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Item No. 4A - Grout-Jacking

Measurement of Materials Accurately measure the dry materials by weight or volume if delivered in bulk or packaged in uniform volume sacks. Batch the water through a meter or scale with a totalizer for the day's consumption. Make these measurements in the presence of the Engineer. Submit weigh bills for cement and sand after slabjacking operations are completed to validate mix proportions used.

Quantity of Portland Cement and Grout

All required grout to evenly raise panels to required grade.

Grout Injection Ports

The existing panels have three, 1-1/4" inch precast injection ports to be use for jacking.

Broken Panels

Repair or replacement of concrete slabs broken due to jacking will not be measured for payment. Furnish all labor, equipment, tools, and materials necessary to repair or replace broken concrete pavement at no cost to the owner.

Qualified Personnel

Only utilize personnel experienced in the stabilization of foundation soils with grout injection and while monitoring at the surface for movement to demonstrate sufficient filling of voids and leveling operations. Provide a crew supervisor with a minimum of five (5) years' experience who is authorized and able to accomplish the work outlined herein and on the Plans.

Submit the crew supervisors resume, and any other applicable licenses, to the Owner for review and approval prior to commencing work for this project.

The crew supervisor is will be on-site during leveling operations and shall be responsible for the safety procedures as set forth herein and maintaining detailed records for each day of work performed under this Contract.

Payment

Leveling of concrete StarTrack™ panels will be measured and compensated for using a per EA unit of measure.

Quality Control

Grouting Operation Plan.

No less than 10 days prior to the initiation of production grouting, submit a grouting operation plan for approval. Devise the grouting procedures to ensure the voids will be completely filled by grout. As a minimum, address and provide procedures for the following items in the grouting operation plan:

- a. Type, quantity, and brand of materials used in the grouting including all material certifications;
- b. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts;
- c. Types and locations of vents;
- d. Types and sizes of grout hoses and connections;
- e. Theoretical grout volume calculations;
- f. General grouting procedure;
- g. Duct cleaning method prior to grouting;
- h. Mixing and pumping procedures;
- i. Type and frequency of quality control production tests;
- j. Direction of grouting;
- k. Sequence of use of the vents;

- l. Method to be used to control the rate of flow and pressure within the ducts;
- m. Procedures for handling blockages, including flushing of ducts;
- n. Procedures for possible post grouting repair;
- o. Names of the persons in charge and the other personnel who will perform the grouting operation, including their relevant certification, experience, and skill.

Do not commence production grouting until the Engineer provides written approval of the grouting operation plan.

Before initiation of production grouting, conduct a joint meeting with the grouting technician, subcontractors, grouting crew, and the Engineer to discuss the grouting operation plan, required testing, corrective procedures, and other relevant issues.

Field Trial Test. Demonstrate to the satisfaction of the Engineer that the grouting equipment, methods, and procedures are appropriate. Conduct field trial tests at least 5 days prior to initiation of production grouting or as specified by the Engineer. Perform batching and testing with the same materials, personnel, and equipment used in production grouting. Furnish all materials and labor at no cost to the Department.

Bench marks

Determine, establish, and maintain elevations of bench marks for grade control.

Equipment for Monitoring Movement: Supply satisfactory equipment such as rotating laser levels and receivers to monitor movement of the panels to within an accuracy of 1/32-inch (or as approved by the Engineer). Equipment is required to verify that the injected foundation soils and bedding materials have been properly injected and to ensure proper lift of panels to grade without adversely affecting the desired profile. Supply satisfactory differential fault meters to monitor movement where required. Supply satisfactory horizontal movement monitoring equipment.

Testing Facilities

Perform sample testing using a commercial testing laboratory approved by the owner and in accordance with the contractor Quality Control Plan. Work requiring testing will not be permitted until the testing facilities have been inspected and approved. Sampling must be conducted by qualified and certified personal. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. The laboratory is to maintain this certification for the duration of the project. Furnish copies of test results to the Engineer within 24 hours of completion of the tests.

