INJECTED POLYURETHANE SLAB JACKING

Final Report

SPR 306-261

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by

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16. Abstract

Conventional methods for raising in-place concrete slabs to align roadway sections or to counteract subsidence requires pressure-injecting grout under the slab. As other transportation organizations have had success with the URETEK Method, which utilizes injected polyurethane, Oregon DOT elected to use this method to raise and stabilize a bridge end panel and adjacent concrete slab. A two-year research project was conducted to monitor the stability of the injected slabs and to evaluate the material. The slabs settled by up to 10.5 mm (0.413 in) after two years. The compressive strength of the polyurethane material was not reduced after underground exposure. The ability of the injected polyurethane to penetrate through holes was characterized. An attempt was made to measure the water permeability of the material.

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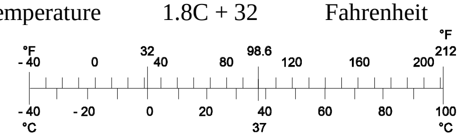
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
TEMPERATURE (exact)				
°C	Celsius temperature	1.8C + 32	Fahrenheit	°F



***** SI is the symbol for the International System of Measurement (4-7-94 jbp)

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INJECTED POLYURETHANE SLAB JACKING

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1.0 INTRODUCTION

1.1 BACKGROUND

Water in the subgrade under a roadway can cause sections of the roadway to settle. The water suspends soil particles that are subsequently pumped out when traffic drives over the concrete slab, causing a void to develop. This mechanism was probably responsible for the settling at the end panel of the southbound I-205 Glenn Jackson Bridge and the adjacent slab of the exit ramp, as shown in Figure 1.1. A leak in a 305 mm (12 in) drainpipe at the site was the source of water. The extent of the settling is shown in Figure 1.2.

As part of a maintenance project on the Bridge, the leaking drainpipe was repaired and the slabs were raised to a smoother profile. Injected polyurethane was used to raise the slabs to the desired profile using The URETEK Method, a technique relatively new in Oregon.

