Coating: One bag of cement to not more than 10 gallons of water applied concurrent with the coating application to coat the steel assembly surface under the rod and the mortar-coating leading edge.

D. Suitably support the pipe during handling and curing to prevent damage to the lining and coating.

2.11 **CURING COMPLETED PIPE**

A. Moist cure the lining for a minimum period of six (6) days. Vapor curing may be used in lieu of or in combination with moist curing on a time ratio basis of one (1) hour vapor curing to four (4)hours moist curing.

B. Protect the mortar lining from temperatures below 40 deg F during the application.

2.12 **JOINT LENGTHS**

A. 40 feet except where shorter lengths are required for fittings, curves, or closures.

2.13 **BENDS AND SPECIFIC FITTINGS**

A. Fabricated short radius bends or special fittings such as wyes, tees and crosses from previously tested steel cylinders, AWWA C208. Fabricate bends or special fittings at least equal in strength to the abutting pipe sections and mortar line and coat after fabrication. Obtain approval of the design before fabrication.

B. Test all seams of bends or special fittings, except those seams previously tested as cylinders. Test seams by the air soap method or by the dye-check method. Repair any leaks by welding and retest the seam and recoat if required.

2.14 **OUTLETS**

A. Fabricate outlets into the wall of the pipe, before testing, for blow-offs, branches, air valves, and access manholes. Provide cast or fabricated steel fittings of suitable design and securely weld to the cylinder before being coated. Reinforce the pipe cylinder, as necessary, for the required opening. Obtain approval of the design of such outlets before fabrication.

2.15 **WELDED JOINTS**

A. Where welded joints are shown on the drawings, the rubber gasketed joint may be welded by inserting a filler rod under the flare of the bell and welding in place to the bell ring and to the spigot ring, or special joints for field welding may be furnished.

2.16 **BEVELED ENDS**

A. Where curves are required which have a shorter radius than can be obtained by unsymmetrical closure of the joint, sections of pipe may be furnished with beveled ends. An end of beveled pipe may have a maximum bevel of five (5) degrees measured from a plane perpendicular to the axis of the pipe. The long point of the bevel shall be so marked on the pipe.

2.17 **SOURCE QUALITY CONTROL**

A. Refer to AWWA C303.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and Section 33 11 00 requirements for water distribution and transmission. Use the more stringent provisions if there are any conflicts.

1. Use slings or pipe manufacturer approved lifting devices.
2. Lay pipe to curved alignment by means of unsymmetrical joint closure.
    a. Use a joint deflection of up to 3/4 inch for pipe sizes 12 inches through 24 inches.
    b. Use a joint deflection of up to 1 inch for pipe sizes 27 inches and larger.
3. Where curves are required which have shorter radius than can be obtained by unsymmetrical closure of the joint, furnish sections of pipe with beveled ends. The end of a beveled pipe may have a maximum bevel of five (5) degrees measured from a plane perpendicular to the axis of the pipe. Mark the long point of the bevel on the pipe.
4. Joints to be grouted inside and outside as per manufacturer's recommendations.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 0514

UTILITY GRADE ADJUSTMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Raise, lower, or change slope of Street Fixtures.

B. Install Cover Collars.

C. This section is NOT APPLICABLE to raising and lowering Street Fixtures that withstand internal pressure.

1.2 DEFINITIONS

A. Box: A structure such as a valve box, meter box, monument box, fire hydrant box, electrical pull box, cleanout box or other like structure not intended for human entry.

B. Cover Collar: A concrete filled annular space between metal frames and the adjacent Pavement structural section.

C. Extension Ring: A concrete or metal ring used to adjust surface elevations and surface cross slopes of Street Fixture covers. Metal rings are used between metal frames and metal covers or grates. Concrete rings are used below metal frames or in the concrete structure below.

D. Manhole: A structure designed to permit human entry and working space inside and to confine and control the flow of pipe-conveyed fluids. These structures are collectively referred to as manholes regardless of composition, design, type or depth.

E. Street Fixture: The top of existing structures such as but not limited to Manholes, catch basin, sumps, inlets, valve boxes, meter boxes, monument boxes, and similar structure in a thoroughfare surface.