Cement

Do not use cement until its test report is approved by the Contracting Officer. Sample cement at the mill or shipping point and at the work site. If tests prove that a cement that has been delivered is unsatisfactory, promptly remove it from the work site. Retest cement that has not been used within 6 months after testing when directed by the Engineer. Cement will be rejected if test results are not satisfactory.

Aggregate

Sample aggregates in the presence of the Engineer. Obtain samples in accordance with ASTM D75/D75M that are representative of the materials to be used for the project. Perform all aggregate tests prior to start of grouting. Conduct aggregate testing in a laboratory approved by the Engineer.

DELIVERY, STORAGE, AND HANDLING

Grout Storage. Store all grout materials in a dry enclosure or building that is convenient to the work site. Limit on site storage of grout to a maximum period of one month.

Provisions for Aggregates

Handle and store aggregates at the site so that segregation, intermixing between stockpiles, or contamination by foreign materials does not occur. Prepare and maintain sites for stockpiles to prevent the inclusion of foreign materials with the aggregate. Segregated aggregate is not permitted. Discard aggregate when segregation is apparent at no cost to the owner.

ENVIRONMENTAL REQUIREMENTS

Do not perform pavement slabjacking when the ambient temperature at the bottom of the pavement slab is less than 40 degrees F or when the subgrade or aggregate base is frozen.

PRODUCTS

Equipment

Furnish all equipment, tools, and other apparatus necessary for the proper construction and acceptable completion of the work specified under this contract. The equipment must be approved by the Engineer prior to starting the work. Maintain equipment in good working condition during the progress of the work. Submit list of proposed equipment to be used in performance of construction work including descriptive data.

Grout Plant

Provide a grout plant consisting of a positive displacement grout injection pump capable of applying up to 250 psi pressure, a high speed colloidal mixing machine, and a grout return system. Produce the colloidal grout by mixing in a colloidal mill connected to the cone-shaped bottom of a cylindrical drum. Operate the colloidal mill between 800 and 2,000 RPM, creating a high shearing action and subsequent pressure release to make a homogeneous mixture. Provide an injection system capable of continuously pumping grout at rates as low as 1-1/2 gallons per minute and equipped with pressure monitoring devices and a quick action valving system that can be closed instantly and provide for the grout to be recirculated through the system.

Water Tanker / Storage

If water tanks and metered pumps are not an integral part of the plant, provide a water truck equipped with a metered pump for delivery to the grout plant. Contractor to provide their own water.

Drilling (If Required)

Existing grout ports within the panels are to be used for grout injection. Additional holes must be approved by the Engineer. If required, use an air compressor and rock drill or other device capable of drilling the grout injection holes through the panel. Keep the equipment in good condition. Provide injection holes that are vertical and round. Do not exceed a down-feed pressure of 200 psi whether by hand or mechanical means.

Flow Cone

Provide a flow cone with necessary components in accordance with ASTM C939/C939M so that the consistency of the mixture can be determined.

Miscellaneous

Provide all necessary hoses; valving, valve manifolds, and positive cut-off and bypass provisions to control pressure and volume; pressure gauges with gauge protectors; expanding packers for positive seal grout injection; wood plugs; hole washing tools; and drill steel and bits.

MATERIALS

Portland Cement

Provide portland cement meeting the requirements of ASTM C150/C150M. Do not use cement salvaged by cleaning bags mechanically or otherwise, or from discarded bags of cement.

Pozzolans and Fly Ash

Provide pozzolans and fly ash meeting the requirements of ASTM C618.

Mineral Aggregate

Provide aggregate to be used for slabjacking consisting of natural sand, manufactured sand, or a combination of natural and manufactured sand and limestone dust. If the aggregate is a combination of separately processed sizes from the same or different sources, or a blend of different materials, batch the different components separately or blend under approved conditions prior to delivery to the batching plant.

Particle Shape

Provide particles of the aggregate that are generally spherical or cubical in shape. Aggregates containing flat platelet grains or rhombohedral grains will not be approved.

