

# **SOMERS STATE PARK**

## **PHASE 2 IMPROVEMENTS**

### **FWP #7216807**



## **SPECIFICATIONS**



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**SOMERS STATE PARK**  
**PHASE 2 IMPROVEMENTS PROJECT**  
**SPECIFICATIONS**  
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# Division 1 General Requirements



## **DIVISION 1 – GENERAL REQUIREMENTS**

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## SECTION 01010

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. The Invitation to Bid contains a general description of the project work to be performed under this Contract. The Supplemental Conditions and Special Provisions and other documents contain additional information necessary to perform the work.

##### 1.2 CONTRACT DOCUMENTS

- A. Portions of the Contract Documents are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, "Furnish..." means "Contractor shall furnish...", "Provide" means "Contractor shall provide...". For imperatives specifically addressing the Engineer/Owner, see paragraph 1.02, General Conditions.
- B. Contract Documents are defined in Article 1, paragraph 1.01.A.12, General Conditions, as modified by Montana Public Works Standard Specifications, any supplemental conditions, and Article 9 of the Agreement Form.
- C. The Contract Documents are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Comply with Article 3, General Conditions. Specifications and Drawings included in these contract documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.
- D. The various portions of the Contract Documents, of which these specifications are a part, are essential parts of the Agreement, and a requirement occurring in any portion or part is binding as though occurring in all. All portions are intended to be complementary and to describe and provide for a complete work as referenced in Article 3, General Conditions. Unless specifically noted otherwise, in the case of discrepancy the following hierarchy shall be observed:
  - 1. Addenda, which will govern over;
  - 2. Special Provisions, which will govern over;



3. Standard Modifications, which will govern over;
  4. Supplementary Specifications, which will govern over;
  5. Project Drawings, which will govern over;
  6. These Specifications and Standard Drawings, which will govern over;
  7. Montana Department of Transportation Standard Specifications for Road and Bridge Construction
- E. The bound copy of the Montana Public Works Standard Specifications, as distributed by the Montana Contractor's Association, Inc., will govern as the legal set of these specifications over any unbound copy, or any CD-ROM or floppy disk versions
- F. A requirement mentioned in one part/section of the Contract Documents shall be considered as having been mentioned in all parts/sections.

### 1.3 WORK SEQUENCE

- A. Comply with paragraph 2.07 and 6.04 of the General Conditions and Milestones specified in the Contract Documents.
- B. Submit detail schedules as specified in the Contract Documents.
- C. Field verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale drawings.
- D. Notify Engineer/Owner of existing conditions differing from those indicated on the drawings. Comply with paragraph 4.03, of the General Conditions and any Supplementary Conditions. Verify the existence and location of underground utilities along the route of the proposed work. Omission of an existing or previous abandoned utility location on the Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Drawings is not to be considered as its definite location. Do not remove or alter existing utilities without prior written approval.

### 1.4 CONTRACTOR USE OF PREMISES:

- A. Comply with paragraph 6.11, General Conditions, and as specified in the Contract Documents.
- B. Do not park vehicles or equipment or store materials on private property without written permission from the property owner. Provide Engineer/Owner with copy of authorization.

1.5 OWNER-FURNISHED ITEMS

- A. Owner-furnished items are listed in the Contract Documents.

**PART 2 PRODUCT — NOT USED PART 3**

**EXECUTION — NOT USED**

**PART 4 MEASUREMENT AND PAYMENT**

4.1 PAYMENT

- 4.1.1 Unless specifically noted otherwise, the work of Division 1 shall be incidental to the work, and no separate payment shall be made.

**END OF SECTION**



## SECTION 01041

### PROJECT COORDINATION

#### **PART 1: GENERAL**

##### 1.1 DESCRIPTION

- A. This section specifies the requirements for coordinating and sequencing the work under the Contract documents, and requirements regarding existing site conditions.

##### 1.2 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES

- A. Comply with Article 7, General Conditions. Permit utility companies to repair or replace their lines in the project limits.
- B. Contact the Montana one-call system for utility locations before starting work.
- C. Comply with paragraph 6.20, General Conditions.

#### **PART 2: PRODUCT — NOT USED PART**

#### **3: EXECUTION — NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT — NOT USED**

**END OF SECTION**

## SECTION 01050

### FIELD ENGINEERING

#### **PART 1: GENERAL**

##### 1.1 ENGINEERING SURVEYS

- A. It is assumed that only minor surveying related to layout for construction is required for this project. This is the responsibility of the contractor to perform this surveying as needed to confirm conformance with contract documents or hire a licensed surveyor for assistance. A2Z can provide the available drawings if requested as reference for this work.
- B. Preserve all benchmarks, control points and stakes.
- C. Replace benchmarks, control points and stakes destroyed or disturbed by Contractor or subcontractor.
- D. Comply with paragraph 4.04, General Conditions.

##### 1.2 STREET MONUMENTS AND PROPERTY CORNERS

- A. Mark and protect existing property pins and/or street monuments.
- B. Use a licensed land surveyor to replace all property corners or other monuments marked or shown on the plans that are destroyed by the work.

#### **PART 2: PRODUCT — NOT USED PART**

#### **3: EXECUTION — NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

##### 4.1 MEASUREMENT

- A. There will be no direct measurement of this item.

##### 4.2 PAYMENT

- A. The surveying that may be required for this project is included within the lump sum item found on the bid tabulation.
- B. Partial payments for quality control/surveying will be made based on the lump sum bid price as follows:
  - 25% of the amount bid for quality control/surveying when the Contractor has moved on-site and begun construction activities.

- 50% of the amount bid for quality control/surveying when 25% of the contract amount (exclusive quality control/surveying) has been completed.
- 75% of the amount bid for quality control/surveying when 50% of the contract amount (exclusive quality control/surveying) has been completed.
- 100% of the amount bid for quality control/surveying when 75% of the contract amount (exclusive quality control/surveying) has been completed.

**END OF SECTION**

## SECTION 01090

### REFERENCES

#### PART 1: GENERAL

##### 1.1 COORDINATION OF CONTRACT DOCUMENTS

##### 1.2 DEFINITIONS

- A. These specifications use "Article 1 - Definitions" of the Standard General Conditions of the Construction Contract, Form No. C-700 prepared and issued by the Engineer's Joint Contract Documents Committee (EJCDC), for the definition of terms herein. Changes to definitions are by either substitution for the article or in Supplementary Conditions.

##### 1.3 REFERECNCES

- A. This section lists some of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards in the Contract Documents along with the abbreviations commonly used for those references. Also included are general requirements for using industry standards specified, and for applying quality control standards.

##### 1.4 USE OF REFERENCE STANDARDS

- A. Work specified by reference to a published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must meet or exceed the minimum quality standards for the material and workmanship in the designated standard or specification.
- B. Where specified, assure products or workmanship meet the prescriptive or performance requirements in the Contract Documents when it is a more stringent standard than the referenced standard. Contract should reference only one specification to prevent argument as to which specification is most stringent.
- C. Where the specific issue date of the standard is not identified in the standard, the edition and all published amendments available on the date of the invitation to Bid applies.
- D. If two or more standards are specified, provide the product and workmanship meeting or exceeding the requirements of the most stringent standard.

- E. If a conflict exists between standards, meet the more stringent standard.
- F. Where both a standard and a brand name are specified, assure the proprietary product names meet or exceed the specified reference standard. The listing of a trade name in a Contract Document does not warrant that the product meets the referenced standard.
- G. Copies of Standards
  1. Copies of applicable referenced standards are not bound in this Contract Document.
  2. Where the contractor needs copies of standards for work superintendence and quality control, obtain a copy or copies directly from the publication sources and maintain copies at the job site, making them available to Contractor personnel, subcontractors, Owner, and Engineer.

## 1.5 ABBREVIATIONS

- A. Abbreviations for Trade Organizations and Government Agencies: Following is a list of construction industry organizations and government agencies commonly referenced in the Contract Documents, with abbreviations used.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALS	American Lumber Standards
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers' Bureau
AWPI	American Wood Preservers' Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America
CRSI	Concrete Reinforcing Steel Institute
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
Fed Spec.	Federal Specifications
FS	Federal Specification
GA	Gypsum Association
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers' Association
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IES	Illuminating Engineering Society of North America
ISA	Instrument Society of America
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MIA	Marble Institute of America
Mil. Sp.	Military Specification
MS	Military Specifications
MMA	Monorail Manufacturers' Association
NAAMM	National Association of Architectural Metal Manufacturers
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NHLA	
NLMA	National Lumber Manufacturers' Association
NTMA	National Terrazzo and Mosaic Association

NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Act (both Federal and State)
PEI	Porcelain Enamel Institute
PS	Product Standards Section - U.S. Department of Commerce
RLM	RLM Standards Institute, Inc.
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SWI	Steel Window Institute
TEMA	Tubular Exchanger Manufacturers' Association
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters' Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

**PART 2: PRODUCT — NOT USED**

**PART 3: EXECUTION — NOT USED**

**PART 4: MEASUREMENT AND PAYMENT — NOT USED**



## SECTION 01300

### SUBMITTALS

#### **PART 1: GENERAL**

##### 1.1 CONSTRUCTION SCHEDULES:

- A. Submit to the Engineer a progress schedule under Sections 2.05, 2.07, and 6.04 of the General Conditions.
- B. Submit to the Engineer adjusted progress schedules under Section 6.04 of the General Conditions.
- C. Submit to the Engineer, value schedules under Sections 2.05, 2.07 and 14.01 of the General Conditions.

##### 1.2 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Submit shop drawings to the Engineer under Sections 2.05 and 6.17 of the General Conditions. Submit all shop drawings for the Contractor, subcontractor(s) and supplier(s)
- B. Review all shop drawings prior to submittal in accordance with Section 6.17 of the General Conditions.
- C. Submit in writing any substitutions to previously approved items for review by the Engineer.
- D. Within 15 days after Notice to Proceed, submit a complete list of products proposed for use, providing manufacturer's name, trade name, and model or catalog numbers, and manufacturer data.

Submit the number of copies needed by the Contractor, plus three copies for Engineer use.

- E. Where specified, submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices.

Where specified, submit samples of finishes including colors, textures, and patterns.

#### **PART 2: PRODUCT — NOT USED**

#### **PART 3: EXECUTION — NOT USED**

#### **PART 4: BASIS & METHOD OF PAYMENT — NOT USED**

**END OF SECTION**

## SECTION 01400

### CONTRACTOR QUALITY CONTROL AND OWNER QUALITY ASSURANCE

#### **PART 1: GENERAL**

##### 1.1 DESCRIPTION

- A. This section describes the Contractor quality control testing requirements and Owner's quality assurance program.

##### 1.2 References

- A. The following ASTM publication is a part of this specification.  
  
ASTM E 329 Evaluation of Testing and Inspection Agencies as Used in  
Construction

#### **PART 2: PRODUCT — NOT USED**

#### **PART 3: EXECUTION**

##### 3.1 GENERAL

- A. Be responsible for quality control tests and inspections to control contractor production and construction processes. Include in the Contractor quality control system an internal organization, plans, and procedures to produce the specified end product. Assure the system covers all construction operations, both on-site and off-site, and is keyed to the construction sequence. Quality control testing frequency is at Contractor discretion, except where tests are specifically required in the technical specifications for individual products.
- B. Sampling and testing to assure specification conformance are performed by the Contractor and observed by the owner or owners representative..
- C. The Owner may select a testing agency to perform quality assurance testing. (ASTM E329 is referenced as a guide to the selection of a qualified testing agency.) The Owner will pay for (or provide) the quality assurance testing. Quality assurance testing frequency is at Owner discretion for individual products.
- D. Quality assurance testing is performed following the standards in the technical specifications for individual products.

##### 3.2 CONTRACTOR COOPERATION WITH QUALITY ASSURANCE AGENCY

- A. Assure the Owner's personnel and quality assurance agency have access to all work areas at all times work is in progress. Provide any special facilities or equipment to access work areas at Contractor expense.
- B. Notify the Engineer of the work ready for quality assurance testing. Contractor

shall provide all testing and owner/engineer shall observe said testing.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 PAYMENT FOR TESTING**

- A. All of the required testing as outlined by the engineer of record and the plans/specification shall be included within the lump sum bid tabulation.
- B. Partial payments for quality control/surveying will be made based on the lump sum bid price as follows:
  - 25% of the amount bid for quality control/surveying when the Contractor has moved on-site and begun construction activities.
  - 50% of the amount bid for quality control/surveying when 25% of the contract amount (exclusive quality control/surveying) has been completed.
  - 75% of the amount bid for quality control/surveying when 50% of the contract amount (exclusive quality control/surveying) has been completed.
  - 100% of the amount bid for quality control/surveying when 75% of the contract amount (exclusive quality control/surveying) has been completed.

