

## Materials Specification – 21 for CONTROLLED LOW STRENGTH BACKFILL MATERIAL

### 1. GENERAL

CLSM shall be manufactured in accordance with the following requirements.

### 2. CLSM MIX SUBMITTAL

A minimum of 2 days prior to beginning CLSM work, CLSM mix designs shall be submitted to Denver Water for approval. Changes shall not be made in the amounts or sources of the approved mix ingredients without Denver Water's written approval. Production inspection and field-testing of the approved mix may be made by Denver Water.

### 3. CLSM FLOW FILL

#### A. Cementitious Materials:

- 1) Cement: Type II Portland cement in accordance with ASTM C 150.
- 2) Fly Ash: Class C or Class F in accordance with ASTM C 618.

#### B. Aggregates:

- 1) Fine Aggregate: In accordance with the grading and quality requirements of ASTM C 33.
- 2) Coarse Aggregate: In accordance with the grading and quality requirements of ASTM C 33 for Size No. 467, No. 57, or No. 67.

C. **Water:** In accordance with the requirements of ASTM C 94.

D. **Admixtures:** Admixtures that do not contain calcium chloride and are in accordance with ASTM C 494 for concrete may be used. Admixtures shall be compatible with the cement and other admixtures.

#### E. Proportions:

- 1) Total cementitious material: 50 to 95 lb/cy.
- 2) Fly ash by weight: Maximum 40% of total cementitious materials.
- 3) Air-entrained to total air content: 4% to 8%.
- 4) Minimum slump: 6 inches.
- 5) Maximum slump: 8 inches, when tested in accordance with ASTM C 143.
- 6) Fine aggregates: Between 50% and 60% by volume of total aggregate.
- 7) Compressive strength at 28 days: 50 to 150 psi when molded and cured in accordance with ASTM D 4832.

### 4. CLSM FLASH FILL

#### A. General Requirements:

- 1) Flash fill is permitted in the pipe zone, the backfill above the pipe zone, and as general backfill.
- 2) Fly ash: Class C or Class F in accordance with ASTM C 618.
- 3) Foaming agents: In accordance with ASTM C 869 and C 796.

**B. Pipe Zone:**

- 1) Compressive strength at 28 days: 50 to 150 psi.
- 2) Removability Modulus less than 1 1/2 when calculated by:

$$RE = \frac{W^{1.5} \times 104 \times C^{0.5}}{10^6}$$

Where: W=unit weight in pounds per cubic foot and C=28 day compressive strength.

- 3) Ratio of Class F to Class C fly ash: Between 5:1 and 6:1.
- 4) Not air-entrained.
- 5) No foaming agent allowed.

**C. Above Pipe Zone and General Backfill:**

- 1) Meeting requirements of the local jurisdiction.
- 2) Compressive strength at 28 days: 50 to 150 psi.
- 3) Removability Modulus of 1.50.
- 4) Minimum air content for resistance to frost-heave of 15% when tested in accordance with ASTM C 231 or by volumetric calculation using the following equation:

$$\text{Air Content} = \frac{(\text{Unit weight no foam} - \text{Unit weight foam}) \times 100\%}{\text{Unit weight no foam}}$$

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