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# 9 Special Fill and Backfill

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# CHAPTER NINE:

## *SPECIAL FILL AND BACKFILL*

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Special backfills play an important role in highway construction. Many times weak subgrades require special backfill to correct problems. Special backfill may also be necessary to facilitate good compaction around structures, such as catch basins, manholes, pipes, or bridge end bents.

The Technician is required to have a good knowledge of how special backfill is used for best highway performance. This chapter discusses materials, compaction, placement, and measurement of special fill and backfill.

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### **B BORROW AND STRUCTURE BACKFILL**

Placing B Borrow and structure backfill consists of backfilling excavated or displaced peat deposits; filling up to designated elevations of spaces excavated for structures and not occupied by permanent work; constructing bridge approach embankment; and filling over structures and over arches between spandrel walls, all with special materials.

#### *MATERIALS*

B Borrow used for special filling is required to be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter. Sand, gravel, crushed stone, air cooled blast furnace slag, granulated blast furnace slag, or other approved materials are used for B Borrow. The material is required to contain no more than 10 % passing the No. 200 sieve and be otherwise suitably graded. The use of an essentially one-size material is not allowed, unless approved.

The Contractor has the option of either providing B borrow or structure backfill from a CAPP source or supplying the material from another source. The Contractor has the following options for supplying B borrow or structure backfill from a local site:

- 1) The establishment of a CAPP Producer Yard at the local site in accordance with 917; or
- 2) Use a CAPP Certified Aggregate Technician or a Consultant on the Department's list of approved Geotechnical Consultants for gradation control testing.

The frequency of gradation control testing is required to be one test per 2000 t based on production samples into a stockpile or by over the scales measurement, with a minimum of two tests per contract (one in the beginning and one near the mid-point). The sampling and testing of these materials is required to be in accordance with the applicable requirements of Section **904** for fine and coarse aggregates. The Contractor is required to indicate in writing the plan to measure the material to the PE/PS and the District Testing Engineer.

#### ***FLOWABLE BACKFILL SUBSTITUTION***

When B borrow for structure backfill is specified, the Contractor may substitute flowable backfill in accordance with Section **213**. However, flowable backfill is not allowed to be placed into or through standing water, unless approved in writing.

#### ***CONSTRUCTION REQUIREMENTS***

If B borrow or structure backfill is obtained from borrow pits, the locations, depths, drainage, and final finish of the pits are required to comply with the provisions for these items in accordance with Section **203**.

If B Borrow or structure backfill is within embankment limits and if the entire fill or backfill is not required to be of B borrow and placed as such, then that portion above free-water level is required to be placed in accordance with applicable provisions of Section **203** and compacted to the required density.

If borrow is required outside the specified limits of B borrow, material in accordance with the Specifications for B borrow may be furnished at the contract unit price for borrow; however, the quantity of borrow measured for payment outside the limits of structure backfill may not exceed the theoretical quantity of B borrow furnished.

Unless otherwise specified, all spaces excavated for and not occupied by bridge abutments and piers, if within embankment limits, are required to be backfilled to the original ground line with B borrow and placed in accordance with Section **211.04**.

Where B borrow or structure backfill is required as backfill at culverts, retaining walls, sewers, manholes, catch basins, and other miscellaneous structures, the material is required to be compacted in accordance with Section **211.04**.

### ***MECHANICAL COMPACTION***

Where B borrow or structure backfill is placed by mechanical compaction, the material, unless otherwise specified, is required to be placed in accordance with the applicable provisions of Section **203.23**. If mechanical tamps or vibrators are used, the material is required to be deposited in approximately 6 in. horizontal layers, loose measurement, and each layer compacted to density requirements.

### ***EMBANKMENT FOR BRIDGES***

When special filling is required, the embankment for bridges are constructed using B borrow within the specified limits shown on the plans. All embankment construction details specifically set out in this Specification for embankment for bridges are required to be in accordance with the applicable requirements of Section **203**.

At the time B borrow is being placed for approach embankment, an earth, watertight, well-compacted dam is required to be constructed in level lifts, the details of which are shown on the plans. Except as hereinafter specified for material to be used in constructing the enclosing dam, and for growing vegetation, and unless otherwise provided, the material for constructing bridge approach embankment is required to be B borrow compacted by mechanical methods. If approach embankment or shoulders are constructed of material not suitable for growing seed or sod, then such areas are required, unless otherwise specified, to be covered with a layer of clay, loam, or other approved material which is suitable. This layer is required to be approximately 1 ft thick after being compacted into place.