**END OF SECTION**

## SECTION 01450

### MOBILIZATION

#### **PART 1 GENERAL**

##### 1.1 DESCRIPTION

- A. This item shall consist of the preparatory work and operations necessary performed by the Contractor for the movement of personnel, equipment, supplies, and incidentals to and from the work site. The work includes those actions necessary for obtaining necessary permits required for mobilization; for the establishment of all offices and facilities necessary to work on the project; for premiums on contract bonds; for insurance for the contract; and for other work on the various items on the project site. Mobilization costs for subcontracted work shall be considered to be included.
- B. Contractor's cost for administration, bonding, insurance, and site documents shall be included in mobilization and shall not be paid as a separate item.
- C. All equipment moved to the project sites shall be in good mechanical condition and free of fuel, oil, lubrication, or other fuel leaks. The Contractor shall immediately remove any equipment potentially or actually discharging environmentally damaging fluids.
- D. All equipment moved to the project sites shall be thoroughly cleaned before it is brought to the sites to prevent the introduction of weed seeds. Equipment removed from the sites may not be returned to the sites again until it is thoroughly cleaned again.

#### **PART 2 PRODUCTS – NOT USED**

#### **PART 3 EXECUTION – NOT USED**

#### **PART 4 MEASUREMENT AND PAYMENT**

##### 4.3 MEASUREMENT

- A. There will be no direct measurement of this item.

##### 4.4 PAYMENT

- 5 Partial payments for mobilization/demobilization will be made based on the lump sum bid price as follows:

- 25% of the amount bid for mobilization/demobilization when the Contractor has moved on-site and begun construction activities.
- 50% of the amount bid for mobilization/demobilization when 25% of the contract amount (exclusive mobilization/demobilization) has been completed.
- 75% of the amount bid for mobilization/demobilization when 50% of the contract amount (exclusive mobilization/demobilization) has been completed.
- 100% of the amount bid for mobilization/demobilization when 75% of the contract amount (exclusive mobilization/demobilization) has been completed.

**END OF SECTION 01450**

## SECTION 01500

### CONSTRUCTION AND TEMPORARY FACILITIES

#### **PART 1: GENERAL**

##### 1.1 CONSTRUCTION FACILITIES

- A. Furnish temporary services and utilities, including use fees and operation costs for: potable and non-potable water; lighting and power; and, materials storage.
- B. Furnish personnel support facilities including: sanitary facilities; drinking water; first aid supplies and facilities; and, trash removal.
- C. Do not park vehicles or equipment or store materials on private property without written permission from the property owner under Section 01010.1.4.B.

##### 1.2 SECURITY

- A. Provide fencing, barricades, warning signs, and lights to secure all work areas, equipment, and materials.

##### 1.3 DUST CONTROL

- 1.4 Be responsible for dust control, providing all equipment and personnel for the work. Furnish Engineer name(s) and telephone number(s) of the person(s) responsible for dust control during evenings and weekends. If this person cannot be contacted, Owner may at Contractor expense, perform the work or contract the work out.

##### 1.5 HAUL ROUTES

- A. Obtain Owner approval of haul routes.

#### **PART 2: PRODUCTS — NOT USED**

#### **PART 3: EXECUTION — NOT USED**

#### **PART 4: MEASUREMENT AND PAYMENT**

##### 4.1 PAYMENT

- A. All items in Part 1 are incidental to the work and no separate payment is made for these items.

**END OF SECTION**

## SECTION 01570

### CONSTRUCTION TRAFFIC CONTROL

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating traffic control devices to insure the safety of the general public and project personnel.

##### 1.2 REQUIREMENTS

- A. Perform work under this section meeting Manual of Uniform Traffic Control Services (MUTCD) and contract requirements.

##### 1.3 NOTIFICATIONS

- A. Coordinate all construction activities to reduce traffic conflicts at the work site, off-site events or other construction projects.
- B. Furnish the Engineer, for Owner review, the construction traffic control plan at least one week before construction begins or before changes in segments or phases of the work on the project. The Owner will review and approve the Traffic Control Plan considering known off-site activities and may require modification to the plan or construction timing to coordinate events. Work shall not commence until said plan is approved.
- C. For project sites involving a through street, provide the Engineer with a news release. Include in the news release, as a minimum, the work activity and duration. Once approved, furnish the news release to the local media at least three days before starting work. Notify all landowners or residents adjacent to the work of the type and duration of the construction.

#### PART 2: PRODUCT

##### 2.1 TRAFFIC CONTROL DEVICES

- A. Assure all signs and barricades are reflectorized. Assure all night time traffic control devices meet MUTCD lighting requirements.
- B. Use traffic control devices meeting the "Manual of Uniform Traffic Control Devices" and the "Traffic Control Devices Handbook" requirements, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20492.
- C. Assure all traffic control devices are clean, legible, reflective for night-time use, and operable.



## **PART 3 EXECUTION**

### **3.1 WORK METHODS:**

- A. Place all traffic control devices as planned before permitting men or equipment on the traveled way. Install signs, cones and barricades in that order.
- B. Inspect the work area at least twice each day during construction and maintain records of traffic control devices used and their location.
- C. Assure traffic control is appropriate to the work. Assure traffic control devices are appropriate and clean before suspending work for the day.
- D. Remove traffic control devices in reverse order of installation at the end of each shift.
- E. Remove and store all unnecessary traffic control devices away from traffic's view.

### **3.2 NONCOMPLIANCE**

- A. Remove, repair or replace any traffic control device not providing its intended function.
- B. Do not begin work until all required traffic control devices are placed.
- C. The Engineer will periodically inspect the traffic control and inform the Contractor of any deficiencies.
- D. Contractor failure to correct any deficiency in the traffic control within 4 hours of notification is cause to deduct monies from the contract payment on the next progress payment.
- E. The Engineer may direct correcting traffic control deficiencies immediately. Failure to immediately correct the deficiency is cause for the Engineer to correct the deficiency at Contractor expense.

### **3.3 FLAGGING**

- A. Furnish competent and properly equipped flag persons as described in the booklet "Instructions for Flag persons" furnished by the Montana Department of Transportation.

## **PART 4: MEASUREMENT AND PAYMENT**

### **4.1 PAYMENT**

- A. Separate measurement for each traffic control device is not made unless the on-site field traffic plan requirements differ materially from the original traffic control plan in the contract. Measurement and payment for the Contractor's off-site traffic control plan and the designed on-site traffic control plan is on a lump sum basis. The lump sum payment is full reimbursement for all costs of furnishing, installing, maintaining, replacing and operating the construction

traffic control systems throughout the work period. The construction traffic control system includes but is not limited to, signs, barricades, pavement markings, watering, flag persons and pilot cars.

- B. Progress payments are in proportion to total construction completed.
- C. If changes in the approved Traffic Control Plan are directed by the Engineer, additional payment or reduction in payment is made for the additional or deleted items as agreed to between the Contractor and the Engineer.

**END OF SECTION**

## SECTION 01700

### CONTRACT CLOSEOUT

#### PART 1: GENERAL

##### 1.1 CLEANUP

- A. Before Final inspection (as outlined in Section 14.06 of the General Conditions) execute the following.
  - 1. Where applicable, clean interior and exterior glass and surfaces exposed to view. Remove temporary labels.
  - 2. Where applicable, clean equipment and fixtures to a sanitary condition.
  - 3. Where applicable, clean debris from roof, gutters, and downspouts.
  - 4. Remove debris, waste, surplus materials, and rubbish from right-of-way, easements (construction or permanent) and private property.
  - 5. Where applicable, remove debris, dirt, and silt from storm drain basins, sanitary sewer and storm drain manholes, and water valve boxes.
  - 6. Rake landscaped surfaces clean of debris.
  - 7. Where applicable, remove temporary coverings from traffic control devices.
  - 8. Clean traffic control devices and signs.
  - 9. Where applicable, remove temporary traffic striping.
  - 10. Sweep dirt and debris from all paved areas affected by the work.

##### 1.2 RECORD DOCUMENTS

- A. Submit record documents as outlined in the General Conditions. Final payment will not be processed until the documents are submitted to and approved by the Engineer.

##### 1.3 OPERATION AND MAINTENANCE DATA

- A. Where applicable, submit two sets, before final inspection, bound in three ring binders. Prepare a table of contents for each volume with each product or system identified.
- B. Where applicable, prepare the following:
  - 1. Directory, listing names, addresses and telephone numbers of Engineer, Contractor, Subcontractor, and Equipment Suppliers.

2. Operations and maintenance instructions, arranged by system. For each category, identify the applicable Contractor(s) or Subcontractor(s) and suppliers. Identify the following:
  1. Significant design criteria
  2. List of equipment
  3. Parts list for each component
  4. Operating instructions
  5. Maintenance instructions

1.4 WARRANTIES AND BONDS

- A. Submit, with final payment request, all warranty certificates, lien releases, and consent of security forms.

**PART 2: PRODUCTS — NOT USED PART**

**3: EXECUTION — NOT USED**

**PART 4: MEASUREMENT AND PAYMENT — NOT USED**

**END OF SECTION**

## SECTION 01750

### FINAL CLEANUP

#### **PART 1 GENERAL**

##### 1.1 DESCRIPTION

- A. This work consists of final cleanup of the project site prior to final acceptance.

#### **PART 2 PRODUCTS – NOT USED**

#### **PART 3 EXECUTION**

##### 3.1 CONTRACTOR RESPONSIBILITIES

The contractor shall be responsible for final clean up at the end of the project to a level satisfactory to the owner. All construction debris, no matter how small, shall be collected and removed from the site. All wheel ruts shall be filled in and be leveled to match the adjacent grade and material. Re-seeding or re-sodding, or other re-surfacing may be necessary to repair any construction related impacts or damage.

All survey markings, stakes, temporary paint marks, flagging and other devices shall be removed regardless of who installed them. All excess pavement, concrete, gravel, soil, or other construction materials not intended for permanent use shall be removed.

All final slopes shall be dressed manually to remove woody debris, accumulated trash and oversized material. Any new slope or topsoil surfaces shall be hand raked to provide a uniform appearance. The contractor shall dress all gravel, pavement and concrete edges to eliminate abrupt edges and provide a smooth transition. All construction related temporary sediment control devices shall be removed as soon as practical.

#### **PART 4 MEASUREMENT AND PAYMENT**

##### 4.1 PAYMENT

Unless specifically noted otherwise, all final cleanup work shall be incidental to other work items in the contract and no separate payment shall be made.

END OF SECTION 01750

# Section 02100 Site Preparation



**SITE PREPARATION**

SECTION 02113 Vault Toilet Installation  
SECTION 02110 Geotextiles



## SECTION 02113

### VAULT TOILET INSTALLATION

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This section consists of locating and installing the vault toilet provided and detailed in the drawings.

#### PART 2: PRODUCTS

##### 2.1 GENERAL

- A. Provide all materials including concrete, brick and mortar, complying with the specification section for the particular material involved, or if the material is not covered in these specifications, the material used for adjusting shall be equal, and comparable to that in the existing structure.

#### PART 3: EXECUTION

##### 3.1 GENERAL

- A. Bring to required grade all surrounding area to install the vault toilet in conformance with the plans.
- B. Provide backfill material conforming to the requirements of Section 02235, 1 inch (25 cm) Minus Crushed Base Course, and compacted to at least 95 percent of the maximum dry density as determined by AASHTO T99 or ASTM D698.

#### PART 4: MEASUREMENT AND PAYMENT

##### 4.1 GENERAL

- A. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work. This shall be a lump sum payment item per the bid tabulation.
- B. Payment of the Vault Toilet installation shall be made once the installation of the vault toilet is completed.

**END OF SECTION**

## SECTION 02110

### GEOTEXTILES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This work consists of furnishing, and placing a geotextile as a subsurface drainage fabric permeable separator between dissimilar materials (such as between subgrade and sub base/base), stabilization fabric, temporary and/or permanent erosion control measures or as waterproofing/stress releasing membrane within pavement structures.