Grading

Unless approved otherwise, provide aggregate for grout mix conforming to the following gradation when tested in accordance with ASTM C136/C136M and ASTM C117.

<u>Sieve designation U.S. Standard square mesh</u>	<u>Percentage by weigh passing</u>
No. 8	100
No. 16	80-95
No. 50	50-70
No. 200	25-45

Deleterious Materials

Do not exceed the following limits for deleterious materials in the aggregate when tested in accordance with ASTM C142/C142M.

<u>Material</u>	<u>Percentage by Weight</u>
Clay lumps	2.0
Coal and lignite	1.0

Chemical Admixtures

Provide chemical admixtures that are proposed to be used to assist in pumping grouts or to compensate for climatic and project conditions conforming to ASTM C494/C494M and ASTM C937.

Water

Provide water for mixing and curing that is fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations may be used if it meets the requirements of ASTM C1602/C1602M.

MIXES

Grout Mixture

Submit certified mix designs by an approved commercial laboratory for each type of concrete, grout, or blended material including a complete list of ingredients, admixtures, and set times. Include certificates for cement, cementitious materials, and admixtures. Proportion and test a mix design to meet the specification requirements. Provide portland cement grout mixture used for slabjacking consisting of portland cement, pozzolan or fly ash, limestone dust, sand, and water. The use of accelerators, high

range water reducers and fluidifiers are subject to the approval of the Engineer. Do not produce grout until the mix design has been approved.

Grout shall be non-shrink, non-corrosive, non-metallic and cement-based grout meeting ASTM C1107, except develop a 28-day compressive strength of at least 5,000 psi when tested according to AASHTO T 106 or ASTM C109.

Grout must have an initial cure time to allow traffic on that next shift or for the next scheduled train. Minimum compressive strength for traffic movement is 700 psi, or as approved by the engineer.

TESTS, INSPECTIONS, AND VERIFICATIONS

Submit certified copies of test reports for aggregates, cement, and fly ash not less than 5 days before the material is required in the work and daily during construction. Provide certified reports of inspections and laboratory tests including analysis and interpretation of test results. Properly identify each report by contract number, location, quantity of material placed, and timed events of milestones. Describe test methods used and compliance with specified standards.

Grout Production Tests. Carry out the minimum number of production grout tests as follows:

Daily Report

Provide daily mixture test results of the materials and additives used in the mixture including aggregate gradation, flow cone times, shrinkage and expansion observed, time of initial set, and 1-day, 3-day, and 7-day strengths of previous day's placements.

Compressive Strength

Unless otherwise approved, provide a minimum 7-day strength not less than 2,000 psi as determined by tests. Fabricate test specimens from the materials being used on the project including water and admixtures. Make, cure, and test specimens using grout cubes as described herein.

Grout Strength Test. Prepare grout cube specimens according to ASTM C942. Perform a minimum of one strength test per day during grouting operations. Submit strength test results within 24 hours of test completion.

Expansion

Determine the expansion in accordance with ASTM C940 at the beginning of the job and whenever the mix proportions are changed.

Set Time

Determine the time of initial set in accordance with ASTM C266 or ASTM C953 at the beginning of the job and when a different lot of cement is used.

Fluidity

Fluidity test. Perform the modified version of ASTM C939 test specified in Subsection 701-2.08. Repeat testing at least every 2 hours of grouting operations. Submit fluidity test results within 24 hours of test completion. Provide time of efflux (fluidity) for pozzolanic grouts that range from 16 to 26 seconds. Provide time of efflux for limestone dust grouts that range from 22 to 32 seconds. A flow cone time of efflux of 9 to 15 seconds can be used during the initial injection at each hole.

TASK EXECUTION

Inspection

Closely examine the slabs for any existing cracks prior to jacking any pavements. Perform this investigation with the Engineer. Both parties must agree regarding the existing condition of the pavement with existing cracks noted and marked.

DRILLING HOLES FOR GROUT INJECTION

This should be avoided, unless special approval is granted.