### ***B BORROW AROUND BENTS***

When specified, B borrow is required to be placed around all bents falling within the limits of the approach grade as shown on the plans. Before placing, the surface of the ground on which the material is placed is scarified or plowed. The embankment slope is required to be 2:1 on the sides and beneath the structure and 6: 1 from the end of the bridge down to the average ground line, or may be required to complete the approaches back to the existing grade. The enclosing dam and provisions for growing vegetation are required to be in accordance with Section **211.05**.

### ***AGGREGATE FOR END BENT BACKFILL***

When specified, coarse aggregate in accordance with Section **211.07** is placed behind the end bents as indicated on the plans. The material is required to be deposited in lifts not to exceed 12 in. loose measurement. Each layer is mechanically compacted with two passes using a hand held vibratory plate compactor having a plate width of 17 in. or larger that delivers 3000 to 9000 lb per blow.

Prior to placing the aggregate, a geotextile in accordance with Section **918.03** is required to be installed in accordance with Section **616.11**.

### ***UNBALANCED BACKFILL***

Unbalanced backfill is not allowed until the concrete required to resist the backfill is at least 10 days old or a flexural strength of 440 lb/in<sup>2</sup> for third point loading has been attained. The unbalanced height may not exceed 10 ft until the concrete is at least 15 days old or a flexural strength of 480 lb/in<sup>2</sup> for third point loading has been attained.

### ***SPANDRELL FILLING***

Unless otherwise specified, spandrel fills for arch structures are required to be composed of B borrow. The fill is carried up symmetrically in horizontal layers from haunch to crown and simultaneously over all piers, abutments, and arch rings. Compaction is required to be in accordance with Section **211.04**.

### ***METHOD OF MEASUREMENT***

B borrow, structure backfill, and aggregate for end bent backfill is measured by the cubic yard as computed from the neat line limits indicated on the plans, or as adjusted. If cubic yards are set out as the pay unit for B borrow or structure backfill in the Schedule of Pay Items and if neat line limits are not specified for measurement of volume for the material, measurement is made by the cubic yard at the loading point in truck beds which have been measured, stenciled, and approved. The B borrow may be weighed and converted to cubic yards by assuming the weight per cubic foot to be 90 % of the standard maximum wet density determined in accordance with **AASHTO T 99**. The material may be cross-sectioned in the original position and again after excavation is complete, and the volume computed by the average end area method. If B borrow is used for backfill in areas where unsuitable material is present or peat excavation has been conducted, the B borrow is cross-sectioned and the volume is computed by the average end area method.

If the material is to be paid for by the ton, the material is weighed in accordance with Section **109.01 (b)**.

If the material is obtained from a wet source such as below water or a washing plant and weighing is the method of measurement, there is required to be a 12 h drainage period prior to the weighing.

Geotextiles are required to be measured in accordance with Section **616.12**.

### ***BASIS OF PAYMENT***

The accepted quantities of B borrow are paid for at the contract unit price per cubic yard or per ton as specified, complete in place.

Structure backfill is paid for at the contract unit price per cubic yard, based on the neat line limits indicated on the plans or as adjusted for authorized changes, provided the material is obtained from outside the permanent right-of-way. If the schedule of pay items does not contain a pay item for structure backfill and this material is required to backfill pipes or culverts within the contract limits, a change order is generated to establish a unit price.

B borrow material placed outside the neat lines is paid for as borrow when such B borrow eliminates required borrow material. Otherwise, no payment is made for backfill material placed outside the neat lines.

If material which is in accordance with the requirements for B borrow is obtained within the excavation limits of the contract and is used as such, this material is paid for at \$5.00/yd<sup>3</sup> for B borrow/structural backfill handling. No further payment is made.

Aggregate for end bent backfill is paid for at the contract unit price per cubic yard, based on the neat line limits indicated on the plans or as adjusted by authorized changes.

Geotextiles are paid for in accordance with Section **616.13**.

Flowable mortar, which is substituted for B borrow or structure backfill, is paid for as B borrow or structure backfill, respectively.

If topsoil, loam, or other suitable material in accordance with Section **211.05** is used for expediting the growth of seed or sod, this material is paid for at the contract unit price per cubic yard for borrow, or for salvaged stockpiled selected materials as shown on the Schedule of Pay Items, unless otherwise provided.

