

**ITEM 636 - FLOWABLE CONTROLLED DENSITY FILL (FCDF)**

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**636.01 Description.** This work shall consist of furnishing and placement of a flowable mixture of Portland cement, fly ash and/or sand for backfilling trenches under various combinations of pavement within public right-of-way or other locations as shown on the plans or as specified. Backfill shall not be used as structure backfill for aluminum and aluminum-coated pipe culverts.

**636.02 Materials.** Materials shall be:

1. Cement .....701.01 or 701.04
2. Fly Ash shall meet ASTM C-618, Class C or Class F except that requirements for moisture and pozzolanic activity are waived for Class F fly ash and Loss-On-Ignition (LOI) shall not exceed 12 percent for Class F fly ash. Fly ash shall come from a source approved by the Director.
3. Fine Aggregate shall be natural or synthetic sand manufactured from stone, gravel, or air-cooled slag. The gradation of the sand shall meet the requirements of Section 703.05, unless otherwise approved by the engineer. The sand shall be fine enough to stay in suspension in the mixture to the extent required for proper flow. The Engineer reserves the right to reject the sand if a flowable mixture cannot be produced.
4. Water used for mixture shall be free from oil, salts, acid, strong alkalis, vegetable matter, and other impurities that would have an adverse effect on the quality of the backfill material.
5. Polyethylene encasement ..... ASTM-674-84

**636.03 Compatibility with Ductile Iron Pipe.** To assure compatibility with ductile iron pipe a Polyethylene encasement shall be required conforming to ASTM A-674-84 and AWWA C-105.

**636.04 Mix Proportioning.** The initial trial mixture shall consist of the following quantities of materials per cubic yard:

	<b>Type I</b>	<b>Type II</b>	<b>Type III</b>	<b>Type IV</b>
Cement	50 lb. (23 kg)	100 lb. (45 kg)	-0- lb. (0 kg)	-0- lb. (0 kg)
Fly Ash, Class F	250 lb. (113 kg)	**.	-0- lb. (0 kg)	1500 lb. (680 kg)
Fly Ash, Class C	-0- lb. (0 kg)	-0- lb. (0 kg)	400 lb. (181 kg)	500 lb. (227 kg)
Sand (SSD)*	2910 lb. (1320 kg)	2850 lb. (1293 kg)	2900 lb. (1315 kg)	-0- lb. (0 kg)
Water (Maximum)	500 lb. (227 kg)	500 lb. (227 kg)	425 lb. (193 kg)	850 lb. (385 kg)

\* Saturated-surface-dry

\*\* Entrained air is substituted for fly ash in this mix

\*\*\* Fine aggregate may be natural or manufactured granular material of stone, gravel, or air cooled blast furnace slag with a gradation that allows 85 to 100 percent to pass the 3/8 inch (9.5 mm) sieve, and 100 percent retained on the No. 200 (75 µm) sieve.

These quantities of materials are expected to yield approximately 1 cubic yard of mixture of a flowable consistency. The proportioning of materials shall be the responsibility of the Contractor. Adjustments of the proportions shall be based on maintaining the total absolute volume and proportioning shall insure that unconfined compressive strength at 90 days does not exceed 150 PSI (10.8 TSF) (1034.5 kPa). The minimum unconfined compressive strength shall not be less than 50 PSI (3.6 TSF) (344.8 kPa). The Contractor shall be required to provide test data from a laboratory inspected by the Cement & Concrete Reference Laboratory (CCRL) and approved by the City that shows the proposed proportioning will meet strength limitations.

**636.05 Mix Adjustment.** To expedite consolidation of Type I or Type II mixtures as defined in Section 636.04, it will be necessary for bleed water to appear on the surface immediately after the mixture is struck off. A delay in bleeding indicates there are too many fines in the mixture, so the fly ash quantity shall be reduced in increments of 50 lb. (23 kg) until mixture is bleeding freely. Approximately 60 lb. (27.2 kg) of sand shall be added to replace each 50 lb. (23 kg) increment of fly ash to maintain the original yield.

To produce a flowable mixture it may be necessary to make one or more cubic yard trial batches at different water contents. Mixture is too dry when cracks develop in the mixture as it flows into place.

**636.06 Flow Test.** A test for the flow consists of filling a 3 inch (76 mm) diameter by 6 inch (152 mm) high open-ended cylinder, on a smooth level surface, to the top with flowable mixture. If necessary strike off the top of the cylinder so the mixture is level. Pull the cylinder straight up, within 5 seconds, and measure the approximate spread of mixture. The diameter of the material spread shall be at least 8 inches (203 mm).