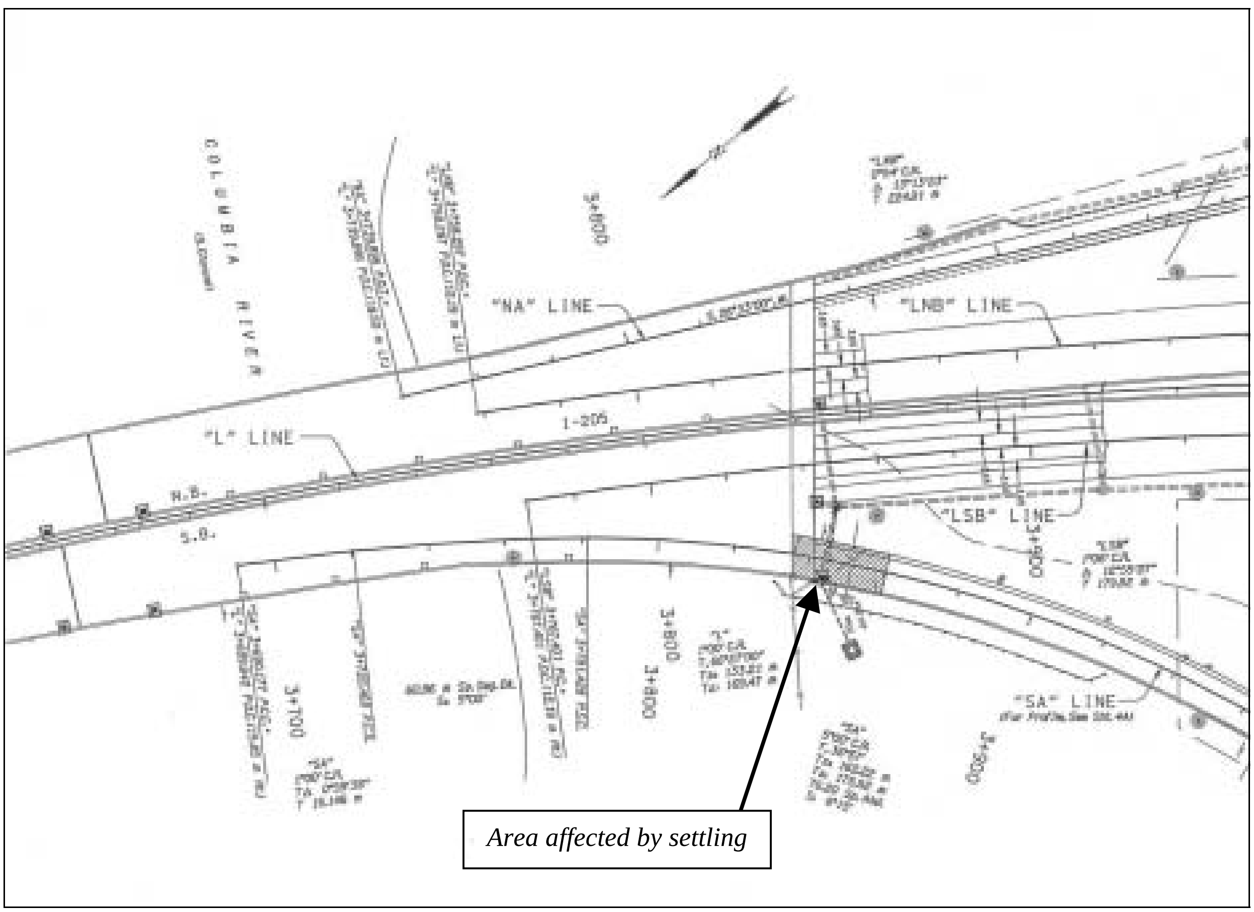


Figure 1.1: Location of slab jacking

Figure 1.2: Side view of joint between the end panel and the adjacent slab before slab jacking

1.2 THE URETEK METHOD

Conventional methods for raising in-place concrete slabs to align roadway sections or to counteract subsidence requires pressure injecting grout under the slab. Holes 50 to 75 mm (2 to 3 in) in diameter are drilled through the concrete to the base soil, and the grout is injected through the holes. The amount of lift is controlled by the injection pressure. Generally, the grout fills voids only near the injection hole.

An alternative method employed by URETEK, USA, Inc. – the URETEK Method™ – uses high-density polyurethane for the injected material. Many transportation organizations have had success with the URETEK Method (*Crawley, et al. 1996; Brewer, et al. 1994*); thus Oregon DOT decided to use the URETEK Method to realign the sections at the Glenn Jackson Bridge.

The process steps of the URETEK Method are outlined below (*URETEK 1998*):

1. Profiling – An initial profile of the roadway is made to determine where the pavement needs to be raised.

2. Drilling – Injection holes 16 mm (0.63 in) in diameter are drilled through the pavement and into the soil below.

3. Injecting – A two-component system is used to create the polyurethane. One component consists of a mixture of a polyhydroxy compound, catalysts, and water; the second component is an isocyanate compound. The two components are injected simultaneously through the drilled holes. The chemicals start reacting immediately to form a rigid polyurethane foam in situ with carbon dioxide given off as a by-product. The volume of the foam is several times that of the reactants; consequently, the reaction produces an expansive force that lifts the slab.

Two workers perform the injection process to minimize the risk of cracking. The amount of rise is controlled by the rate at which the reactants are injected through the holes. Multiple lifts can be used to reach the desired profile if necessary. A taught string or laser level is used to monitor elevations during the process.

4. Clean-up – After each hole is injected, any excess foam is removed from the hole. The hole may be sealed with cementitious grout. Quite often, the hole is not sealed because it is believed that the polyurethane foam itself creates an effective seal.

The polyurethane foam expands into voids in the subgrade, improving the stability of the subgrade and increasing the capacity of the subgrade to withstand weight. In addition, because the foam has a closed cellular structure, water infiltration that can cause subgrade instability should be reduced. Because the foam has low density in comparison to grout or mud, the polyurethane should cause less weight-induced settling.

URETEK lists the following advantages of the URETEK Method compared to conventional slab jacking techniques (*URETEK 1998*):

- Shorter repair time. The polyurethane reaches 90% of its full compressive strength within 15 minutes from injection, at which time the roadway can be opened to traffic.
- Good void filling characteristics.
- High compressive and tensile strengths.
- Fewer holes and smaller holes reduce the chance of weakening the slab.
- Injected material is lightweight, reducing the likelihood of settling or further subsidence.
- Void-filling characteristics of the material reduce the chance of water infiltration.
- Inert behavior in many environments provides a long-term, stable support for the slab.
- Repair process is more controllable. Successive lifts can be applied easily and quickly, providing the means to incrementally raise slabs.

1.3 OBJECTIVE

It was expected that slabs raised with the injected polyurethane would remain in position for many years. ODOT had very limited experience with the technology, however, to confirm the long-term stability. In addition, the technique may have other uses such as stabilizing areas prone to chronic settling. Thus the project had the following objectives:

- Monitor the stability of the Glenn Jackson Bridge site for two years.
- Determine the void size that can be penetrated by the foam.
- Evaluate the water permeability of the foam.

2.0 TESTING METHODS

2.1 ELEVATION MONITORING

Twelve surveying caps were drilled into the slabs, as shown in Figure 2.1, to monitor vertical displacement over time. Baseline elevation measurements were made 4 days after the slab jacking. Additional measurements were made at 3, 6, 12, 18, and 24 months after the slab jacking.