WASH HOLES

Subject to the Engineer's approval, holes may be washed or air blown to create a small cavity to allow the initial spread of grout.

JACKING

Erect string lines that will be blocked up from the pavement high points to monitor movement prior to jacking operations. Lower into the holes an expanding rubber packer or other approved device providing a positive seal and connected to the discharge hose on the grout plant. Do not extend the discharge end of the packer or hose below the lower surface of the concrete pavement. Pump in a pattern and in the amount required to raise the panel to grade. Continuous pressures up to 200 psi are permitted. Pressures within the range of 200 psi to 300 psi are allowed only for short periods. In the event the pavement is bonded to the aggregate base, brief pressure up to 600 psi are allowed. Loss of grout through cracks, joints, other injection holes, or from back pressure in the hose or in the shoulder area is not permitted. Do not use grout for jacking that is held for an inappropriate amount of time in the mixer or in the injection pump or hose, based on mix design.

RAISING OF SLABS

Do not raise the slabs more than 1/4 inch when pumping in any one hole at any time. Do not raise any part of a slab so that it leads any other part of the slab or any adjacent slab more than 1/4 inch at any time. Keep the entire slab and all adjacent slabs on the same plane at all times within the 1/4 inch tolerance. Make observations to ensure that when pumping from one hole, the grout flows to adjacent holes filling all voids. Slabs can be cut to prevent breakage when it is bound against an adjoining slab.

SEALING OF INJECTION HOLES

Immediately remove the packer and plug the hole temporarily with a tapered wooden plug or approved equal, after jacking has been completed at any one hole. Do not remove the temporary wooden plugs, or approved equal, until the grout has set sufficiently so that back pressure will not force it through the hole. Permanently seal each hole flush with the pavement surface with a fast setting sand/cement or other patch material approved by the Contracting Officer. Provide patch material having a minimum thickness of 3 inches.

PLAN GRADE REQUIREMENTS

Provide qualified personnel and equipment for determining the proper elevations required to conform to the plan elevations. Perform jacking operations so that all panels within the work area present an even grade at each joint and that do not vary from the plan grade elevations by more than 1/4 inch. If slabs are found that are lower than the specified tolerance from the plan grade, continue jacking these slabs until the tolerance is met. Extreme caution is to be taken to insure that slabs are not jacked higher than the specified tolerance. Should the overjacking occur resulting in a defective rail alignment, the Owner has the option to require removal and replacement of that section at no additional cost to the Owner.

PRODUCTION SAMPLING AND TESTING

Aggregates

Sample aggregates delivered to the mixer during slabjacking operations to determine compliance with specifications. Test aggregate gradation daily.

Field Test Specimens

Take samples of grout in the field from mixtures used for jacking to determine the adequacy of control of materials and the proportioning, consistency, and mixing of the grout. Take three sets of three cylinders from each day's operation or when the mixture proportions are changed. Make and cure the test cylinders in accordance with ASTM C31/C31M or ASTM 507 and test them in accordance with ASTM C39/C39M for strength. Additional sets of test cylinders will be required at the start of jacking operations and when the aggregate source, aggregate characteristics, or mix design is changed until the Engineer is satisfied that the grout mixture being used complies with the strength requirements specified. Use an approved commercial laboratory to cure and test specimens for compressive strength. The test result will be the average of the strength of the 3 cylinders. If the average strength of cylinders falls below the specified strength, the Contracting Officer may require changes in the mix proportions.

PROTECTION

Do not permit traffic on the pavement slab until the grout has obtained a minimum set. Include the minimum set time in the grout mixture submittal. Adjust the minimum set time daily to account for variations in temperature.

ACCEPTANCE OF WORK

Prior to acceptance, remove loose concrete, joint filler, or grout spilled on the surface or shoulder. Remove waste construction material and leave the surrounding areas in a neat and orderly condition prior to opening to traffic or final acceptance.

