

## SECTION 02315

### EXCAVATION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Examination.
- B. Preparation.
- C. Excavation Drainage and Stabilization
- D. Preparation
- E. Excavating Operations
- F. Storage and Disposal of Excavated Materials
- G. Excavation and Disposal of Rocks and Boulders
- H. Site Inspection
- I. Cleanup

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. D75 Standard Practice for Sampling Aggregates.
  - 3. D422 Standard Test Methods for Particle-Size Analysis of Soils
  - 4. 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>).
  - 5. D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2,700 kN-m/m<sup>3</sup>).
  - 6. D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - 7. D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
  - 8. D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 9. D3017 Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
  - 10. D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. City Engineers Association of Minnesota Standard Specifications.

- C. State of Minnesota Department of Transportation (MnDOT) Standard Specification for Construction.

**1.3 DEFINITIONS**

- A. Borrow material: material required for construction that is not available or not to be obtained from project excavations.
- B. Classified excavation: Any excavation meeting one of the following definitions (MnDOT 2105) muck, common channel, or rock.
- C. Clear Rock: Sorted and washed rock used for drainage and excavation stabilization.
- D. Excavated materials: soil materials excavated from trench, foundation, or project site.
- E. Muck Excavation: As defined in MnDOT 2105.
- F. Rock: MnDOT 2105.2A2. Pavement shall not be considered rock.
- G. Salvage Material: As defined in MnDOT 2105.
- H. Subgrade Excavation: As defined in MnDOT 2105.
- I. Subsoil: The mineral soil horizon immediately below the topsoil usually containing no or little organic material.
- J. Suitable Fill: Borrow and site materials not containing unsuitable materials and meeting the material requirements defined in SECTION 02316 FILL AND BACKFILL for each fill and embankment use.
- K. Unclassified Excavation: As defined in MnDOT 2105. Includes all excavations except muck, common channel, or rock regardless of character or classification of material.
- L. Unsuitable Materials: Roots or other organic matter, trash, refuse, debris, frozen materials, rock, or other materials not defined for use as backfill or are too wet to obtain specified compaction rates.

**1.4 SUBMITTALS**

- A. Provide following submittals consistent with SECTION 01300 SUBMITTALS.
  - 1. Excavation Plan/Shop Drawings:
    - a. Methods and sequencing of excavation.
    - b. Proposed locations of stockpiled excavated material.
    - c. Proposed onsite and offsite spoil disposal sites.
    - d. Numbers, types, and sizes of equipment proposed to perform excavations.
    - e. Anticipated difficulties and proposed resolutions.
    - f. Reclamation of onsite spoil disposal areas.

- g. Number, types and sizes of equipment proposed to perform cleaning and street sweeping.
  - h. List of site contacts, responsibilities, and site phone numbers.
2. Excavation Support Plan: Excavation support calculations and details shall be certified by a Professional Engineer licensed in the State of Minnesota and include:
- a. Design assumptions and calculations.
  - b. Sheet piling, type, size, material properties, penetration, location(s), installation, equipment.
  - c. Bracing, type, size, material properties, location.
  - d. Layout plan and profile of excavation bracing system.
  - e. Anticipated difficulties and proposed resolutions.
  - f. Minimum lateral distance from the crest of slopes for vehicles, equipment and stockpiled excavated materials.

## 1.5 EXISTING CONDITIONS

- A. Project site subsurface information is provided in the appendix

## 1.6 SEQUENCING AND SCHEDULING

- A. Excavation support: Provide and maintain as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed work.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Clear Rock: Clean 1 ½ –inch minus sorted and washed crushed rock excluding crushed carbonate rock and free of clay balls, debris, and organic materials. 100 percent retained by the #4 sieve.
- B. Geotextile Fabric: MN/DOT 3733, Type V.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Prior to construction, inspect existing utility structures and surface features with ENGINEER and document condition.
- B. Verify with ENGINEER that permits necessary to do work are obtained.

### 3.2 PREPARATION

- A. Stake excavation limits and maintain activities within limits shown.
- B. Protect surface features that are not designated to be removed. Complete temporary removals of surface features. Saw cut pavement along straight lines before excavation. Install mailboxes for temporary service if necessary.
- C. Protect survey monuments.
- D. Install and maintain excavation support systems as shown or as required according to the submitted in the excavation support plan.

**3.3 EXCAVATION DRAINAGE AND STABILIZATION**

- A. Dewater all areas to receive fill to 1-foot below grade prior to preparation for fill or embankment. Remove water in a manner that minimizes soil erosion.
- B. Direct surface and groundwater discharges to natural drainage channels, drains, or storm sewers. Provide energy dissipation and sedimentation basins at discharge point.
- C. Provide continuous water control until backfill is complete.
- D. In areas where dewatering by sump pit or well point cannot adequately remove water, at the discretion of the CONTRACTOR and approval of the ENGINEER construct alternate drainage using the following means:
  - 1. Over excavate as required to slope cut toward dewatering sump or natural drainage. Remove all material sloughed from excavation or trench walls.
  - 2. Backfill to working grade line using Clear Rock as specified above. Bedding and compaction requirements for Clear Rock shall be identical to the bedding and compaction requirements of the overlying materials.
  - 3. Separate Clear Rock material from all natural or imported material using Geotextile Fabric MN/DOT 3733, Type V.
  - 4. Overlap all Geotextile Fabric a minimum of 2 feet. In pipe trenches, the fabric shall be overlapped 2 feet longitudinal, and 2 feet transverse to the trench.
  - 5. Compact each lift so as to provide a firm, unyielding support for the overlying material.
  - 6. Constructing alternate drainage including all materials shall be incidental to the project except where shown on the Contract Drawings.

**3.4 EXCAVATING OPERATIONS**

- A. Excavation is unclassified. Complete excavation regardless of the type, nature, or condition of the materials encountered.
- B. Excavate, shape, and prepare all soils to the elevations and dimensions staked. Perform additional excavation as required for construction operations, forming

and inspection. Footings and foundations to rest on undisturbed soil, unless shown otherwise.

- C. Provide temporary support of existing utilities located within excavation.
- D. Slopes: Excavated to at least the angle of repose or brace, shore or sheet as required by OSHA, 29 CFR Part 1926 and to maintain trench widths limitations shown on the Contract Drawings.
- E. Earth Retention Systems: Excavation retention systems shall be designed and located in the field by the CONTRACTOR'S registered Professional Engineer.
- F. Segregate Suitable Fill meeting the requirements of SECTION 02316 FILL AND BACKFILL for reuse on site from the remaining excavated material. Store all materials according to Article 3.5.
- G. Utilities:
  - 1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the CONTRACTOR prior to excavation. If damaged, repair or replace.
  - 2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the CONTRACTOR, promptly take necessary steps to assure that service is not interrupted.
  - 3. If existing utilities are found to interfere with the permanent subsurface work being constructed under this Section, immediately notify the ENGINEER.
  - 4. Do not proceed with permanent relocation of utilities until written instructions are received from the ENGINEER.
- H. Trenching:
  - 1. Pipe Envelope: Excavate to trench width and initial backfill depth, as shown. Width at top of excavation will vary depending on native soil type and depth of trench.
  - 2. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for Bedding Material if shown or specified.
  - 3. Unstable Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify ENGINEER. ENGINEER will determine the depth of over excavation, if any, required.
  - 4. Remove all sheeting in the trenches except when, in the opinion of the ENGINEER, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impractical. In such cases, ENGINEER may permit portions of sheeting to be cut off and remain in the trench.
- I. Protection of persons and property:
  - 1. Barricade or fence open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or within public access.

- 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
  - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by performance of the work, under this Section.
- J. Maintain access to adjacent areas at all times.
- K. Excavate for roadway subgrades in accordance with Mn/DOT 2105.

**3.5 STORAGE AND DISPOSAL OF EXCAVATED MATERIALS**

- A. Stockpiling Excavated Material:
- 1. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
  - 2. Post signs indicating proposed use of material stockpiles. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position. Letters are to be white, 8 inches high, on blue background.
  - 3. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads, streets, driveways or sidewalks.
  - 4. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
  - 5. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed work, unless approved in writing by ENGINEER as part of excavation or filling plan.
  - 6. Store excavated material outside of delineated wetland areas.
- B. Disposal of Spoil:
- 1. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

**3.6 EXCAVATION AND DISPOSAL ROCKS AND BOULDERS**

- A. Rock excavation may be performed by jack hammering, expansive chemical splitting, or other similar process. No blasting will be allowed.
- B. Rock and boulders may be crushed and screened for reuse in the work, provided that the resultant materials meet the requirements for gravel, crush stone, or structural fill as specified in SECTION 02316 FILL AND BACKFILL.
- C. Unused rock and boulders shall be removed and disposed of off-site at no additional expense.

