

SECTION 220—FLOWABLE BACKFILL

220.1 DESCRIPTION—This work is furnishing, transporting, and placing flowable backfill. Flowable backfill is a mixture of coarse aggregate, fine aggregate, water and air entraining agents, either cement or pozzolans, or a combination of both, and may or may not include bottom ash, or other admixtures. The four types of flowable backfill are as follows:

(a) Flowable Backfill, Type A and Type B. Future excavation of the backfill may be necessary such as at utility trenches, pipe trenches, bridge abutments, and around box or arch culverts.

(b) Flowable Backfill, Type C. Excavation of backfills not anticipated, including replacing unsuitable soils below structure foundations, filling abandoned conduits, tunnels and mines, and backfilling around pipe culverts where extra strength is required.

(c) Flowable Backfill, Type D. Construction in areas requiring low-density backfill material as in abutments over highly deformable soils, backfilling retaining walls, filling vaults, and backfilling on top of buried structures.

220.2 MATERIAL—

(a) Cement. Type I, IP, or II, [Section 701](#). If using Type IP cement, adjust the quantity of flyash in the design as necessary. From a source listed in [Bulletin 15](#).

(b) Flyash. Type F or C flyash, [Section 724](#) except as follows:

- Flyash—conforming to AASHTO M 295 (or [ASTM C 618](#)) Table 1 requirements except maximum loss on ignition is 16%, and excluding the requirements of Table 1A, 2, or 2A.

From a source listed in [Bulletin 15](#) or tested and approved before incorporating into the flowable backfill mix.

(c) Ground Granulated Blast Furnace Slag. [Section 724.3](#). From a source listed in [Bulletin 15](#).

(d) Fine Aggregate. Type A, B, or C; [Section 703.1](#); except, having a maximum loss of 20% in the Soundness Test, [PTM No. 510](#). The fine aggregate may be natural sand, manufactured sand, or foundry sand meeting [Section 703.1](#). From a source listed in [Bulletin 14](#).

(e) Coarse Aggregate. Type A, B, or C, AASHTO 10, [Section 703.2](#). Except 10% maximum for material finer than the 75 μm (No. 200) sieve. From a source listed in [Bulletin 14](#).

(f) Bottom Ash. From a source listed in [Bulletin 14](#). Coal ash having a maximum loss of 20% in the Soundness Test, [PTM No. 510](#), and conforming to the following dry sieve gradation requirements:

Sieve Size	% Passing
12.5 mm (1/2-inch)	100
75 μm (No. 200)	0-10

(g) Water. [Section 720.1](#)

(h) Admixtures. [Section 711.3](#). Including air-generating admixtures.

(i) Geotextile, Class 4, Type A. [Section 735](#)

(j) Mix Design. Submit a mix design and test results (density and strength) to the Representative, at least 3 weeks before construction. Use Table A as a guideline for the mix design or submit an alternate design based on density guidelines and conforming to the strength requirements of Table A. Base the submitted mix design on an absolute volume of 1 m³ (1 cubic yard).

**TABLE A
Mix Design**

Properties & Criteria	Type A	Type B	Type C	Type D
Mix Design (/m ³ (/CY))				
Cement (kg (lbs))*	45 (100)	23 (50)	68-90 (150-200)	136-320 (300-700)
Pozzolans (kg (lbs))*	910 (2000)	136 (300)	136 (300)	45-180 (100-400)
Bottom ash (kg (lbs))* or Coarse Aggregate or Fine Aggregate Air Generating Admixture*	0	1180 (2600)	1180 (2600)	**
Slump (mm (inches)) AASHTO T 121, C 136	178 (7) min ****	178 (7) min ****	178 (7) min ****	178 (7) min ****
Density (kg/m ³ (pcf)) AASHTO T 121, C 136	N/A	N/A	N/A	480-1120 (30-70) or as specified ***
Water Absorption of Aggregate AASHTO T 85	--	--	--	20% max
Compressive Strength (MPa (psi)) PTM No. 604 28 Days	0.86 (125) max	0.86 (125) max	5.51 (800) min	0.62-2.75 (90-400)

*Quantities may be varied or alternate designs submitted to adapt mix to conform to density and strength requirements or to adapt to specific site conditions.

**Requires using a suitable lightweight aggregate or air entraining admixture. Provide a mix design that achieves the specified strength and density requirements.

***Approximate Value. Use of air entraining agent may reduce these values.

****Some applications may require containing flowable backfill by constructing dikes from the mix by using less water to produce a 75 mm (3-inch) minimum slump, if approved by the Representative. Thickening of the mix in other areas is allowed if approved by the Representative.

Provide mix designs that conform to specific density requirements, if specified. If source of material is changed, submit a revised mix design before using material. Conduct design mix testing at the highest flowability or slump being used for the project.

If applications involve exposed metal or metal coated with a layer of thin concrete (< 13 mm (< 1/2 inch)), test the design mixes for corrosion resistance as follows:

Resistivity, AASHTO T 288, 60 day cure	> 2000 ohm-centimeters
pH of pulverized flowable backfill	5.0 to 9.5
Chlorides of pulverized backfill after cure	< 200 ppm
Sulfates of pulverized backfill after cure	< 1000 ppm
Sulfides of pulverized backfill after cure	< 200 ppm

(k) Certification. Certify the properties of flowable backfill as specified in [Section 106.03\(b\)3](#).

