SECTION 31 23 23.33
FLOWABLE FILL

SPEC WRITER NOTES:
1. Use this section only for NCA projects.
2. Delete between // --- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs. Use this section when the potential exists for soil backfill conditions where it will not be possible to provide specified compaction of fill or backfill as a result of limited or restricted space or access conditions.

PART 1 - GENERAL
1.1 INTRODUCTION

A. Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places (such as under undercuts of existing slabs), is self-leveling, and hardens in a matter of a few hours without the need for compaction in layers. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.

SPEC WRITER NOTES:
1. Modify following paragraph and delete those portions of the paragraph that aren’t applicable to the specific NCA project.

B. Flowable fill materials will be used only as a structural fill replacement on NCA projects. // Unless otherwise noted, flowable fill installed as a substitution for structural earth fill, shall not be designed to be removed by the use of hand tools. // The materials and mix design for the flowable fill should be designed // to produce a comparable compressive strength to the surrounding soil after hardening, making excavation at a later time possible // to produce the compressive strength indicated for the placed location, as determined by the Resident Engineer //.

SPEC WRITER NOTES:
Modify following paragraph as required, for site conditions and potential for conditions that may require the use of flowable fill.
1.2 DESCRIPTION

Furnish and place flowable fill in a fluid condition, that sets within the required time and, after curing, obtains the desired strength properties as evidenced by the laboratory testing of the specific mix design, at locations shown on the plans or as directed by the Resident Engineer, verbally in writing verbally or in writing. This section specifies flowable fill for use as structural fill to remain excavatable using hand tools remain easily excavatable using a backhoe as would be utilized for adjoining earth remain permanently.

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

SPEC WRITER NOTES:
1. Select one of the Paragraph B options below and delete the other, as applicable for the NCA project characteristics.

B. Earthwork, excavation and backfill and compaction requirements: Section 31 20 00, EARTH MOVING.

B. Earthwork, excavation and backfill and compaction requirements: Section 31 20 11, EARTH MOVING (Short Form).

1.4 DEFINITIONS

A. Flowable fill - Ready-mix Controlled Low Strength Material used as an alternative to compacted soil, and is also known as controlled density fill, and several other names, some of which are trademark names of material suppliers. Flowable fill (Controlled Low Strength Material) differs from portland cement concrete as it contains a low cementitious content to reduce strength development for possible future removal. Design strength for this permanent type flowable fill shall be a compressive strength of 2.1 MPa (300 psi) minimum at 28 days. Chemical admixtures may also be used in flowable fill to modify performance properties of strength, flow, set and permeability.

SPEC WRITER NOTES:
1. Clearly designate in the project whether there are to be instances where excavatable flowable fill is required. Utility trench crossings are the typical locations where excavatable flowable fill would be required for NCA projects. Indicate whether machine or hand excavation is required.

B. Excavatable Flowable fill - flowable fill designed with a compressive strength that will allow excavation as either machine tool excavatable at compressive strength of 1.5 MPa (200 psi) maximum at 1 year, or hand
tool excavatable at compressive strength of 0.7 MPa (100 psi) maximum at 1 year.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Flowable fill Mix Design: Provide flowable fill mix design containing cement and water. At the contractor’s option, it may also contain fly ash, aggregate, or chemical admixtures in any proportions such that the final product meets the strength and flow consistency, and shrinkage requirements included in this specifications.

1. Test and Performance - Submit the following data:

   a. Flowable fill shall have a minimum strength of 2.1 MPa (300 psi) according to ASTM C 39 at 28 days after placement.

   b. Flowable fill shall have minimal subsidence and bleed water shrinkage. Evaporation of bleed water shall not result in shrinkage of more than 0.4 mm per m (1/8 inch per ft.) of flowable fill depth (for mixes containing high fly ash content). Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C 940 “Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.

   SPEC WRITER NOTES:
   Modify following paragraph as required, for site conditions. Select lower unit weight for use where soils supporting Flowable fill has poor bearing value. Under normal conditions the unit weight will vary depending on the amount of sand and fly ash in the mix design.

   c. Flowable fill shall have a unit weight of // 1500 – 1900 kg/m3 (90 – 115 lbs/feet 3) // 1900 – 2300 kg/m3 (115 – 145 lb/feet 3) // 320 – 1300 kg/m3 (20 – 80 lb/feet 3) // measured at the point of placement after a 60 minute ready-mix truck ride.

   C. Provide documentation that the admixture supplier has experience of at least one year, with the products being provided and any equipment required to obtain desired performance of the product.

   D. Manufacturer’s Certificates: Provide Resident Engineer with a certification that the materials incorporated in the flowable fill, following achievement of the required strength, do not represent a threat to groundwater quality.