**3.7 SITE INSPECTION**

- A. In the event the inspections indicate the work has not been performed in accordance with the Drawings and Specifications, the materials shall be removed and the work redone and retested.

**3.8 CLEANUP**

- A. Remove all surplus and discarded materials, equipment, rubbish and temporary structures on all parts of the Work. The project site shall be left in a clean and acceptable condition.

**END OF SECTION**

## **SECTION 02316**

### **FILL AND BACKFILL**

#### **PART 1 GENERAL**

##### **1.1 SECTION INCLUDES**

- A. Examination.
- B. Excavation Drainage and Stabilization.
- C. Preparation.
- D. General Procedures.
- E. Initial Backfill.
- F. Backfill and Compaction.
- G. Placing Embankments.
- H. Testing and Inspection.
- I. Tolerances and Warranty.

##### **1.2 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. C33 Standard Specification for Concrete Aggregates.
  - 2. C117 Standard Test Method for Materials Finer than 75  $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing.
  - 3. C94 Specification for Ready-Mixed Concrete.
  - 4. C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 5. C150 Portland Cement.
  - 6. C331 Standard Specification for Lightweight Aggregate for Concrete Masonry Units.
  - 7. C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
  - 8. C618 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
  - 9. D2487 Standard Classification of Soils for Engineering Purposes.
  - 10. D420 Standard Guide for Investigating and Sampling Soil and Rock.
  - 11. D422 Standard Test Method for Particle-Size Analysis of Soils
  - 12. D75 Standard Practice for Sampling Aggregates.



13. D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 feet-lb f/feet<sup>3</sup>) (2,700 kN-m/m<sup>3</sup>).]
  14. D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  15. D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 feet-lb f/feet<sup>3</sup>) (2,700 kN-m/m<sup>3</sup>).]
  16. D2487 Standard Classification of Soils for Engineering Purposes.
  17. D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
  18. D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  19. D3017 Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
  20. D4253 Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
  21. D4254 Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
  22. D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  23. D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.
- B. State of Minnesota Department of Transportation (MnDOT) Standard Specifications for Construction.
- C. City Engineers Association of Minnesota Standard Specifications.
- D. American National Standards Institute (ANSI):
1. Standard Practice for Direct Design of Buried Pre-cast Concrete Pipe Using Standard Installations (SIDD).
  2. Z535.1 Safety Color Code.
- E. American Public Works Association (APWA):
1. Uniform Color Code for Temporary Marking of Underground Utility Locations.
- F. Department of Labor, Occupational Safety and Health Administration, Occupational Safety and Health Standards - Excavations, Final Rule - 29 CFR, Part 1926.

### 1.3 DEFINITIONS

- A. Aggregate Base: Graded aggregate for use in pipe embedment, beneath structural foundations, beneath pavement or slab surfaces, or as an aggregate surfacing.
- B. Borrow Material: Earthen material required for construction or other specified purpose that is not to be obtained from the project site.

- C. Clear Rock: Sorted and washed rock used for drainage and excavation stabilization.
- D. Completed Lift: A lift that is ready for next layer or next phase of work.
- E. Geotextile: a permeable geosynthetic comprised solely of textiles (ASTM D4439)
- F. Granular Backfill: Graded aggregate and clean coarse sands and gravels for use in backfill.
- G. Imported Material: Material obtained by the CONTRACTOR from an approved offsite source(s).
- H. Lift: Loose (uncompacted) layer of material.
- I. Optimum Moisture Content:
  - 1. Determined in accordance with ASTM standard specified to determine maximum dry density for Relative Compaction.
  - 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- J. Pipe Bedding: Granular material upon which pipes, conduits, cables, or duct banks are placed.
- K. Pipe Haunch: Granular material placed beneath the spring line of a pipe.
- L. Pipe Initial Backfill: Backfill materials placed over the pipe to as to protect the pipe.
- M. Pipe Spring Line: The horizontal line bisecting a pipe between the invert and the crown.
- N. Pipe Zone: Backfill zone that includes full trench width and extends from Prepared Trench Bottom to an upper limit of 12 inches above top outside surface of pipe, conduit, cable or duct bank.
- O. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry unit weight as determined in accordance with compaction tests by ASTM D698. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the ENGINEER.
- P. Relative Density: As defined by ASTM D4253 and ASTM D4254. Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.
- Q. Riprap Stone: Protective stone covering on earth slopes, abutments, walls, and other structures where the soil is susceptible to erosion.

- R. Select Granular Borrow: Graded aggregate and coarse sands and gravels for use in pipe embedment and beneath structural foundations.
- S. Suitable Fill: Borrow and site materials not containing Unsuitable Materials and meeting the material requirements defined for each fill and embankment use.
- T. Topsoil: The earth horizon immediately below the sod layer and consisting of 3 to 20 percent of organic material. It is generally either black or a darker color than the underlying mineral subsoil.
- U. Unsuitable Materials: Roots or other organic matter, trash, refuse, debris, frozen materials, rock, or other materials not defined for use as backfill or are too wet to obtain specified compaction rates.

**1.4 SUBMITTALS**

- A. Provide following submittals consistent with Section 01300 submittals.
- B. Shop drawings – Fill and Embankment Plan, Detailing:
  - 1. Methods and sequencing of filling operations.
  - 2. Fill material.
  - 3. Compaction requirements.
  - 4. Compactive effort (number of passes with specific equipment).
  - 5. Equipment and load on underground facilities.
  - 6. Schedule.
  - 7. Field compaction testing plan including:
    - a. Laboratory name.
    - b. Tests and Frequency.
    - c. Method(s).
- C. Sample of each type of borrow to testing laboratory, in accordance with ASTM D420.
- D. Samples:
  - 1. For each borrow material:
    - a. Bag sample at source (except riprap) ASTM D75 (50-lb minimum) - one sample per source.
    - b. Consistent with Section 01400 QUALITY CONTROL, deliver sample to Independent Testing Lab (ITL).
  - 2. Marking Tape: 4-foot long.
  - 3. Geotextile Fabric
- E. Test reports:
  - 1. For each borrow and excavation material:
    - a. Laboratory classification; ASTM D2487.
    - b. Gradation test(s) results; ASTM D422 or ASTM C136.
    - c. Moisture dry unit weight relationship ASTM D698.
  - 2. Field quality control test results consistent with Section 01400 QUALITY CONTROL.
  - 3. Manufacturers certificate that riprap materials meet the requirements of MnDOT 3601 for gradation and material properties.

## 1.5 EXISTING CONDITIONS

Two borings from the previous interceptor work are attached to this section.

## 1.6 QUALITY ASSURANCE

- A. Notify ENGINEER when:
1. Structure, tank or trench is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
  2. Subgrade materials consist of unsuitable materials or cannot be compacted to specified limits.
  3. Fill material appears to be deviating from specifications or material classification is deviating from the classification of the material previously accepted for use as fill or backfill.

## 1.7 WEATHER LIMITATIONS

- A. Do not place frozen material as fill or backfill on frozen foundation or other fill material.
- B. Do not place material which will freeze during backfilling or compaction operations.
- C. Do not place material excavated during inclement weather until after material dries sufficiently to meet compaction requirements.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Suitable Fill: Borrow and site materials not containing organic matter, debris, boulders or rock fragments larger than 1/2 cubic foot, or any other Unsuitable Materials and that the ENGINEER determines to be suitable for specific uses.
- B. Pipe Bedding Material: Material meeting MnDOT 3149.2H modified to 100% crushed.
- C. Granular Backfill: Graded aggregate and clean coarse grained sands and gravels. Materials classified by ASTM D2487 as SP, SW, GW, GP, GM, GC, SM, and SC meeting the following gradation requirements:
1. 100 percent passing the 3-inch sieve.
  2. The portion passing the #200 sieve divided by the portion passing the 1-inch sieve may not exceed 20 percent by mass.

Acceptable materials include those meeting MN/DOT 3149.D.

- D. Select Granular Borrow: Graded aggregate and clean coarse grained sands and gravels. Materials classified by ASTM D2487 as SP, SW, GW, and GP meeting the following gradation requirements:

1. 100 percent passing the 1 ½ -inch sieve.
2. The portion passing the #200 sieve divided by the portion passing the 1-inch sieve may not exceed 12 percent by mass.

Acceptable materials include those meeting MN/DOT 3149.B2.