Work includes all equipment, labor, materials, and supervision required to restore the StarTrack™ panels to the specified elevations and profiles. This work shall include drilling of injection holes, injecting of the materials, testing and surveying to control the lift of the panels, cleanup, and other related work. Locations to be restored shall be as shown on the plans or as designated by the Engineer.

Work includes all equipment, labor, materials, and supervision required to perform Star Track™ panel leveling to the desired lines and grades shown on the Plans, or as directed by the Engineer and verified in the field by a licensed surveyor. Leveling shall be performed by subsurface polyurethane material injection, or an approved equal method.

Work shall be performed as indicated herein.

MATERIALS.

Two Component High Density Polyurethane Material. Use a two component closed cell, hydro-insensitive, high density polyurethane system that upon injection results in rapid expansion and curing.

Prior to the start of work, provide a supplier certification with each shipment for review. The manufacturer shall provide documentation that the lot(s) of material meet the specified properties. Manufacturer's certification shall list lot number(s) and documentation of compliance with the Contract Documents Certify that the material conforms to the following requirements for property test results and properties listed herein in the table below:

Property	Test Method	Parameters
Density, lbs./cu. ft.	ASTM D-1622	4.7-6.5
Compressive Strength, psi (min.)	ASTM D-1621	80
Tensile Strength, psi (min.)	ASTM D-1623	90
Shear Strength, psi (min.)	ASTM C-273	45
Flexural Strength, psi (min.)	ASTM D-790	90
Closed Cell content (%)	ASTM D-1940	+85
Cure Time		60 psi within 30 minutes
Performance in Water		Ensure Material is not Effected

Table 3-1 - Material Properties

The material shall be water blown, not chemical blown. The material shall be a polyurethane-forming mixture, having a water insoluble diluent, which permits the formation of polyurethanes in excess water. The presence of these water insoluble diluents provides polyurethane foam with improved dimensional stability properties. The presence of a water insoluble diluent and the characteristics and properties listed above must be certified by the manufacturer. Testing of the material is to be performed by a certified, licensed and professional, third party testing laboratory. The laboratory and material certification shall be submitted with the bid documents.

The polymer must be non-toxic. Toxicity testing must be performed by an independent laboratory. The certification shall be submitted with material submittals.

The polymer must pass the NYSDOT Panel Test for hydro-insensitivity and the Contractor must submit a certificate from an independent testing lab under the supervision and review of a licensed Professional Engineer certifying that the polyurethane material meets or exceeds the limits set forth in the panel test specification. The certification from the third-party testing lab shall be submitted with the bid documents.

Non-shrink Grout: Supplied by an approved manufacturer and used within the shelf life and temperature limitation set by the manufacturer that is suitable for use in patching core/drill holes.

The non-shrink grout shall only be used for filling the injection holes after the elevation and grade-slopes of the panels have been restored.

SUBMITTALS.

1. Certification by the manufacturer that the polymer to be used meets all the requirements in the Material section outlined herein.
2. Certification of a third-party testing lab that the polymer has passed the NYSDOT Panel Test, confirming the polymer is effective in wet or dry conditions. The Toxicity Testing Results by an independent laboratory.
3. A list of all supervisors, lead men, and technicians with their years of required experience and OSHA certifications (OSHA 30 for supervisors, OSHA 10 for all lead men and technicians).
4. The name, model number, and a description of any testing / Inspection units that will be used on the project.
5. An equipment list including the VIN number and license plate numbers of all the production trucks, and the VIN number and license plate numbers of any other equipment that may be used on projects.
6. The calibration documents for the flow meters (They need verified in the field and addressed in the QC Plan).
7. Evidence of prior experience: 3 awarded contracts minimum within the last three years
8. The name, hire date, and resume of the licensed professional engineer employed by the Contractor with a minimum of 3 years of experience in stabilization of pavement foundation soils by injecting expansive polymers through tubes, into soils while monitoring at the surface of the pavement for movement to demonstrate sufficient densification of the soils.

CONSTRUCTION.