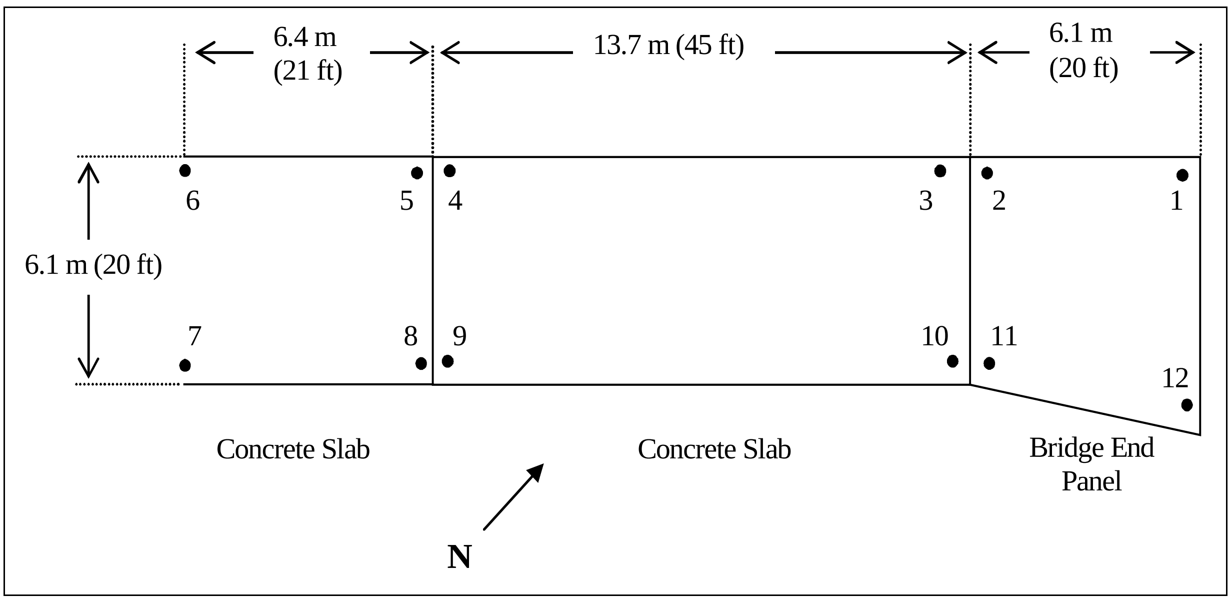


Figure 2.1: Layout of the surveying nails

2.2 HOLE INFILTRATION

An expected characteristic of polyurethane injection is that the material infiltrates small openings as it stabilizes the subgrade. The capacity to fill small voids also reduces the overall water permeability of a grade, which can protect the grade from further instability. Part of this project was to determine the smallest hole that the material could pass through as a function of the distance from the injection point.

Two fixtures based on the design shown in Figure 2.2 were constructed to quantify the invasiveness of the polyurethane foam. One fixture, Tube 1, was 1640 mm (64.6 in) long from the injection pipe to the end of the large-diameter PVC pipe. The other fixture, Tube 2, was

1410 mm (55.5 in) long, cut lengthwise along the top of the large-diameter pipe, and fitted with ten band clamps spaced along the pipe. There was a concern that the pressure due to the expanding foam would break the pipes; the intent of the split pipe was to relieve some of the expansion pressure while the band clamps maintained constraint. A 16 mm (0.63 in) ID injection pipe was used to be compatible with the URETEK equipment. Both tubes were injected with polyurethane foam.

