MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**GROUT BACKFILL**

BRG:MGB 1 of 3 APPR:DMG:TEB:05-21-21

**a. Description.** The work consists of performing all operations necessary for the consolidation of soil and filling voids underlying structures by injection of grout backfill at locations shown on the plans and described herein. Perform all work in accordance with the standard specifications, as directed by the Engineer and this special provision.

**b. Contractor.** Ensure the work is conducted by a Contractor with experience in this type of operation and with a successful record of job performance in work of similar scope. Ensure the work is supervised by a full-time superintendent or technical specialist qualified by experience in similar injection procedures. Perform the grout backfill work using experienced crews familiar with the equipment and methods specified. Provide evidence to the satisfaction of the Engineer of relevant experience prior to starting work.

**c. Materials.** Furnish a mixture of Portland cement, water, sand, and chemical admixtures for the grout backfill as desirable to accomplish the intent of this special provision. The grout backfill is required to have a minimum 28-day compressive strength of 2,000 psi and an entrained air content of 6.5 percent, ±1.5 percent.

1. Cementitious Materials. Provide Type I Portland Cement in accordance with subsection 901.03.A of the Standard Specifications for Construction. If cementitious replacement is used, provide slag cement in accordance with subsection 901.06 of the Standard Specifications for Construction or fly ash in accordance with subsection 901.07 of the Standard Specifications for Construction.

2. Admixtures. Provide chemical admixtures in accordance with subsections 903.01 and 903.03 of the Standard Specifications for Construction.

3. Water. Provide water in accordance with section 911 of the Standard Specifications for Construction.

4. Fine Aggregate. Provide fine aggregate meeting the requirements of 2NS natural sand in accordance with section 902 of the Standard Specifications for Construction.

5. Mortar. Provide R-2 mortar in accordance with section 1005 of the Standard Specifications for Construction for filling injection holes.

**d. Equipment.**

Use a mechanically driven mixer and a positive displacement grout pump for the grout mixing and pumping equipment.

Use a double-tub mixer or a mixer and agitator capable of mixing grout with water/cementitious material ratios varying from 0.4 to 0.6 measured by weight. The maximum volume of grout per batch must not exceed the rated capacity of the mixer. The mixer must also have a suitable water-measuring device, consisting of a water meter or a calibrated water batching tank.

For the grout pump, use a positive displacement piston type capable of delivering material at a pressure of a least 300 psi at the pump discharge.

Remove all oil or other rust inhibitors from the mixing drums, stirring mechanisms, and other parts of the equipment in contact with the grout before the mixers are used.

The hoses connecting the grout pump to the grout injection pipe must be at least 1 inch or of such diameter to convey the grout with a minimum amount of friction.

In addition to the above equipment, provide all valves, pressure gauges, pressure hose packers, inserts, tools, and accessories required to provide a continuous supply of grout and accurate pressure control.

**e. Mix Proportions.** Accurately measure all materials by volume, weight, or other approved means. Add sand to the mixture when, in the opinion of the Engineer, the grout take is such as to warrant the use. Adjust grout mix proportions for each point of injection and from batch to batch during injection, if necessary, to obtain optimum grout take and penetration at minimum pressure.

Base mix proportions on strength test results from a trial batch that conforms to a minimum compressive strength of 2000 psi at 28 days. Replacement of Portland cement with fly ash is permissible at a 1:1 ratio up to a maximum of 30 percent replacement. Replacement of Portland cement with slag cement is permissible at a ratio of 1:1 up to a maximum of 40 percent replacement. Do not replace with both fly ash and slag cement.

Test the grout mix by making one set of 4 inch diameter by 8 inch high cylinders for each batch. A set of cylinders consists of 2 cylinders to be tested at 28 days. Additional test cylinders may be made to verify grout strength prior to the 28-day period. Make test cylinders in accordance with *ASTM C31/C31M*, with the exception that the grout should be restrained from expansion by a top plate and tested by the Department in accordance with *ASTM C39/C39M*.

**Table 1: Trial Mix Proportions by Dry Weight**

|  |  |
| --- | --- |
| Component | Pounds per Cubic Foot |
| Portland cement | 32 |
| Fine aggregate | 95 |
| Water | 17 |
| Water reducing, water-reducing/retarding | In accordance with Qualified Products List |

Batch the trial mix after testing and approval by the Engineer. Adjust proportions as necessary to meet site conditions and compressive strength requirements.

**f. Construction.** Place grout backfill by injection under pressure with or without the use of a primer solution and at such location, depths, and pressures as is necessary to fill voids within pervious rock structures or form within a soil mass, lenses, columns, or bulbs of hardened cementitious material, as well as fill voids within soil, whenever possible. The placement of grout backfill within the voids, rock, or soil must act to fill, compress, and consolidate surrounding soil so that bearing values are improved.

Drill injection holes of the sizes and at the locations shown on the plans to ensure that grout has entirely filled the voids. Verify and avoid the location of existing reinforcement using a pachometer or similar device prior to drilling test holes. Upon completion of the work fill holes with R-2 mortar.

Use the split-spacing method of injection point location, in which primary points are first located at maximum anticipated spacing, as determined by structure conditions. After completing grout injection at these points, locate secondary injection points at the midpoint between the primary points. Further splitting of injection point spacing may be required, depending on results obtained in previous grouting operations.

Place primary injection points to maximum anticipated depth or locations as determined by structure conditions. Rely on results obtained at previous locations to determine depth or location of succeeding injection points. In soils or embankments of unconsolidated materials, drive, drill, or jet injection points into place without disturbing soil structure, as would occur, for example, by consolidating or plugging voids in such a way as to reduce grout quantities or permit undesirable relief of grouting pressure at the interface of soil and injecting pipes.

Ensure the diameter of injection pipes or drill holes is adequate to permit injection of the most viscous mix anticipated without undue loss of head due to hydraulic friction; the diameter must in no case be less than the existing drill hole of 3/4 inch pipe. Keep accurate installation records for all types of injection points, including location and depth, installation method and other pertinent data, such as water loss during rotary drilling, difficulties during drilling or pipe driving, and blow count data, if using hand pipe drivers.

In soils or unconsolidated materials, generally start grout injection at maximum depth and continue steadily as the injection point is withdrawn to a minimum depth. Determine injection pressure by grout consumption and structure conditions. Ensure that injection pressure is in no case great enough to cause heaving of surrounding soil or cause distress in the structure.

Lower pressure and take measures to prevent uplift of the structure when grout injection is proceeding near the bottom of the structure or surface level. Continue until the void is completely filled once grouting has started.

Keep accurate records of grout mix proportions, quantities at each location, and injection pressures. The actual sequence of grouting operations, proportioning of grout mixes, etc., will be as herein provided, except as modified by the Engineer as required by field conditions.

**g. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

**Pay Item Pay Unit**

Grout Backfill Cubic Yard

**Grout Backfill** includes producing the grout and injection to consolidate subsurface voids. No allowance will be made for excess, waste, or otherwise unused materials.