**636.07 Pumping.** The mix proportioning of Types I and II are not designed to be pumpable. If the Contractor elects to pump the flowable mixture, a new mix, specifically designed for pumping must be submitted for approval.

**636.08 FCDF Fast Setting, Type III and IV.** The initial mixture shall be as specified in Section 636.04.

FCDF Fast setting mixture shall be used as directed by the Engineer for backfilling trenches under pavement within public right-of-way when it is deemed that the pavement must be quickly reopened to traffic so as to minimize inconvenience to vehicular traffic or as shown in the plans. Use of FCDF Fast Setting mixture is intended to allow for placement of an asphalt concrete pavement within 4 hours of mixture placement.

FCDF Fast Setting mixture shall meet the following performance criteria:

1. Unconfined compressive strength as provided for in 636.04.
2. Four hour field penetrometer tests shall have an average resistance strength of 400 PSI (2759 kPa) for each trench; up to 4 penetrometer tests may be required per trench. If trench length exceeds 500 lineal feet (152.4 m), additional tests may be required as set forth herein at the rate of 4 per 500 feet (152.4 m) of trench or part thereof. In the absence of a penetrometer test, the FCDF material may be subjected to a load when a rod (reinforcing bar) approximately 1/2 inch (12.7 mm) or larger in diameter will not penetrate the in-place mix.

**636.09 Mixing Equipment.** Sufficient mixing capacity and delivery equipment shall be provided to permit the FCDF mixture to be placed without interruption as much as practical. FCDF mixtures may be placed in intermittent horizontal lifts without having to provide for uninterrupted mixture placement as approved or directed by the Engineer.

Delivery equipment shall be as follows:

Type I and Type II FCDF mixtures shall be delivered and placed from ready mixed concrete trucks or volumetric mobile concrete mixers. These mixtures may be pumped if modified in accordance with Section 636.07.

Type III FCDF mixtures may be delivered and placed from ready mixed concrete trucks or, volumetric mobile concrete mixers.

Type IV FCDF Fast Setting mixture shall be delivered and placed from volumetric mobile concrete mixers. Volumetric mixers shall be calibrated so as to combine mix materials in accordance with the proportions of 636.04 and sufficiently mix mixture to obtain a uniform mixture meeting the requirements of this specification.

**636.10 Placing Mixture.** FCDF mixture shall be discharged from mixing and delivery equipment by any reasonable means into the space to be filled. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer. Placing of any material over low strength mortar backfill may commence, as specified herein, as soon as the surface water is gone, or as directed by the Engineer.

**636.11 Limitations of Operations.**

1. Mixture shall not be placed on frozen ground.
2. Mixture shall be protected from freezing.
3. Each filling stage shall be as continuous as is practicable.
4. Temperature affects the cure time of FCDF. As temperatures near freezing or below additional time will be needed for the proper curing of the material prior to any paving type of operations.
5. The final mix shall have the required strength, fill the voids of the intended usage and setup within 12 hours (4 hours for Type IV).

**636.12 Approval of Alternate Materials.** Manufacturers or suppliers of materials other than those approved by the Director and as indicated by these specifications may request to be added as an approved equal through the Director. Each request shall be in writing and submitted to the Director for review and approval, in accordance with the current policy and procedure concerning such matters. If approved the material will be added to a list which will be kept on file in the office of the City testing facility located at the Construction Inspection Division.

**636.13 Method of Measurement.** Flowable Controlled Density Fill mixture will be measured by the cubic yard (cubic meter). Quantities will be determined by calculations from dimensions shown on the plans, contract, field measurements, or as ordered by the Engineer. Should disputes arise in yield values the number of cubic yards (cubic meters) of FCDF will be measured by conversion of the total batch(s) weight(s).

A conversion factor of 3, 650 lb. per cubic yard (2190 kg/m<sup>3</sup>) will be used for Types I and II. A conversion factor of 2850 lb. per cubic yard (1710 kg/m<sup>3</sup>) will be used for Types III and IV.

**636.14 Basis of Payment.** For the volume of mixture furnished and placed, the Contractor will be paid at the contract unit price per cubic yard (cubic meter). This payment shall be full compensation for placing the low strength mixture and for furnishing all materials, equipment and incidentals necessary to complete this item, unless included under other items on the plans. Payment will be made under:

<b>Item</b>	<b>Unit</b>	<b>Description</b>
636	Cubic Yard (Cubic Meter)	Flowable Controlled Density Fill, Type I, Type II, or Type III
636	Cubic Yard (Cubic Meter)	Flowable Controlled Density Fill, Fast Setting, Type III and Type IV