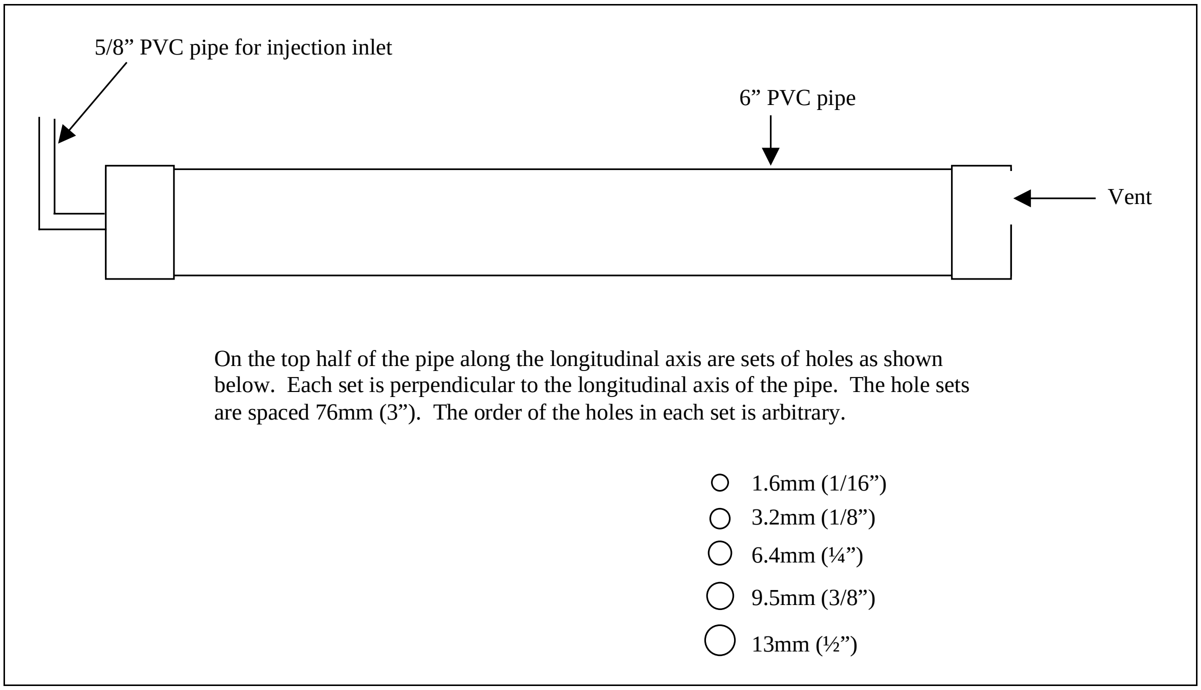


Figure 2.2: Fixture design for measuring invasiveness of injected polyurethane

2.3 COMPRESSIVE STRENGTH

One of the advantages of polyurethane is that it has excellent degradation resistance in many environments. In this project, compressive strength measurements were used to monitor the extent of degradation. A total of twenty-three slices 51 mm (2 in) thick were cut from the 6-inch diameter PVC pipes used for the hole infiltration experiments. Thirteen slices were cut from Tube 1, and ten slices were cut from Tube 2. The PVC rings were removed and the foam samples were randomized per pipe to eliminate any bias due to position effects within the pipes. The density of all the samples was measured according to ASTM D 1622 (*ASTM 1994b*).

The samples were divided into three groups, with each group comprised of four samples from Tube 1 and three samples from Tube 2 as shown in Table 2.1. One slice from each tube was set aside as an extra. The testing of each group of samples for compressive strength according to ASTM D 1621 was conducted as follows (*ASTM 1994a*):

1. Group 1 samples were immediately tested.

2. Group 2 samples were stored indoors, and the compressive strength was measured 23 months after injection.

3. Group 3 samples were buried approximately 100 mm (4 in) underground 38 days after injection. They remained underground until compressive tests were performed 23 months after injection.

The strength results from the three groups were compared to determine if any time-dependent degradation occurred and if the underground environment had any influence on degradation.

Table 2.1: Identification and source for the density and compressive strength samples

Sample No.	Tube Source	Assigned Group
1	2	3
2	2	3
3	2	1
4	2	1
5	2	1
6	2	3
7	2	2
8	2	2
9	2	2
10	2	Extra
11	1	3
12	1	2
13	1	3
14	1	1
15	1	1
16	1	1
17	1	3
18	1	1
19	1	2
20	1	3
21	1	2
22	1	2
23	1	Extra

It should be noted that the density and strength data should not be used as a measure of these properties in actual field projects. The constraint during expansion and curing would vary widely over the volume of foam and would not be the same as the constraint provided by the PVC pipe. More constraint would provide a more dense, stronger foam.

2.4 WATER PERMEABILITY

The ability of the polyurethane material to behave as a water barrier is important in preventing soil instability caused by water infiltration. One effort of this study was to measure the water permeability of the material using the apparatus shown in Figure 2.3 and the following equation:

$$V = \frac{K}{\mu} \times \frac{P}{l} \qquad \textbf{(2-1)}$$

where:

V is the volumetric flow rate in volume/time;
K is the permeability of the material in $(\text{length})^2$;
μ is the kinematic viscosity of water in mass/(length*time);
P is the pressure; and
l is the length of the section under test.

In the equation, V, P, and l can be measured in the test, and μ is a value available in handbooks.