##### 1.2 REFERENCES

- A. The current publications listed below form part of this specification.
- B. ASTM Standards

D123	Standard Terminology Relating to Textiles
D276	Standard Test Methods for Identification of Fibers in Textiles
D4354	Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing
D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab Method)
D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
D3786	Standard Test Method for Bursting of Textile Fabrics - Dia-phragm Bursting Strength Tester Method
D4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
D4491	Standard Test Method for Water Permeability of Geotextiles by Permeability
D4751	Standard Test Method for Determining the Number of Constrictions "m" of Non-Woven Geotextiles as a Complementary Filtration Property

D4354	Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing
D4759	Standard Practice for Determining the Specification Conformance of Geosynthetics
D276	Standard Test Methods for Identification of Fibers in Textiles
D4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
D4873	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
D5141	Standard Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration for Component of a Sediment Retention Device
D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
D1140	Standard Test Methods for Determining the Amount of Material Finer than (No. 200) Sieve in Soils by Washing
D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))

- C. AASHTO Specifications – Standard Specifications for Transportation Materials and Methods of Sampling and Testing
  - 1. Augmenting and prevailing over this specification section.

## PART 2 - PRODUCTS

### 2.1 PHYSICAL AND CHEMICAL REQUIREMENTS

- A. Assure that fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, consist of long-chain synthetic polymers, composed of at least 95 percent by weight polyolefins or polyesters. They must be formed into a network so the filaments on yarns retain dimensional stability relative to each other, including selvages. Furnish materials meeting the physical

requirements listed in Section 2.4 or as shown on the plans.

- B. Provide moderate or high survivability non-woven polypropylene fabric that is inert to commonly encountered chemicals and soils and that remains stable over a temperature range of -50 degrees Fahrenheit (-46° C) to 150 degrees Fahrenheit (66° C) and at a pH range of 2 to 13.

## **2.2 CERTIFICATION**

- A. Assure the manufacturer furnishes the purchaser a certificate stating: the name of the manufacturer, the chemical composition of the filaments or yarns, and other information fully describing the geotextile. The manufacturer must include in the certificate, a guarantee stating that the geotextile furnished meets specifications. The certificate must be attested to by a person having a legal authority to bind the company. Mismatching, or misrepresentation by the manufacturer is reason to reject the geotextile under these specifications. Notice sent to the manufacturer by the purchaser regarding rejection of, will be considered to be notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.
- B. Label the fabric and its container with the manufacturer's name and fabric type or trade name, lot number and quantity.

## **2.3 SHIPMENT AND STORAGE**

- A. During shipment and storage, protect the fabric from direct sunlight, ultra-violet rays, temperatures exceeding 160 degrees Fahrenheit (71°C), mud, dust and debris. Keep the fabrics in the manufacturer's wrapping until just before use. Include with each shipping, a document, a certification showing that the geotextile meets the manufacturer's certificate and a guarantee that has been previously filed with the purchaser.
- B. At the time of installation, the fabric will be rejected if it has defects, seams or weakness, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation or storage.

## **2.4 MATERIALS**

- A. Stabilization Fabric
  1. Furnish a Mirafi 140N or approved equal per plans.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Where placing geotextiles on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all

sharp objects and large rocks. Fill depressions or holes with a suitable material to provide a firm foundation.

- B. Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet, in all directions, (0.9m) beyond the damaged area.

### **3.2 DRAINAGE, SEPARATION AND STABILIZATION APPLICATIONS**

- A. Shape the subgrade to a smooth surface and to the cross section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts, the intersection of cuts, and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.
- B. Remove all material larger than 6 inches (15 cm) within the top 6 inches (15 cm) of the roadbed. Remove unsuitable material from the roadbed and replace with suitable material. Finish the roadbed and ditches to the required elevation and cross-section.
- C. Place the geotextile smooth and free of tension, stress, or wrinkles. Fold and cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet (0.6m) at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of cover material.
- D. End dump the cover material onto the geotextile from the edge of the geotextile or from previously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 10 inches (250mm). Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.
- E. Place subsequent lifts of cover material in the same manner as the initial lift. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. This section is specific to the trail construction and all measurement and payment is included within the trail construction costs.
- B. Payment for trail construction is indicated to include complete compensation

for all labor, equipment, materials and incidentals required for the completion of the work related to this section.

**END OF SECTION**

MPW

# Section - 02200 Earthwork



## **EARTHWORK**

SECTION 02221	Trench Excavation and Backfill for Pipelines and Appurtenance Structures
SECTION 02230	Street Excavation, Backfill, and Compaction
SECTION 02234	Sub Base Coarse
SECTION 02235	Crushed Base Coarse



## SECTION 02221

### TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is the excavation, trenching and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation, final grading, site dressing and cleanup.

##### 1.2 REFERENCES

- A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

##### 1.3 STANDARD DRAWINGS

- A. Standard Drawings applicable to this section are as follows:

1. Standard Drawing No. 02221-1 - Typical Utility Trench Detail

## 1.4 TESTING

### A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the Engineer's discretion.
3. Re-testing failing areas is at the expense of the Contractor.
4. At the direction of the Engineer, provide necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Engineer.

### B. Laboratory Maximum Density and Optimum Moisture

1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698.

### C. Material Submittals

1. Submit to the Engineer material quality test results including Type 1 Bedding gradation and plasticity index; and Type 2 Bedding gradation.
2. Submit to the Engineer samples of on-site and off-site borrow soils for laboratory moisture-density relationship testing by the Engineer.
3. If applicable, submit a blasting plan to the Engineer.

## **PART 2: PRODUCTS**

### 2.1 PIPE BEDDING MATERIALS

#### A. TYPE 1 PIPE BEDDING

1. Type 1 Pipe Bedding includes the material placed from 4 inches (100mm) below the bottom of the pipe, around the pipe, and up to the springline of the pipe.
2. Provide Type 1 Bedding consisting of sand, sandy gravel, or gravel having

a maximum 3/4 inch size (19mm) and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

3. Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be free draining and non-plastic
4. Refer to Standard Drawing 02221-1 and Special Provisions for other requirements.

**B. SELECT TYPE 1 BEDDING**

1. Select Type 1 Bedding includes the material placed from the springline of the pipe to 6 inches (15cm) over the pipe.
2. Select Type I Bedding shall consist of soil, sand or fine gravel, free from clods, lumps of frozen material, or rock exceeding 1-1/2 inches (38mm) in its greatest dimension.
3. Excavated trench material may be screened or sorted for use as backfill subject to approval of the Engineer.
4. Where trench excavation encounters wet or unstable material, Select Type 1 Bedding must be free draining and non-plastic.

**C. TYPE 2 PIPE BEDDING**

1. Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.
2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
3. Type 2 Bedding shall consist of granular material meeting the following gradation.

<u>Sieve Opening</u>	<u>% Passing</u>
3 Inch	100
No. 4	0 - 25
No. 8	0 - 10

**D. SEPARATION GEOTEXTILE**

1. The plans may require, or the engineer may direct, the use of non-woven geo-textile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as directed by the engineer. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the Engineer and shall fully comply with MPW Section 2110.

## 2.2 TRENCH BACKFILL MATERIALS

### A. Materials from Trench Excavation

1. Backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the Execution Section of this specification.

### B. Imported Backfill Material

1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the Engineer, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

## 2.3 FLOWABLE FILL

- A. If used, Flowable Fill is to meet the requirements of Section 2225, Flowable Fill.

## 2.4 DETECTABLE BURIED WARNING TAPE

- A. Detectable buried warning tape is to have a minimum 6 inch (15cm) width and 5 mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36 inch(90cm) imprint.

## **PART 3: EXECUTION**

### 3.1 PROTECTION OF EXISTING PROPERTIES

#### A. General

1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at Contractor's expense.
2. Contact utility owners using the Montana One Call System in accordance with Section 01041, PROJECT COORDINATION, Paragraph 1.2.B., for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.
3. Re-locate existing water mains, sanitary sewers and storm drains shown

on the plans, that conflict with new pipelines or structures as indicated in the contract documents. No separate payment will be made for this work unless shown as a payment item. If the Owner authorizes the relocation of mains or sewers which are not indicated in the bid documents, and the Engineer determines the work was not included in the original contract, payment will be made under the applicable sections of the General Conditions.

4. Cut and replace existing service lines interfering with trenching operations only with the engineer's permission and at the contractor's expense.  
Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.
5. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

**B. Privately Owned Utilities**

1. If any existing private utility interferes with the work in either alignment or grade, and has to be moved, the work will be performed by the appropriate UTILITY Owner, unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.
2. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.
3. Such payment will be made only if the work is determined by the Engineer to be a change from the original contract work scope.

**C. Existing Structures**

1. Prevent damage to existing buildings or structures in the work area.  
Repair all construction related damage to the satisfaction of the Owner.

**D. Existing Overhead Utilities**

1. Use extreme caution to avoid conflict, contact or damage to overhead utilities during the work.

**E. Exploratory Excavation**

1. The location of existing buried public utilities may need to be verified by exploratory excavation before construction.
2. Where authorized by the Engineer, the Contractor will be reimbursed for exploratory excavation work at the unit price bid per hour for a backhoe/excavator with operator and a laborer to assist. Use a backhoe/excavator having at least 60 horsepower (45kw), as rated by the

manufacturer.

3. The unit price per hour includes the backhoe/excavator, operator and one laborer based upon the actual time, to the nearest one-half hour, that the equipment and personnel are used in actual excavating and backfilling operations including standby time between excavation and backfilling which allows the Engineer to make the necessary survey of the underground utilities.
4. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping

1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavations edge using a spade-bitted air hammer, concrete saw or other suitable equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.
2. For trenches passing through existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between trench and edge of pavement.
3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.

G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion as trench backfill or legally dispose of the surfacing material.

H. When excavating across cultivated or sodded areas, remove topsoil full depth or to a maximum 12 inch (30cm) depth, whichever is less, and stockpile for possible project use.

I. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, in accordance with Section 2910, and/or 2920, to the satisfaction of the Engineer.

3.2 MAINTENANCE OF FLOWS

A. Maintain the flow of sewers, drains and water courses encountered during construction. Restore culverts, ditches, fences, crosswalks and structures disturbed by construction to their original condition upon completion of the work.

3.3 TRENCH EXCAVATION

A. General

1. Meet current OSHA Safety and Health Standards for all excavation,

trenching, shoring, and related work.

2. Excavate at the specified locations for pipeline installations and appurtenant structures.
3. Crossings under sidewalks or curbs may be made by tunneling, if approved by the Engineer. If a portion of a sidewalk or curb is removed, use a concrete saw to make joints, compact the backfill as specified, and replace the removed section with new concrete sidewalk or curb.
4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants, valves, manholes and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.
5. Remove and dispose of all excess or unsuitable excavated materials.
6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.
7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the excavation to the required length, depth and width for making the particular type of joint used. Backfill over- excavations with Type 2 Bedding Material.
8. No differentiation between common and rock trench excavation is made, except when listed as separate bid items on the bid proposal or bid form. Excavation includes removing and subsequent handling of all earth, gravel, bedrock or other material encountered regardless of the type, character, composition or condition of the material.
9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

#### B. Trench Dimensions

1. Excavate to the trench dimensions specified below.
2. Width
  - a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches

(0.5m). Maximum trench width may be specified in the contract documents.

3. Depth

- a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders or large stones are encountered at the bottom of the trench, excavate at least 6 inches (15cm) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unstable material is encountered at the trench subgrade which will not uniformly support the pipe, excavate the material to the depth directed by the Engineer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Blasting

1. Obtain Engineer approval to blast for excavation. If approved, the Engineer will establish the time limits blasting will be permitted.
2. Use utmost care to protect life and property during blasting. Use only a licensed blaster with experience in the type of blasting required for the work.
3. Safely and securely store all blasting materials meeting local laws and ordinances and clearly mark all storage places "Dangerous Explosives". Do not leave any explosives where they could endanger persons or property.
4. Blasting Rock in Trenches
  - a. When blasting rock in trenches, cover the blasting area with earth backfill or approved blasting mats. Before blasting, station workers and provide danger signals to warn people and stop vehicles.
  - b. Assume responsibility for all damage to property and injury to persons resulting from blasting or accidental explosions during the work.
  - c. Furnish the following information to the Owner and Engineer at least 48 hours before the commencement of blasting operations: Name of the contractor's powder man, powder man's experience, type of shot, type of explosives and detonator being used, proof of insurance covering liability for such operation, traffic control plans and planned procedures for protecting the public.