- E. Clear Rock: Clean 1 ½ –inch minus sorted and washed crushed rock excluding crushed carbonate rock and free of clay balls, debris, and organic materials. 100 percent retained by the #4 sieve.
- F. Aggregate Base: Graded aggregate free of clay balls and organic materials. Meeting the requirements of MN/DOT 3138.2 Class V
- G. Geotextile Fabric: As specified in MN/DOT 3733, Type V.
- H. Clay Fill: Clay Fill material used for trench dams shall meeting the following requirements:
  1. Low permeability soil free of organic materials
  2. On-site excavated clay material or imported fill material
  3. 30 to 80 percent by weight passing No. 200 Standard Sieve.
  4. Maximum permeability at compacted density of 95 percent:  $5 \times 10^{-7}$  cm/sec when tested by falling head method.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Inspect surfaces to receive fill/foundation soils/trench foundation soils with ENGINEER.
- B. Re-inspect surfaces to receive fill with ENGINEER if more than 0.25 inches of rainfall has occurred after initial inspection, but prior to placing next course of material.
- C. Re-inspect foundation soils with ENGINEER if rainfall, or snow has occurred after initial inspection, but prior to construction foundation, mud mat, or placing pipe and bedding.
- D. Advise ENGINEER of soil types or conditions that are not in accordance with soil borings provided in Volume II of the Contract Documents.
- E. Notify ENGINEER if subgrade material is not suitable for construction.

### **3.2 PREPARATION**

- A. Remove ice, frozen material, and snow prior to grading or filling operations.

### **3.3 GENERAL PROCEDURES**

- A. Replace unsuitable soils with the same material used for the overlying fill or backfill. Placement and compaction of the material shall comply with the requirements for the overlying fill or backfill.
- B. Replace excavation carried below grade lines on permanent cut Slopes (where overlying area is not to receive fill or backfill) with Granular Backfill.
- C. Place fill, backfill or embankment and compact to the required density over the full width and length of the excavation before placing the next lift.
- D. Do not allow or cause any of the Work performed to be covered or enclosed by work of this Section prior to required inspections, tests, or approvals. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, backfill and compact as specified.
- E. Dress complete embankment, backfill or fill with allowance for topsoil, surfacing or slope protection where applicable.
- F. Do not place backfill or fill on frozen ground.

### **3.4 PIPE BEDDING ZONE**

- A. Backfill RPMP with Bedding Material to the elevations shown on the Drawing.
- B. Do not block pipe. Dig bell holes in Bedding Material at each joint such that pipe barrel rests continuously on bedding.
- C. Bedding Material shall be hand worked under the bottom and haunches of the pipe prior to compaction to the pipe spring line.
- D. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.
- E. Place Bedding Material in 9-inch lifts and compact each lift to a minimum 75 percent Relative Density as determined by ASTM D4253. Use hand held rammer or vibratory plate compactors in the Pipe Bedding Zone.
- F. Do not allow Bedding Material to free fall more than 2 feet into the trench.
- G. Protect pipe from the dropping of large rocks or other impact loads.

### **3.5 TRENCH BACKFILL ZONE**

- A. General.
  - 1. Scarify slopes receiving Backfill Materials.
  - 2. Do not allow Backfill Materials to free fall more than 2 feet into the trench until at least 2 foot of material has been placed over the pipe crown.

3. Use hand held rammer or vibratory plate compactors until at least 2 feet of material has been placed over pipe crown.
  4. Backfill around access structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.
- B. In areas outside the load influence of structures, tanks, pavements, curbs, sidewalks, slabs, piping, and other facilities, place Backfill Material to finished grade or pre-paving grade as follows:
1. Maximum 12-inch thick loose lifts.
  2. Compact each lift to minimum 92% Standard Proctor Density as determined by ASTM D698.
- C. In areas within the load influence of structures, tanks, pavements (including trail pavements), curbs, slabs, or other facilities place Backfill Material of Sand Fill, Granular Backfill, or Select Granular Borrow, in maximum 9-inch thick loose lifts to minimum 95% Standard Proctor Density as determined by ASTM D698 to three feet below finished grade or pre-paving grade. In the upper three feet, compact each lift to a minimum of 100 percent Standard Proctor Density as determined by ASTM D698.
- D. Pipe Locating
1. Install tracer wire continuously along the centerline of the Interceptor a maximum of two feet above the crown of the pipe.
  2. Install marking tape continuously over the centerline of all newly installed piping and utilities approximately four feet above each utility.
- E. Controlled Low Strength Material (CLSM):
1. CLSM design per Section 03301 FLOWABLE FILL.
  2. Allow CLSM to cure prior to backfilling.
- F. Replace topsoil and landscape or complete surface improvements as shown on the Drawings.

### 3.6 PLACING EMBANKMENTS

- A. Excavate to lines, grades, and slopes shown.
- B. Provide seepage trenches for Granular Backfill replacement of unstable areas.
- C. Use Suitable Fill from excavated materials for embankment construction.
- D. Construct embankment layers from uniform materials.
- E. Place granular materials in upper most portion of the embankment.
- F. Mechanically mix non-uniform soils to produce uniform moisture content and density.
- G. Do not place stone, concrete or bituminous fragments exceeding three inches in the upper six inches of roadbed embankment or within 18 inches of the structure.

- H. Backfill excavations below subgrade and seepage trenches in accordance with this section.
- I. Place upper three feet of roadbed in maximum eight-inch loose layers.
- J. Place remainder of roadbed in maximum twelve-inch loose layers.
- K. Compact upper three-feet of embankment to not less than 95% Standard Proctor Density as determined by ASTM D698.
- L. Compact remainder of embankment to not less than 85% Standard Proctor Density as determined by ASTM D698.

### **3.7 FIELD QUALITY CONTROL**

- A. The following gradation and proctor tests will be conducted at CONTRACTOR'S expense:
  - 1. Imported Material:
    - a. Suitable Material, Sand Fill, Granular Backfill, Select Granular Borrow: 1 test per 1,000 cubic yards (loose volume).
    - b. Bedding Material: 1 test per 1,000 cubic yards (loose volume).
    - c. Aggregate Base: 1 test per 100 cubic yards (loose volume).

### **3.8 TESTING AND INSPECTION**

- A. The following tests will be completed at no cost to the Contractor. The frequency and location of tests will be directed by the ENGINEER.
  - 1. Gradation of onsite material for use as trench backfill per ASTM C136
  - 2. All in-place density tests: In accordance with ASTM D1556 and D2922.
  - 3. All in-place moisture tests: in accordance with ASTM D3017.
  - 4. Standard Proctor Density Test of onsite material for use as trench backfill in Accordance with ASTM D698.

### **3.9 TOLERANCES AND WARRANTY**

- A. Remove material placed in work that does not meet material or compaction requirements
- B. Repair settlements greater than ½-inch (as measured by a 10 foot straight edge) that occur in paved surfaces or yard areas during the guarantee period. Repair trench settlements greater than 1 inch as measured by a 10-foot straight edge in remaining areas.
- C. Replace surface material to match existing.





# SUBSURFACE BORING LOG

AET JOB NO: **22-02680** LOG OF BORING NO. **B-6 (p. 1 of 2)**  
 PROJECT: **CSAH 101 Minnetonka Mainline; Minnetonka, MN**  
 SURFACE ELEVATION: **881.4** Co. Coordinates: **N 137814.013 E 465833.614**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%#200
1	SANDY LEAN CLAY, slightly organic, trace roots, black, frozen to 16" then soft (CL) (A-6) (possible fill)	TOPSOIL OR FILL	6	F/M	SS	6	33				
2			1	M	SS	4	24				
3											
4	SANDY LEAN CLAY, a little gravel, trace roots, brown and gray mottled, firm (CL) (A-6)	TILL	5	M	SS	12	26				
5											
6											
7	SANDY LEAN CLAY, a little gravel, gray, a little brown mottled, firm, laminations of sand (CL) (A-6)		5	M	SS	14	20				
8											
9											
9	SANDY SILT, gray, moist, loose, laminations of sandy lean clay (ML) (A-4)	FINE ALLUVIUM	9	M	SS	8	27				
10											
11											
12	CLAYEY SAND, a little gravel, gray, stiff (SC) (A-6)	TILL	12	M	SS	12	15				
13											
14											
15	SILTY SAND WITH GRAVEL, fine to medium grained, gray, wet, loose (SM) (A-2-4)	COARSE ALLUVIUM OR TILL	11	M	SS	14	20				
16											
17											
18											
19											
20			9	W	SS	6					
21											

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG	
<b>0-29½'</b>	<b>3.25" HSA</b>	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL		WATER LEVEL
		1/16/14	11:30	21.0	19.5	19.5			15.9
		1/16/14	11:48	31.0	29.5	29.6			27.0
BORING COMPLETED: <b>1/16/14</b>									
DR: <b>JM</b> LG: <b>SHS</b> Rig: <b>68C</b>									