F. Vault: A structure intended for human entry containing electrical/telephone facilities or other like utilities.

PART 2 - PRODUCTS

2.1 PAVEMENT

A. Asphalt Concrete: AC-20-DM-1/2, Section 32 12 05.

B. Cast-in-place Concrete: Class 4000, Section 03 30 04.

2.2 GROUT

A. Hydraulic cement, Section 03 61 00.

2.3 EXTENSION RINGS

A. Metal: Cast iron or steel, Section 05 56 00.

B. Cast-in-place Concrete: Class 4000, Section 03 30 04.

PART 3 - EXECUTION

3.1 PREPARATION

A. Determine condition of existing incidental structure. Any item not reported damaged prior to construction shall be considered unbroken and must be replaced by CONTRACTOR at no additional cost to OWNER.

B. Provide invert cover over pipe in cleanout box to prevent gravel, concrete, or debris from entering pipeline.

C. Unless indicated otherwise, arrange for utility companies to adjust their own structures.

D. Coordinate all adjustments with requirements of affected utility company.

3.2 ADJUST STRUCTURE TO GRADE

A. Restrict excavation around the structure to a minimum area.
B. At the completion of the structure adjustment, backfill the void around the structure and compact before paving or landscaping.
C. Apply mortar to inside and outside of concrete grade rings used to make adjustments.
D. If the cone is cracked during construction, restack the Manhole with shorter Manhole sections and install a new cone at no additional cost to the OWNER.

3.3 ADJUST COVER IN PAVEMENT SURFACE

A. Method A - Metal Extension Rings:
    1. Use rings that lock together.
    2. Set frame at desired elevation and cross-slope.
    3. Seal joints between Pavement and ring, Section 32 01 17.
B. Method B – Concrete Extension Rings:
    1. Place concrete grade rings under frame or in structure riser shaft.
    2. Set frame at desired elevation and cross-slope.
    3. Provide 100 percent concrete support under frame. Do not use wood, bricks, concrete fragments, blocks or particles as support.
    4. Grout seams between concrete rings and between frame and concrete rings.
C. Method C – Place Concrete:
    1. Set frame at desired elevation and cross-slope.
    2. Place concrete and provide 100 percent concrete support under frame.
D. Method D – Concrete Deck:
    1. Remove existing concrete deck.
    2. Reset steel rebar.
    3. Set frame to grade, set forms.
    4. Pour concrete. Provide complete concrete support under Street Fixture.

3.4 INSTALLING COVER COLLAR

A. Open an annular space between pavement and Street Fixture cover. Unless indicated otherwise, provide 12 inches of annular space.
B. Set concrete collar to 1/4 inch minimum to 1/2 inch maximum below asphalt concrete pavement surface and 1/4 inch below Portland cement concrete pavement surface.
C. Trowel finish, Section 03 35 00.

3.5 PAVEMENT SURFACE RESTORATION

A. In new streets or overlays, adjust Street Fixture cover after bituminous paving is complete.
B. Pavement restoration, Section 33 05 25.

END OF SECTION

SECTION 33 0520

BACKFILLING TRENCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trench backfill materials.
B. Trench backfilling requirements.
C. Surface restoration requirements.

1.2 DEFINITIONS

A. Bedding: That surface of the Excavation or portion of the Pipe Zone below the pipe.
B. Pipe Zone: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.3 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:
    1. Subgrade material, and
    2. Each type of fill to be used.
B. Upon ENGINEER's request, submit a written quality control Inspections and testing report describing source and field quality control activities performed by CONTRACTOR and its Suppliers.

1.4 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.
B. Reject backfill material that does not comply with requirements specified in this section.

1.5 STORAGE AND PROTECTION

A. Storage:
    1. Safely stockpile backfill materials.
    2. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.
C. Protection:
    1. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.
    2. Avoid displacement of and injury to Work while compacting or operating equipment.
    3. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.6 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.
B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.
C. Reshape and compact damaged structural section to required density. D. Restore any damaged structure to its original strength and condition. E. Replace contaminated backfill at no additional cost to OWNER.

1.7 SEQUENCING

A. Coordinate backfilling operation with pipeline commissioning requirements in Section 33 08 00.

1.8 ACCEPTANCE

A. General:
    1. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.
    2. For material acceptance refer to.
        a. Common fill, Section 31 05 13.
        b. Crushed aggregate base, Section 32 11 23.
        c. Cement treated fill, Section 31 05 15.
B. Trench Backfilling: One test per Lot.

Table 1: Lot Size for Trench Backfilling Operation		
Material	**Test Criteria**	**Lot size**
Subgrade	Standard (a)	200 lineal feet
Common Fill	Standard (a)	200 lineal feet per lift 25 square feet of footing area per lift
Crushed Aggregate	Modified (a)	200 lineal feet per lift 25 square feet of footing area per lift
Flowable Fill	Strength (b)	50 cubic yards
NOTES (a) Proctor density, Section 33 05 05 (b) Compressive strength, Section 31 05 15 (c) Lift thickness above the pipe zone before compaction, 8 inches.		

