## Section 2506. Flowable Mortar

### 2506.01 DESCRIPTION.

Place a flowable mortar fill material. Uses include, but are not limited to, placement under existing bridges, around or within box culverts or culvert pipes, in open trenches, or at other locations as shown in the contract documents.

### 2506.02 MATERIALS.

Meet the requirements for the respective items in Division 41 with the following exceptions:

**A. Cement.**
Meet the requirements of Section 4101.

**B. Fly Ash.**
Meet the requirements of Section 4108. Use fly ash from a source approved by the Engineer.

**C. Fine Aggregate.**

**1.** Use natural sand consisting of mineral aggregate particles or foundry sand from the castings of ferrous material. Use the gradation shown in Table 2506.02-1:

**Table 2506.02-1: Fine Aggregate Gradation**

| Sieve Size | Percent Passing |
|---|---|
| 3/4 inch (9.5 mm) | 100 |
| No. 200 (75 µm) | 0-10 |

**2.** It is intended that the sand be a fine sand that will stay in suspension in the mortar to the extent required for proper flow. For the Contractor's information, uniformly graded sand in the gradation range shown in Table 2506.02-2 has generally shown good flow characteristics when using the normal amount of fly ash (300 pounds per cubic yard (180 $kg/m^3$)). Concrete sand normally does not produce the desired flowability.

**Table 2506.02-2: Informational Gradation Limits**

| Sieve Size | Percent Passing |
|---|---|
| 3/8 inch (9.5 mm) | 100 |
| No. 8 (2.36 mm) | 80-100 |
| No. 16 (1.18 mm) | 60-100 |
| No. 30 (600 µm) | 45-80 |
| No. 50 (300 µm) | 12-40 |
| No. 100 (150 µm) | 1.5-25 |
| No. 200 (75 µm) | 0-5 |

**3.** Fine aggregate meeting the above informational gradation limits may be used in the basic proportions shown in Article 2506.02, E, without initial mix design, provided the flowable mortar is used in noncritical fluidity locations described in Article 2506.02, F. The Engineer reserves the

right to reject the intended sand if a flowable mortar cannot be produced using the specified proportions.

**4.** The Contractor is not responsible for certified aggregate testing. The Engineer will provide appropriate inspection (normally, source approval) followed by visual inspection. If foundry sand is used, ensure it meets the requirements of IAC 567 Section 108. Ensure suppliers of foundry sand submit a processing plan to the District Materials Engineer for review and approval.

**D. Admixtures.**

Air entraining and water reducing admixtures may be added to increase the fluidity of flowable mortar.

**E. Mix Design.**

**1.** Use the basic proportioning for flowable mortar shown in Table 2506.02-1:

**Table 2506.02-1: Quantities of Dry Materials Per Cubic Yard (Cubic Meter)**

| | |
|---|---|
| Cement | 100 pounds (60 kg) |
| Fly Ash | 300 pounds (180 kg) |
| Fine Aggregate | 2600 pounds (1545 kg) |

**2.** Submit samples of fine aggregate, cement, and fly ash intended for use to the Engineer. Submit the samples before the work begins for mix proportions to produce the required efflux time.

**3.** The Engineer will determine the mix design. The cement content is not to exceed 100 pounds per cubic yard (60 kg/$m^3$). The total amount of cementitious material is not to exceed 500 pounds per cubic yard (295 kg/$m^3$).

**4.** These quantities of dry materials, with approximately 70 gallons (345 L) of water (mixes utilizing foundry sand may require more water), will yield approximately 1 cubic yard (1 $m^3$) of flowable mortar of the proper consistency. The quantity of water used for the trial mix or at the project may require adjustment to achieve proper solids suspension and optimum flowability.

**5.** For information, volume loss during the cure period resulting from surface evaporation, moisture migration away from the flowable mortar unit, and hydration have been observed to be less than 4% of the original volume determined in the fluid condition. In mixes utilizing foundry sand, additional fly ash may be required and the limit of total cementitious material will not apply.

**F. Fluidity.**

**1.** Measure the fluidity of the flowable mortar using the method described by Materials I.M. 375. Prior to filling the flow cone with flowable mortar, pass the mixture through a 1/4 inch (6.3 mm) screen.

**2.** In locations where fluidity is critical, such as inside existing culverts and between the beams under existing bridges, use an efflux time of 10 seconds to 16 seconds. The Engineer will measure prior to placement and at least once every 4 working hours until work is complete.

**3.** In locations where fluidity is not critical, such as for placement below the beams under existing bridges or for use as backfill material in open trenches, use an efflux time of 10 seconds to 26 seconds. The Engineer will visually monitor.

**G. Granular Backfill Material.**
For granular backfill material used under flowable mortar, meet the requirements of Section 4133.

## 2506.03 CONSTRUCTION.

**A. Proportioning and Mixing Equipment.**
Use equipment meeting the requirements of Articles 2001.20 and 2001.21. Provide mixers with sufficient mixing capacity to permit the intended placement without interruption.

**B. Flange Filler Material.**
When the flowable mortar is to be placed under a bridge, cover the bridge beams with a filler material, as shown in the contract documents, to fill the flange areas in a manner that will minimize intrusion of the mortar into the flange area of the beams. Construction insulation board or any other suitable material may be used.