AET\_CORP W-COORDINATES 22-02680.GPJ AET+CPT+WELL.GDT 3/5/14



# SUBSURFACE BORING LOG

AET JOB NO: **22-02680** LOG OF BORING NO. **B-6 (p. 2 of 2)**  
 PROJECT: **CSAH 101 Minnetonka Mainline; Minnetonka, MN**  
 Co. Coordinates: **N 137814.013 E 465833.614**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS					
							WC	DEN	LL	PL	%-#200	
23	SILTY SAND WITH GRAVEL, fine to medium grained, gray, wet, loose (SM) (A-2-4) <i>(continued)</i>	TILL	12	M	SS	12	18					
24	CLAYEY SAND, a little gravel, gray, stiff, laminations of silty sand (SC) (A-6)											
25												
26												
27												
28	LEAN CLAY, gray, very stiff, laminations of silt (CL) (A-6)	FINE ALLUVIUM	24	M	SS	14	23					
29												
30												
31	<b>END OF BORING</b>											

AET\_CORP W-COORDINATES 22-02680.GPJ AET+CPT+WELL.GDT 3/5/14



# SUBSURFACE BORING LOG

AET JOB NO: **22-02680** LOG OF BORING NO. **B-5 (p. 1 of 2)**  
 PROJECT: **CSAH 101 Minnetonka Mainline; Minnetonka, MN**  
 SURFACE ELEVATION: **882.9** Co. Coordinates: **N 137749.679 E 465897.49**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS					
							WC	DEN	LL	PL	%#200	
1	FILL, mostly clayey sand, a little gravel, trace roots, dark brown, frozen to 1", A-6	FILL	6	F/M	SS	6	33					
2	FILL, mostly lean clay with sand, a little gravel, trace roots, black and gray, A-6		7	M	SS	6	27					
4	LEAN CLAY WITH SAND, trace roots, brown and gray mottled, firm (CL) (A-6)	FINE ALLUVIUM OR TILL	7	M	SS	6	20					
6	SANDY LEAN CLAY, a little gravel, gray, a little brown, stiff, laminations of silt (CL) (A-6)	TILL	9	M	SS	12	19					
9	SANDY LEAN CLAY, a little gravel, gray, stiff (CL) (A-6)		10	M	SS	14	18					
13			10	M	SS	10	29					
14	CLAYEY SAND, a little gravel, brownish gray, firm, lenses and laminations of silty sand (SC) (A-6)		6	M	SS	16	20					
19	CLAYEY SAND, a little gravel, gray, stiff (SC) (A-6)		9	M	SS	14	14					

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-24½'	3.25" HSA								
24½-34½'	RD w/DM	1/16/14	1:30	16.0	14.0	14.9		None	
		1/16/14	1:48	26.0	24.5	17.2		14.6	
BORING COMPLETED: 1/16/14		1/16/14	2:00	26.0	24.5	20.9		13.9	

AET\_CORP W-COORDINATES 22-02680.GPJ AET+CPT+WELL.GDT 3/5/14



# SUBSURFACE BORING LOG

AET JOB NO: **22-02680** LOG OF BORING NO. **B-5 (p. 2 of 2)**  
 PROJECT: **CSAH 101 Minnetonka Mainline; Minnetonka, MN**  
 Co. Coordinates: **N 137749.679 E 465897.49**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
23	CLAYEY SAND, a little gravel, gray, stiff (SC) (A-6) <i>(continued)</i>	COARSE ALLUVIUM	2	W	SS	18					
24	SAND WITH SILT, fine grained, gray, waterbearing, very loose (SP-SM) (A-3)										
25											
26											
27											
28	LEAN LAY, gray, a little light gray, very stiff, laminations of silt and silty sand (CL) (A-6)	FINE ALLUVIUM	16	M	SS	10	29				
29											
30											
31											
32											
33	SANDY SILT, gray, wet, dense, laminations of lean clay and silty sand (ML) (A-4)										
34											
35			37	M	SS	12	16				
36	<b>END OF BORING</b>										

AET\_CORP W-COORDINATES 22-02680.GPJ AET+CPT+WELL.GDT 3/5/14

**END OF SECTION**

## SECTION 02605

### MAINTENANCE ACCESS STRUCTURES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Concrete Maintenance Holes (MH)
- B. Precast Polymer Concrete Maintenance Holes (MH)
- C. Glass-fiber Reinforced Polyester (FRP) Maintenance Holes (MH)
- D. Castings

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. A48 Gray Iron Casting.
  - 2. A240 Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. A276 Stainless Steel Bars and Shapes.
  - 4. C33 Concrete Aggregates.
  - 5. C443 Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
  - 6. C478 Precast Reinforced Concrete Manhole Sections.
  - 7. C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service.
  - 8. C923 Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
  - 9. D695 Test Methods for Compressive Properties of Rigid Plastics
  - 10. D790 Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - 11. D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
  - 12. D3753 Standard Specification for Glass-Fiber Reinforced Polyester Manholes
  - 13. D6783 Polymer Concrete Pipe
- B. American Concrete Institute (ACI):
  - 1. ACI 318 Building Code Requirements for Structural Concrete

- C. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. AASHTO H-20 Axial Loading Requirements.

### 1.3 SUBMITTALS

- A. Submit the following items consistent with Section 01300:
  - 1. Manufacturer's Product Data for the following items:
    - a. Castings
    - b. Gaskets, including allowable joint deflections.
    - c. Joint Sealants, including allowable joint deflections.
    - d. Manufacturers recommended installation procedures for jointing.
    - e. Design information indicating that each MH or structure will be structurally sound for each specific installation as shown on the Drawings. Design information shall be completed by a registered professional engineer licensed in the State of Minnesota.
  - 2. Shop Drawings showing depth, relative elevations of connecting pipe, and orientation of connecting pipe. Field verify all information before fabrication and provide ENGINEER with field notes.
  - 3. Quality Assurance:
    - a. Manufacturer's Certificate of Compliance for the following items:
      - i Gray Iron Castings.
      - ii Precast Concrete Maintenance Hole (MH) Sections.
      - iii Glass-fiber Reinforced Polyester (FRP) Maintenance Hole Sections
        - a) Shop Drawings showing details of construction of resin, MH material, dimensions, joints, pipe connections, and castings for all maintenance holes.
        - b) Design information indicating that each MH will be structurally sound for each specific installation as shown on Drawings. Design information shall be completed by a registered professional engineer licensed in the State of Minnesota.
      - iv Precast Polymer Concrete Maintenance Hole Sections (MH):
        - a) Shop Drawings showing details of construction of resin, MH material, dimensions, joints, pipe connections, and castings for all maintenance holes.
        - b) Design information indicating that each MH will be structurally sound for each specific installation as shown on Drawings. Design information shall be completed by a registered professional engineer licensed in the State of Minnesota.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Conform to size, elevations, locations, and connection orientations shown on the Drawings. Field verify connections prior to fabrication

### **2.2 CONCRETE MH DOGHOUSE RISER**

- A. Precast concrete sections conforming to ASTM C478. No lift holes permitted.
- B. Cast-in-Place Concrete sections per Section 03300.
- C. Joints: O-ring, press seal, Type 1.
- D. Gaskets: ASTM C443, Cretex CX-2.
- E. Pipe Connections:
  - 1. As shown on the Drawings.
  - 2. Cast gaskets integrally into the base section for each pipe connection.
  - 3. Conform to ASTM C443 and C923 for pipe joints.
  - 4. Conform to ASTM C923 for connections between maintenance hole structures and pipes.

### **2.3 PRECAST POLYMER CONCRETE MAINTENANCE HOLES AND LINERS**

- A. Manufacturers: Equipment from the following manufacturers and which meet these specifications will be accepted.
  - 1. Geneva Polymer Products
- B. Provide polymer concrete MH composed of a thermosetting resin and aggregate.
- C. Polymer concrete MH shall be constructed of polyester or vinyl ester resin systems designed for the service intended. MH shall not contain corrodible elements.
- D. Polymer concrete MH shall be with material properties as specified in ASTM D6783.
- E. MH shall be manufactured to meet the requirements of the project drawings and specifications.
- F. MH shall contain preformed flow channels in base slab for existing and future connections. See drawings for details.
- G. Structure Joints: O-ring, press seal, Type 1.
- H. Gaskets: ASTM C443.



- I. Pipe Connections:
  - 1. Cast gaskets integrally into the base section for each pipe connection.
  - 2. Conform to ASTM C923 for connections between maintenance hole structures and pipes.
  