General. The construction methods outlined below may, for sufficient justifications, be modified by the Engineer as field conditions dictate. The Contractor shall maintain all panel surfaces adjacent to the actual operation in progress. The area shall be cleaned prior to the placement of traffic on the work area.

Equipment for Monitoring Movement. Supply satisfactory equipment such as rotating laser levels and receivers to monitor movement of the panels to within an accuracy of 1/32-inch (or as approved by the Engineer). Equipment is required to verify that the injected foundation soils and bedding materials have been properly densified and to ensure proper lift of panels to grade without adversely affecting the desired profile. Supply satisfactory differential fault meters to monitor movement where required. Supply satisfactory horizontal movement monitoring equipment.

Drills. Pneumatic or electric drills are required, capable of efficiently drilling 5/8" to 2" diameter (if needed for multiple injection tubes) injection holes through the concrete and rebar (if necessary) without damaging the structural integrity of the existing panels. Drill host holes for the placement of injection tubing cut to proper length(s) as per the Drawings, or as indicated on the field QC plan and per DCP (or other approved) testing method and as approved by the Representative.

Drilling Holes and Installation of Injection Tubes. Drill injection holes in the approved pattern and as indicated on the field QC plan, as approved by the Representative. Drill 5/8" to 2" diameter holes (if necessary), vertical and round, and to a depth indicated on the approved field QC plan. If necessary, install injection tubes to the prescribed injection depth or depths. Tubes will be pushed to a minimum of four (4) inches below the grade of the panel prior to the commencement of injections. Pushing tubes or pulling tubes after injections break the bond between the tube and polymer thus weakening effects of the polymer injections.

The pneumatic drill shall be rotated to avoid cracking the pavement and to provide satisfactory holes of the proper diameter for effective operations. When drilling holes, the drill shall be held as nearly

perpendicular as possible to the panel surface. Irregular or unsatisfactory holes, which cannot be satisfactorily used, shall be filled and sealed with nonshrink grout and new holes shall be drilled. The Contractor shall exercise sufficient precautions during all operations to insure that StarTrack™ panels are not broken or cracked. Any panel that develops a crack that extends through the drill hole will be considered to have been damaged during the process of the work and it shall be repaired or replaced. Repair or replacement shall be in accordance with techniques approved by the Engineer

Mixing. Using state certified flow meters, a quality check shall be performed on the ratio of the two-component chemical system. The part A (Resin) to the part B (ISO) ratio by volume should be 1:1, unless approved by the representative.

Prior to performing the work each shift, the Contractor shall reset the flow meters on the pumping units to zero. The Contractor shall perform a test shot of material from 1 injection gun at a time with a minimum of 0.5 gallons of each material, comparing the digital output in gallons of resin to the gallons of ISO to determine the injected ratio. If the ratio is less than 0.95 or greater than 1.05, the system is to be checked for problems, adjusted, and the ratio rechecked until a proper ratio is assured. Contractor shall repeat the quality check for all the injection guns to be used on the project. Calibration of the Contractor's equipment will be required daily before any work begins. The Contractor shall submit with other bid documents the most recent (within the past 12 months) calibration documents for the flow meters.

Panel Foundation Soil Stabilization and Leveling. The injection material shall not be placed when the pavement surface temperature is below 35 °F or if the subgrade and/or base course material is frozen. When injecting the material, the panels shall be raised to the profile elevations with the proper grade slopes and elevations. The Contractor shall be responsible for any excessive or uneven pavement moving, and shall replace or repair any damaged areas. When the injection nozzle is removed from the hole, excess foam at joints and cracks and a minimum depth of 6 inches in the injection holes shall be removed from the area. The injection holes shall be sealed with nonshrink grout. The Contractor is to inject the high-density polyurethane material through holes, via injection tubes when needed, into the foundation soils / bedding material beneath the panels to the prescribed depth or depths and required to fill voids created by subsurface erosion. Control the stabilization of the foundation soils and bedding material by regulating the rate of injection of the material.