   SPEC WRITER NOTES:
   1. Modify the following paragraph to insure that the dates of the standards indicated are current at the time the specifications are submitted.
1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):
- C33/C33M-08 ............ Standard Specification for Concrete Aggregates
- C150-07 .................. Standard Specification for Portland Cement
- C260-06 .................. Standard Specification for Air-Entraining Admixtures for Concrete
- C403/C403M-08 .......... Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
- C494/C494M-08a ......... Standard Specification for Chemical Admixtures for Concrete
- C618-08a ................. Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- D4832-02 ................. Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

C. American Concrete Institute (ACI):
- SP-150-94 ............... Controlled Low-Strength Materials

1.7 QUALITY ASSURANCE

A. Manufacturer: Flowable fill shall be manufactured by a ready-mix concrete producer with a minimum of 1 year experience in the production of similar products.

B. Materials: For each type of material required for the work of this Section, provide primary materials that are the products of one manufacturer. If not otherwise specified here, materials shall comply with recommendations of ACI 229R-99: "Controlled Low-Strength Materials (Reapproved 2005)."

C. Pre-Approval Procedures: The use of flowable fill during any part of the project shall be restricted to those incidences where, due to field conditions, the Contractor has made the Resident Engineer aware of the conditions for which he recommends the use of the flowable, and the Resident Engineer has confirmed those conditions and approved the use of the flowable fill, in advance. During the submittal process, the contractor shall prepare and submit various flowable fill mix designs.
corresponding to required conditions or if the contractor desires to use flowable fill due to economics. Approval for the strength of the flowable fill shall be obtained from the Resident Engineer, through the submittal process, when the contractor desires, or is required, to use flowable fill at specific location(s) within the project. Prior to commencement of field operations the contractor shall establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.8 DELIVERY, STORAGE, AND HANDLING

Deliver and handle all products and equipment required, in strict compliance with manufacturer’s recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

1.9 PROJECT CONDITIONS

Perform installation of flowable fill only when approved in advance by the Resident Engineer, and when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide flowable fill containing, at a minimum, cementitious materials and water. Cementitious materials shall be portland cement, pozzolanic materials, or other self-cementing materials, or combinations thereof, at the contractor’s option as long as the Certification regarding no degradation of groundwater quality has been submitted. The flowable fill mix design may also contain, fine aggregate or filler, and/or chemical admixtures in any proportions such that the final product meets the strength, flow consistency and shrinkage requirements included in this specification.

SPEC WRITER NOTES:
Modify following material items as required. Whenever possible use the standards already developed by the local State Department of Transportation (DOT) for use in cast-in-place concrete or if applicable (CLSM) or flowable fill.

1. Portland Cement: ASTM C150, Type 1 or Type 2. Meeting _____ (Insert state in which the project is being built) State DOT standards. //

2. Mixing Water: Fresh, clean, and potable. Meeting _____ (Insert State in which the project is being built) State DOT standards for use as mix-water for cast-in-place concrete. //


2.2 FLOWABLE FILL MIXTURE

A. Mix design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.

B. Flowable fill shall have a minimum strength of 2.1 MPa (300 psi) according to ASTM C39 at 28 days after placement.

C. Flowable fill shall have minimal subsidence and bleed water shrinkage. Evaporation of bleed water shall not result in shrinkage of more than 10.4 mm per m (1/8 inch per foot) of flowable fill depth (for mixes containing high fly ash content). Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C 940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.

SPEC WRITER NOTES:
1. Select the appropriate unit weight based upon the type and strength of the flowable fill to be used. Contact the providers within the maximum allowable transit time for the specific unit weight parameters for the flowable fill material provided local to the project.

D. Flowable fill shall have a unit weight of // 1500 - 1900 kg/m3 (90 - 115 lbs/feet3) // 1900 - 2300 kg/m3 (115 - 145 lbs/feet3) // 320 - 1300 kg/m3 (20 - 80 lbs/feet3) // measured at the point of placement after a 60 minute ready-mix truck ride. In the absence of strength data the cementitious content shall be a maximum of 90 kg/m3 (150 lbs/cy).

E. Flowable fill shall have an in-place yield of // at least 98% of design yield for permanent type // a maximum of 110% of design yield for removable types at 1 year //.

F. Provide equipment as recommended by the Manufacturer and comply with manufacturer's recommendations for the addition of additives, whether at the production plant or prior to placement at the site.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine conditions of substrates and other conditions under which work is to be performed and notify Resident Engineer, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 APPLICATION OF FLOWABLE FILL

Secure tanks, pipes and other members to be encased in flowable fill. Insure that there are no exposed metallic pipes, conduits, or other
items that will be in contact with the flowable fill after placement. If so, replace with non-metallic materials or apply manufacturers recommended coating to protect metallic objects before placing the flowable fill. Replacement or protection of metallic objects is subject to the approval of the Resident Engineer.

3.3 PROTECTION AND CURING

Protect exposed surfaces of flowable fill from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by Resident Engineer.

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