- J. Materials:
  - 1. Resin: The manufacturer shall use only polyester resin systems designed for use with this particular application.
  - 2. Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C33.
  - 3. Additives: Resin additives, such as curing agents, pigments, dyes, fillers and thixotropic agents shall not be detrimental to the MH.
  - 4. Steel reinforcing: Shall meet the requirements of ASTM C-478.
  
- K. Design and Testing:
  - 1. Manholes and structures shall be designed to withstand all live and dead loads as seen on project plans and specifications. Dead loads include overburden load, soil side pressure and hydrostatic loading. Manholes and structures shall be designed to resist buoyancy for project conditions.
  - 2. Polymer concrete shall have a minimum unconfined compressive strength of 13,000 psi when measure in accordance with ASTM D6783.

## **2.4 GLASS-FIBER REINFORCED POLYESTER (FRP) MAINTENANCE HOLES, LINERS AND OTHER STRUCTURES**

- A. Manufacturers: Materials from the following manufacturers and which meet these specifications will be accepted.
  - 1. L.F. Manufacturing Inc., Giddings, TX, 800-237-5791
  - 2. Containment Solutions, Conroe, TX, 888-409-7731
  
- B. Dimensions:
  - 1. MH shall be a circular cylinder, reduced at the top to a eccentric circular opening not smaller than [30]" inside diameter. Maintenance holes shall be produced in half-foot increments of length +/- 2". Nominal inside diameters shall be 54 inches, or as shown on the Drawings. Tolerance on the inside diameter shall be +/- 1%.
  - 2. The minimum wall thickness is 0.480".
  - 3. Wall thickness, concrete base, and any required floatation flanges shall be determined by the manufacturer.
  - 4. MH sections shall be joined with the use of an internal joint strip (internal bell & spigot joint) and sealed with a minimum 6-inch strip of fiberglass made up of one layer of mat, one layer of woven roving, covered by an additional layer of mat, and the manufacturer recommended appropriate amount of catalyzed resin.

C. Configuration:

1. Cone Sections: The cone section must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The reducer shall be concentric and shall be joined to the barrel section at the factory with resin and glass fiber reinforcement, thus providing required monolithic design to prevent infiltration of groundwater and/or exfiltration of wastewater through the MH.
2. Manway reducer cone section shall be self-centering to permit vertical height adjustment (raising or lowering) of MH by CONTRACTOR utilizing manufacturer provided materials and detailed written instructions.

D. Class:

1. FRP MH's shall be manufactured to withstand AASHTO class H-20 wheel load (minimum 16,000 pounds dynamic wheel load).

E. Marking and Identification:

1. All MH's shall be marked in letters no less than 1" in height with the following information:
  - a Manufacturers Identification
  - b Manufacturers Serial Number
  - c MH Length
  - d ASTM Designation
  - e Installation assist marks (vertical lines 90° apart at base of MH).

F. Materials

1. Resin:
  - a The resins used shall be unsaturated, supplier certified, isophthalic polyester resins.
  - b Resin from different manufacturers or "odd-lotting" of resins shall not be permitted.
  - c Quality-assurance records on the resin shall be maintained. Non-pigmented Resin is required to allow for light or "sand" color of MH surface in order to facilitate interior inspection from above grade and without having to enter the structure.
  - d UV Inhibitors shall be added directly to resins to prevent photodegradation. Exterior gel-coating shall not be permitted.
2. Reinforcing Materials:
  - a The reinforcing materials shall be commercial grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or both, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
3. Surfacing Material:
  - a Reinforcing material used on the surface exposed to the contained substance shall be a commercial grade chemical-resistant glass

or organic surfacing mat having a coupling agent that will provide a suitable bond with the resin.

4. Fillers and Additives:
  - a Fillers, when used, shall be inert to the environment and MH construction additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of this standard. However, calcium carbonate mixed by the fabricator shall not be permitted. The resulting reinforced plastic material must meet the requirement of this specification.
5. Laminate:
  - a The laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the sewer/chemical environment shall be resin rich and shall have no exposed fibers.

#### G. Requirements

1. Exterior Surface:
  - a The exterior surface shall be relatively smooth with no sharp projections.
  - b Hand-work finish is acceptable if enough resin is present to eliminate fiber show.
  - c The exterior surface shall be free of blisters larger than 0.5" in diameter, delamination and fiber show.
2. Interior Surface:
  - a Interior surface shall be smooth for improved corrosion resistance and reduced sludge build-up.
  - b The surface shall be free of crazing, delamination, blisters larger than 0.5" in diameter, and wrinkles of 0.125" or greater in depth.
  - c Surface shall be free of all pits.
  - d Structure wall shall be free of all voids.
3. Design
  - a MH's shall be designed to withstand all live and dead loads as seen on project plans and specifications. Dead loads include overburden load, soil side pressure and hydrostatic loading. MH's shall be designed to resist buoyancy for project conditions.
4. Repairs: Any MH repair is required to meet all requirements of this specification.
5. Load Rating:
  - a The complete MH shall have a minimum dynamic load rating of 16,000 lbs., when tested in accordance with ASTM 3753, 8.4 (note 1). To establish this rating the complete MH shall not leak, crack, or suffer other damage when load tested to 40,000 lbs. and shall not deflect vertically downward more than 0.25" at the point of load application when loaded to 24,000 lb.
6. Stiffness: The cylindrical portion of the MH is to be tested in accordance with ASTM Method D2412. The MH cylinder shall have the minimum pipe-stiffness values shown in the table below, when tested in accordance with ASTM D3753, Section 8.5, (note 1). For depths greater than shown in the table below, consult the manufacturer.

MH Length (ft)	PSI
3 – 6	0.72
7 – 12	1.26
3 – 20	2.01
21 – 25	3.02
26 – 35	5.24

7. Soundness:

a In order to determine soundness, an air or water test is to be applied to the MH test sample. While holding the pressure between 3-5 psi, the entire MH must be inspected for leaks. Any leakage through the laminate is cause for failure of the test. Refer to ASTM 3753, Sec. 8.6.

8. Chemical Resistance:

a Per ASTM C 581; (see ASTM 3753, Section 8.7), Flexural strength, flexural modulus, and barcol hardness are plotted versus time on log-log coordinates. The line defined by these points is extrapolated to 100,000 hours. The minimum extrapolation retention allowed for any of these properties is 50%. Test samples used are actual pieces of MH or samples manufactured in a manner consistent in every way with the MH component construction.

9. Physical Properties:

Flexural Strength (cone)	Hoop: 15.4 x 103 psi Axial: 17.2 x 103 psi
Flexural Strength (pipe)	Hoop: 22.5 x 103 psi Axial: 14.3 x 103 psi Compressive Strength: 18.9 x 103 psi

10. Test Methods

a. All tests shall be performed as specified in ASTM D3753, Section 8, Titled "Test Methods". See ASTM D3753, Section 8, Note 5, for Test method D-790 and test method D-695.

11. Quality Assurance/Quality Control

- a. Examination: Each MH component part shall be examined for dimensional requirements, hardness, and workmanship.
- b. Composition Control:
  - i Controls on glass and resin content shall be maintained for all manufacturing processes and for each portion of MH fabrication. Records shall be maintained of these control checks. Proper glass content may be shown by glass usage checks, by glass and resin application rate checks, in accordance with the material composition test in ASTM 8.8.1.
- c. All required ASTM 3753 testing shall be completed and records of all testing shall be kept and copies of test results shall be

presented to the ENGINEER upon written request within a reasonable time period.

## 2.5 CASTINGS: ASTM A48, CLASS 35C.

- A. Machine bearing surfaces of frame and cover to provide true surfaces.
- B. Provide a solid lid with two concealed pick holes.
- C. Furnish lids which read "Interceptor Sanitary Sewer" in 2-inch high cast letters.
- D. Opening Size: 24-inches
- E. Standard Casting is the Neenah model R-1733.

## 2.6 ADJUSTMENT RINGS

- A. A maximum of one adjustment ring shall be used at a thickness of 2", 4" or 6".
- B. Concrete adjusting ring shall comply with ASTM C478 and be free from cracks, voids, and other defects.
- C. The inside diameter of the adjustment ring shall not be less than the inside diameter of the MH frame.

## 2.7 ACCESSORIES

- A. Chimney Seals (External and Internal):
  - 1. ASTM C923, extruded or molded from high-grade rubber compound.
  - 2. Double pleated sleeves.
  - 3. Capable of minimum 2-inch vertical expansion when installed.
  - 4. Compression Bands:
    - a. Expandable or contractible, for compressing sleeves against the maintenance hole.
    - b. Material: 16 gauge stainless steel: ASTM A240, Type 304.
    - c. Minimum Width: 1-inch.
    - d. Hardware: stainless steel, ASTM A276, Type 304.
  - 5. External or internal mounting.
  - 6. Equipment from the following manufacturers and which meet these specifications will be accepted:
    - a. Cretex Chimney Sleeve
    - b. NPC, FlexRib Manhole Frame-Chimney Sleeve
- B. Joint Sealers:
  - 1. Sealer between upper precast section and casting frame:
    - a. Thickness: 1/4-inch.
    - b. High quality butyl rubber, 98 percent solids that will not harden, shrink or oxidize. ASTM C443, molded rubber gaskets.