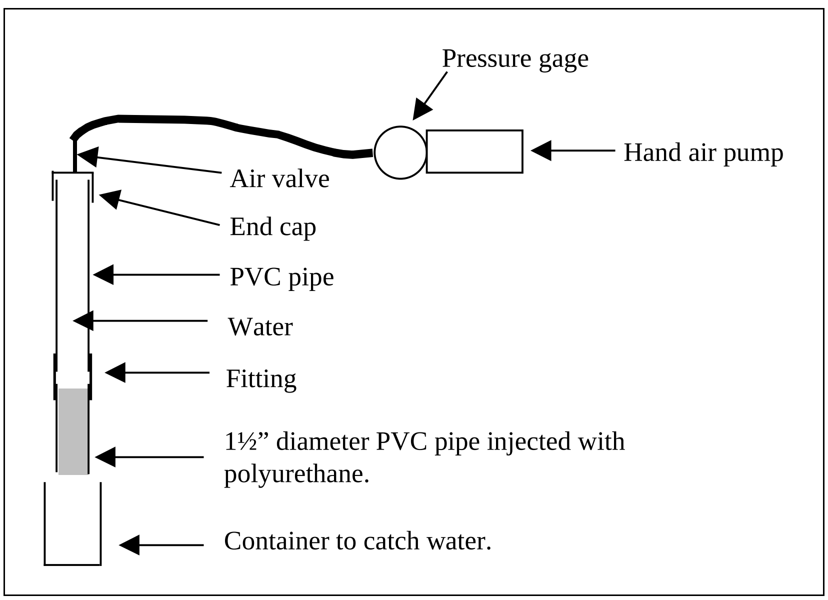


Figure 2.3: Apparatus to measure water permeability

Polyurethane was injected into 1.5 in (38 mm) diameter PVC pipes to make specimens for the permeability tests. It was expected that the polyurethane would expand tightly against the sides of the pipe creating a watertight seal. It was observed, however, that a slight space developed between the foam and the pipe.

To address this problem, several sections were cut from the filled pipes, and the polyurethane core was pushed out. Some of these foam cores were then cemented back into their respective pipe sections with PVC cement. Other cores were put back in place with silicone sealer. In all cases, however, water still leaked from between the polyurethane and the pipe. Consequently, the permeability measurements could not be made.

3.0 CONSTRUCTION

3.1 INJECTION

For the Glenn Jackson Bridge, the URETEK representatives determined that a lift of 90 to 100 mm (3.5 to 4 in) was required, based on initial profiles along the two sides and the center of the exit ramp. String lines were put in place to guide the technicians during injection.

Six 16 mm (0.62 in) holes approximately 500 mm (20 in) deep were drilled in various locations for the lifting operation. Working from one side of the ramp to the other, the holes were injected with URETEK 486 to raise the slabs. Using the same six holes, the process was repeated several times until the desired profile was obtained.

After the lift was completed, holes spaced approximately 1.2 m (4 ft) apart were drilled over the entire work area. These holes were injected to fill voids that formed during the lifting operation or any preexisting voids. After all injection was completed, all the holes were sealed with a cementitious grout.

3.2 COST

The entire operation required approximately 10.5 hours and cost $42,260. URETEK generally determines project costs by applying a unit price per kilogram of injected material. For this project, 2113 kg (4649 lb) of polyurethane was used at a unit price of $20 per kilogram.

4.0 POST-CONSTRUCTION ANALYSIS AND MONITORING

4.1 FIELD OBSERVATIONS

Figure 4.1a shows a hole after injection and 4 days of traffic exposure. Like many of the other injection points, the polyurethane was exposed, indicating that the grout seal either had not been applied or had popped off. Holes that were not sealed showed signs of raveling after being exposed to traffic for two years, as shown in Figure 4.1b. Holes that were properly sealed with grout showed no signs of damage after two years, as shown in Figure 4.1c.

(a)

(b)

(c)

Figure 4.1: Injection holes a) with no seal four days after injection; b) with no seal two years after injection; and c) with grout seal two years after injection.

The aligning effect of the injection project is visually illustrated in Figure 4.2, which is a photograph of the same location as Figure 1.2 after polyurethane injection.

Figure 4.2: Side view of joint between the end panel and the adjacent slab after slab jacking

The elevations for each of the 12 locations on the slabs were measured 4 days after injection. Subsequent elevation measurements were made in September 2000, December 2000, June 2001, December 2001 and June 2002. The Appendix lists all the measurements, and Table 4.1 shows the relative change in elevation as a function of time, using the first set of measurements as a baseline. Figure 4.3 compares these results graphically by position.

Table 4.1: Relative change in elevation over time. Units are in mm.

Position	**Date of Survey**					
	6/14/00	**9/14/00**	**12/14/00**	**6/14/01**	**12/17/01**	**6/17/02**
1	0	-1.5	-1.1	-0.9	-1.9	-2.1
2	0	-4.6	-6.0	-6.6	-8.8	-9.8
3	0	-5.3	-5.5	-6.7	-9.0	-9.7
4	0	-4.7	-5.5	-5.8	-7.6	-7.9
5	0	-4.5	-4.5	-5.3	-6.6	-9.7
6	0	-3.1	-4.1	-4.5	-4.9	-5.3
7	0	-3.4	-4.4	-4.8	-4.2	-5.3
8	0	-5.3	-4.8	-6.1	-6.3	-7.3
9	0	-4.8	-5.4	-5.1	-6.1	-6.8
10	0	-6.0	-6.7	-7.0	-8.0	-9.7
11	0	-7.2	-7.7	-8.1	-8.5	-10.5
12	0	-2.4	-3.6	-1.6	-2.0	-2.7