5. Assure blasting plan meets federal, state and local ordinances. Obtain all required permits before blasting starts.

E. Pavement Damage Cause by Equipment

1. Equip all track mounted equipment operated on pavement surfacing with pads to prevent pavement damage.
2. Restore all pavement damaged by construction to its original condition.

F. Shoring, Bracing and Sheeting

1. Provide all shoring, bracing and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the cost for trench excavation.

G. Excavation for Appurtenances

1. Make excavations for manholes, hydrants, structures and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

### 3.4 DEWATERING

- A. Remove all ground water encountered in trench excavations. Do not place pipe, bedding or backfill materials below the groundwater elevation established by dewatering operations. The cost of dewatering operations is considered a part of the excavation cost.

### 3.5 EXCAVATION STABILITY AND SAFETY

- A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the responsibility of the Contractor. Meet current OSHA regulations. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

### 3.6 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches as specified immediately after grade, alignment and pipe jointing has been inspected and approved by the Engineer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.

B. Pipe Bedding Placement

1. Type 1 Bedding.
  - a. Place Type 1 Pipe Bedding material 4 inches (10cm) under the pipe, around the pipe, and up to the springline of the pipe. Place in maximum lifts of 6 inches (15cm), using hand operated or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer. Use special care to assure compaction under the pipe haunches.
  - b. Place backfill material in equal lifts on both sides of the pipe for the full trench width. Take care to prevent migration of Type 1 Bedding into surrounding soils during placement and compaction
2. Select Type 1 Bedding.
  - a. Place Select Type 1 Bedding material from the springline to 6 inches (15cm) over the pipe. Where wet or unstable material exists, assure the material is free draining and non-plastic.
  - b. Place in maximum lifts of 6 inches (15cm) using hand or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer.
  - c. Place backfill in equal lifts on both sides of the pipe for the full trench width. Take care to prevent migration of Select Type 1 Bedding into surrounding soils during placement and compaction.
3. Type 2 Pipe Bedding.
  - a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the Engineer to replace unsuitable material encountered in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.
4. SEPARATION GEOTEXTILE
  - a. Place Separation Geotextile where shown on the plans or where directed by the Engineer.

C. Trench Backfill

1. After the pipe bedding materials are placed and compacted as specified, backfill the trench. Use backfill material free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. From the top of the Select Type 1 Pipe Bedding to 6 inches (15cm) below the ground surface, or to the subgrade elevation, material containing rock up to 8 inches (20cm) in the greatest dimension may be used.

2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.
  - a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.
  - b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.
  - c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.
3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.
4. Watering
  - a. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
  - b. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.
  - c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Owner, or from other sources.
5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Engineer at the contractor's expense.
6. Trench backfill types are designated as follows:
  - a. Type A Trench Backfill. Place trench backfill in maximum 8 inch compacted lifts within 3 percent of optimum moisture content, and compact to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698.
  - b. Type B Trench Backfill. Place backfill in maximum 8 inch (205mm) lifts, within 3 percent of optimum moisture content, and compact to at least 90 percent of maximum dry density, as determined by AASHTO T99 or by ASTM D698.
  - c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12 inch lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if so directed by the Engineer.

- d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the Engineer. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the Engineer and at the expense of the Contractor.

D. Replacement of Unsuitable Backfill Material

1. Remove and dispose of excavated soils that are saturated, contain deleterious materials or have characteristics that, in the opinion of the Engineer, render the soils unsuitable as backfill.
2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor. If suitable replacement material is not available within project limits, obtain material from an approved borrow source, to be paid for as Imported Backfill Material.
3. Place and compact all imported material according to the applicable backfill specification requirements.

E. Backfill of Appurtances

1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes and other underground items without disturbing appurtenance alignments.
2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.

F. Detectable Buried Warning Tape

1. The use of warning tape is optional and if used must not be relied on as the primary locating device. Provide warning tape as described in PRODUCTS Section 2.3. Bury tape a maximum 18 inches (45cm) below finish surface grade.

### 3.7 SURVEY MARKERS AND MONUMENTS

- A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Engineer.
- B. Replace all Contractor disturbed or destroyed survey markers or monuments, not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

### 3.8 CLEANUP

- A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.

### 3.9 TIME AND DISTANCE OF OPEN TRENCHES

- A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.
- B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.
- C. The maximum permissible distance between backfilling/ compaction operations and the end of newly installed pipe is 200 feet (60m) in existing streets (and/or alleys) and 500 feet (150m) in all other areas.
- D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.
- E. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling/compacting crew, the maximum allowable open ditch at any time is 300 feet (90m) in existing streets (and/or alleys) and 700 feet (210m) in all other areas.
- F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement or pavement replacement.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 GENERAL

- A. The following items constitute pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

### 4.2 TRENCH EXCAVATION AND BACKFILL

- A. No separate measurement and payment is made for TRENCH EXCAVATION AND BACKFILL. All of this work is to be included within the vault toilet installation lump sum bid item.

**END OF SECTION**

## SECTION 02230

### STREET EXCAVATION, BACKFILL AND COMPACTION

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This work is the clearing and grubbing, excavation, filling or backfilling, and subgrade preparation to the specified lines, grades and cross sections as preparation for overlying base course or other courses as shown in the contract documents. Also included are the removal and disposal of debris and excess soil, the furnishing and placement of fill materials, and compaction.

##### 1.2 REFERENCES

- A. The current publications listed below are a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> ) (600 kN-m/m <sup>3</sup> )
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method (ASTM D1556)
AASHTO T310	In-Place density and water content of the soil and soil aggregate
(ASTM D6938)	by Nuclear Method (Shallow Depth)
AASHTO T11	Materials Finer Than No. 200 (0.075mm) Sieve in Mineral (ASTM C117) Aggregates by Washing
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregate (ASTM C136)
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

##### 1.3 DENSITY CONTROL TESTING

- A. Field Density Testing
1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.

2. In-place field density tests for quality assurance are at Owner expense meeting ASTM D1556A (ASHTO T191), Sand Cone Method; or ASTM D2922 and ASTM D3017 (AASHTO T238 and T239) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the discretion of the Engineer.
  3. Retesting of failing areas is at the expense of the Contractor.
- B. Laboratory Maximum Density and Optimum Moisture
1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content under AASHTO T99 or ASTM D698.
- C. Material Submittals
1. Submit to the Engineer results of gradation tests for Sub-excavation/Replacement Below Subgrade pitrun gravel/sand.
  2. Submit to the Engineer samples of soils and/or aggregates for laboratory moisture-density relationship testing by the Engineer.

## **PART 2 - PRODUCTS**

### **2.1 ON-SITE EMBANKMENT**

- A. Fill and backfill materials are to consist of natural soils free from organic matter, frozen material, refuse, construction debris or other man-made items. Obtain approval of the Engineer for all fill before placing and use only the fill from designated borrow areas.

### **2.2 IMPORTED BORROW MATERIALS (FOR EMBANKMENTS IN-PLACE)**

- A. If required, obtain borrow soil for embankments from areas off the project site. Furnish imported borrow at Contractor expense. Obtain Engineer approval of borrow areas. Imported borrow is to meet the requirements of Section 2.1, On-Site Embankment.

### **2.3 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE**

- A. Sub-excavation consists of removing and disposing of unstable material from below planned subgrade elevation in cut sections or from below the natural ground line in embankment sections.
- B. Replacement material for sub-excavations consists of either:
1. Suitable materials from within the project limits if suitable material is present within the project limits, or

- 2 Imported materials if suitable material is not present within the project limits. Where imported pitrun gravel is used, furnish replacement material meeting the following gradation requirement:

<u>Sieve Opening</u>	<u>% Passing</u>
3 Inch	100
No. 4	25 - 60
No. 200	12 Max.

### **PART 3 - EXECUTION**

#### **3.1 CLEARING AND GRUBBING**

- A. Perform clearing and grubbing including the excavation, removal and disposal of roots, stumps, sod, or any organic material and buried debris from within construction limits. Construction limits are defined by all areas within the cut/fill limits and extending 1 foot (0.3 m) beyond the back of sidewalk and/or curb and gutter, or 2 feet (0.6 m) beyond the edge of pavement if no sidewalk or curb and gutter is present. Remove unsuitable material to at least 12 inches (30 cm) below subgrade elevation.
- B. Stockpile for project use any topsoil removed by clearing and grubbing.
- C. Dispose of all clearing and grubbing material as specified.

#### **3.2 EXCAVATION STABILITY AND SAFETY**

- A. Meet OSHA requirements for excavations and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

#### **3.3 PROTECTION OF PROPERTY**

- A. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, fences, and vegetation. Any disturbed or damaged facilities will be suitably restored or replaced consistent with condition(s) which existed prior to construction.

#### **3.4 EXCAVATION**

- A. Excavate to the specified lines and grades or as directed by the Engineer. Excavate without causing rutting, pumping or other disturbance to underlying materials.
- B. Excavation made outside the specified grade limits is not measured for payment in the Excavation or Embankment In-Place quantities.



1. Restore sub-excavated areas as directed by the Engineer. Correct subgrade disturbance by removing the disturbed soil and replacing and compacting to reach at least 95 percent of the maximum laboratory dry density determined by AASHTO T99 or ASTM D698.
  2. Correct subgrade disturbance before placing overlying fill, backfill, base course or other courses. Disturbed soils may be replaced with imported material approved by the Engineer and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.
- C. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.
- D. Construct and maintain temporary drainage where existing surface drainage, sewers, or under-drainage are disturbed during the work until permanent drainage facilities are completed. Protect and preserve all existing drains, sewers, sub-surface drains, conduits, gas lines, and other underground structures which may be affected by the work. Repair all damage to these facilities or structures resulting from the work, to the satisfaction of the Engineer.
- E. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.
- F. Grade all intersecting streets and approaches within the project limits as specified or as directed using suitable materials on the surfaces to produce smooth riding and satisfactory approaches to the intersections.

### **3.5 DISPOSAL OF EXCAVATED MATERIAL**

- A. Dispose of debris and unused excavated materials off the project site in accordance with all applicable state and local regulations. Locate and provide suitable disposal areas.

### **3.6 DUST CONTROL**

- A. Furnish dust control meeting Section 01500, Construction and Temporary Facilities, requirements.

### **3.7 SUBGRADE PREPARATION AND COMPACTION**

- A. General
1. Assure the subgrade beneath pavements, curb, or sidewalks is natural soil free of topsoil, organic material or refuse. Place pavement components, curb and sidewalk over the prepared subgrade as soon as practical. Do not place pavement components on frozen subgrade. No separate payment is made for subgrade preparation since it is considered incidental to construction of overlying pavements/structures.

2. If the surface of a previous roadbed or pavement surface matches the surface of the finished subgrade scarify the top 6 inches (15cm) of the previous surface the full width of the subgrade to permit uniform reshaping and compaction.
- B. Fine Grading
1. Assure the finished surface does not deviate not more than 0.1 foot (3cm) at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet (9m) apart does not exceed 0.1 foot (3cm).
- C. Compaction
1. Compact the upper 8 inches (20cm) of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Engineer. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipment as determined by the Engineer. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade as specified under Section 3.9, Sub-excavation/Replacement Below Subgrade.

### 3.8 EMBANKMENT PLACEMENT AND COMPACTION

- A. General
1. Place fill materials (embankment) to the specified lines and grades. Place fill in uniform layers not exceeding 8 inches (20cm) in loose thickness. Once placed, moisten or aerate, mix, and compact each layer as specified. Work clay soils to maximum 2-inch (5cm) nominal size before compacting. Do not begin fill placement until the subgrade construction has been approved by the Engineer. Do not place fill on wet or frozen areas. Do not operate heavy equipment for spreading or compacting fill within 4 feet (1.2m) of structures.
  2. If grading operations are suspended due to weather, blade the entire area until it is smooth, free of depressions and ruts, and crowned to drain water.
- B. Compaction
1. Control the fill moisture content to assist in obtaining the specified field density. Maintain the moisture content of fill soils within  $\pm 3\%$  of optimum moisture. Compact each fill layer and the top 8 inches (20cm) of subgrade soil to at least 95 percent of maximum laboratory density as determined by AASHTO T99 or ASTM D698. Compact areas within 4 feet (1.2m) of structures in maximum 8-inch (20cm) loose lifts using power-driven hand-held tampers.
  2. Apply water, when required, at the locations and in the amounts required to compact the material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Apply water during the work to control dust and to maintain

all embankment and base courses in a damp condition in accordance with Section 1500. Water required for compacting subgrade and/or embankments may be obtained from the municipal system if approved by the Owner, or from other sources.