- c. Equipment from the following manufacturers and which meet these specifications will be accepted:
            - i E-Z stik
            - ii Gore Joint Sealant
    - 2. Waterstop:
      - a. Bentonite-based material from the following manufacturers and which meet these specifications will be accepted:
        - i Cetco - Volclay Waterstop
        - ii Rx by American Colloid
- C. Mortar:
  - 1. Grout:
    - a. Cement and fine aggregate as specified for concrete.
    - b. Mix proportion: 1 part Portland cement, 2 parts sand, by weight.
    - c. Water/cement ratio: 0.50 maximum.
    - d. Non - setting by prolonged mixing.
    - e. Mix ten minutes in a power mixer.
    - f. Slump: 6 inches  $\pm$  1-inch.
  - 2. Non-Shrink Grout:
    - a. Pre-mixed material for site mixing with water. Prepare as directed by manufacturer's instructions.
    - b. Equipment from the following manufacturers and which meet these specifications will be accepted:
      - i L&M "Crystex"
      - ii Sonneborn "SonogROUT."
  - 3. Hydraulic Cement:
    - a. Follow manufacturer's instructions.
    - b. Use for sealing exterior maintenance hole wall at pipe penetration.
    - c. Equipment from the following manufacturers and which meet these specifications will be accepted.
      - i Thoro "Waterplug"
      - ii Unitex
- D. Damp proofing:
  - 1. Manufacturer: Equipment from the following manufacturer and which meet these specifications will be accepted.
    - a. Hydrocide 648 by Sonneborn Building Products
    - b. Dehydratine 4 by A.C. Horn
    - c. Meadows Trowel Mastic (Type 3).

## **PART 3 EXECUTION**

### **3.1 MH INSTALLATION**

- A. Install maintenance structures in accordance with the Drawings and this Section. Completed installation shall be plumb within ½-inch over entire structure build.

- B. Protect all work against flooding and floatation.
- C. Place base slab on compacted granular subgrade in accordance with 02316 FILL AND BACKFILL.
- D. Form flow channels in the grouted invert of MHs to match the connecting pipe inverts.
- E. Fill joints with nonshrink grout to eliminate infiltration.
- F. Include a 1'-0" riser section under the cone section to permit height adjustment.
- G. Joints
  - 1. Seal joint at the casting frame seat with 2 rows of ½ - inch joint sealer.
  - 2. Seal joints between precast sections with a rubber O-ring set in a recess.
  - 3. Fill joints with compatible epoxy bonding agent to eliminate infiltration. Finish flush with the adjoining surfaces. Fill the inside of any leaking joint with epoxy bonding agent to the satisfaction of the ENGINEER.
  - 4. Allow joints to set for 14 hours before backfilling unless the ENGINEER specifically approves a shorter period. Backfill carefully and evenly around maintenance hole section.
- H. Adjustment Rings:
  - 1. Maximum allowed: one in pavement areas, zero in unsurfaced areas.
  - 2. A minimum of one adjustment ring shall be used for Polymer/FRP maintenance access structures.
  - 3. Completely fill joints with mortar.
  - 4. Strike interior smooth.
  - 5. Provide mortar or sealant coating on exterior.
- J. Casting Adjustment:
  - 1. Pavement Areas: Adjust to between 1/4-inch to 1/2-inch below finished surface elevation.
  - 2. Non - Surfaced Areas: Adjust to within 6 inches to 18-inches above finished grade.
  - 3. Readjust castings not meeting the above tolerances.
- K. Chimney Seals:
  - 1. Provide internal seals on structures.
- L. Prevent entrance of dirt and debris into all new and existing maintenance holes.
- M. Bench:
  - 1. Install cast-in-place concrete.
  - 2. Top of bench to be at springline of inlet and outlet pipe connections.

3. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown or as ordered. Benches shall be a minimum of 18" on either side of the flow channel.
4. The shape of the manhole channel shall conform exactly to the pipe it connects. In no case shall the channel cross section be greater than that of the effluent pipe in any direction. All channels must have a finished smooth, clean surface.
5. Slope all benches toward the invert channel at a slope of 1-inch per foot for proper drainage.

**END OF SECTION**



## SECTION 02700

### GRAVITY SANITARY SEWERS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Gravity Sanitary Sewers, including Reinforced Plastic Mortar Pipe (RPMP).

##### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. C924 Standard Practice for Testing Concrete Pipe Sewer Line by Low-Pressure Air Test Method.
  - 2. D2412 Standard Test Method for Determination of External Loading Characteristics.
  - 3. D3034 Type PSC Polyvinyl Chloride PVC Sewer Pipe and Fittings.
  - 4. D3212 Joints for Drains and Sewer Plastic Pipes using Flexible Elastometric Seals.
  - 5. D3262 Standard for Fiberglass Sewer Pipe.
  - 6. D4161 Standard for Fiberglass Pipe Joints Using Flexible Elastomeric Seals.
  - 7. F477 Specification for Electrometric Seals (Gaskets) for Joining Plastic Pipe.

##### 1.3 SUBMITTALS

- A. Provide following submittals consistent with Section 01300 SUBMITTALS.
- B. Certificates of Compliance for each diameter and class of pipe as required under Article 1.5 QUALITY ASSURANCE.
- C. Manufacturer's recommendations for installation of pipe.
- D. Proposed method for leak and deflection testing
- E. Results of leak testing
- F. For each pipe material and size supplied, provide:
  - 1. Drawings
  - 2. Specifications
  - 3. Details
  - 4. Pipe Length
  - 5. Joint Detail/Gasket Material
  - 6. Data on accessories

- G. For RPMP Provide:
  - 1. Test or historical performance data to verify that joint design meets requirements of these specifications.
  - 2. For each stiffness class specified, results of the Long Term (10,000 hour) Test per ASTM 3261.
  - 3. Installation list of pipe of same diameter and type specified.

#### **1.4 DELIVERY AND STORAGE OF MATERIALS**

- A. Ship and store in accordance with manufactures recommendations.
- B. Inspect all materials during unloading process.
- C. Notify Field Personnel of any cracked, flawed or otherwise defective material.
- D. Remove all materials from the site that are found to be unsatisfactory by the Field Personnel.

#### **1.5 QUALITY ASSURANCE**

- A. Provide certification that the gasket material is suitable for intended service.

### **PART 2 PRODUCTS**

#### **2.1 RPMP**

- A. Pipe
  - 1. Conform with requirements of this Section and ASTM D 3262 and Stiffness Class shown on the drawings.
  - 2. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
  - 3. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.
  - 4. Silica Sand: Sand shall be minimum 98 percent silica with a maximum moisture content of 0.2 percent.
  - 5. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.
  - 6. Gaskets: Per ASTM F 477.
  - 7. Dimensions

- a. Diameters: The nominal diameter of the pipes shall be in accordance with ASTM D3262.
- b. Lengths: Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal +2 inches. At least 90 percent of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.
- c. Wall Thickness: The minimum wall thickness shall be not less than the wall thickness published in the manufacture's literature.
- d. End Squareness: Pipe ends shall be square to the pipe axis. All points around each end of pipe unit shall fall within ¼-inch.
- e. Marking: Identify each pipe with the name of manufacturer, plant location, code date of manufacturer, nominal pipe size, pipe stiffness designation and ASTM D3262.

B. Joints

1. Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize fiberglass, gasket-sealed closure couplings.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

A. General

1. Trench excavation and backfill in conformance Section 02315 TRENCH EXCAVATION AND BACKFILL.

### **3.2 PIPE INSTALLATION**

A. General

1. Verify size, pipe condition, and pipe class prior to installation of pipe.
2. Pipe and joints shall be carefully examined for cracks and other defects immediately before installation.
3. Remove foreign matter and dirt from inside of pipe and fittings and keep clean during and after laying. Wash ends of section clean with wet brush prior to joining sections of pipe.
4. Install and handle pipe sections in accordance with Manufacture's recommendations.
5. Install DIP consistent with the provisions of ANSI/AWWA C600.
6. Install flexible pipe consistent with the provisions of ASTM D2321.

B. Alignment

1. Maintain reference line and grade with laser. At least every 4 hours check equipment for adjustment and accuracy. Correct deficiencies in

- equipment, reference line and reference grade. Take precautions to prevent deflections in reference line and grade.
- 2. Non - conforming pipe installation: Remove and reinstall.