1.9 WARRANTY

A. Any settlement noted in Trench backfill or in structures built over the Trench backfill will be considered to be caused by improper compaction methods and shall be corrected at no cost to the OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Crushed aggregate base, Section 32 11 23.

C. Cement treated fill, Section 31 05 15.

D. Slag or asphalt bearing material not allowed.

2.2 ACCESSORIES

A. Water: Make arrangements for sources of water during construction and make arrangements for delivery of water to site. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

B. Geotextile Fabric: Section 31 05 19.

C. Identification Tape: Permanent, bright-colored, continuous-printed magnetic plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick. The tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color of tape as follows.

1. Red: Electric power lines, cables, conduit and lighting cables
2. Yellow: Gas, oil, steam, Petroleum or gaseous materials
3. Orange: Communications, alarm, signal, cables or conduits.
4. Blue: Potable water
5. Purple: Reclaimed Water, irrigation and slurry lines
6. Green: Sewer and storm drain lines

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify backfill material meets gradation requirements, foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water, and Trench bottom is not frozen.

B. If Subgrade is not readily compactable secure written authorization for extra excavation and backfill; Section 31 23 16.

C. Avoid injuring and displacement of pipe and structures while compacting soil or operating equipment next to pipeline.

D. Place geotextile fabrics; Section 31 05 19.

3.2 GENERAL BACKFILLING REQUIREMENTS

A. Protect Subgrade from desiccation, flooding and freezing.

B. Do not damage corrosion protection on pipe.

C. Repair or replace damaged pipe at no additional cost to OWNER.

D. Withdraw sheathing, Shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

E. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

F. Water settling of Trench backfill is not permitted. "Jetting" of Trench backfill is prohibited.

3.3 PIPE ZONE

A. Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

B. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.

C. Do not permit free fall of backfill material which may damage pipe, pipe finish, or pipe alignment.

D. Except where piping must remain exposed for tests, fill Pipe Zone as soon as possible.

3.4 TRENCH ABOVE PIPE ZONE.

A. Maximum lift thickness before compaction is 8 inches.

B. Fill unauthorized Excavations with material acceptable to ENGINEER at no additional cost to OWNER.

C. Do not damage adjacent structures or service lines.

D. Install continuous plastic line marker directly over buried lines 18 inches below finished grade.

3.5 MODIFIED BACKFILL LAYER METHOD

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions.

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.6 COMPACTION

A. Compact backfill, Section 33 05 05.

1. A-1 soils: 95 percent or greater of a Modified Proctor Density.
2. Other soils: 95 percent or greater of a Standard Proctor Density.

3.7 COMPRESSIVE STRENGTH

A. Where a flowable fill is used, provide compressive strength indicated in Section 31 05 15. Use fill which flows easily and vibration is not required.

3.8 SURFACE RESTORATION

A. Provide temporary paved surfaces where Trenches pass through roadways, Driveways or sidewalks.

B. Restore paved surfaces; Section 33 05 25.

C. Finish landscaped surfaces with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

3.9 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 0525

PAVEMENT RESTORATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aggregate base restoration.
B. Concrete base restoration.
C. Surface restoration.

1.2 REFERENCES

A. ACI 305: Hot Weather Concreting.
B. ACI 306: Cold Weather Concreting.
C. ASTM C 615: Standard Specification for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement.
D. ASTM C 78: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading).
E. ASTM C 928: Standard Specification for Packaged, Dry, Rapid- Hardening Cementitious Materials for Concrete Repairs.
F. ASTM D 1664: Standard Test Method for Coating and Stripping of Bitumen-Aggregate Mixtures.

1.3 SUBMITTALS

A. Mix design for,
   1. Temporary patching material.
   2. Permanent cold weather patching material.
B. Manufacturer's chemical additive data sheets.

1.4 WEATHER

A. Asphalt Concrete Pavement Patch:
   1. Provide temporary or permanent cold weather asphalt patching material when air and roadbed temperature in the shade are less than 40 deg. F.
   2. Remove any temporary patching and provide permanent patching material when temperatures exceed 40 deg. F. CONTRACTOR may perform work after cold weather season if authorized in writing by ENGINEER.
B. Portland Cement Concrete Pavement Patch: Comply with hot and cold weather requirements, ACI 305 or ACI 306.