3. Do not place fill or embankment when moisture content prevents effective compaction or causes rutting. Dry all embankments having excessive moisture by scarifying and blading the affected areas before compacting or placing succeeding layers.

### **3.9 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE**

- A. Sub-excavation consists of removing and disposing of unsuitable material from below planned subgrade elevation in cut sections or from below the natural groundline in embankment sections.
- B. Soil is unsuitable if, in the opinion of the Engineer, it contains excessive organics, refuse, construction debris, or other objectionable material; or if it is unstable, rutting or yielding; or if it contains excessive moisture. Generally, soils will be sub-excavated and replaced only if they are unable to adequately support equipment typically used for excavation and soil transport.
- C. Assure the Engineer has measured the area where unstable materials have been removed before backfilling. Do not backfill any area where unstable foundation soils have been excavated until authorized by the Engineer. Backfill placed without approval may be ordered removed and replaced at Contractor expense.
- D. Backfill with either suitable soils from within the project limits or imported pit run gravel complying with the requirements of Section 2.3, Sub-excavation/Replacement Below Subgrade. Different measurement and payment items are used for the on-site soil and pit run gravel replacements.
- E. Compact the replacement material to 95% of the maximum laboratory density as determined by AASHTO T99 or ASTM D698.

### **3.10 PROTECTION OF THE WORK**

- A. Repair damaged embankments to the specified elevations and grades. Maintain ditches and drains along the subgrade to drain the subgrade. Assure the finished grade does not deviate more than 0.1 (3cm) foot at any point from the staked elevation and the sum of the deviations from true grade of any two points not more than 30 feet (9m) apart does not exceed 0.1 foot (3cm). Do not place any surface course or pavement until the subgrade has been checked and approved by the Engineer.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

- A. Excavation Above Subgrade
  - 1. This item includes full compensation for all labor, equipment, tools and incidentals necessary to accomplish all clearing, grubbing, old pavement removals, hauling, disposal, and excavating to prepare the subgrade shown in the contract.
  - 2. Excavation Above Subgrade is not specified in the contract, the cost of this item is incidental to and included in the unit prices bid for the associated bid items for the work. (Trail Construction)
  
- B. Sub-excavation/Replacement Below Subgrade.
  - 1. This item includes full compensation for all labor, equipment, tools, and incidentals to complete the excavation and disposal of unsuitable material in the embankment foundation or in the subgrade. The cost of backfilling and compacting holes created by the removal of unsuitable material with the specified replacement material is also included in Sub-excavation/Replacement Below Subgrade Item.
  - 2. Sub-excavation/Replacement Below Subgrade is not specified in the contract, the cost of this item is incidental to and included in the unit prices bid for the associated bid items for the work. (Trail Construction)
  
- C. Embankment In Place.
  - 1. This item includes full compensation for all labor, tools, equipment, and other incidentals necessary to secure borrow material, haul, place, level, manipulate, compact the embankment material, and perform other work for embankment construction.
  - 2. Embankment In Place is not specified in the contract, the cost of constructing embankments is incidental to and included in the unit prices bid for the associated bid items for the work. (Trail Construction)

**END OF SECTION**

## SECTION 02234

### SUB-BASE COURSE

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This work is constructing a sub-base course of either crushed or uncrushed materials meeting the specified gradations and other quality criteria specified herein.

##### 1.2 REFERENCES

AASHTO T11	Amount of Material Finer Than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Plastic Fines in Graded Aggregates and Soils by the Use of the Sand Equivalent Test
AASHTO T96	Resistance to Degradation of Small-Size Course Aggregate By Abrasion and Impact in the Los Angeles Machine
AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures (ASTM D698) Using 5-lb (2.5kg) Rammer and 12-Inch (305mm) Drop
ASTM D5821	Determining the percentage of Fractured Particles in Coarse Aggregate
AASHTO T191	Density of Soil in-Place By Sand Cone Method (ASTM D1556)
AASHTO T310	In-Place density and water content of the soil and soil aggregate by (ASTM D6938) Nuclear Method (Shallow Depth)

##### 1.3 DENSITY CONTROL TESTING

- A. Field Density Testing
1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.

2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D 6938), Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.
  3. Retesting of failing areas is at the expense of the Contractor.
- B. Laboratory Maximum Density and Optimum Moisture
1. Moisture density curves will be provided by the Contractor for each base material supplied. These will be provided at the expense of the Contractor.
- C. Materials Submittals
1. Submit to the Engineer gradations, moisture density curves and other preliminary test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Furnish select sub-base material meeting the applicable aggregate quality.

### **2.2 CRUSHED SUBBASE**

- A. Furnish material having both fine and coarse crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with soil, sand, screenings, recycled concrete and/or asphalt or other materials.
- B. Furnish crushed gravel or stone consisting of hard, durable particles, not containing excessive flat, elongated, soft or disintegrated rock, dirt, or other deleterious matter, and having a wear not exceeding 50% at 500 revolutions as determined by AASHTO T96.
- C. Use production methods that produce a percent of fractured rock in the finished product that is constant and uniform. Crush aggregate so that at least 25% of the material is retained on the No. 4 sieve and has one or more mechanically fractured faces.

**2.3 GRADATION**

- A. Produce material, including any added binder or filler, meeting the following Table of Gradations as determined by AASHTO Methods T11 and T27:

**TABLE OF GRADATIONS PERCENTAGES BY WEIGHT**

**PASSING SQUARE MESH**

**SIEVES**

Passing	4" Minus	3" Minus	2" Minus	1-1/2" Minus	1" Minus
1-1/2 Inch	---	---	---	100	
1 Inch	---	---	---	---	100
No.4	25-60	25-60	25-60	25-60	25-70
No.40	10-30	10-30	10-30	10-30	10-30
No.200	2-10	2-10	2-10	2-10	2-10

- B. Up to 5% "oversized" material is permitted provided that the "oversized" material pass the screen size immediately larger than the top size specified. The material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.
- C. Suitability of the aggregate is determined by the gradation testing of material placed in the project as required in the Contract documents, within the allowable limits described by the Table of Gradations for the particular grading specified.
- D. Assure the liquid limit for the aggregate fraction passing a No.40 sieve does not exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

**2.4 WATERING:**

- A. Use water from an approved source.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Immediately before placing the base course, blade smooth and shape the underlying subgrade, subbase or base course to the plan cross-section before the base course is placed on the street. Do not place sub-base course on wet or muddy subgrade or subbase course. Maintain at least 1 completed area of finished and

accepted subgrade or sub-basecourse in advance of placing base course.

### **3.2 PLACEMENT AND SPREADING**

- A. Mix and place the material in maximum 6-inch (15 cm) horizontal layers loose thickness. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base course layer continuously without breaks. Assure hauling over the subgrade or over any completed subbase course does not damage the subgrade, sub-base or base course.
- B. Spread using dump boards, spreader boxes, or moving vehicles equipped to distribute the material in a uniform layer or a windrow. Place and spread the material in a uniform layer to the specified depth without causing segregation. Once the base course is spread, blade-mix it the full depth by alternately blading the entire layer to the centerline and back to the roadway edge.
- C. For multiple layers, mix each layer as specified above. Blade smooth and compact each layer before placing the succeeding layer.
- D. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
- E. Apply water during the work to control dust and to maintain the base course in a damp condition.
- F. Where crushed sub-base is specified, produce a product with at least 25% of the material retained on the No.4 sieve having one or more fractured faces.
- G. Water required for compacting base gravel may be obtained from the municipal system if approved by the Owner, or from other sources.
- H. Compact the material using appropriate tamping equipment or power rollers. Correct all irregularities or depressions that develop under rolling by scarifying the material and adding or removing material, as required, until the surface meets specifications.
- I. Blade and compact alternately, as required to produce the specified surface until final inspection. Tamp the material along curbs, headers, manholes, and similar structures and all places inaccessible to rollers using approved mechanical tampers or hand tampers meet field density requirements.

### **3.3 FIELD DENSITY REQUIREMENTS**

- A. Furnish watering and rolling to obtain a minimum field density of 95% of the maximum dry density determined by AASHTO T99. No separate compensation is allowed for rolling and watering the sub-base course other than the sub-base course bid item or items listed on the Contract documents.

### **3.4 SURFACE TOLERANCES**



- A. Finish the sub-base course so that when tested using a 10-foot (3m) straight edge placed on the surface with its center line parallel to the street center, the maximum surface deviation from the straight edge does not exceed ½ inch (12.7mm). Additionally, the finished grade cannot deviate more than 0.1 foot (30mm) at any point from the staked elevation and the sum of the deviations from two points not more than 30 feet (9.14m) apart cannot exceed 0.1 feet (30mm).
- B. Perform all sub-base course corrections to meet the above tolerances using approved methods and materials. Payment for patching aggregate is at the unit price bid for the sub-base course material.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 CUBIC YARD BASIS: SUB-BASECOURSE**

- A. This item is measured and paid for as part of the lump sum per the bid documents which constitutes full compensation for furnishing, loading, hauling, spreading, blending, shaping, watering, and compacting the sub-base course material, and for all tools, labor and incidentals necessary to complete this item.

**END OF SECTION**

## SECTION 02235

### CRUSHED BASE COURSE

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This work is the placing of one or more base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

##### 1.2 REFERENCES

AASHTO T11	Materials Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T96	Resistance to Degradation of Small-Size Coarse Aggregate By Abrasion and Impact in the Los Angeles Machine
AASHTO T99	Moisture-density Relations of Soils and Soil-Aggregate Mixtures (ASTM D698) Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191	Density of Soil In-Place By Sand Cone Method (ASTM D1556)
AASHTO T310	In-Place density and water content of the soil and soil aggregate by (ASTM D6938) Nuclear Method (Shallow Depth)

##### 1.3 DENSITY CONTROL TESTING

- A. Field Density Testing
  1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
  2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field

- density testing frequency is at the discretion of the Engineer.
3. Retesting of failing areas is at the expense of the Contractor.
- B. Laboratory Maximum Density and Optimum Moisture
1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

#### 1.4 MATERIALS SUBMITTALS

- A. Submit to the Engineer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Furnish aggregate base material meeting the applicable aggregate quality requirements.

#### 2.2 CRUSHED BASE MATERIAL

- A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials. Where recycled materials are permitted, project specifications shall state the minimum required CBR value (design minimum) of the Crushed Base Course.
- B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.
- C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50% of the material retained on the No. 4 sieve has at least one fractured face.
- D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

#### 2.3 GRADATION

- A. As determined by AASHTO Methods T11 and T27, furnish material for the grading

specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

**TABLE OF GRADATIONS**

**PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE**

Passing	1½" Minus	1" Minus	¾" Minus
1½ Inch	100		
1 Inch	—	100	
¾ Inch	—	—	100
½ Inch	—	—	—
No. 4 Sieve	25 - 60	40 - 70	40 - 70
No. 10 Sieve	—	25 - 55	25 - 55
No. 200 Sieve	0 - 8	2 - 10	2 - 10

- B. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.
- C. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.
- D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60% of that portion passing the No. 40 sieve.
- E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index have a minimum of 6 and maximum of 12, as determined by AASHTO T89 and T90.

2.4 WATERING:

- A. Use water from an approved source.

**PART 3 - EXECUTION**

3.1 GENERAL

- A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.
- B. Do not place base course on a wet or muddy subgrade or sub-base course. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

### 3.2 PLACEMENT AND SPREADING

- A. Mix and place the material in maximum 8 inches compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.
- B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.
- C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.
- D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.
- E. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street.
- F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.
- G. Apply water during the work to control dust and to maintain the base course in a damp condition in accordance with Section 01500 under Dust Control.
- H. Uncontaminated water required for compacting base gravel may be obtained from the municipal system if approved by the owner, or from other sources.

### 3.3 FIELD DENSITY REQUIREMENTS

- A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.
- B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.
- C. Provide the watering and rolling required to obtain a minimum field density of 95% of maximum dry density as determined by AASHTO T99. No separate compensation is Made for rolling and watering the base course other than the base course bid item or items listed on the contract documents.