(l) Forms. [Section 1001.2\(h\)1](#)

220.3 CONSTRUCTION—

(a) General. Furnish indicated type of flowable backfill conforming to Table A. Do not allow the flowable backfill to contact aluminized materials or compounds.

Produce and transport according to [Section 704](#), excluding maximum temperature range of 32° C (90F), or by other approved methods from a facility accepted by the Department. The Contractor may adjust the mix in the field provided it achieves the criteria specified in Table A.

(b) Placement. Submit the sequence of operations at least 4 weeks before starting the work. If required, design the forms to sustain lateral fluid pressure equal to total weight of unhardened flowable backfill with a minimum 1.3 factor of safety. Construct formwork according to [Section 1001.3\(a\)](#).

Do not place flowable backfill through flowing water. Remove and replace flowable backfill damaged by rain or flowing water. If excavation cannot be dewatered, place flowable backfill by a tremie procedure approved by the Representative.

Break up lumps by remixing or other approved methods.

Ensure that base drain outlets do not intersect areas where placing flowable backfill. Furnish solid base drain outlet pipes in areas intersecting the flowable backfill.

Do not place flowable backfill at a material temperature below 10° C (50F) or if the temperature of either the air or the surface that the flowable backfill is placed on is 5° C (40F) or lower. Maintain the temperature of the in-place flowable backfill at no less than 10° C (50F) for a minimum of 24 hours or until the next lift is placed.

Do not place additional lifts until surface bleed water dissipates or the preceding lift hardens sufficiently to support foot traffic or both.

Protect finished surface from frost, erosion, and damage with suitable covers of soil, aggregate, concrete, pavement, or other material approved by the Representative.

If required, contain flowable backfill by constructing dikes from the mix. For the mix for dikes use less water to produce a 75 mm (3-inch) minimum slump, as directed by the Representative. Dikes will remain an integral part of completed flowable backfill. The Contractor may thicken the mix in other areas if allowed by the Representative.

1. Structure Backfill. When backfilling, place flowable backfill in lifts to prevent lateral pressures from exceeding resisting capacity of structure. Do not place lifts that exceed 1.2 m (4-foot), unless approved by the Representative. Protect structure foundation drains from intrusion and contamination of flowable backfill by using a separation membrane of Class 4, Type A geotextile. During placement of flowable backfill, protect existing structures, drainage facilities, utilities, etc., that are to remain within the fill area from movement or floating, damage, or misalignment. Repair or replace any damaged items, as directed by the Representative, at no additional cost to the Department. Provide preformed drain, no more than 50 mm (2 inches) thick, between the wall and the flowable fill and provide outlets at not more than 4.5 m (15 feet) through the wall, or as directed by the Representative.

2. Pipe Bedding and Backfill. Backfill the trench as shown on the Flowable Backfill Detail in the [Standard Drawings](#). Place adequate support to provide the minimum required bedding from trench bottom to bottom of pipe, and protect pipe from damage, movement, floating and improper alignment. Protect pipe from intrusion of flowable backfill. If shown, place Class 4, Type A geotextile membrane around pipe.

Prevent floating of pipe by placing flowable backfill in lifts or use sandbags or other weights to ballast pipe until lift is set. Place the backfill evenly on both sides of the trench to avoid overstressing the pipe. Monitor pipe alignment according to [Section 601.3\(c\)](#).

3. Utility Trench Backfill. Provide adequate tie-downs or weights, if required, for utility conduits to prevent floating. Protect utilities from damage and movement. Maintain proper alignment of conduits during placement of flowable backfill. Perform all utility work according to the permit requirements.

(c) Testing and Acceptance. [Section 704.1\(d\)1](#), [Section 704.1\(d\)2](#), [Section 704.1\(d\)4](#), and as follows:

Test flowable backfill slump, according to AASHTO T 119, and for yield, according to AASHTO T 121, C 136, as part of the QC Plan.

Test flowable backfill for proper flowability using the slump cone. Conduct slump tests as often as necessary (at least once daily or every 150 m³ (200 cubic yard)) to maintain the correct flowability at placement and if requested by the Representative. The Contractor may add water on-site to maintain flowability as needed. Test flowable backfill for yield at least once daily, or one test for every 150 m³ (200 cubic yard) of material. Record all test results and submit to the Representative.

Mold 76 mm x 152 mm (3-inch by 6-inch) or 152 mm x 305 mm (6-inch by 12-inch) cylinders according to [PTM No. 611](#), except specimens will remain in the mold until just before testing. Mold cylinders from the sample obtained for testing material flowability. Test for compressive strength according to [PTM No. 604](#), except use neoprene caps.

Ensure the Inspector witnesses compressive strength tests. Remove material that does not conform to Table A strength requirements. The Representative may allow the material to remain in place with liquidated damages assessed at \$32.70/m³ (\$25/cubic yard) per lot of deficient flowable fill.

(d) Opening to Traffic. For flowable backfill Type A, Type B, and Type C material, do not open to traffic until 1 hour after the surface bleed water has dissipated and as allowed by the Representative. Open flowable backfill Type D to traffic when directed by the Representative.

220.4 MEASUREMENT AND PAYMENT—

(a) Flowable Backfill. Cubic Meter (Cubic Yard). For the type indicated.

(b) Class 4 Geotextile, Type A. [Section 212.4\(d\)](#)

If using flowable backfill in place of a material incidental to another item of work, then the flowable backfill is also incidental.