

**SPECIFICATIONS - DETAILED PROVISIONS**  
**Section 02253 – Controlled Low Strength Material**

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**SECTION 02253**  
**CONTROLLED LOW STRENGTH MATERIAL**

**PART 1 - GENERAL**

1.01 DESCRIPTION

Controlled Low Strength Material (CLSM) is used as a bedding material for Vitrified Clay Pipe to meet the requirements of ASTM C12 Practice for Installing Vitrified Clay Pipe, Section 6, Bedding and Encasement, and the National Clay Pipe Engineering Manual (2006), Chapter 4, Part II, Structural Design.

The CLSM mix design shall consist of Portland cement, fine aggregate, water and chemical admixtures to accelerate cure time and entrained air.

The actual mix design shall be determined by the producer of the CLSM within these guidelines and be approved by the engineer.

These guidelines are for CLSM when it is desirable for a mix to cure rapidly to facilitate initial backfill at the earliest possible time.

1.02 CLSM MIX DESIGN & EXAMPLE MIX (PER 27 CU. FT. OF MIX)

CLSM Mix Design

A. Cement:	188 pounds (Type II/V)
B. Fine Aggregate:	74% - 80% (by weight)
C. Coarse Aggregate (3/8"):	20% - 25% (by weight)
D. Water:	water necessary to obtain slump (see slump)
E. Accelerator:	4% (as a percent of cement)
F. Air Entrainment:	15% - 20%
G. Slump:	8 inch +/- 1 inch spread diameter (3 inch diameter by 6 inch long cylinder, ASTM D 6103)
H. Compressive Strength:	28 days, 100 – 300 psi

CLSM Example Mix

A. Cement:	188 pounds (Type II/V)
B. Fine Aggregate:	2028 pounds (Specific Gravity 2.58)
C. Coarse Aggregate (3/8"):	507 pounds (Specific Gravity 2.61)
D. Water:	375 pounds (total water)
E. Accelerator:	4% (as a percent of cement)
F. Air Entrainment:	18% total air including entrapped air

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- G. Slump: 8 inch +/- 1 inch spread diameter (3 inch diameter by 6 inch long cylinder, ASTM D 6103)
- H. Compressive Strength: 28 days, 100 – 300 psi

1.03 REFERENCE STANDARDS

Referenced ASTM:

ASTM C 12	Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Standard Specifications for Portland Cement
ASTM C 226	Standard Specifications for Air-Entrained Additions for use in the Manufacture of Air Entrained Hydraulic Cement
ASTM C 403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494	Standard Specifications for Chemical Admixtures
ASTM C 618	Standard Specifications for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 684	Standard Test Method for Making, Accelerated Curing, and Testing Concrete Compression Test Specimen
ASTM C 684	Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

**PART 2 - PRODUCT**

2.01 PORTLAND CEMENT

Portland cement shall meet the requirements of ASTM C 150, Type II, V or a combination thereof, including Section 03300, Part 2.01 A of the EMWD Specifications.

2.02 FINE AGGREGATES

Aggregates shall conform to ASTM C 33 and Section 03300, Part 2.01 B of the EMWD Specifications, except as follows: Aggregates shall be pretested in CLSM mixtures similar to those anticipated for the work, confirming their ability to perform as required for the specific application. Fine aggregates will be 75% - 80% of total aggregate by weight.

### 2.03 COARSE AGGREGATES

Aggregates shall conform to ASTM C 33 and Section 03300, Part 2.01 B of the EMWD Specifications, be 3/8" in size, except as follows: Aggregates shall be pretested in CLSM mixtures similar to those anticipated for the work, confirming their ability to perform as required for the specific application. Coarse aggregates will be 20% - 25% of total aggregate by weight.

### 2.04 WATER

Water shall be free of oils, acids, alkalies, organic matter or other deleterious substances. The amount added shall be adjusted for moisture content of the aggregates.