### 3.4 SURFACE TOLERANCES

- D. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edge placed on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8-inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).
- E. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).
- F. If patching of the base course is necessary to meet the tolerances, perform patching using methods and aggregates approved by the Engineer. Payment for patching aggregate is at the unit price bid for the base course material.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 CUBIC YARD BASIS: CRUSHED BASE COURSE.**

- A. This is a lump sum item included in the bid totals which constitutes full compensation for furnishing, loading, hauling, spreading, blending, shaping, watering, and compacting the sub-base course material, and for all tools, labor and incidentals necessary to complete this item.

**END OF SECTION**

# Sections - 2900 Landscaping

MPW





**LANDSCAPING**

**SECTION 02910 SEEDING**

## SECTION 02910

### SEEDING

#### **PART 1: GENERAL**

##### 1.1 DESCRIPTION

- A. This section includes ground surface preparation; furnishing and applying fertilizer; and furnishing and planting seed in areas described in the contract documents or directed by the Engineer.
- B. Hydraulic seeding is not included in this section. Hydraulic seeding is covered in Section 02920, Hydraulic Seeding.

##### 1.2 SUBMITTALS

- A. Submit to the Engineer applicable seed mixture certifications, fertilizer descriptions and mulch certifications. Furnish duplicate signed copies of the vendors statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

#### **PART 2: PRODUCTS**

##### 2.1 SEED

- A. Furnish seed and seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.
- B. Seal and label all seed containers to comply with Montana Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce.
- C. Do not use wet, moldy, or otherwise damaged seed in the work.
- D. Furnish seed mixture of the species described in the contract documents. Furnish seed in standard containers labeled with the seed name, lot number, net weight,

percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species.

## 2.2 TOPSOIL

- A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other undesirable material that would form a poor seedbed. Before striping topsoil, assure it has supported the growth of healthy crops, grass or other vegetable growth.

## 2.3 LIME

- A. Furnish ground limestone or other material deemed suitable by the Engineer containing a minimum 85 percent of total carbonate equivalent ground so that 90 percent will pass through a No. 100 mesh sieve. Coarser material may be acceptable, if the application rates are increased to provide at least the minimum quantities and depth specified using an approved Dolomitic lime or a high magnesium lime containing at least 10 percent magnesium oxide.

## 2.4 FERTILIZER

- A. Furnish standard commercial fertilizers supplied separately or in mixtures containing the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. Apply fertilizer at the specified rate and depth meeting the applicable State and Federal laws. Furnish fertilizer in standard containers clearly labeled with name, weight, and guaranteed analysis of contents. No cyanamide compounds of hydrated lime are permitted in mixed fertilizers.
- B. Fertilizers may be supplied in one of the following forms:
  - 1. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
  - 2. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
  - 3. A granular or pellet form suitable for application by blower equipment.

## 2.5 SOILS FOR REPAIRS

- A. Use soil for filling and topsoiling repair areas of equal quality to the existing topsoil being repaired. Assure the soil is free of large stones, roots, stumps, or other

materials that interfere with sowing, compacting, and establishing turf. Obtain approval from the Engineer before placing topsoil.

## **PART 3: EXECUTION**

### **3.1 TOPSOIL**

- A. Place at least 6 inches (15 cm) of topsoil in all areas to be seeded. Import topsoil if sufficient topsoil is not available from excavated areas of the project.

### **3.2 ALLOWABLE SEEDING MONTHS**

- A. Perform seeding when the temperature and moisture are favorable to germination and plant growth. Seed preferably before June 1st and after October 1st of each year. Seeding dates must be approved by the Engineer.

### **3.3 SEEDBED PREPARATION AND SOWING**

- A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the Engineer to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.
- B. Sow seed in the areas described in the contract documents at the specified application rates.
- C. Sow seed using a force feed drill having a grass seed attachment, except of slopes steeper than three to one or on areas too small to be seeded with a force feed drill. In these areas, seed may be sown by power sprayers, blowers or other effective methods. Use equipment in good working order.
- D. Seed a Native Grass mix as approved by the Montana FWP staff.**
- A. Spread and work fertilizer into the soil during the final seedbed preparation. Apply fertilizer at the rate described in the contract documents.

### **3.5 CARE OF SEEDED AREAS**

- A. Keep the seeded area moist until it has germinated and it's continued growth is assured. Prevent erosion during watering. Water is incidental to the item

“Seeding”.

- B. Protect all seeded areas from traffic or pedestrian use with warning barricades or other Engineer approved methods.
- C. Maintain the seeded area, performing any required watering and mowing until the seed is firmly established. Prevent weeds and other undesirable vegetation from establishing in the seeded area. Mow weeds and rake and remove the clippings from the areas.
- D. Replace any seeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. The contract warranty period applies to this item.

#### **PART 4: MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. Seeding is a lump sum item in the bid for all disturbed areas in the project and shall be done including topsoil salvage and/or importing, topsoil placement, seedbed preparation, and seeding, complete in place and accepted by the Engineer.
- E. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work. Do not sow seed in winds that prevent proper imbedment into the surface.

# SECTION 03000 CONCRETE

MPW



## SECTION 03210

### REINFORCING STEEL

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. This work is furnishing and placing reinforcing steel or wire fabric meeting the quality, type and size specified in the contract.

##### 1.2 REFERENCES

ASTM A-615	ASTM A-705	
AASHTO M 31		Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO M 32		Cold Drawn Steel Wire for Concrete Reinforcement
AASHTO M 55		Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
AASHTO M 54		Fabric Deformed Steel Bar or Rod Mats for Concrete Reinforcement

#### PART 2: PRODUCT

##### 2.1 Furnish all new material meeting the following requirements.

- A. Bar Reinforcement
  - 1. Furnish deformed reinforcement steel meeting ASTM A 615, (AASHTO M 31) or ASTM A705, Grade 40 or Grade 60.
    - a. Small quantities purchased from warehouses may, at the Engineer's direction, be accepted if bend tested under ASTM A615 or AASHTO M31. The test specimen must cold bend around a pin without cracking on the outside of the bent portion.
- B. Wire and Wire Mesh
  - 1. Furnish wire meeting cold-drawn steel wire AASHTO M32 (ASTM A82) requirements.
  - 2. Furnish wire mesh for concrete reinforcement meeting AASHTO M 55

(ASTMA A 185).

3. Furnish bar mats meeting AASHTO M54 (ASTM A 184).

## **PART 3: EXECUTION**

### **3.1 PROTECTION**

- A. Protect steel reinforcement from damage at all times. Place steel free from dirt, detrimental scale, paint, oil and other foreign substance. Clean steel reinforcement having easily removed rust, loose scale, and dust using an approved method.

### **3.2 FABRICATION**

- A. Furnish four copies of shop details and placing drawings for all reinforcing steel to the Engineer for approval. Once checked, the Engineer will return two marked- up sets of prints or drawings for correction. The Engineer's review is only for general conformity with the plans. Checking the detailed dimensions is the Contractor's responsibility. The Engineer's review does not relieve the Contractor's responsibility to furnish all material meeting the Contract requirements. Detail Reinforcing, steel meeting the ACI "Standard Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" published by the American Concrete Institute (ACI 315).
- B. Assure all bars are bent cold. Do not field bend any bar partially imbedded in concrete except as specified on the plans.
- C. Ship bar reinforcement in standard bundles, tagged and marked meeting the "Details and Detailing of Concrete Structures" (ACI 315) requirements.
- D. Concrete reinforcement and accessory details, not covered herein or on the drawings, must meet "Details and Detailing of Concrete Structures" and the "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures" (ACI 315 and 315R) requirements.

### **3.3 PLACING AND FASTENING**

- A. Accurately place and hold firm all steel reinforcement in the plan locations as concrete is being placed.
- B. Support and fasten together all reinforcement to prevent displacement due to construction loads. It is permissible to use on ground, where necessary, concrete



support blocks having a minimum 4 square inches (2580 MM<sup>2</sup>) bearing area and having a compressive strength equal to the concrete being placed. Use approved bar chairs and spacers over form work. For concrete surfaces exposed to the weather in the finished structure, assure the portions of all accessories within ½- inch (12.7 mm) of the concrete surface are noncorrosive or protected against corrosion.

- C. Overlap welded wire fabric for successive mats or rolls providing an overlap measured between outermost cross wires of each fabric sheet at least 2 inches (50.8 mm). Extend the fabric across supporting beams and walls to within 4 inches (101.6 mm) of concrete edges. It may extend through contraction joints. Adequately support the fabric during concrete placement to maintain its position in the slab using the methods previously described or by laying the fabric on a concrete layer of the required depth before placing the upper slab layer.
- D. Offset vertical bars in columns at least one bar diameter at lap splices. Furnish templates for all column dowels.
- E. Obtain Engineer approval for all splices not shown on the plans. Mechanical connectors for reinforcing bars may be used if approved.
- F. Do not use pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe, or wooden block to position the fabric.
- G. Follow the minimum concrete protective covering for reinforcement below.
  - 1. Concrete deposited against ground: 76.2 mm (3 inches)
  - 2. Formed surfaces exposed to weather or in contact with the ground:
    - a. #6 bars or larger 50.8 mm (2 inches)
    - b. Smaller than #6 bars 38.1 mm (1-1/2 inches)
  - 3. Interior Surfaces:
    - a. Beams, girders and columns 38.1 mm (1-1/2 inches)
    - b. Slabs, walls and joists:
      - 1) #11 bars or smaller 19.05 mm (3/4-inch)
      - 2) #14 and #18 bars 38.1 mm (1-1/2 inches)
- H. For corrosive atmospheres or fire protection, see special provisions for minimum covering requirements.
- I. Obtain Engineer approval of reinforcement placement before placing concrete. Remove and replace concrete placed without Engineer approval of reinforcing.

- J. Straighten fabric reinforcement shipped in rolls into flat sheets before placing it.

### 3.4 WELDING

- A. When specified or approved, weld reinforcing steel meeting "Reinforcing Steel Welding Code" (AWS D 1-4). Do not weld at bends in bars. Do not tack weld crossbars without Engineer approval.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 GENERAL

- A. Reinforcing steel used in the work is not measured. The cost of furnishing and placing reinforcing steel is incidental and included in the unit price or lump sum price bid for various items of the work.

**END OF SECTION**

## SECTION 03310

### STRUCTURAL CONCRETE

#### PART 1: GENERAL

##### 1.1 DESCRIPTION

- A. Furnish structural concrete meeting all specified requirements that is composed of Portland cement, aggregates, water. Furnish Ready-mixed concrete meeting ASTM C94 unless otherwise specified.

##### 1.2 REFERENCES

ASTM C-94	Standard Specification for Ready-Mixed Concrete
ASTM C-150	Specification for Portland Cement
ASTM C-618	Specification for Coal Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C-989	Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C-595	Specification for Blended Hydraulic Cements
ASTM C-157	Performance Specification for Hydraulic Cements
ASTM C-33	Specification for Concrete Aggregates
ASTM C-260	Specification for Air-Entraining Admixtures for Concrete
ASTM C-494	Specification for Chemical Admixtures for Concrete
ASTM C-1017	Specification for Chemical Admixtures for Use in producing Flowing Concrete
ASTM D-98	
ASTM C-138	Test Method for Density(Unit Weight), Yield, and Air Content(Gravimetric) of Concrete
ASTM C-173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C-231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C-31	Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C-39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-172	Practice for Sampling Freshly Mixed Concrete
ACI 301	Standard Specification for Structural Concrete for Buildings
ACI 305	Hot Weather Concrete
ACI 306	Cold Weather Concrete
ACI 318	Building Code Requirements for Reinforced Concrete

### 1.3 QUALITY ASSURANCE

- A. Codes and Standards: The codes and standards referred to in this section are declared to be part of this specification as if fully set forth herein. In addition, the following ACI Standards are incorporated in their entirety, unless specifically required otherwise:
1. ACI Standard 301, "Specifications for Structural Concrete for Buildings," American Concrete Institute, Edition.
  2. ACI Standard 318, "Building Code Requirements for Reinforced Concrete", American Concrete Institute, current edition.
  3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
  4. International Building Code of I.C.B.O.
- B. Concrete Testing: The Contractor shall employ at his expense a testing laboratory acceptable to the Engineer to perform material evaluation tests and/or perform the mix design prior to placing any concrete. Retesting or additional testing of concrete or materials failing to meet the requirements of these specifications shall be done by the Contractor at no additional cost to the Owner.