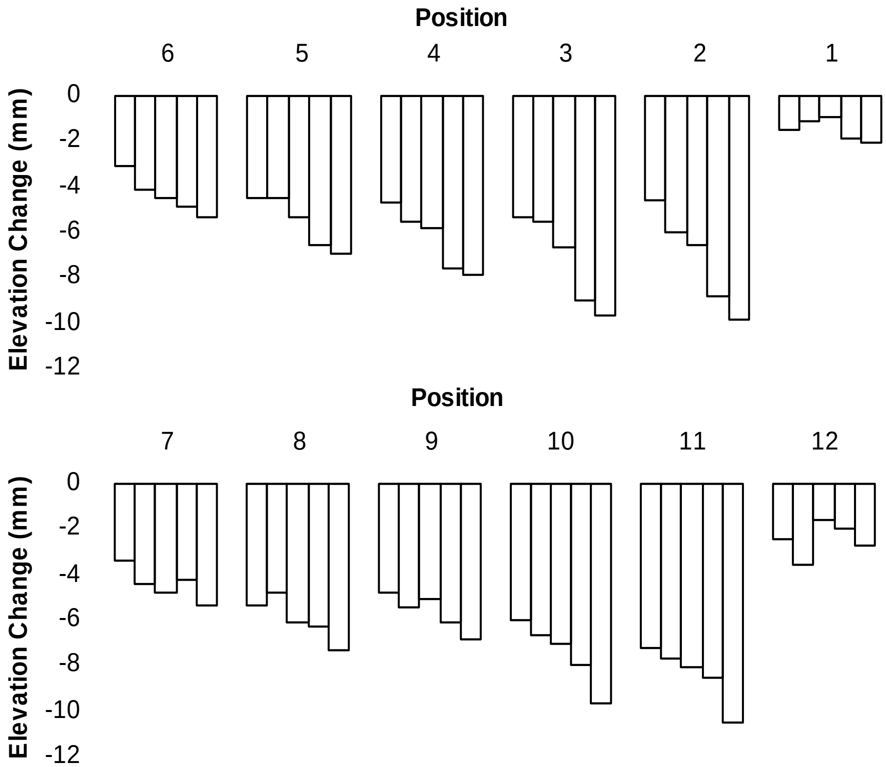


Figure 4.3: Comparison of elevation data from Table 4.1. Positions aligned vertically in the figure are opposite each other on the roadway (see Figure 2.1).

The roadway settled at all twelve positions with a maximum decrease in elevation of 10.5 mm (0.413 in). The majority of the settling occurred within the first three months after injection with one position sinking 7.2 mm during that period. The settling was still continuing two years after injection. The reason for the settling was not investigated, and it was not known whether the settling would continue.

The joint between the roadway slab and the end-panel, which had the largest elevation discontinuity before injection, experienced the largest amount of settling. Both sides of the joint (positions 2 and 11 vs. 3 and 10) settled by nearly the same amount; therefore, the ride over the joint was not affected by the settling. However, the difference in elevation between the ends of the end-panel (Positions 1 and 12 vs. 2 and 11) increased over two years. This change in elevation may have been responsible for new cracks that appeared in the end-panel. Figure 4.4 shows a pre-existing crack and a crack that either opened up or was created since the first survey four days after injection.

Figure 4.4: Cracks in the end-panel near Position 2

The observed settling, though minor after two years of service, highlights the fact that slab jacking, regardless of method, does not guarantee a static slab. In addition, raising a slab can crack the slab or open up existing cracks. Good technique and experience are essential to achieve a successful outcome, but they do not guarantee success. Arguably, injected polyurethane provides more control in the lifting process, and should produce a higher percentage of successfully raised slabs, than injected grout or mud.

4.2 LABORATORY ANALYSIS

4.2.1 Hole Penetration

Figure 4.5 and Tables 4.2 and 4.3 show the results of the hole penetration trials. To be considered penetrated, a hole had to be completely filled. The polyurethane penetrated through all holes 6.4 mm (0.25 in) in diameter and larger. None of the 1.6 mm (0.062 in) holes was filled. Based on these results, it was expected that with injection holes drilled every 1.2 m (4 ft), the foam should have penetrated all openings (based on the smallest dimension) as small as 6.4 mm (0.25 in). Openings with a minimum dimension of 3.0 mm (0.12 in) should have been penetrated up to 0.62 m (2 ft) from the injection point. It was thought that actual field injection probably resulted in greater penetration due to higher pressures from the constraining weight of the slab.

