
13 Pipe and Structure Backfill

Backfill Limits

Basis of Use

Backfill Methods

Trench Details

Rock

Bedding Details

Backfill Placement

Method 1 Backfill

Method 2 Backfill

Other Backfill

Backfilling Outside Specified Limits

Cover Limits

Ramps over Structure for Protection

Limitations

Payment for Backfill

Structure Backfill

Flowable Backfill

Example Problem

CHAPTER THIRTEEN:

PIPE AND STRUCTURE BACKFILL

BACKFILL LIMITS

The trench for the pipe is required to be backfilled as indicated on the plans or Standard Sheets with structural backfill or coarse aggregate (Section **211.02**) or flowable backfill (Section **213.02**). When flowable backfill is used, the Contractor is required to submit a mix design and arrange for a trial batch demonstration.

BASIS OF USE

The basis of use for structure backfill or coarse aggregate is a Certified Aggregate Producer Program (CAPP) D Number. The Contractor has the option of using a local site and having a CAPP Certified Aggregate Technician or a consultant on the Department's list of approved Geotechnical Consultants for gradation control. The Frequency Manual is reviewed to verify the testing requirements. The basis of use for flowable mortar is the flow test in accordance with **ASTM D 6103**, the lightweight dynamic cone penetrometer test in accordance with **ITM 216**, and the dry unit weight test in accordance with **ITM 218**.

To conduct the flow test, a 3 in. diameter by a 6 in. cylinder is placed on a smooth level surface and filled to the top with the flowable mortar. The cylinder is quickly pulled straight up and the mortar spread measured. The diameter of the mortar spread is required to be at least 8 in. The lightweight dynamic cone penetrometer (DCP) test requires determination of the blow count penetration resistance of flowable backfill to assess the strength of the material. The dry unit weight test is used to calculate the removability modulus (RM) of the flowable backfill. This value is required to determine if the flowable backfill is classified as removable or non removable.

BACKFILL METHODS

There are different methods of backfill required, depending on where the pipe structure is located and what the purpose of the structure is. These are indicated on Standard Drawings **E 715-BKFL -01** through **E 715-BKFL - 08**.

TRENCH DETAILS

The basic trench details are indicated on Standard Drawings **E 715-BKFL-01** through **E 715-BKFL-08**.

ROCK

If rock is encountered during excavation for the pipe, the rock is required to be removed 8 in. below the bottom of the pipe. B borrow is used as backfill to bring the pipe to the proper flowline.

BEDDING DETAILS

All of the details use structure backfill or flowable mortar bedding for pipe (where pipe is bedded in a soil cradle cut). On Standard Drawings **E 715-BKFL-01**, **-03**, **-05**, and **-07** the proper limits and dimensions for backfilling with structure backfill are indicated. On Standard Drawings **E 715-BKFL-02**, **-04**, **-06** and **-08** the proper limits and dimensions for backfilling with flowable mortar are indicated.

BACKFILL PLACEMENT

All plastic pipes that are not fabricated with hydrostatic design basis resins, except underdrains, are to be backfilled with flowable mortar when the pipes are within 5 ft of the mainline or public road approaches.

Placement of structure backfill material is required to be in 6 in. loose lifts and compacted with mechanical compactors to the required density. When compacting structure backfill, the material is required to be at optimum moisture content to obtain the required density.

Flowable mortar is required to be uniformly placed up to the fill line as indicated on the plans or Standards. Before flowable mortar is placed in a trench, all standing water is required to be removed. If removal of water is not possible, structure backfill is used up to an elevation of 2 ft above the ground water.

METHOD 1 BACKFILL

When a pipe is placed under the mainline pavement or is within 5 ft or less of the pavement, sidewalk, curbs or gutters, Method 1 Backfill is used. Pipes placed under public road approaches also use Method 1 Backfill. Method 1 requires that flowable mortar or structure backfill be used as backfill for the width of the pavement plus 5 ft on each side of the pavement. Method 1 is also used for a distance required to maintain a 2:1 slope from the above width down to the bottom of the pipe structure. Method 1 Backfill for a fill section is indicated on Standard Drawings **E**

715-BKFL-01 and **715-BKFL-02** and for a cut section is indicated in Standard Drawings **E 715-BKFL-03** and **E 715-BKFL-04**. The proper elevation of backfill material is always maintained as indicated in the these Standards. The remaining area may be backfilled with suitable materials in layers of not more than 6 in. when inside the slope stake area.

METHOD 2 BACKFILL

When a pipe is placed under commercial or private drive approaches, Method 2 Backfill is used. Method 2 requires that B borrow or flowable mortar be placed at a height of over one-half the outside diameter of the pipe structure. The length of the backfill material is the same as Method 1 Backfill. Method 2 Backfill for a cut and a fill section is indicated on Standard Sheets **715-BKFL-07** and **715-BKFL-08**. The remaining area may be backfilled with suitable materials in layers of not more than 6 in. when inside the slope stake area.

OTHER BACKFILL

Where other than special backfill material is required, the material is required to be easily compacted and free of large stones for the portions around and 6 in. above the pipe.

BACKFILLING OUTSIDE SPECIFIED LIMITS

If the structure is outside the aforementioned areas, the pipe may be backfilled with suitable material.

COVER LIMITS

The proper cover is required to always be maintained for heavy equipment to cross pipe structures during construction. The cover requirements are:

- 1) Up to and including 18 in. diameter or equal - 1 ft 6 in. cover
- 2) 21 in. up to and including 54 in. diameter or equal - 3 ft 0 in. cover
- 3) Over 54 in. diameter or equal - 4 ft 0 in. cover

RAMPS OVER STRUCTURE FOR PROTECTION

If the minimum amount of cover is not available, the Contractor is required to ramp over with soil to provide the cover needed to prevent structure damage.

LIMITATIONS

Flowable mortar is not to be placed on frozen ground and is required to be protected from freezing until set. Flowable mortar may not be loaded or disturbed by construction until an average penetration resistance of 70 psi under a PCCP pavement or 1200 psi under a HMA pavement is obtained.

PAYMENT FOR BACKFILL

STRUCTURE BACKFILL

When the proposal contains an item for structure backfill, the material is paid for by the cubic yard based on a theoretical measurement. The Construction Record Guide has charts indicating different cover heights and the amount of structure backfill per linear foot required for different pipe diameters and material types. This guide is for pipe backfill limits only. The cost of backfilling manholes, inlets and catch basins is included in the item cost.

FLOWABLE BACKFILL

When the contract contains an item for flowable backfill, this material is paid for by the cubic yard based on a neat line theoretical measurement. If flowable backfill is used as a substitute for structure backfill or if used to backfill plastic pipe fabricated with nonhydrostatic design basis resins, flowable backfill is paid for as structure backfill.

EXAMPLE PROBLEM

A Contractor placed a 30 in. diameter corrugated metal pipe which measured 152 Lft. outside to outside of the inlets. The Technician measured the cover in several locations and found the coverage to be an average of 5.8 ft. The theoretical pay quantity for structural backfill would be:

Using the table for backfill, factor = 1.2203 yd³/Lft.

$$152 \text{ Lft.} \times 1.2203 \text{ yd}^3/\text{Lft.} = 185.5 \text{ yd}^3$$