## **PART 2: PRODUCT**

### 2.1 CLASSIFICATION

- A. Concrete is classified as set forth below. Place the specified class of concrete for each structure element as specified. Concrete with prefixes "C" contain 1-1/2 inch (38.1 mm) size aggregate and those with "M" contain 3/4 inch (19.05 mm) size aggregate.. Concrete with prefixes "M" may be substituted for concrete with prefixes "C."
1. Use M-3000 concrete for structural concrete for walls, interior slabs, and footings.

2. M-3000 is concrete with 3/4 inch (19-05 mm) maximum aggregate and a 28-day compressive strength of 3000 pounds per square inch (psi) (27.6 Mpa).

B. If concrete strength or durability requirements established by design exceed the above strength classifications, the Engineer may specify additional concrete classifications to meet those requirements, contractor shall verify this on the structural general notes found in the plan set.

## 2.2 COMPOSITION OF CONCRETE

A. Upon receipt of the notice of award of the contract, furnish the Engineer with names of suppliers and locations of sources of materials proposed for use.

### 1. Materials

a. Cementitious Material: Cementitious material consists of Portland cement meeting ASTM C 150, with or without the addition of cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989, or blended hydraulic cement meeting ASTM C595 or hydraulic cement meeting ASTM 1157. Unless otherwise specified, assure cementitious material meets ASTM C 150 Type I or Type II. Assure cementitious material used in concrete is the same brand and type and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test date or used in the trial mixtures.

b. Aggregates: Assure aggregates meet ASTM C33. When a single size or a combination of two or more sizes of coarse aggregates are used, assure the final gradation meets the grading requirements of ASTM C33. Obtain concrete aggregates from the same source and use the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.

c. Water and Ice: Use concrete mixing water and water to make ice meeting requirements of ASTM C94.

d. Admixtures: Use admixtures meeting the following requirements:

- |    |                              |           |
|----|------------------------------|-----------|
| 1) | Air entraining, admixtures - | ASTM C260 |
| 2) | Chemical admixtures-         | ASTM C494 |

- 3) Chemical admixtures for use in producing, flowing concrete- ASTM C1017
- 4) Calcium Chloride - ASTM D98
- 5) Use admixtures in the concrete that are the same as those used in the concrete represented by submitted field test data or in trial mixtures.

2. Change of materials

- a. When brand, type, size, or source of cementitious materials, aggregates, water, ice or admixtures are requested to be changed, submit new field data or data from new trial mixtures or furnish evidence that indicates that the change will not adversely affect the relevant properties of the concrete for acceptance before using the concrete.

B. Performance and Design Requirements

- 1. Assure the cementitious material content is adequate to meet the specified requirements for strength, water-cement ratio and finishing requirements. For concrete used in floors, assure the cement content is at least that indicated in Table 2.1. For concrete exposed to freezing and thawing or concrete exposed to deicers, assure a maximum water-cement ration of 0.45.

**TABLE 2.1  
MINIMUM CEMENT CONTENT REQUIREMENTS**

Nominal Maximum size of aggregate, in(mm)	Minimum cement content lb/yd <sup>3</sup> (kg/m <sup>3</sup> )
1-1/2 (38-1)	470* (163.0)
1 (25.4)	520 (180.3)
3/4 (19-05)	540 (187-3)
3/8 (9-5)	641 (222.3)

\* Minimum cement content is 520 lb/yd<sup>3</sup> (180.3 kg/m<sup>3</sup>) and maximum H<sub>2</sub>O/cement ratio of 0.45 if concrete will be exposed to freezing and thawing and/or in the presence of deicing chemicals.

Furnish concrete at the point of delivery having a slump of 4 inches (max) (100 mm) determined by ASTM C 143. Meet slump tolerances in ACI 117. When a plasticizing admixture is used meeting ASTM C 10 17 or when a Type F or G high range water reducing admixture meeting ASTM C494 is approved to increase the concrete slump, assure the concrete has a slump of 2 to 4 inches (50-100mm) before the

admixture is added and a maximum slump of 8 inches (200 mm) at the point of delivery after the admixture is added.

1. Assure the nominal maximum size of coarse aggregate does not exceed three fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms or one-third of the thickness of slabs or toppings.
2. Concrete must be air entrained. Measure air content under ASTM C 138, C 173 or C 231. Unless otherwise specified, ASTM C 231 shall be used.

**TABLE 2.2**  
**TOTAL AIR CONTENT\* OF CONCRETE FOR**  
**VARIOUS SIZES OF COARSE AGGREGATE**

Nominal maximum Size of aggregate mm, (in.)	Total air content, percent		
	Severe exposure	Moderate exposure	Mild exposure
Less than 9.53(3/8)	9	7	8
9.53(3/8)	7.5	6	4.5
12.5(1/2)	7	5.5	4
19(3/4)	6	5	3.5
25.4(1)	6	4.5	3
12.7(1-1/2)	5.5	4.5	3
50.8(2)	5	3.5	1.5
76.2(3)	4.5	3.5	1.5
152.4(6)	4	3	1

\* Measure in accordance with ASTM C 138, C 173, or C 231.

Air content tolerance is +/- 1 1/2 percent

- a. When admixtures are specified in the Contract documents for particular parts of the work, use types specified. Use of calcium chloride or other admixtures containing chloride ions is subject to the limitations in Table 2.3 Chloride Ion Concentration. When approved, use calcium chloride in solution form only, when introduced into the mixture.

Assure the maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days attributed to the ingredients including water, aggregates, cementitious materials and admixtures do

1) not exceed the limits of Table 2.3. Use tests to determine water soluble chloride ion content meeting AASHTO T260. The type of member described in Table 2.3 applies to the work as indicated in the Contract Documents.

**TABLE 2.3  
MAXIMUM ALLOWABLE CHLORIDE ION CONTENT**

Type of Member	Maximum water soluble chloride (Cl) Content in concrete, percent by weight of cement
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	.30

- b. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40°F (40°C) for more than three successive days, deliver concrete in accordance with ASTM C-94.
- c. Furnish the compressive strength and the water-cement or water cementitious, material ratio of concrete for each portion of the work as specified in the Contract documents.
  - 1) If cementitious or pozzolanic mineral admixtures meeting, ASTM C618 or ASTM C989 are used, the cement portion of the water-cement ratio must be the total weight of cementitious material.
  - 2) The maximum weight of fly ash, pozzolan or ground granulated blast-furnace slag included in the calculation of water-cementitious material ratio cannot exceed the following percentages of the total weight of portland cement plus fly ash, pozzolan and ground granulated blast- furnace slag:

The combined weight of fly ash and pozzolan meeting ASTM C618 cannot exceed limits in ACI 318.. The fly ash and pozzolan present in an ASTM Type IP or IPM blended cement meeting ASTM C595 must be included in the calculated percentage.



- 3) The weight of ground granulated blast-furnace slag meeting ASTM C989 cannot exceed 50 percent of the total weight of cementitious material. The slag used in manufacture of a Type IS or ISM blended hydraulic cement meeting ASTM C595 must be included in the calculated percentage.
- 4) If fly ash or pozzolan is used in concrete with ground granulated blast-furnace slag, the portland cement constituent meeting ASTM C 150 cannot be less than 50 percent of the total weight of cementitious material. Fly ash or pozzolan must not constitute more than 25 percent of the total weight of cementitious material.
- 5) Strength requirements are based on the 28-day compressive strength determined on 6" x 12" (150mm x 300mm) cylindrical specimens made and tested under ASTM C31 and C39 respectively.

## 2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved.

## **PART 3: EXECUTION**

### 3.1 CONCRETE MIXES

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch match mixer. For mixers of one cu. Yd., or small capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. Yd., increase minimum 1-1/2 minutes of mixing time by 2.5 minutes for each additional cu. yd., or fraction thereof.
- B. Provide batch ticket for each batch discharged and used in work, indicating

project identification name and number, date, mix type, mix time, batch quantities, and amount of water introduced.

- C. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.
- D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C94 may be required.
- E. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

### 3.2 CONSISTENCY

- A. Assure concrete is of such consistency that it will flow around reinforcing steel, but individual particles of the coarse aggregate, when isolated, show a coating of mortar containing its proportionate quantity of sand. The consistency of the concrete will be gauged by the ability of the equipment to properly place the concrete in its final position and not by the difficulty in mixing or transporting. Use the minimum quantity of mixing water necessary to provide workability within the ranges of slump specified.

### 3.3 MIXING

- A. Thoroughly mix concrete to assure a uniform distribution of the materials throughout the mass. Mix concrete only in quantities required for immediate use and place it within the time limits specified. Waste all concrete which initial set has begun. Retempering of concrete is prohibited. Aggregates, or bags of cement containing lumps or crusts of hardened material shall not be used. Mix concrete in an approved truck mixer meeting the requirements of ASTM C94 herein.
- B. The capacity of the plant and the transportation equipment must ensure delivery at a rate that will permit proper handling, placement and finishing at the point of delivery. Maintain the concrete delivery rate to provide for the continuous operation of placing, handling and finishing concrete as is practical. Maintain the interval between delivery of loads so that layers or lifts of concrete in place do not harden before succeeding layers or lifts are placed. In general, no lift or layer of concrete can remain exposed for more than 20 minutes before being covered by fresh concrete.
- C. The volume of mixed concrete in the mixing drum shall not exceed the manufacturer's rating, on the capacity plate.

- D. During freezing weather, other approved methods of measuring water will be permitted.
- E. A recording water metering device is always required at the primary point of the batching operation.
- F. Do not add water to concrete in transit. Water may be introduced into the mixer at the job site under direction of the Engineer, if the specified water-cement ratio is not exceeded. Water must be added in accordance with ASTM C94, Assure the drum revolves continuously after the introduction of the cement and water until the concrete is discharged.
- G. Begin mixing immediately after introduction of the cement and water and continue for at least 70 revolutions of the drum at mixing speed. This minimum revolution count will be waived when the concrete is produced at a central mixing plant. Not more than 100 drum revolutions can exceed 6 revolutions per minute. All other revolutions must be at agitating speed of not less than 2 or more than 6 revolutions per minute.
- H. Discharge the concrete at the job and place in its final position within 1- 1/2 hours after the introduction of the mixing water and cement. When the air temperature is 90°F (30°C) or above, place the concrete in its final position within 1 hour after the introduction of the mixing, water and cement. Concrete mixes with an approved set retarding admixture may be held an additional ½ hour beyond limits specified above.
- I. No mixed or agitated concrete that has remained in the drum of the truck mixer more than 10 minutes without agitation can be used. If the Engineer determines the concrete has not suffered any detrimental effects. It may be used, after remixing for a minimum of 20 revolutions of the drum at mixing speed, if it can still be placed in the forms within the specified time limits.
- J. Provide a revolution counter on each truck that registers the number of revolutions of the drum.
- K. Mount the counter so it can be easily read by both the operator and the Engineer.