C. Laying and Jointing

- 1. Lay pipe upgrade with bell ends pointing in direction of laying.
- 2. Pipe shall not be laid in water or under unsuitable weather or trench conditions.
- 3. Place sufficient pipe bedding material to secure pipe from movement before next joint is installed.
- 4. When laying operations are not in progress, block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints.

**3.3 GRAVITY PIPE LEAK TESTING**

A. General

- 1. Commence test procedures only when pipe is clean and free of dirt, water, or other foreign matter, and, for buried pipe, trench has been backfilled.
- 2. Test all lines for excessive leakage before being put in service. Notify FIELD PERSONNEL of time prior to actual testing. Test each section by one of the following methods.

B. Low pressure air test (for pipe sizes to 24-inches).

- 1. Check pneumatic plugs for proper sealing.
- 2. Place plugs in line at each maintenance hole and inflate to 25 psig.
- 3. Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than groundwater that may be over the pipe. Use test gage conforming to ANSI B40.1 with 0 to 15 psi scale and accuracy of 1 percent of full range.
- 4. Allow two (2) minutes for air pressure to stabilize.
- 5. After stabilization period (3.5 psig minimum pressure in pipe), discontinue air supply to line segment.
- 6. Acceptable time for loss of one (1) psig of air pressure shall be:

<u>Pipe Size</u>	<u>Time, Minutes/100 FT</u>
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21 and 24	3.0

C. Hydrostatic Exfiltration Test (water table below or within pipe zone)

- 1. Bulkhead downstream end of test section.

2. Applied head.
  - a. Three feet above invert at upper maintenance hole when groundwater elevation is below the pipe invert.
  - b. Three feet above water table elevation when groundwater elevation is within the pipe zone to three feet above the pipe invert elevation at the upper maintenance hole.
  - c. Absorption Period - maintain head for one hour.
  - d. Test Period - maintain head for one additional hour.
  - e. Allowable leakage during second hour:

Sewer Diameter (in inches)	Maximum Loss Gallons per hour per 100 feet
15	1.2
18	1.4
21	1.7
24 & larger	1.9

- D. Hydrostatic Infiltration Test (use for high groundwater)
  1. May use when groundwater is three feet or more above the pipe invert at upper maintenance hole of test section.
  2. Set up weir or flume type measuring device at downstream end of test section.
  3. Allowable leakage - use same criteria as in D.2.e above

### 3.3 RESTORATION REQUIREMENTS

- A. Leak Test Failure
  1. Repair piping as necessary to conform to requirements.
  2. All repair work shall be subject to approval by the FIELD PERSONNEL
  3. Chemical type sealants added to the test water will not be permitted.
  4. Any pipe segment that causes a pressure test failure may require removal and replacement of pipe in failed test sections. Damaged pipe shall not be reinstalled, but shall be removed from the Work site. The FIELD PERSONNEL may require removal and replacement of pipe in failed test sections.
  5. The cost of replacement, repair and re-testing of failed pipe sections shall be borne by the CONTRACTOR.
  6. Re-test after corrective measures are completed.

**END OF SECTION**

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, curing requirements and finishes.

##### 1.2 REFERENCES

- A. American Concrete Institution (ACI):
  1. 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  2. 301 Specifications for Structural Concrete.
  3. 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete.
  4. 305R Hot Weather Concreting.
  5. 306.1 Standard Specification for Cold Weather Concreting.
  6. 308R Guide to Curing Concrete.
  7. 309R Guide for Consolidation of Concrete.
  8. 318/318R Building Code Requirements for Structural Concrete and Commentary.
  9. 350/350R Code Requirements for Environmental Engineering Concrete Structures and Commentary.
  10. 503R Use of Epoxy Compounds with Concrete: Appendix A – Test Methods.
- B. American Society for Testing and Materials (ASTM):
  1. C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  2. C33 Standard Specification for Concrete Aggregates.
  3. C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  4. C94 Standard Specification for Ready-Mixed Concrete.
  5. C117 Standard Test Method for Materials Finer than 75-um (No. 200)
  6. C143 Standard Test Method for Slump of Hydraulic Cement Concrete.
  7. C150 Standard Specification for Portland Cement.
  8. C157 Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
  9. C171 Standard Specification for Sheet Materials for Curing Concrete.
  10. C172 Standard Practice for Sampling Freshly Mixed Concrete.
  11. C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

12. C192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
13. C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
14. C260 Standard Specification for Air-Entraining Admixtures for Concrete.
15. C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. C494 Standard Specification for Chemical Admixtures for Concrete.
17. C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
18. C920 Standard Specification for Elastomeric Joint Sealants.
19. C928 Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
20. C1012 Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
21. C1018 Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).
22. C1059 Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
23. C1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
24. C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
25. C1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
26. C1152 Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete.
27. C1218 Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
28. C1315 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
29. D2103 Standard Specification for Polyethylene Film and Sheeting.
30. E329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

C. Corps of Engineers (COE):

1. CRD-C572 Corps of Engineers Specifications for Polyvinylchloride Waterstop

D. National Institute of Standards and Technology (NIST):

1. Handbook No. 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.

E. Minnesota Department of Transportation (Mn/DOT):

1. Standard Specifications for Construction.

- a. 2461 Structural Concrete.
- F. National Ready Mixed Concrete Association (NRMCA):
1. QC 123 Certification of Ready Mixed Concrete Production Facilities.

### 1.3 SUBMITTALS

- A. Provide the following submittals consistent with Section 01300 SUBMITTALS.
- B. Shop Drawings:
1. Reinforcing drawings
  2. Water repellent
  3. Concrete mix, including all mix components
  4. For Mix 1 (Exterior Concrete) only, submit:
    - a. Mix design following ACI flow chart procedure.
    - b. Weight and volume of all mix ingredients, including brand and type, if applicable.
    - c. Water/cementitious ratio clearly identified.
    - d. Coarse aggregate size designation, corresponding to a gradation per ASTM C33
    - e. Slump.
    - f. Air content.
    - g. Compressive strength test results used to generate standard deviation for mix, if applicable.
    - h. F'cr for mix.
    - i. Compressive strength test results verifying that mix meets F'cr:
      - i. Trial batch test results or
      - ii. Test results for similar mix "field experience"

### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment
- B. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer
- C. Comply with ACI 301, "Specification for Structural Concrete," including the following sections, unless modified by requirements in the Contract Documents:
1. "General Requirements."
  2. "Formwork and Formwork Accessories."
  3. "Reinforcement and Reinforcement Supports."
  4. "Concrete Mixtures."



- 5. "Handling, Placing, and Constructing.
- D. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

**PART 2 PRODUCTS**

**2.1 FORMWORK**

- A. Furnish formwork and formwork accessories according to ACI 301.

**2.2 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

**2.3 CONCRETE MATERIALS**

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project
  - 1. Portland Cement: ASTM C 150, see schedule on Drawings. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C or F. see schedule on Drawings.
  - B. Normal-Weight Aggregate: ASTM C 33, see schedule on Drawings for size.
  - C. Water: ASTM C 94/C 94M; potable.
  - D. Synthetic Fiber: Monofilament or fibrillated polypropylene or polyethylene "Macro Fibers", engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1½ to 2½ inches long. Include in all Mix 1 concrete.
    - 1. Manufacturers:
      - a. Grace.
      - b. Forta.
      - c. Novomesh.
      - d. Euclid.
  - E. Admixtures: Furnish from one manufacturer.
    - 1. Air-Entraining Admixture: ASTM C 260, containing no chlorides.
    - 2. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
      - a. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
      - b. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
      - c. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
      - d. Manufacturers:

- i. BASF.
- ii. W.R. Grace & Company.
- iii. Euclid.
- iv. GRT.