1.5 ACCEPTANCE

A. Aggregate base compaction.
B. Asphalt concrete compaction.
C. Grade and cross slope of pavement surface.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Untreated Base Course: Section 32 11 23.
B. Flowable Fill Base: Section 31 05 15.
C. Portland Cement Concrete Base: Class 4000, Section 03 30 04.
D. Tack Coat: Section 32 12 14, Grade SS-1.
E. Permanent Warm Weather Asphalt Concrete Patching Material: Section 32 12 05, AC-20-DM-1/2 unless indicated otherwise.
F. Permanent Cold Weather Asphalt Concrete Patching Material: MC-250-FM-1, Section 32 12 05 modified as follows.
   1. Asphalt Cement:
      a. Kinematic viscosity at 140 deg F: 250 to 800 cSt.
      b. Flash Point: 175 deg F.
      c. Water: 0.2 percent maximum.
      d. Distillate Test:
         To 437 deg F: None.
         To 500 deg F: 0 - 15 percent. To 600 deg F: 15 – 75 percent.
         To 680 deg F: 75 percent minimum.
      e. Residue Tests:
         Penetration at 77 deg F: None.
         Ductility at 77 deg F: 100 cm minimum.
         Solubility in Trichloroethylene: 99 percent minimum.
   2. Composition of Mixture:
      a. Minimum Mix: 115 pounds asphalt cement per finished ton (5.75 percent).
      b. Maximum Mix: 135 pounds asphalt cement per finished ton (6.75 percent).
      c. Stripping: Not more than 5 percent, ASTM D 1664, after mixing.
      d. Workability: Material stockpiled for 1 year shall be capable of being shoveled, raked, spread and compacted.
   3. Chemical Additives: Capable of coating wet aggregates without stripping and maintains adhesive qualities in damp or wet applications.
G. Temporary Cold Weather Asphalt Concrete Patching Material: Type MC-250-DM-1/2, Section 32 12 05 with hydrated lime or anti- stripping agent as indicated in the mix design.
H. Pavement Sealing:
   1. Slurry seal Type RS-1-SS-II, Section 32 01 13.

2. Chip seal Type MC-250-CS-A, Section 32 01 14.

I. Portland Cement Concrete Patching Material: Class 4000, Section 03 30 05.

J. High Early Strength Portland Cement Concrete Patching Material:

1. Concrete compressive strength of 3,000 psi minimum in 4 hours.
2. Cementatious Material: Rapid hardening or very rapid hardening, ASTM C 928.
3. Cement content of mix, per cement manufacturer's recommendations or approved mix design.
4. Non-reactive aggregates in applications subjected to wetting, extended exposure to humid atmosphere, or contact with moist ground.

K. Pavement Marking: Tape or paint, Section 32 17 23.

PART 3 - EXECUTION

3.1 PREPARATION

A. At site, post name, address and telephone number of CONTRACTOR to contact in emergencies.

B. Notify ENGINEER within 24 hours of commencing work of this section but not less than 4 hours.

C. Provide worker and public safety; Section 01 55 26.

D. Cutting Pavements: Cut full depth and straight, Section 02 41 14. Remove all bonding inhibitors.

3.2 AGGREGATE BASE OR FLOWABLE FILL BASE

A. Match depth of existing aggregate base or 8 inches thick minimum.

B. Place crushed aggregate base in lifts not exceeding 8 inches before compaction. Compact per Section 33 23 26 to a Modified Proctor Density of 95 percent or greater.

C. When providing controlled low strength material (CLSM as specified in 31 05 15) match depth of existing aggregate base. Use fill that flows easily and vibration is not required. Cure the fill before placing surface patch.

3.3 CONCRETE SUBSTRATE

A. Apply concrete bonding compound, Section 03 30 10, to edge of existing concrete. Place concrete, Section 03 30 10.

3.4 ASPHALT CONCRETE PATCH

A. Match existing Pavement thickness plus 1 inch, but not less than 4 inches.

B. Clean all vertical surfaces that butt against new patchwork. Provide full coverage spray tack coat. Do not spray tack coat on surfaces exposed

to public view. Do not apply tack coat by brush.

C. Place asphalt concrete in lifts not exceeding 3 inches after compaction

D. Compaction: 94 percent of ASTM D 2041 (Rice) plus or minus 2 percent.

E. Match adjacent surface slopes.

1. Plane off surface distortions that exceed 1/4-inch vertical deviation in 10 feet.
2. Coat planed surfaces with a cationic or anionic tack emulsion that complies with Section 32 12 03. Cover tack with sand.