## **FLOWABLE BACKFILL**

Flowable backfill is used to fill trenches for pipe structures, culverts, utility cuts and other work extending under pavement locations, to fill cavities beneath slopewalls and other locations in accordance with Section **105.03**.

If fly ash is used as a filler and not as a pozzolanic material, this material is required to be in accordance with the applicable requirements of Section **904**.

### ***PROPORTIONING***

The Contractor is required to submit a mix design and arrange for a trial batch demonstration to ensure compliance in accordance with the requirements listed herein. The mix design includes a list of all ingredients, the source of all materials, the gradation of all aggregates, the names of all admixtures and dosage rates, and the batch weights. Except

for adjustments to compensate for routine moisture fluctuations, mix design changes after the trial batch verification are required to be documented and justified prior to implementation by the Contractor. A change in the source of materials or addition or deletion of admixtures or cementitious materials requires a new mix design.

Only the materials listed in Section **213.02** may be used in the flowable backfill mix designs. The proposed mix design materials and proportions are submitted to the District Testing Engineer. Final proportioning is determined based on the approved mix design.

#### ***FLOW***

The test (**ASTM D 6103**) for flow consists of filling a 3 in. diameter by 6 in. high open-ended cylinder placed on a smooth level surface to the top with the flowable backfill. If necessary, the cylinder is struck off so that the mixture is level. The cylinder is pulled straight up within 5s. The spread of the material is then measured. The diameter of the spread is required to be at least 8 in. Flow adjustments may be made by making minor adjustments in the water or fly ash filler content in the mixture.

#### ***DYNAMIC CONE PENETROMETER***

The lightweight dynamic cone penetrometer (DCP) test is required to determine the strength of flowable backfill through a measured resistance to penetration by a sharp pointed cone. The test procedure (**ITM 216**) requires that a 5 lbm steel hammer be dropped until a cone has penetrated the flowable backfill to a reference point on the DCP rod. The number of blows to reach this designated point is determined.

#### ***UNIT WEIGHT***

The dry unit weight test (**ITM 218**) requires that the flowable backfill be placed into a 6 in. by 12 in. mold, cured, and the cylinder weighed and measured. From the weight and dimensions of the cylinder, the dry unit weight is determined. The dry unit weight is used to calculate the removability modulus (RM) of flowable backfill. Flowable backfill is classified as either removable or non removable for different applications of the material. If the removability modulus is 1.0 or less, the flowable backfill is classified as removable.

#### ***MIXING EQUIPMENT***

The mixing equipment is required to be in accordance with the applicable requirements of Section **702** or Section **722**, except that instead of the calibration requirements of Section **722.11**, the mixer operator is required to make delivery in a properly calibrated continuous mixer.

### ***PLACEMENT***

The mixture is discharged from the mixing equipment by a reasonable means into the spaces to be filled. The flowable backfill is brought up uniformly to the fill line as indicated on the plans or as directed. Placing of material over the flowable backfill may commence as specified herein or as directed.

Voids beneath a reinforced concrete bridge approach pavement are filled as directed. Holes are drilled at locations as directed and in accordance with Section **612.04**. The flowable backfill is placed until the bridge approach pavement has uniform support by means of completely filling all voids. During the filling operation, plugs may be required. Plugs are installed to confine the backfill as directed. The bridge approach pavement is required to not lift off the bridge seat.

### ***LIMITATION OF OPERATIONS***

Flowable backfill may not be placed on frozen ground and is required to be protected from freezing until the material has set.

The flowable backfill is not subject to any load nor disturbed by construction activities until the penetration resistance testing has been completed. Penetration resistance is determined in accordance with **ITM 213**.

### ***METHOD OF MEASUREMENT***

Flowable backfill is measured by the cubic yard as computed from the neat line limits shown on the plans, or as adjusted. If neat line limits are not shown on the plans, the volume in cubic yards of flowable backfill furnished and placed is computed from the nominal volume of each batch and a count of the batches. Unused and wasted flowable backfill is estimated and deducted. Drilled holes are measured by the number of holes drilled.

### ***BASIS OF PAYMENT***

The accepted quantities of flowable backfill are paid for at the contract unit price per cubic yard furnished and placed.

Filling voids beneath a concrete bridge approach pavement is paid for at the contract unit price per cubic yard for flowable backfill. Holes drilled in the pavement are paid for at the contract unit price per each