Continuously monitor for movement of the panel. Continuous laser level or dial indicator micrometer readings shall be in place and monitored by the Contractor during initial injection to determine if sufficient material has been injected to the cause panel movement a minimum of 1/32 in. After the initial movement has been recorded, the Contractor may proceed to raise the panels to the desired grade and elevations.

Injection may continue into the soils as needed to lift the panel to grade, returning the panel system to original construction profiles and as measured in the field. The Contractor is to be careful as to not "over inject" causing the panel to crest outside the planed vertical profile. If no vertical movement has occurred, the Representative may direct the Contractor to cease injecting.

The Contractor shall inject material using an evenly spaced grid grouping pattern which conforms to the panel dimensions (usually 4' on center) and approved by the engineer. Injection holes are anticipated to reach typical depths of between 15.25" to 21" or down to bedrock, whichever is greater with measurements taken from the top of the panel.

The process should stabilize the foundation soils, fill void spaces and compress the drainable base material back up against the bottom of the panels, without eliminating the draining nature of the base course. The representative may determine need for polyurethane injection from visual inspection, knowledge of the subsurface structure profile, and/or other testing such as FWD, borings, GPR, Train Geometry profiling or DCP testing.

Testing and/or survey shall be performed to determine if one level of injection is sufficient to correct the cause of the settlement. the Contractor shall make recommendation to the engineer for additional levels

of injection. Additional levels shall only be injected following Representative's approval. Representative shall approve the scope of the injection area, pattern and depth prior to injection of polyurethane material.

Due to the nature of the Tunnel drainage, it is likely that void pockets are present below the concrete panels. These pockets are likely filled with water are currently causing pumping conditions. The Contractor will perform material injection directly beneath the concrete panels will be necessary to fill these voids.

The concrete StarTrack™ panels within the Whittier Tunnel are butted up against one another in a faulted jointed configuration. The Contractor shall use both a laser level and the differential fault meter to ensure the high side of the joint is not over-lifted causing poor ride quality. The adjacent corners of the panels are to be level with one another and the panel corners are to be leveled with the plan tunnel profiles and grades.

When wet foundation soils are suspected, or found to exist, vent holes may be installed to allow water to escape from under the panel system, if approved by the engineer. Otherwise, injection proceedings shall be performed in such a way that water is forced out from under the panel system. The tunnel panels have been placed over a self-draining base course. Adjustments to injecting speeds may be necessary to allow trapped water to drain and reducing the pore pressure during the operation.

Traffic. Unless directed by the engineer, traffic must not impact the leveled panels for a minimum of 30 minutes after final injection of the polyurethane material. The polyurethane material must be at a minimum 60 psi strength prior to traffic allowance.

Pot Hole Patching. Install a rapid set, non-shrink patching material into the drilled-out hole. Strike patches flush with the surface of the surrounding concrete.

Warranty. A two-year unconditional warranty against settlement of more than 1/4" of differential settlement of concrete panels. If settlement of more than 1/4" of concrete panels occurs, Contractor shall return to inject the affected area to lift to proper grade at no additional charge, except maintenance of traffic, to the owner. Areas excluded from the warranty shall be identified by the Owner on, or around, final completion

Qualified Personnel. Only utilize personnel experienced in the stabilization of pavement foundation soils by injecting two-part 1:1 by volume expansive polymers through holes or tubes into soils, while monitoring at the surface for movement to demonstrate sufficient densification of the soils. Provide a crew supervisor with a minimum of five (5) years' experience who is authorized and able to accomplish the work outlined herein and on the Plans.

Submit the crew supervisors resume, and any other applicable licenses, to the Owner for review and approval prior to commencing work for this project.

The crew supervisor is will be on-site during drilling and injecting operations and shall be responsible for the safety procedures as set forth herein and maintaining detailed records for each day of work performed under this Contract.

Leveling of concrete StarTrack™ panels will be measured and compensated for using a per EA unit of measure.

BASIS OF PAYMENT. Compensation shall be made per the agreed upon unit price; and in accordance with Section 109 and Supplemental Condition SC-01.