### 2.05 ACCELERATOR

Chemical admixtures for the use in accelerating the CLSM cure time shall be 4% of the cement content. CaCl shall not be used because of its corrosive nature and the availability of admixtures specifically designed for the purpose. Accelerating admixtures shall meet the requirements of ASTM C 494.

### 2.06 AIR ENTRAINMENT

Chemical admixtures shall be specifically designed for air entrainment and meet the requirements of ASTM C 226.

The mix shall have 15% - 20% air entrainment including entrapped air.

### 2.07 FLY ASH

Fly ash is not necessary for this mix design. The mix contains entrained air and a slump that provides adequate flowability.

The addition of fly ash will retard the cure rate and will change the ultimate compressive strength.

### 2.08 SLUMP

Slump shall have 8 inch +/- 1 inch spread diameter using a three (3) inch diameter by six (6) inch long cylinder and shall meet the requirements of ASTM D 6103.

### 2.09 COMPRESSIVE STRENGTH

The 28 day compressive strength of the CLSM shall be 100 psi to 300 psi per ASTM C 39.

### 2.10 PENETROMETER

A penetrometer shall be used to determine the set time for the placed CLSM and meet the requirements of ASTM C 403.

The penetrometer must have a maximum load reading of 700 psi and have a one (1) square inch by one (1) inch long cylinder foot attachment to a ¼ inch diameter pin. ASTM C 403 for configuration.

The penetrometer shall be inserted into the CLSM to a depth of one (1) inch and the reading recorded.

The load readings on the penetrometer are not the compressive strength of the CLSM as measured by the standard concrete cylinder test.

### **PART 3 - EXECUTION**

#### **3.01 MIXING**

The supplier shall determine the unit weights based upon the specific gravity of the fine and coarse aggregate. The ratio shall be 75% - 80% fine aggregate to 20% - 25% coarse aggregate by weight. Mixing shall conform to the requirements of Section 03300, Part 2.03 of the EMWD Specifications, except for the one and one-half hour time limit specified in Paragraph B of Part 2.03. The minimum mix time required shall be specified by the supplier. Unless otherwise specified, under conditions contributing to quick setting, the Engineer may specify a time limit, not to exceed two and one-half hours.

Adjustment of the mixture to achieve improved placement characteristics shall be through the use of chemical admixtures. No increase in water content or water to cement ratio will be allowed.

Admixtures shall be added per the suppliers' recommendations.

Water shall be added as specified and yield a slump as above.

#### **3.02 TESTING**

CLSM shall be tested for plastic unit weight. Plastic unit weight shall not deviate more than +/-10 percent of theoretical unit weight shown on the approved mix design. Unit weight shall be determined in accordance with ASTM C138.

CLSM's consistency shall be tested by the slump method. The slump shall be measured in accordance with ASTM C143.

Penetrometer readings shall be made.

#### **3.03 PLACEMENT**

Refer to ASTM C 12 for bedding details.

CLSM must be thoroughly mixed in the delivery truck immediately before discharge and carefully placed by tremme, chute, conveyer, bucket or pump and placed on top of the pipe and alternating equally on both sides of the pipe in a manner so as not to move the pipe from the installed position. CLSM should not be free fall placed from a height greater than seven (7) feet or impact against the trench walls. To contain CLSM when filling long open trenches, the end points shall be adequately bulkheaded to prevent movement. Methods may include bulkheading with sandbags, earth dams, forms or stiffer mixtures of CLSM.

CLSM may be placed in one lift.

CLSM must be placed continuously to the trench sidewalls.

Vibratory equipment must not be used.

#### 3.04 BACKFILL

Initial backfill shall only commence after the following requirements are met:

- A. Penetrometer (as defined herein) readings shall be taken in the CLSM alongside the pipe.
- B. If it is not practical to use the penetrometer in the trench, CLSM may be collected in a cardboard box of approximately 12" wide by 12" wide by 9" tall for each 30 minute interval of pour and penetrometer measurements made from this accessible location.
- C. A 500 psi minimum penetrometer reading is required.

**END OF SECTION 02253**

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