# Special Specification 3086

# Soil Densification and Raising Concrete Slabs with High Density Polyurethane Foam (HDPF)

## 1. DESCRIPTION

Soil densification to strengthen base and sub-base soils under concrete pavement by furnishing and injecting a two-part 1:1 by volume, water resistant High Density Polyurethane Foam (HDPF) into the foundation soils beneath the pavement through holes or injection tubes at locations shown on the plans or as directed, while monitoring for movement at the surface.

## 2. MATERIAL

Furnish a two-part 1:1 by volume High Density Polyurethane Foam (HDPF). The material must reach 90% compressive strength within 30 min of injection and have a water insoluble diluent, which permits the formation of polyurethanes in excess water.

Furnish materials in accordance with the following:

| | | |
|---|---|---|
| ■ ASTM D-1622 | Density | 3.8 to 4.2 pounds / cubic foot |
| ■ ASTM D-1621 | Compressive Strength | 60 psi (minimum) |
| ■ ASTM D-1623 | Tensile Strength | 90 psi (minimum) |
| ■ ASTM C-273 | Shear Strength | 45 psi (minimum) |
| ■ ASTM D-790 | Flexural Strength | 90 psi (minimum) |
| ■ ASTM D-1940 | Closed Cell Content | +85% |

Furnish non-shrink grout to patch drill holes. The grout must meet the requirements of DMS 4675 and used within the shelf life and temperature limitations set by the manufacturer.

## 3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work. At a minimum, provide the following:

3.1. Dynamic Cone Penetrometer (DCP). Provide a portable DCP for on-site soils investigation to assist in location and depth of weak foundation soils and determination of correct injection pattern and injection elevations through tubes to densify weak soils. The DCP must be capable of taking readings as approved by the Engineer. Extension rods are required to perform this investigation.

3.2. Drill. Use a pneumatic or electric drill capable of efficiently drilling 5/8 in. to 2-in. diameter (if needed for multiple injection tubes) injection holes through the pavement without damaging the structural integrity of the existing pavement. Drill host holes for the placement of injection tubing cut to proper length(s) as per the plans, or as indicated on the field QC plan and DCP testing.

3.3. Pumps. Furnish as a minimum 2 trucks each with 2 mounted pumping units capable of injecting the polyurethane material at a controlled rate into the foundation soils to the require depths. Ensure:

- the pumping units are equipped with certified flow meters to precisely measure the amount of each component injected, so that the 1:1 ratio by volume is maintained for quality control and a certified volume of injected polymer material is obtained and;
- the pumping units are equipped with pressure and temperature control devices capable of maintaining proper temperature.

3.4. **Level.** Provide satisfactory equipment such as rotating laser levels and receivers to monitor movement of the pavement to within 1 mm, to verify that the injected foundation soils have been properly densified and to ensure the proper lift of pavement to grade is achieved.

## 4. CONSTRUCTION

4.1. **Preparation.** Prepare a profile of each area to determine the extent of the concrete slab that requires adjustment or raising. Ensure that the finished concrete slabs will conform to the grades and cross-section of the slabs as shown in the plans or as directed. Determine the exact locations of the injection holes for each treated area. Obtain approval for the injection hole locations.

4.2. **Drilling.** Use drilling operations that do not damage the surrounding concrete. Drill injection holes through the concrete, with diameters from 5/8 in. to 2-in. diameter holes, vertical and round, and to a depth indicated on the approved field QC plan. Install injection tubes to the prescribed injection depth or depths.

4.3. **Mixing.** Use the flow meters, to perform a quality check on the ratio of the two-part chemical system. The part A (Resin) to the part B (ISO) ratio by volume should be 1:1. Each day, reset the flow meters on the pumping units to zero. Perform a test shot of material from 1 injection gun at a time with a minimum of 0.5 gal. of each material, comparing the digital output in gallons of resin to the gallons of ISO to determine the injected ratio. The ratio range must be between 0.95 to 1.05 for all the injection guns to be used on the project. Be prepared to show the most recent calibration documents for the flow meters prior to using on the project.

4.4. **Injection and patching.** Inject high-density polyurethane formulation through holes, via injection tubes into the foundation soils beneath the pavement to the prescribed depth or depths. Control the stabilization of the foundation soils by regulating the rate of injection of the material. Continuously monitor for movement of the pavement. Foundation soils are sufficiently stabilized when movement of the pavement is not detected. Continue injection into the soils as needed to lift the pavement to grade. If no vertical movement has occurred, TxDOT may direct the Contractor to cease injecting. Take precautions to prevent the intrusion of injected material into any drainage facility and other structures. Remove any excessive polyurethane material after the nozzle is removed from the hole. Push down or drill out injection tubing 2 in. below the pavement surface and install a rapid set, non-shrink patching material into the drilled-out holes. Strike patches flush with the surface of the surrounding pavement.

4.5. **Set Time.** Open pavement to construction traffic within 30 min. of final injection of the polyurethane material since material is at a minimum 90% strength within 30 min. Pavement must be free of debris and swept clean prior to opening to traffic.

4.6. **Repairs.** As directed, repair any pavement slab or bridge approach/departure slab that has cracked or did not achieve required grades as a result of the Contractor's operation at no additional cost to the Department.

4.7. **Ride Quality**. Use Surface Test Type B, Schedule 3 to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

## 5. MEASUREMENT

This Item will be measured by the pound of high-density polyurethane foam injected and accepted. Measure the two chemical components and total to calculate the total weight of the material.

## 6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Soil Densification and Raising Concrete Slabs with HDPF." This price is full compensation for drilling, furnishing and injecting polyurethane material, concrete repairs, labor, materials, tools, and incidentals.