Figure 4.5: Penetration tubes after injection

Table 4.2: Description of hole penetration tubes

	Tube 1	Tube 2
Restraint	No added restraint	Cut lengthwise; restrained with 10 band clamps
Distance from injection tube to 1st hole set	190 mm	235 mm
Distance from injection tube to last hole set.	1480 mm	1230 mm
Distance between hole sets	78 mm	78 mm

Table 4.3: Hole penetration as a function of hole size and distance from the injection point

Hole Size	Farthest Distance from Injection Point	
	Tube 1	Tube 2
1/16 in (1.6 mm)	No holes filled	No holes filled
1/8 in (3.2 mm)	1100 mm except at 950 mm	620 mm
1/4 in (6.4 mm)	All holes filled	All holes filled
3/8 in (9.5 mm)	All holes filled	All holes filled
1/2 in (13 mm)	All holes filled	All holes filled

This ability to fill small spaces should allow injected polyurethane to effectively stop water flow through the subgrade wherever the polyurethane has been successfully injected. Any water present will find another path; therefore, proper hydraulic engineering needs to be used if the intent is to prevent water from infiltrating the subgrade.

4.2.2 Density and Compressive Strength

The density of the polyurethane was found to be greater in Tube 1 than in Tube 2, as shown in Table 4.4. Originally, it was anticipated that the density of the samples from each tube would be nearly the same, and subsequent compressive strength testing would be conducted on the three groups of samples randomly selected from the two tubes. However, the actual density difference between the tubes would have resulted in a relatively large variance within the sample groups, which might mask any differences between the groups. Consequently, the tube source was added as another factor in the compressive strength comparisons.

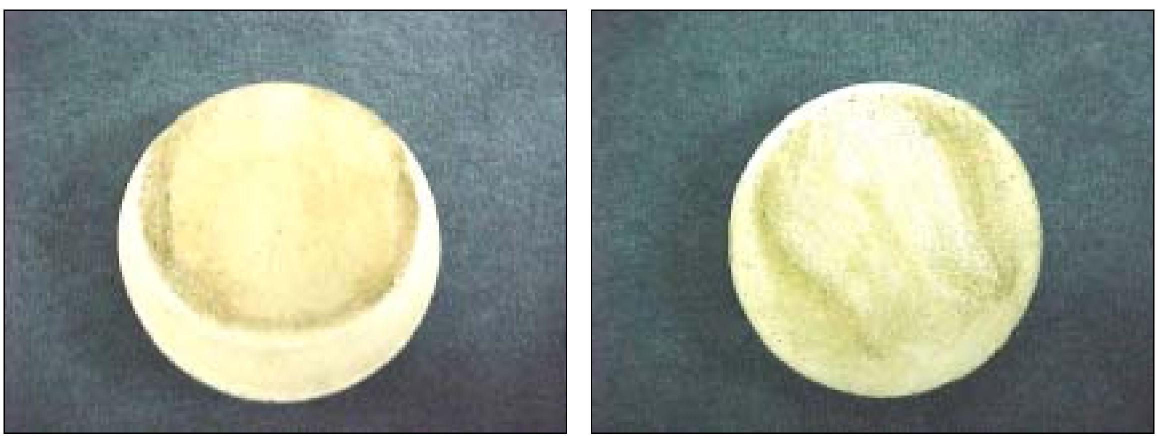
Table 4.4: Density and strength measurements

Sample No.	Tube Source	Assigned Group	Density 40 Days after Injection 10^{-5} g/mm^3 (lb/ft^3)	Compressive Strength MPa (psi)
1	2	3	6.49 (4.05)	0.317 (46.0)
2	2	3	6.85 (4.27)	0.341 (49.5)
3	2	1	6.58 (4.10)	Not valid. Sample 10 used instead
4	2	1	6.91 (4.31)	0.342 (49.7)
5	2	1	6.20 (3.87)	0.266 (38.6)
6	2	3	6.77 (4.22)	0.325 (47.1)
7	2	2	6.68 (4.16)	0.343 (49.7)
8	2	2	7.07 (4.41)	0.391 (56.7)
9	2	2	6.29 (3.92)	0.319 (46.3)
10	2	1	6.77 (4.22)	0.319 (46.2)
			mean = 6.66 (4.15) s = 0.27 (0.17)	
11	1	3	9.61 (5.99)	0.742 (108)
12	1	2	9.81 (6.12)	0.635 (92.1)
13	1	3	9.71 (6.05)	0.655 (95.0)
14	1	1	9.84 (6.13)	0.645 (92.8)
15	1	1	9.56 (5.96)	0.674 (97.5)
16	1	1	9.52 (5.94)	0.663 (96.3)
17	1	3	9.75 (6.08)	0.640 (92.8)
18	1	1	9.70 (6.04)	0.589 (85.3)
19	1	2	9.79 (6.10)	0.690 (100)
20	1	3	9.74 (6.07)	0.644 (93.4)
21	1	2	9.86 (6.14)	0.673 (97.6)
22	1	2	9.68 (6.03)	0.663 (96.2)
23	1	Extra	9.86 (6.15)	0.708 (103)
			mean = 9.72 (6.08) s = 0.11 (0.07)	