**C. Placement of Mortar under Existing Bridges.**

**1.** First construct the shoulder area as shown in the contract documents, with the drainage system shown. Complete this work in conjunction with pipe placement, if a pipe culvert is required.

**2.** If a culvert is required, place engineering fabric meeting requirements of Article 4196.01, B, 2 over all joints in the culvert, within the area where flowable mortar is to be placed as backfill material. Place the fabric from the underlying ground line around the culvert, 1 foot (0.3 m) on each side of the joint.

**3.** Discharge flowable mortar from the mixer by any reasonable means into the area to be filled.

**4.** Bring the mortar fill up uniformly to the elevation of the first stage fill line, if specified. Cease mortar placement for a period of 72 hours.

5. If there is only one stage of flowable mortar, place granular backfill material in the lower part of the fill and around the pipe as specified. Compact the granular backfill material according to Article 2402.03, H, or thoroughly and uniformly wet with water in a quantity of approximately 10% of the granular backfill material. Complete flooding may be required. Regardless of the method of consolidation, wait 72 hours to commence flowable mortar placement.

6. Place the flowable mortar in a sequential operation from side to side and longitudinally. Begin with fill in one shoulder area, then proceed through each hole in the deck adjacent to the shoulder until mortar is expelled from the adjacent longitudinal hole. Place the last fill on the opposite shoulder. Place mortar through holes in the deck using a suitable funnel which can create a 3 foot (1 m) head during filling.

7. The locations for holes in the deck will normally be shown in the contract documents. When not shown, drill a hole approximately 5 feet (1.5 m) from each end of the bridge in each area between bridge beams. Drill additional holes as necessary so the longitudinal spacing does not exceed 20 feet (6 m). Limit the size of the holes to that necessary to accommodate filling equipment.

8. When placement of flowable mortar is completed and set, remove the mortar in the holes in the deck and replace with a suitable PCC mixture.

**D. Placement of Mortar as Culvert Backfill Material.**

1. First construct the shoulder area with suitable soil as shown in the contract documents, with the drainage system shown. Complete this work in conjunction with the pipe placement, if the culvert is a pipe.

2. Place engineering fabric meeting requirements of Article 4196.01, B, 2 over all joints in the culvert, within the area where flowable mortar is to be placed as backfill material. Place the fabric from the underlying ground line around the culvert, 1 foot (0.3 m) on each side of the joint.

3. Place granular backfill material meeting requirements of Section 4133 to approximately mid-height of the culvert. Place the backfill simultaneously on both sides of the culvert so that the two fills are kept at approximately the same elevation at all times. Granular backfill material compaction is not necessary.

4. Discharge flowable mortar from the mixer into the remaining area to be filled. Fill simultaneously on both sides of the structure so that the two fills are kept at approximately the same elevation at all times.

5. If the culvert starts to float, cease the filling operation. Apply an external load to the culvert, sufficient to hold it in place, before the filling is continued. As an alternate, the filling may be suspended until the buoyancy effect of the mortar has ceased.

6. Place the flowable mortar to the elevation shown in the contract documents. When not shown, place the mortar as follows:
    a. If the subgrade elevation is not more than 5 feet (1.5 m) over the top of the culvert, place mortar to 1 foot (0.3 m) below subgrade elevation.
    b. If the subgrade is more than 5 feet (1.5 m) over the top of the culvert, place the mortar to an elevation 2 feet (0.6 m) over the top of the culvert. Complete the remainder of the backfill operation using soil designated by the Engineer.

**E. Limitation of Operations.**

1. Do not place flowable mortar on frozen ground.

2. Flowable mortar batching, mixing, and placing may be started when the temperature is at least 34°F (1°C) and rising, if weather conditions are favorable. At time of placement, mortar shall have a temperature of at least 40°F (4°C). Cease mixing and placing when the temperature is 38°F (3°C) or less and falling.

3. Complete each filling stage in as continuous an operation as practical.

4. Do not allow flowable mortar into streams and waterways.

## 2506.04 METHOD OF MEASUREMENT.

**A.** The Engineer will compute the volume of Flowable Mortar furnished and placed, from the nominal volume of each batch and a count of batches. The Engineer will estimate and deduct unused mortar; however, deduction will not be made for a partial batch remaining at the completion of the operation.

**B.** Granular backfill material used in the lower part of the fill area will be based on the contract document quantity.

**C.** When the flowable mortar elevation for placing backfill around culverts is shown in the contract documents, payment for Flowable Mortar will be based on the quantity shown in the contract documents.

## 2506.05 BASIS OF PAYMENT.

**A.** Payment for Flowable Mortar will be the contract unit price per cubic yard (cubic meter).

**B.** Payment is full compensation for:
- Placing the flowable mortar,
- Flange filler material,
- Engineering fabric as required,
- Drilling and filling the bridge deck holes, and
- Furnishing all materials, equipment, and labor necessary to complete the work.

**C.** Payment for granular backfill material used in the lower part of the fill area will be based on the quantity shown in the contract documents, and this will normally be included in the quantity of other granular backfill material on the project.

**D.** Excavation, placing backfill material for construction of the shoulder area, and moisture control if designated necessary for this work, will be paid for separately. These items will be included in the quantities of other similar work on the project. Furnishing and placing the drainage system in the shoulder area will be considered incidental to the payment for Flowable Mortar.