3.5 PORTLAND CEMENT CONCRETE PATCH

A. Full Depth restorations:

1. Clean vertical surfaces in patchwork. Install dowels in vertical load bearing joints. Apply concrete bonding compound, Section 03 30 10.
2. Match adjacent surface slopes. Apply membrane forming compound, Section 03 39 00 immediately to protect work from hot or cold weather.
3. After concrete cure, plane off surface distortions that exceed 1/4 inch deviation in 10 feet. Use a water repelling product, Section 07

   19 00 to water proof planed surfaces.
4. Do not allow traffic on the repaired area until concrete strength is achieved.

B. Partial Depth Patching:

1. Chip, hydro-blast or saw cut concrete to a minimum depth of 1 inch.
2. Make surfaces free of frost, ice, mud, water, grease, dirt and other materials that hamper bonding.
3. Install bonding agent per manufacturer's recommendations.
4. Apply membrane forming compound, Section 03 39 00 immediately to protect work from hot or cold weather.
5. After concrete cure, plane off surface distortions that exceed 1/4 inch deviation in 10 feet. Use a water repelling product, Section 07

   19 00 to water proof planed surfaces.
6. Do not allow traffic on the repaired area until concrete strength is achieved.

3.6 CONCRETE PAVERS

A. Screed Bedding with a notched and cambered screed board to achieve a crown between existing pavers. Use graded aggregate, geotextile, and bedding sand, Section 32 14 13.

B. In asphalt concrete or portland cement concrete surfaces place pavers against Pavement cuts to form a border course, i.e. the short side of the paver against the cut except at corners.

C. After placement, use a plate-type vibrating compactor to compact pavers. Size compactor to provide at least 5,000 lbf. force. Sweep sand into the joints and vibrate until joints are full. Remove excess sand.

D. Match adjacent surface grades with no more than 1/4 inch vertical deviation in 10 feet.

3.7 PAVEMENT MARKINGS

A. Unless indicated otherwise, repair all damaged Pavement markings with matching type of materials and installation.

END OF SECTION

SECTION 33 12 16

WATER VALVES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Gate, butterfly, plug, check, pressure reducing, pressure relief, control valves and their installation.

1.2 REFERENCES

A. **AWWA Standards**:

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C504 Rubber-Seated Butterfly Valves.

C508 Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS.

C509 Resilient-Seated Gate Valves for Water and Sewerage Systems.

C550 Protective Interior Coatings for Valves and Hydrants. C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 SUBMITTALS

A. Provide technical information for evaluating quality of valve. As a minimum include dimensions, weights, materials lists and operation charts.

PART 2 PRODUCTS

2.1 VALVES - GENERAL

A. Underground:

1. Less than three (3) inches: Screwed ends.
2. 3 inches and larger: Flanged or mechanical joint ends. Non-rising stem. Two inches square operating nut. Low alloy steel bolts, AWWA C111.

B. Submerged or Above Sewage or Water:

1. Valve body bolts per manufacturer's recommendations.
2. For joining valve to piping system use stainless steel nuts and bolts, Section 05 05 23.

C. Below an Operating Deck: Provide shaft extension from the valve to deck level.

D. Above Ground: Non-rising stems equipped with a hand wheel.

E. Manually Operated Valves Over six (6) feet Above Operating Level: Provide chain operated handles.

F. Clearance: Install so handles clear all obstruction when moved from open to closed.

G. Rated Working Pressure: 150 psi if not indicated.

H. Coating: Interior, AWWA C550. Exterior per manufacturer's recommendation.

2.2 **GATE VALVES**

A. AWWA C509.

B. 3 inches through 48 inches, cast iron body, bronze mounted, non-rising stem with "O" ring seals.

C. Open counterclockwise.

2.3 **BUTTERFLY VALVES**

A. AWWA C504.

B. 3 inches through 48 inches, cast iron body, bronze mounted.

C. Short body if disc will not interfere with adjacent fittings or long body at CONTRACTOR's option.

D. Wafer Valves: Subject to ENGINEER's approval.

2.4 **ECCENTRIC PLUG VALVES**

A. Material: Cast iron body, bronze mounted, non-lubricated, eccentric, quarter-turn type with resilient face plugs, ductile iron discs with upper and lower shafts integral.

B. Markings: Indicate open and close position.

C. Port Areas: At least 82 percent of full pipe area.

D. Resilient Seat Seals: Buna N, field replaceable.

2.5 **CHECK VALVES**

A. AWWA C508.

B. Less than three (3) inches: Y-pattern, bronze, regrinding, swing check valve, 200 psi working pressure.

C. 3 inches and larger: Iron body, bronze mounted, swing valves with stainless steel hinge pins and outside weight and lever if not indicated otherwise.