Based on the judgement of the technician, a sufficient quantity of polyurethane was injected into each tube so that the material would expand to fill the volume without fracturing the pipe. In filling a similar void to lift a slab, more material would have been injected, producing a denser foam than what was obtained in the PVC pipes. URETEK reports the density of their expanded product as 8.02×10^{-5} to 3.21×10^{-4} g/mm^3 (5 to 20 lb/ft^3) (*URETEK 1998*). The samples from Tube 2 were below the reported density range, and the samples from Tube 1 were at the lower end of this range.

The characteristic of the expanded foam having a higher density under conditions of higher constraint can reduce material usage. More material is situated where it is needed, such as in load-bearing locations. Voids that are not supporting a load are filled with a lower density foam, which is still adequate to stabilize the surrounding soil.

Two distinct regions were visible in all the samples cut from the tubes, as shown in Figure 4.6. One section was relatively dense and extended around much of the circumference. The second region occupied the interior of the samples and was less dense than the first region. The samples cut from Tube 1 had a greater volume of the relatively dense section, which resulted in the higher measured density values reported in Table 4.4.



(a) (b)

Figure 4.6: Samples cut from (a) Tube 1 and (b) Tube 2

Tables 4.4 and 4.5 show the compressive strength of the specimens. As expected, the higher density material had higher strength. There was no decrease in strength due to aging in the laboratory or aging underground.

Table 4.5: Comparison of compressive strength between sample groups

	Low density samples from tube 2 MPa (psi)	High density samples from Tube 1 MPa (psi)
Group 1 **40 days after injection**	mean = 0.309 (44.8) s = 0.039 (5.7) n = 3	mean = 0.643 (93.0) s = 0.038 (5.5) n = 4
Group 2 **23 months after injection** **Stored indoors**	mean = 0.351 (50.9) s = 0.037 (5.3) n = 3	mean = 0.665 (96.5) s = 0.023 (3.3) n = 4
Group 3 **23 months after injection** **Buried**	mean = 0.328 (47.5) s = 0.012 (1.8) n = 3	mean = 0.670 (97.3) s = 0.048 (7.2) n = 4

5.0 CONCLUSIONS

This project was undertaken to determine the long-term stability of concrete slabs raised with the URETEK Method of injected polyurethane. Following the slab jacking process, ODOT monitored the extent of settling at the site for two years. In addition, the polyurethane's strength and ability to penetrate openings was tested in the lab.

Based on the results of this project, the following conclusions are presented:

- Injected polyurethane can successfully raise concrete slabs to a target profile.

- Injected polyurethane will consistently penetrate openings as small as 6.4 mm (0.25 in) and will penetrate some openings as small as 3.2 mm (0.125 in). Because of its ability to flow into small spaces, injected polyurethane should be considered for applications that require reducing the water flow through the subgrade.

- Slabs may settle after being raised with injected polyurethane. The settling may open up existing cracks or create new cracks.

- Compressive strength of the polyurethane product does not appear to decrease after 23 months of exposure to air and underground conditions.

6.0 REFERENCES

ASTM 1994a. Standard Test Method for Compressive Properties of Rigid Cellular Plastics. Designation D 1621-94. American Society for Testing Materials.

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APPENDIX

Elevation Measurements

Elevation measurements are in meters. All measurements were made relative to the nearby survey marker, which was assigned an elevation of 1000 m.

Position	**Date of Survey**					
	6/14/00	**9/14/00**	**12/14/00**	**6/14/01**	**12/17/01**	**6/17/02**
Survey reference BM N 684	1000	1000	1000	1000	1000	1000
1	999.3034	999.3019	999.3023	999.3025	999.3015	999.3013
2	999.1568	999.1522	999.1508	999.1502	999.1480	999.1470
3	999.1290	999.1237	999.1235	999.1223	999.1200	999.1193
4	998.8224	998.8177	998.8169	998.8166	998.8148	998.8145
5	998.8083	998.8038	998.8038	998.8030	998.8017	998.8014
6	998.5837	998.5806	998.5796	998.5792	998.5788	998.5784
7	999.1691	999.1657	999.1647	999.1643	999.1649	999.1638
8	999.4311	999.4258	999.4263	999.4250	999.4248	999.4238
9	999.4379	999.4331	999.4325	999.4328	999.4318	999.4311
10	999.7943	999.7883	999.7876	999.7873	999.7863	999.7846
11	999.8299	999.8227	999.8222	999.8218	999.8214	999.8194
12	1000.1013	1000.0990	1000.0977	1000.1000	1000.0993	1000.0990