### 3.4 PLACING CONCRETE

Thoroughly compact concrete into its final position. Assure it is thoroughly consolidated around fittings and embedded items. Assure all reinforcement and embedded items are accurately placed as shown on the plans and are clean and free from coatings of dried mortar, detrimental rust, scale, oil or foreign matter

### 3.5 CURING CONCRETE

- A. Thoroughly cure concrete surfaces subject to premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap and sand or other satisfactory materials and keep concrete moist. If the concrete surfaces are not covered, keep them moist by flushing or sprinkling. Continue curing for at least 7 days after placing the concrete. Concrete surfaces placed against forms may be cured by leaving the forms in place for at least 7 days, when approved.
- B. Protect concrete against freezing or other conditions detrimental to strength development meeting the applicable requirements of this specification.
- C. To aid finishing, side forms on ornamental work, curbs and sidewalks, railing and parapets may be removed after 12 hours, not to exceed 48 hours, depending on weather conditions. Continue moist curing during the concrete finishing operation.
- D. Untreated forms and existing concrete must be kept continuously wet for at least 1 hour before any concrete is placed. Keep wet until covered with concrete except that adequately treated forms must be thoroughly washed with a water spray immediately before placing the concrete.
- E. The curing of concrete, by either water curing or membrane curing, must be as follows unless otherwise approved by the Engineer.
  - 1. Water Curing
    - a. Keep all concrete top surfaces continuously moist after finishing, with a fine water spray, until the concrete has set. Cover the moist concrete with water or an approved curing covering.
    - b. Cure concrete deck slabs and concrete floors for at least 7 days. Cure by placing burlap, cotton mats or other absorptive material as close behind the finishing operation as possible without marring the finished surface. Keep the absorptive material continuously moist for the full time it is used. The absorptive material may be kept in place for the entire curing period or it may be removed as soon as practical and the entire surface covered with approximately 1-1/2 inches (38.1 mm) of sand, kept continuously moist for the entire curing period.
    - c. Remove forms and repair surface irregularities without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, cover the concrete with absorptive material, kept continuously wet for the balance of the curing a period.
  - 2. Impervious Membrane Curing

- a. Assure membrane curing compounds are delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. The clear curing compound must be sufficiently transparent and free from permanent color that would change the color of the natural concrete. Use clear compound containing a fugitive dye having color sufficient to render the film visible on the concrete for at least 4 hours after application. The concrete surface must maintain its natural color after curing.
- b. Use a compound ready for use as shipped by the manufacturer. Dilute following the manufacturer's recommendations. Use curing compound only with written approval. Sampling will not be required if manufacturer's certification is available. Apply the curing compound under pressure with a spray nozzle to cover the entire exposed surface thoroughly and completely with a uniform film not exceeding manufacturer's specifications. Maintain the required pressure in the spray machine to force the material to leave the nozzle in a fine mist. Keep all concrete surfaces moist with a fine water spray or with wetted burlap until the sealing compound is applied. Keep the curing compound application close to the finishers of the top surface of concrete at all times. Seal the concrete immediately after the finishing operations have been completed, to the satisfaction of the Engineer.
- c. If it is necessary to allow workers or equipment on the surface before the 7 day curing period is completed, cover the top surface of sealed concrete with a protective cushion for runways. Use a cushion consisting of a moist, 1 –inch (25mm) minimum thick layer of fine sand, or layers of moist burlap that will prevent damage to the finished concrete. Cover the approved cushion with four by eight foot sheets of 3/4 inch(19mm) plywood laid over the cushion. Do not place the cushion material for at least 8 hours after the final application of the curing compound. Obtain the Engineer's written approval for any other proposed cushion material before use. Layers of plastic, visqueen or canvas are not an acceptable cushion material.
- d. Keep concrete, which has not completed its curing period, continuously moist during the stripping and surface repair operations. Remove all surface irregularities, repair all depressions, voids or holes, including those formed by trapped air, to the satisfaction of the Engineer. Immediately apply the curing compound before the surface has had an opportunity to dry out. Keep concrete, from which forms have been stripped, continuously moist until surface repair and finishing are completed and the impervious membrane curing has been applied.

### 3.6 WEATHER AND NIGHT LIMITATIONS

#### A. General

1. Stop concreting operations when darkness prevents obtaining the specified placing, and finishing work. Night operations may be conducted with written approval and when approved artificial lighting is provided.
2. Cold weather concreting is governed by ACI 306 unless otherwise specified herein. Hot weather concreting methods is governed by ACI 305 unless otherwise specified herein. Except by specific written authorization, stop concreting operations when a descending air temperature in the shade and away from artificial heat falls below 40°F (4°C), or do not resume until an ascending air temperature in the shade and away from artificial heat reaches frozen foundation course or subgrade.
3. Assume all risk of placing concrete in cold weather. Placing concrete during cold weather does not relieve the Contractor of the responsibility for obtaining the specified results. Remove and replace all concrete injured by frost at Contractor expense.
4. Before any concrete is placed, remove all ice, snow and frost completely from the formwork receiving the concrete.
5. Heating and Placing Concrete
  - a. When concreting is authorized during cold weather, assure concrete temperature meets ASTM C94.
6. Protection of Concrete
  - a. During the curing period, if the air temperature is anticipated to fall below 32°F (0°C), provide an approved blanket type insulating material along the work for covering all concrete that has been in place for 7 days or less. If, at any time, the ambient temperature drops to 32°F (0°C) or less, protect the concrete using a method approved by the Engineer. The minimum method of protection under such conditions is as follows: between two layers of plastic sheeting, the insulating materials, with the exception of commercial blankets, must be spread loosely to a minimum depth of 6 inches (150mm), but in all cases, to the depth required to prevent freezing of, or frost damage to, the concrete. Maintain the blanketing material at least until the end of the regular specified curing, period which is not less than 7 days. The

Engineer may direct leaving the blanketing material in place for an additional period if the recorded temperatures indicate that additional curing may be necessary. If during the construction period the mean daily temperature is expected to fall below 40°F(4°C) for 3 consecutive days, furnish approved heating enclosures and devices capable of maintaining the surface temperature of the concrete in place between 55°F (13°C) and 80°F (26°C). The curing, period under these conditions is 7 days when Type I-II cement is used and 5 days when a pre-approved "high early strength" mix is used. At the close of the curing period, the heat may be reduced so that the temperature inside the housing does not decrease faster than 15° per hour until the temperature inside the housing is the same as outside.

- b. A Contractor may, at their own expense, field cure concrete cylinders with their in-place concrete and discontinue protection when those field cylinders reach 70 percent of design strength as indicated by the 28 day requirement of these specifications.
- c. Perform all concrete protection using methods consistent with ACI-306-1-87 and approved by the Engineer.

### 3.7 TESTING

A. All concrete must be tested by an ACI Grade I or equivalent certified testing technician. Unless otherwise specified, the contractor shall be responsible for all acceptance testing during the on-site placement of the concrete.

#### 1. Materials

- a. The Testing Firm or their representative must have access to the ready mix production facility for sampling constituent materials during production to assure the materials meet these specifications and represent those stated on the approved mix design.

#### 2. Standard Slump Tests

The Testing Firm hired by the contractor shall, during each day's placement, check the consistency of the concrete by slump test. A slump test will also be made each time that strength specimens are made. Slump tests are performed meeting ASTM C143 "Method of Test for the Slump of Portland Cement Compression Tests

- a. A minimum of three specimens, 6 inch (150 mm) in diameter or 4 inch(100 mm) , shall be made and tested for every concrete placement. Mold and test one set of test cylinders for every 100 yards (76.5 cubic meters) of concrete or fraction thereof placed each day. On a given project, if the total volume of concrete is such that frequency of testing required above would generate less than 5 strength tests for a given class of concrete, make tests from at least 5 randomly selected batches or from each batch if fewer than 5 batches are used. Cure these cylinders under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete.
- b. Take samples for strength tests in accordance with ASTM C172, entitled
- c. Mold test cylinders and laboratory-cure in accordance with ASTM C31. Test cylinders in accordance with ASTM C39, entitled " "Method of Test for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39, using an independent testing laboratory, as approved by the Engineer.
- d. Of each of the 3 cylinders take for a pour, test 1 for information strength at 7 days and test 2 for acceptance strength at 28 days. To meet this specification, average strength of two cylinders from the same sample, tested at 28 days or the specified earlier age, is required for each strength test. Strength level of an individual class of concrete is considered satisfactory if both of the following requirements are met:
  - 1) The average of all sets of 3 consecutive tests equal or exceed the specified strength.
  - 2) No individual strength test (average of two cylinders) falls below specified strength by more than 500 psi (3400 kPa).
- e. Cure field cured cylinders under field conditions meeting Section 7.4 of "Method of Making and Curing Concrete Test Specimens in the Field" (ASTM C31).
- f. Mold field cured test cylinders at the same time and from the same samples as laboratory cured test cylinders. Improve procedures for protecting and curing concrete when strength of field cured cylinders at the test age designated for measuring specified strength is less than 85 percent of that of companion laboratory



cured cylinders. When laboratory cured cylinder strengths are appreciably higher than the specified strength, field cured cylinder strengths need not exceed the specified strength by more than 500 psi (3400 kPa) even though the 85 percent criterion is met.

- g. The strengths of any specimens cured on the job are to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed or the structure placed in service. When the strengths of the job cured specimens are below those specified above, the Contractor must improve the procedures for protecting and curing the concrete.
- h. When concrete fails to meet the requirements above or when tests of field cured cylinders indicate deficiencies in protection and curing, the Owner's representative may order tests on the hardened concrete under Chapter 17.3 of ACI-301-84 or order load tests in Chapter 20 of the ACI Building Code (ACI 318-83) for that portion of the structure where the questionable concrete has been placed. In the event the load or core tests indicate that the structure is unsatisfactory, make all modifications as directed by the Engineer to make the structure sound. If the load or core tests indicate the concrete is satisfactory, all cost of testing shall be paid by Owner.

#### 4. Air Content Tests

- a. The Testing Firm hired by the contractor shall during each strength test, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C173) or "Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete" (ASTM C138)

#### 5. Temperature

- a. Test hourly when air temperature is 40°F (4°C) and below, and when 80°F (27°C) and above; and each time a set of compression test specimens is made.

**PART 4: MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The method of measurement and basis of payment is as outlined in the contract documents for the various items of concrete work found within the project. If cubic yard measurement is required for payment the contractor is responsible for verifying and submitting these measurements for payment.

**4.2 REQUIRED SUBMITTALS**

- A. The following are submittals required to become an approved source of supply for Portland Cement concrete placed:
  - 1. Complete concrete mix design meeting all specification requirements. Meet the Mix proportions specified in ACI 301, Chapter 3. Submittals will include the following:

**MIX PROPORTIONS**

-cement in lbs (kgs) .....	Type and source of supply
-coarse aggregate .....	Size and source of supply
-fine aggregate .....	Source of supply
-water, gallons(liters) .....	City or well
-admixtures,oz/yd <sup>3</sup> (g/M <sup>3</sup> ) ....	Brand and description*

\*description as retarder, accelerator, air entraining, etc.

- B. **MATERIALS INFORMATION**

- 1. Specific gravity (bulk s.s.d. Basis) of coarse and fine aggregate and 1 percent absorption-coarse aggregate unit weight (dry-rodded)-ASTM C33 quality tests including the following:
  - a. Fine aggregate
    - 1) gradation AASHTO, T27 and T11 deleterious substances soundness (AASHTO T104) organic impurities (AASHTO T21) mortar-making properties (AASHTO T71)
  - b. Coarse aggregate
    - 1. deleterious substances gradation (AASHTO T27 and T11) soundness (AASHTO T104) percentage of wear (AASHTO T96)

- c. Current Chemical Analysis of Mixing Water (if well)
  - d. Current cement mill analysis

2. CONCRETE MIX DATA

- a. slump
- b. % air
- c. unit weight
- d. 7 and 28 day compressive strength

3. VARIATIONS

- a. The following variations will be cause for submittal of a new mix design.

- 1) Change of aggregate source
- 2) Change of cement content
- 3) Addition or exclusion of certain admixtures including, but not limited to, pozzolans, accelerators, retarders and water reducers
- 4) Change in aggregate size
- 5) Change in type of cement
- 6) Failure to attain strength requirements as outlined in ACI 214 or ASTM C94

- b. A variation in any of the following will require 'Informing the Engineer and possibly data indicating acceptability for use in existing mix designs.

- 1) Change of cement supplier
- 2) Change of admixture brands or dosages (not types)
- 3) Minor adjustments of aggregate proportions accompanying materials changes or to accommodate placement conditions (same w/c ratio)

C. Certification of Ready Mixed Concrete Production Facilities

- 2. Concrete producers are to allow access to their facilities by Engineer or their representatives for inspecting their facilities and/or sampling materials. All facilities should meet the requirements of the "National Ready-Mix Concrete Association" check list for concrete production

1. Items directly affecting a facility's ability to properly proportion, transport and deliver concrete may be reason for disqualifying that facility as a source of supply until such deficiencies are corrected. Examples would include cement and aggregate scales that will not accurately weight materials or mixer units that will not thoroughly mix concrete materials.

D. The following chart indicates the submittal frequency for each item required for approval as a source of supply.

**TABLE 4.1 SUBMITTAL  
FREQUENCY**

SUBMITTAL	FREQUENCY		
	Monthly	Twice Yearly	Other
1- Complete mix design			(See Item 1, No 4)
2. Aggregate gradations	X		With mix design
3. L.A. Abrasion			With mix design
4. Soundness			With mix design
5. Deleterious substances			With mix design
6. Water quality (if well)		X	
6a. Cube strengths and time of set			With mix design
7. Cement mill certificates	X		
8. Organic Impurities			With mix design
9. Inspection of facilities			As indicated

Note: The above chart applies to the first year of this program. Frequency of submittals may change as dictated by variations of test data.

**END OF SECTION**