

Material Specification – 21

CONTROLLED LOW STRENGTH BACKFILL MATERIAL

1. GENERAL

CLSM shall be manufactured in accordance with the following requirements.

2. CLSM MIX SUBMITTAL

A minimum of 14 days prior to beginning CLSM work, CLSM mix designs shall be submitted to Denver Water for approval. Submittals shall include data sheets demonstrating that all mix components meet the requirements outlined in this specification. Mix design shall be signed and sealed by the PE and include historical compressive strength test results. 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 may be made by Denver Water.

3. CLSM FLOW FILL

A. General Requirements:

- 1) Flow fill is permitted in the pipe zone, the backfill above the pipe zone, and as general backfill.
- 2) Cement shall be Type II Portland cement in accordance with ASTM C 150.
- 3) Fly ash shall be in accordance with ASTM C 618, Type C or Type F.
- 4) Aggregates shall not exceed 0.10% expansion at 14 days when tested for alkali reactivity per ASTM C 1260.

B. Pipe Zone:

- 1) Unconfined compressive strength at 28 days shall be 50 psi to 150 psi when molded and cured in accordance with ASTM D 4832.
- 2) Removability modulus less than 1.5 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 unconfined compressive strength.

- 3) Maximum air content of 8%.

C. Above Pipe Zone and General Backfill:

- 1) Meeting the requirements of the authority having jurisdiction.
- 2) Unconfined compressive strength at 28 days shall be 50 psi to 150 psi when molded and cured in accordance with ASTM D 4832.
- 3) Air content shall be in accordance with the authority having jurisdiction; typically greater than the maximum pipe zone air content.
- 4) Maximum removability modulus of 1.5.

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) Flash fill shall not be placed in contact with PVC due to heat of hydration. A minimum of 6-inches of pipe zone material is required between PVC and flash fill.
- 3) Flash fill shall not be used as a wearing surface.
- 4) Fly ash shall be in accordance with ASTM C 618, Type C or Type F.
- 5) Air-entraining admixtures shall be in accordance with ASTM C 260.
- 6) Foaming agents shall be in accordance with ASTM C 869 and C 796.

B. Pipe Zone:

- 1) Minimum slump shall be 8-inches.
- 2) Unconfined compressive strength at 24 hours shall be at least 150 psi when molded and cured in accordance with ASTM D 4832.
- 3) Removability modulus less than 1.5 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 unconfined compressive strength.

C. Above Pipe Zone and General Backfill:

- 1) Meeting the requirements of the authority having jurisdiction.
- 2) Unconfined compressive strength at 28 days shall be 100 psi to 300 psi.
- 3) Removability modulus of 1.5.
- 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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