2.6 **PRESSURE REDUCING VALVES - SERVICE LINE**

A. Operation: Capable of reducing a varying higher upstream pressure to an adjustable constant lower downstream pressure.

B. Spring and nylon reinforced diaphragm type construction.

C. Equip with Y-strainer upstream of valve.

2.7 **PRESSURE REDUCING VALVES - MAIN LINE**

A. Operation: Capable of maintaining an adjustable constant downstream pressure regardless of upstream pressure.

B. Type: Hydraulically operated using a direct-acting, spring-loaded, normally open, pilot valve controlled diaphragm:
   1. Single removable seat and a resilient disc. No "O" ring type discs permitted. No external packing glands permitted. No pistons operating main valve or pilot controls permitted.
   2. Y-strainers on pilot controls, variable closing and opening speed controls and a valve position indicator.
C. Rating: 250 psi working pressure.
D. Connection: Flanged.
E. Pressure Gage: Upstream and downstream of valve capable of accurately measuring system pressures.

2.8 **PRESSURE RELIEF VALVES**

A. Operation: Maintain a constant upstream pressure by passing or relieving excess pressure.
B. Closed Valves: Drip-tight.
C. Type: Hydraulically operated, pilot control using a diaphragm with a single removable seat and resilient disc.
D. Pilot Controls: Direct acting, adjustable between 20 and 200 psi, spring- loaded diaphragm valve.
E. Rating: 250 psi working pressure.
F. Connection: Flanged.

2.9 **CONTROL VALVE**

A. Globe: Diaphragm actuated, single seated, composition disc, hydraulically operated.
B. Pilot Controls: Externally mounted, four-way, solenoid pilot valve with self cleaning strainers and diaphragm type check valves:
   1. Equipped with a limit switch for pump control.
   2. Equipped with a built-in lift check valve to prevent flow reversal.
E. Rating: 250 psi working pressure.
F. Connection: Flanged.
G. Solenoids and Limit Switch: Supplied with operating voltage indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Flush all lines before valve installation.
B. In ductile iron water mains, AWWA C600.
C. Install butterfly valve shafts vertical in vault boxes and horizontal otherwise.

SECTION 33 4100

STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Gravity systems such as irrigation, sub-drains, and storm drains.
B. Pressure systems are indicated in Section 33 12 19.

1.2 REFERENCES
A. ASTM C 478: Standard Specification for Precast Reinforced Concrete Manhole Section.
B. ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
C. ASTM C 923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 PERFORMANCE REQUIREMENTS
A. Vertical Cover: 2 feet minimum or as indicated.
B. Remove any section of pipe already placed that is found to be out of alignment tolerance indicated, defective, or damaged. Relay or replace without additional cost to OWNER.

1.4 PROJECT CONDITIONS
A. Minimize neighborhood traffic interruptions. Barricade stockpiles.
B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.
C. Repair public and private facilities damaged by CONTRACTOR. D. Prior to Backfilling: Commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.

1.5 ACCEPTANCE
A. Each storm drain system component must pass applicable requirements in Section 33 08 00.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS
A. Provide piping materials and factory fabricated piping products of sizes, types, and classes indicated.
B. Where not indicated, provide proper selection acceptable to ENGINEER to comply with installation requirements.
C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.
D. Pressure culinary water or irrigation water distribution system piping for main lines shall be either ductile iron or polyvinyl chloride (PVC) pressure pipe. Special circumstances for other pipe shall be reviewed with engineer. Review with engineer for any cement mortar lining.
    1. Polyvinyl Chloride: AWWA C900 or PVC 1120, DR 18.
    2. Ductile Iron Pipe: AWWA A151, Class 50. Flanged Class 53 Cement Mortar AWWA C104.
E. Gravity flow drainage sanitary sewer or storm sewer main lines shall be concrete, polyethylene or Polyvinyl Chloride (PVC) Gravity Sewer Pipe.
    1. Concrete or Reinforced Concrete: ASTM C14 & C76.
    2. Polyvinyl Chloride (PVC): ASTM D 3034, SDR-35, 4"-15".
    3. Polyethylene: ASTM F 405, ASTM F 667, ASTM D 2321, ASTM D 3034 (sanitary sewer), AASHTO M 252, AASHTO M294, 4"-36" (storm drainage), 4"-18" (sanitary sewer), Pipe shall be corrugated exterior with smooth interior.