## 2.4 RELATED MATERIALS

- A. Expansion Joint-Filler: Neoprene, closed-cell, expanded, in accordance with ASTM D1056, Type 2C5.
- B. Water repellent
  1. Clear, non-staining, silane/siloxane, breathable sealer and water repellent, intended by manufacturer for horizontal and vertical surfaces.
  2. Manufacturers: Material from the following manufacturers and which meet these specifications will be accepted:
    - a. L&M Construction Chemicals, Inc. Aquapel.
    - b. BASF Building Systems, HYDROZO Silane 40 VOC
- C. Joint Sealants (unless specified elsewhere)
  1. Multi-part, gun grade, non-slump elastomeric polyurethane.
  2. Formulated specifically for constant immersion in wastewater.
  3. ASTM C920, Type M, Grade NS, Class 25, Use I.
  4. Bond breaker and backer rod: per sealant manufacturers written recommendations.
  5. Manufacturers: Material from the following manufacturers and which meet these specifications will be accepted:
    - a. Polymeric Systems, Inc., PSI-270/RC 270.
    - b. BASF Building Systems, Sonolastic NP2

## 2.5 CURING MATERIALS

- A. Evaporation Retardant:
  1. Monomolecular film, water-based, non-residual.
  2. Optional: Fluorescent color tint that disappears completely upon drying.
  3. Manufacturers: Material from the following manufacturers and which meet these specifications will be accepted:
    - a. BASF Admixtures, Inc., CONFILM.
    - b. Euclid Chemical Co., Eucobar.
    - c. L&M Construction Chemicals Inc., E-Con.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

## **2.6 CONCRETE MIXTURES**

- A. Comply with ACI 301 requirements for concrete mixtures.
- B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:
  - 1. Minimum Compressive Strength: see schedule on Drawings
  - 2. Maximum Water-Cementitious Materials Ratio: see schedule on Drawings
  - 3. Slump Limit: Before adding superplasticizers: 1-3 inches. After adding superplasticizers: 5-9 inches.
  - 4. Air Content: see schedule on Drawings
- C. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate but not less than a rate of 3.0 lb/cu. yd.

## **2.7 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
  - 1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. Prior to placing concrete on ground:
  - 1. Surface-compact existing subgrade to 95% of ASTM D698.

## **3.2 FORMWORK**

- A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

## **3.3 STEEL REINFORCEMENT**

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

## **3.4 CONCRETE PLACEMENT**

- A. Comply with ACI 301 for measuring, batching, mixing, transporting, and placing concrete.
- B. Do not add water to concrete during delivery, at Project site, or during placement.

- C. Consolidate concrete with mechanical vibrating equipment.

### **3.5 FINISHING FORMED SURFACES**

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/4 inch (13 mm).
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm).
  - 1. Apply to concrete surfaces exposed to public view, including vertical concrete surfaces 4 inches or less below grade, or to be covered with a coating or covering material applied directly to concrete.

### **3.6 FINISHING UNFORMED SURFACES**

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
  - 1. Do not further disturb surfaces before starting finishing operations.
- C. Trowel and Light-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Do not allow brooming operation to raise synthetic fibers.
  - 2. Match finish of adjacent slabs.

### **3.7 CONCRETE PROTECTING AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

- D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.
1. Contractor shall refer to Section 01400.
- B. Tests: Perform according to ACI 301.
1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m) but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

### **3.9 REPAIRS**

- A. Remove and replace concrete that does not comply with requirements in this Section. Provide and place sleeves for conduits penetrating floors, walls, partitions, etc. Locate necessary slots for electrical work and form before concrete is poured.

**END OF SECTION**

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## SECTION 03301

### FLOWABLE FILL (CLSM)

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Flowable Fill.

##### 1.2 DEFINITIONS

- A. CLSM: Controlled Low Strength Material. Bedding and backfill material requiring no compaction using portland cement, an approved aggregate, and enough water to allow the material to freely flow (flowable fill). Normal weight CLSM shall be a standard mix as produced by a ready-mix concrete supplier, and lightweight CLSM shall be site-produced by a Specialty Contractor. CLSM shall be self-leveling and self-compacting.

##### 1.3 REFERENCES

- A. American Concrete Institute (ACI):
  1. 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
  2. 229R Controlled Low-Strength Materials (CLSM).
  3. 301 Specifications for Structural Concrete.
- B. American Society for Testing and Materials (ASTM):
  1. C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  2. C33 Standard Specification for Concrete Aggregates.
  3. C94 Standard Specification for Ready-Mixed Concrete.
  4. C150 Standard Specification for Portland Cement.
  5. C172 Standard Practice for Sampling Freshly Mixed Concrete.
  6. C232 Standard Test Methods for Bleeding of Concrete.
  7. C403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
  8. C494 Standard Specification for Chemical Admixtures for Concrete.
  9. D4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
  10. D6103 Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM).

##### 1.4 SUBMITTALS

- A Shop Drawings:

1. CLSM design mix, giving dry weights of cement, saturated surface-dry weights of aggregate, types, names and percent of admixtures, air content, and water used per cubic yard CLSM. Include laboratory test data on 7 and 28 day strengths.
  2. Initial and final set times of design mix as determined by ASTM C403.
- B. Quality Control
1. Submit required experience information for ready mix plant(s) supplying CLSM.
  2. Submit required experience information for Specialty Contractor supplying lightweight CLSM.

**1.5 QUALITY ASSURANCE**

- A. Ready mix supplier shall have a minimum of two years' experience producing CLSM of the type required. Submit list of projects including quantity, density and strength of CLSM supplied for similar projects in past two years as proof of experience.

**PART 2 PRODUCTS**

**2.1 CLSM MATERIALS**

- A. Unless otherwise noted, all materials shall comply with requirements of ACI 229R.
- B. Cement – ASTM C150 – Type 1.
- C. Fine Aggregate: ASTM C33.
- D. Admixtures: Certified to be compatible with each other. Admixtures shall not contain calcium chloride.
- E. Water: Potable, clean and containing less than 100 ppm of chlorides. Free of any substances deleterious to lightweight CLSM foaming agent.

**2.2 CLSM MIX DESIGN**

- A. Consistency - the mixture of cement, aggregate, water and admixture(s) shall be so proportioned to create a flowable slurry with a minimum flow of 8 inches when tested in accordance with ASTM D6103. The mix must be a homogeneous slurry so that the materials do not readily segregate upon deposition. Bleed water shall be no greater than 10 percent of the mixing water as measured by Method A of ASTM C232.
- B. Proportioning and Design of CLSM mixes. Field experience test data or laboratory test batches prepared in accordance with ACI 211.1 and ACI 301.
- C. Set time - the mix will be so proportioned that it will have a minimum of 500 psi penetration resistance in four hours as measured by ASTM C403.
- D. Flowable Fill (CLSM) – normal weight:



1. Non-Excavatable.
2. 28-day compressive strength: 150 psi +/- 50 psi.
3. Minimum compressive strength at 3 days: 20 psi.
4. Density: 120 pcf +/- 20 pcf.
5. Preparation and testing of cylinders shall be in accordance with ASTM D4832.

### **2.3 MIXING**

- A. Normal weight CLSM shall be provided by ready mix industry and shall comply with ASTM C94.
- B. Sufficient mixing capacity shall be provided to permit the CLSM to be placed without interruption. The mixer drum shall be completely emptied prior to the initial batch of CLSM to ensure that no additional cement fines are incorporated into the mix.

## **PART 3 EXECUTION**

### **3.1 USES**

- A. CLSM may be used at the CONTRACTOR'S discretion for the following:
  1. Structural fill
  2. Bedding Material and Suitable Material
  3. In lieu of Clear Rock for trench stabilization
  4. Filling of abandoned pipes.
  5. Backfill Grout for carrier pipes less than 50 feet in length

### **3.2 CLSM PLACEMENT PROCEDURES**

- A. Deposit CLSM by ready mix truck, pump, or other approved method by continuous discharging material in the space specified to be filled.
- B. Where used to backfill the trench above the pipe to some specified elevation, delay placement of base or other fill until CLSM, in the opinion of the ENGINEER, has gained sufficient strength to support the next layer to be placed.
- C. For all piping located under paved areas continue placing CLSM from the bedding surface thru the pipe zone to the subgrade elevation. Excess excavated materials taken from these paved sections shall be reused in other areas where applicable or shall be otherwise disposed of.
- D. Where CLSM is specified for bedding piping or lightweight ducts, placement will be required in stages to prevent uplift of the pipe or duct. The first stage placement shall stop at one fourth the diameter of the pipe or duct. After setting of the first lift as determined by the ENGINEER the second stage placement shall stop at mid height of the pipe or duct. After consolidation (setting) of the second lift, the remainder of the trench shall be filled in one operation.

### **3.3 LIMITATION OF OPERATIONS**

- A. CLSM shall not be placed on frozen ground. Mixing and placing may begin only if the air temperature is at least 35 degrees F and rising. At time of placement, CLSM shall have a temperature of at least 40 degrees F. Mixing and placing shall stop when the air temperature is 40 degrees F and falling.

### **3.4 TESTING AND INSPECTION**

- A. The following tests will be conducted at no cost to the CONTRACTOR:
  - 1. Normal weight CSLM: Cylinders shall be made in field and tested in laboratory in accordance with ASTM D4832.
  - 2. Test 4 specimens for every 100 cubic yards of CLSM.
- B. Strength level of CLSM will be considered satisfactory if average 28 day strength test results are within the strength range specified and 3 day strength is at least 20 psi.

**END OF SECTION**

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