

FOR CONTRACT NO.: 04-3G0604
ROUTE: 04-So1-680-PM R7.7/R8.1

INFORMATION HANDOUTS

04-3G0604 INFORMATION HANDOUT

04-3G6504 CCO # 6:
SOIL DENSIFICATION (HIGH DENSITY POLYURETHANE)-

Add to section 19:

19-10 SOIL DENSIFICATION (HIGH DENSITY POLYURETHANE)

19-10.01 GENERAL

19-10.01A Summary

Section 19-10 includes specifications for soil densification with high density polyurethane material at locations shown and as directed by the Engineer.

19-10.01B Definitions

Soil densification: A process where a **two-part, hydro-insensitive**, high density polyurethane material is injected under pressure through tubes into the ground at various elevations to displace and densify in-situ soils **while elevations being monitored at the surface**.

Injection point: **Depths of the injection tubes for soil densification.**

19-10.01C Submittals

19-10.01C(1) General

At least 15 days before starting soil densification work at the job site, submit 3 copies of a Soil Densification Operations Work Plan for review. Allow 5 days for the Department's review. The Engineer provides comments and specifies the date when the review stopped if revisions are required. Change and resubmit a revised Soil Densification Operations Work Plan within 5 days of receiving the Engineer's comments. The Department's review resumes when a complete Soil Densification Operations Work Plan has been resubmitted. When the Engineer authorizes the Soil Densification Operations Work Plan, submit an electronic copy and 3 printed copies of the authorized Soil Densification Operations Work Plan.

Immediately upon completion of soil densification work at each individual injection point, submit a copy of recorded forms of **injection point**, polyurethane injection, and monitoring logs.

19-10.01C(2) Soil Densification Operations Work Plan

Submit a Soil Densification Operations Work Plan outlining the proposed work for soil densification. The work plan must include:

1. Specific field location, by station and offset from shown roadway alignment, for soil densification
2. A certificate of compliance for high density polyurethane material
3. Manufacturer's material specifications **and MSDS** of high density polyurethane
4. Manufacturer's instructions for application of high density polyurethanes
5. Sample forms of **injection point**, high density polyurethane injection, and monitoring logs
6. A list of personnel to be used and their experience with soil densification using high density polyurethane
7. Resumes of key personnel, including soil densification supervisor, detailing past project experiences
8. Equipment and methods for measuring and recording high density polyurethane injection pumping rate and volume with calibration procedures and equipment certification
9. Complete description of the materials, equipment, including size and type, and methods to be used in soil densification operation, including inclination and depth of injection **tubes**
10. Detailed description of the proposed monitoring program for ground surface movement and distress to related freeway facilities such as pavement, storm drains, and utility conduits
11. Injection program for high density polyurethane, including proposed rate and amount of material to be injected to obtain proper densification of the base and sub-base soils



19-10.01D Quality Control and Assurance

19-10.01D(1) General

Perform soil densification with high density polyurethane material work under the direct supervision of soil densification supervisor. Soil densification supervisor and foreman must be present and supervise all soil densification shifts of each densification operation.

19-10.01D(1) Soil Densification Supervisor

The soil densification supervisor must have a minimum of 5 years experience in planning and directing work dealing with soil densification, in the actual placement of injection pipes, and in the mixing and injection of the polyurethane material. The supervisor must have minimum 3 years of actual on-the-job supervisory experience in similar applications.

19-10.01D(2) Dynamic Cone Penetrometer Test

Before and after completion of soil densification operation, test the base soil conditions with dynamic cone penetrometer.

19-10.01D(3) Monitoring Pavement Movement

Use continuous laser level or dial indicator micrometer readings during injection to monitor pavement movement.

19-10.02 MATERIALS

19-10.02A General

Not Used

19-10.02A High Density Polyurethane

Soil densification material must be a closed cell, hydro-insensitive, high density polyurethane or equivalent, as authorized by the Engineer. The material must be a polyurethane-forming mixture having water insoluble diluents, which permits the formation of polyurethane in excess water. It must have a minimum free rise density of 3.0 lbs/ft³ with a minimum compressive strength of 38.0 psi. The maximum free rise density must be less than 3.2 lbs/ft³.

19-10.03 CONSTRUCTION

19-10.03A General

Determine on the ground, the vertical and horizontal projection of the exterior limits of all underground structures, conduits, irrigation systems, storm drain pipes, and other utilities. Adjust locations of polyurethane injection holes to fit the field conditions. Adjustment must be authorized by the Engineer.

Determine the position on the ground of each injection point and the elevation.

Drill series of 5/8" to 3/4" holes (as required for injection tube placement) through the existing pavement as shown. If necessary, first inject high density polyurethane material until all encountered voids are filled before starting soil densification operation. Inject high density polyurethane material through the injection tubes inserted into the drilled holes to the shown injection point depths. Any adjustment or change to the tube size, location, spacing, or depth must be authorized by the Engineer. The rate and amount of high density polyurethane material injected at injection points must comply with the Injection Program of your Soil Densification Operations Work Plan.

Record data of high density polyurethane injection and monitoring at each individual injection point.

If naturally acceptable soil conditions are encountered or should unacceptable soil densification results be obtained, such as performance criteria not being satisfied, the Engineer may delete sections or locations of soil densification.



Protect and monitor the existing concrete pavement, barriers, storm drains, unpaved embankment soils, and other facilities for indications of movement or distress during soil densification operation. Establish and monitor a minimum of 5 survey reference points on the existing pavement. Monitor overhead poles, electroliers, and structures within 30 feet of injection points.

Record the interior of existing storm drains and other utilities for signs of distress such as deflection, heaving, or cracking. Stop soil densification operation immediately if the existing facility shows signs of distress.

Provide access for inspection and monitoring of the existing freeway facilities for movement.

You are responsible for any pavement blowouts, excessive pavement lifting, or pavement damage that may occur as result of your work. At your expense, repair damaged areas as authorized by the Engineer.

Backfill tops of injection points with pea gravel and hydraulic cement grout, or the equivalent, toweled smooth to match the pavement surface.

19-10.03B Equipment

In addition to any other equipment necessary for soil densification work, provide the following equipment:

1. A truck-mounted pumping unit capable of injecting the high density polyurethane material beneath the pavement through tubes to the depths required. The pumping unit must be capable of controlling the rate of flow of material as required to densify soils and prevent pavement blowouts.
2. The pumping unit must be equipped with a manufacturer's certified flow meter to measure the amount of high density polyurethane injected at each location. The certified flow meter must have a digital output in both pounds and gallons.
3. Pressure and temperature control devices capable of maintaining proper temperature and proportionate mixing of the polyurethane component materials.
4. Pneumatic or electric drills capable of efficiently drilling 5/8" diameter injection holes through the pavement without damaging the structural integrity of the adjacent pavement.
5. Laser levels or dial indicator devices capable of monitoring movement at the surface of the pavement to verify that the injected high density polyurethane have been properly densified.
6. A portable dynamic cone penetrometer for on-site soils investigation to assist in location of weak sub-base soils and determination of injection pattern through tubes to densify weak soils.
7. All necessary equipment, such as electric generators, compressors, heaters, hoses, containers, valves and gauges, and light towers to efficiently conduct and control the work.

19-10.03C Disposal of Residue and Surplus Material

Contain, remove, and dispose of material from pavement drilling.

Residue from soil densification work must not flow into existing gutters, drainage facilities or left on the surface of the pavement or embankment. Remove and dispose of residue and surplus materials generated from the soil densification work.

19-10.04 PAYMENT

Not used.