F. Fittings for pressure pipe shall be gray ductile and shall conform with requirements of AWWA C110. Fittings shall be furnished with cement mortar lining conforming to AWWA C104. Fittings shall be tar coated on outside and Class 250. All fittings shall be wrapped with 3 mil visqueen. Fittings matching the pipe specified a., b., and c. above may also be used.

G. Special attention shall be given to soil resistivity.

H. Joints (Pressure Pipe):
   1. Push on: "Tylon" - U.S. Pipe and Foundry Company "Fastite" - American Cast Iron Company "Beltite" - James B. Slow and Sons, Inc.
   2. Mechanical - ASI Specification A21.22.
   3. Flanged - ANSI Publication B16.12, Class 125/250.
   4. All follower glands must meet ASTM-A536 Grade 65-45-12 Standards on all M.J. Style Fittings.

I. Polyvinyl Chloride (PVC) pipe and polyethylene pipe must be installed with magnetic markers such as "DEEP-1" manufactured by Berntsen, Inc. or approved equal, taped to the top of the pipe at 50 foot maximum spacing and at all bends.

J. Concrete Pipe
   1. Gravity flow drainage systems shall be reinforced concrete or non-reinforced concrete pipe as designed by the engineer. Non-reinforced concrete pipe shall only be used where load requirements permit. Reinforced concrete pipe shall be used in areas of traffic loading.
      a. Reinforced Concrete Pipe, Section 02612, ASTM C76.
      b. Non-reinforced concrete pipe shall receive review engineer prior to design and construction, ASTM C14.
   2. Bell and spigot joints shall be used and meet requirements of ASTM C443.

K. Reinforced Concrete Pipe
   1. Plans shall be of sufficient quality to ensure proper grade and alignment to correctly construct the project and according to ASTM Designation C76.
   2. Bell and spigot joints shall be used and meet requirements of ASTM Designation
   3. C443.

L. Ductile Iron Pipe
   1. Ductile iron pipe shall be mechanical or push-on joint type. Flanged joints shall be reviewed with engineer. All pipe joints shall conform to applicable dimensions and weights according to the latest revision of ANSI/AWWA C111/A21.11. All pipe shall conform to the latest revision of AWWA C 151 (Pipe), AWWA C105 (Polyethylene Encasement), AWWA C110 (Fittings), AWWA C111 (Gaskets), AWWA C115 (Flanges), AWWA C600 (Installation).
   2. All pipe shall have inside and outside coating of an asphalt (tar) coating approximately 1 mil thick.
   3. Bedding requirements shall be determined for all pipe reaches of the project. Minimum Class 50 pipe shall be used.
   4. All pipe shall be provided with full polyethylene encasement.

M. Polyethylene Sewer and Storm Drainage Pipe
   1. Polyethylene sewer pipe shall conform to ASTM D-3034. Size 4" to 18" diameter. Use not allowed for sizes larger than 18" diameter. Pipe shall be corrugated exterior with smooth interior.
   2. Fittings for sanitary sewer applications shall be thermal molded PVC meeting SDR-35 specification with air tight gasket.
   3. Polyethylene storm drainage pipe shall conform to ASTM F 405, ASTM F 667, AASHTO M 252, and AASHTO M 294. Size 4" to 36" diameter. Use not allowed for sizes larger than 36" diameter.
   4. Fittings for storm drainage applications shall be thermal molded PVC meeting SDR-35 specification with leak resistant neoprene gasket.

2.2 IN-PLANE WALL DRAINAGE

A. Drainage Core: Manufacturer's standard three-dimensional non-bio- degradable, plastic designed to effectively conduct water to foundation drainage system.
B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 SUB DRAIN FILL MATERIALS

A. Sewer Rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 MORTAR, GROUT AND CONCRETE

A. Mortar: Cement, Section 04 05 16.
B. Grout: Cement, Section 03 61 00.
C. Concrete:
    1. Cast-in-place: Class 4000, Section 03 30 04.
    2. Precast: Class 5000, Section 03 40 00.

2.5 CLEANOUTS AND MANHOLES

A. Basin: Concrete floor with cast in place concrete walls or ASTM C 478 precast requirements.
B. Steps: None.
C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.
D. Frame and Cover: Asphalt coated, heavy duty, ductile iron; Section 05 56 00 with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as indicated.
E. Pipe Connectors:
    1. Precast Bases: Resilient, ASTM C 923. Sand mortar grout pipe connections.
    2. Cast in Place or Connections to Existing Manhole with Plastic Pipe: Use rubber Manhole adapter gasket for precast sections. Grout; Section 03 61 00 for cast in place sections.
F. Joints in Sections: Bituminous mastic coating unless indicated otherwise.
G. Manholes and cleanouts may be cast-in-place or pre-cast as shown on appropriate standard details.
H. Quality control schedules shall be determined and may include sampling, slump, air content, and compressive strength. Reports of test results shall be made in writing to the architect and/or engineer.
I. Specify the following strength of concrete (28-day compressive strength):
    1. Grout: 2,500 psi.
    2. Pre-cast concrete: 5,000 psi.
    3. All other concrete: 4,000 psi.
J. Provide mix design. Air entrainment between 5 and 7 percent. Water cement ratio shall not exceed 0.45. Minimum cement content per cubic yard:
    1. 4,000 psi: 6.5 sacks.
    2. 5,000 psi: 7.0 sacks.
    *Minimum cement content per cubic yard should be converted to pounds of cement per cubic yard.

2.6 INLETS AND CATCH BASINS

A. Basin: Concrete floor and walls.
B. Frame and Grate:
    1. Asphalt coated, heavy duty, cast iron: Section 05 56 00. Shape and size as indicated.
    2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10. Shape and size as indicated.
C. Pipe Connectors: Resilient, ASTM C 923. Sand mortar grout.

2.7 OUTFALLS

A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide

riprap, Section 31 37 00, if indicated.

2.8 DRAIN PIPE JOINT SCREENS

A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.
B. Plastic or corrosion resistant metal bands.

2.9 STORM WATER HOLDING PONDS

A. Storm water holding ponds shall be constructed with the areas designated on the Utilities Master Plan and shall be changed only with the approval of engineer.
B. Sites shall be cleared and grubbed of debris and unsuitable material disposed of in a legal manner off University property.
C. The CONTRACTOR to furnish and place imported material as needed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are as indicated.
B. Hand-trim Excavations to required elevations. Backfill over excavations and compact, Section 33 05 05.
C. Remove stones larger than 2 inches or other hard matter that could damage pipe or impede backfilling or compaction. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.
D. Clearly identify and promptly set aside defective or damaged pipe.
E. Use pipe cutting tool acceptable to pipe manufacturer.
F. Drainage structures shall be constructed to the dimensions and elevations shown on the plans and standard plans or as directed by engineer.

3.2 INSTALLATION - PIPE AND FITTINGS

A. Place bell or groove end facing upstream.
B. Install gaskets per manufacturer's recommendations.
C. Plug pipeline branches, stubs or other open ends which are not to be immediately connected.
D. Clean interior of pipe of dirt and debris as work progresses.
E. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.
F. Meet line and grade tolerance specified in Section 33 08 00.

3.3 INSTALLATION - CLEANOUTS AND MANHOLES

A. Form bottom of Excavation clean and smooth to correct elevation.
B. Place structures in location indicated.
C. Install precast units, ASTM C 891.
D. Provide elevations and pipe inverts for inlets and outlets indicated.
E. Where structures occur in Pavements, mount frame and cover 1/2 inch below finished surface, elsewhere set 3 inches above finished grade. Provide a concrete Cover Collar between the frame and asphalt Pavement.

3.4 INSTALLATION - INLETS OR CATCH BASINS

A. Form bottom of Excavation clean and smooth to correct elevation.
B. Construct with all connecting piping and appurtenances in their final position.
C. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.5 INSTALLATION - SUB DRAIN SYSTEMS

A. Install pipe and fittings per manufacturer's instruction.
B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe

circumference, centered over joint.
C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.
D. Place drainage pipe on bed of Sewer Rock, Section 31 05 13.

3.6 ABANDONED UTILITIES
A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.
B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.7 TAP CONNECTIONS
A. Not allowed. Provide a cleanout or Manhole structure.

3.8 BACKFILLING
A. Prior to Backfilling: Commission pipeline, Section 33 08 00. Provide sizes and types of equipment connections and fittings which match pipe materials when pressure testing system.
B. Trenches: Section 33 05 20.
C. Structures or Landscapes: Section 31 23 23.

3.9 CLEANING
A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.
B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping system.

3.10 SURFACE RESTORATION
A. Provide temporary paved surfaces where Trenches pass through roadways, Driveways, or sidewalks.
B. Restore paved surfaces, Section 33 05 25.
C. Finish landscaped surfaces as applicable.
    1. With grass; Section 32 92 00 or
    2. Other ground cover; Section 32 93 13.

END OF SECTION