ITEM 555.8202- -11 M REPAIR CRACKS BY CHEMICAL GROUT INJECTION

DESCRIPTION.

The Work consists of cleaning the existing cracks, and then injecting liquid grout into cracks as shown on the Contract Drawings and as designated by the Engineer.

The Work shall include the furnishing of all supervision, training, labor, materials, tools and equipment and the performing of all operations necessary for the chemical grouting work indicated in the Contract Drawings and as specified herein.

MATERIALS.

Polyurethane Grout.

Polyurethane grout shall be water-reactive liquid polyurethane base solutions which when reacted with water, will expand by foaming to produce a flexible closed void solid, resistant to degradation by wet and dry cycles as well as chemicals found in concrete construction. Grouts marketed by the following manufacturers or approved equals shall be used for the purpose of sealing leaks:

De Neef Construction Chemicals (Hydro-Active Seal Foam)
5610 Brystone Drive
Houston, Texas, 77041
Tel. (713) 896 0123
Fax. (713) 849 3340

Prime Resins, Inc. (Prime Flex 900 XLV)
2291 Plunkett Road
Conyers, GA, 30012-3433
Tel. (770) 388 0626 (800) 321 7212
Fax. (770) 388 0936

Other Grout Components.

All grout products such as catalysts, accelerators or other additives needed to make the grout function properly shall be those recommended by the manufacturer of the specific grout. Other products shall not be added to the grout unless specifically approved by the Engineer.

Alternative Product Approval.

All grout products shall have a recorded and published history of successful use in at least five (5) similar applications of major scope for a period of at least four (4) years, and shall have a chemical makeup of recognized permanence.

Each proposed alternative grout shall be demonstrated to and approved by the Engineer prior to the start of grouting.

Manufacturer's literature describing the components, mixing and handling procedures, and characteristics for the particular grout product proposed shall be submitted to the Engineer for approval before the start of injection work. Alternative products will be evaluated on viscosity, elongation, shrinkage, tensile strength and other...
characteristics.

Handling, Storage and Disposal of Materials.

All grout materials shall be delivered to the site in unopened containers bearing the manufacturer's original label. All grout materials shall be stored and handled as recommended by the manufacturer, in a safe and responsible manner, and in accordance with all Authority, Local, State and/or Federal regulations, codes and ordinances. Spilled, spoiled, or open unused chemicals shall be disposed of in accordance with all applicable Authority, Local, State and Federal codes and regulations.

CONSTRUCTION DETAILS.

Equipment.

General:

Contractor shall submit the following completed documents:

- Chemical Review Request Form (CRRF)
- Chemical Product Data Request (CPDR)
- Material Safety Data Sheet (MSDS)
- Flammability & Toxicity Characteristics for Accelerator

The Contractor shall supply all equipment, including pumps, containers, hoses, gauges, packers, drills, bits, scaffolds, compressors, generators, vacuums, accessories and all other items required to perform the work.

The equipment shall be of a type, capacity, and mechanical condition suitable for completing the Work in an effective and efficient manner. All equipment, including all power sources, cables, containers, scaffolds, and other items required for the performance of the Work, shall meet all applicable safety and other requirements of the Authority, Local, State and Federal ordinances, laws, regulations and codes.

All equipment shall be maintained in excellent working condition at all times. Sufficient spare parts and tools shall be maintained on the job to provide for immediate (1-hour) repairs of essential operating items.

Each grout crew shall maintain its own equipment items required herein in order to operate independently of, and separately from, other grout crews.

Pumping Units:

Supply pumping units, including separate containers, hoses, and all other accessories, for injection of grout.

Pumps shall be capable of continuous injection of the liquid grout under variable pressures up to a maximum pressure of 20.68 MPa and at flow rates of at least 0.14785 Liters per minute at high pressure (20.68 MPa) and flow rates of at least 0.946 Liters per minute at pressures of 3.45 MPa and lower, and in accordance with the grout manufacturers' recommendations. Pumps may be electric, air or hand driven provided the above capabilities are attained. Pumps shall be so arranged that rapid changes in pumping rates and pressures may
be made by the pump operator without effecting the mixture of the grout being injected and without stopping the pumps.

Pumping units shall be made of materials compatible with the chemicals being used, and shall be equipped with all necessary hoses, containers, gauges, fittings, packers and other accessories required to properly inject the grout. Seals and cracks shall be such that no grout leakage occurs and no air is aspirated into the injected grout.

Grouting units shall be so arranged that flushing can be accomplished with grout in-take valves open, and the pump operated at full speeds.

Pumping units shall be equipped with accurate pressure gauges at the pump and near the injection point. Gauges shall be accurate to within 5% and shall be periodically checked for accuracy against new, undamaged, calibrated gauges. Damaged or inaccurate gauges shall be replaced immediately. Pumping units shall not be operated without properly operating gauges. Replacement gauges shall be on hand at all times.

Hoses and fittings shall have maximum safe operating pressure ratings and dimensions as recommended by the manufacturer.

Suitable mixing and holding tanks shall be supplied with each grouting unit to permit continuous pumping at maximum pump capacity. Tanks shall have satisfactory covers and shall be stable against tipping over under normal usage.

Polyurethane Grout Pumps:

Grout pumps shall be either single or double pump type as recommended by the grout manufacturer. Pumps shall be arranged and operated in a manner consistent with the grouts injected and the grout manufacturer's recommendations.

Packers:

Packers shall be specifically designed for the grouting operation and capable of safely sealing and packing grout holes drilled into concrete and injected at pressures of up to 20.68 MPa, and shall be installed in the manner recommended by the manufacturer of the grout. Packers shall be of the removable type such that the drilled hole can be cleaned and patched to at least 7.62 centimeters deep.

Drills:

Hand drills capable of drilling small diameter holes of 1.25 to 2.5 centimeters in diameter in concrete shall be used. The following two types of drills shall be used by each grouting crew: (i) Rotary percussion capable of drilling up to 45 centimeters depth in unreinforced concrete; (ii) Rotary flushing type with diamond coring bits capable of drilling up to 60 centimeters depth in reinforced concrete. Drills shall be supplied with bits of a diameter and length consistent with packer requirements and hole lengths needed for the drilled holes to intersect the target crack as specified. Damaged or worn bits shall not be used. Backup drills and bits shall be supplied in sufficient numbers so that two drills of either type can be used simultaneously.
Water Removal Equipment and Supplies:

Sufficient equipment and supplies shall be provided to remove water and mineral deposits from walls, roofs and floors in whatever quantities may be encountered, in order to permit visual or tactile observation of leakage sources and origins. Such equipment shall include, but not be limited to: chipping hammer, wet-dry vacuum, pumps, air blowers, mops and rags. Temporary dams may be constructed using sand bags or other suitable materials to keep water out of areas being grouted.

Scaffolding:

Supply scaffolding and other access means for grouting crews to the indicated work areas as required.

Work Procedures.

General: The injection work shall be performed with the skill and expertise typical of a specialty contractor experienced in waterproofing grouting of concrete cracks. The planning of the Work and direction of the grouting crews shall be managed by the Contractor so as to timely accomplish the Work. The approved contractor shall have a minimum of 5 years in-house experience with chemical grout and a foreman on site with a minimum of 5 years experience in chemical grouting. Documented references with working phone numbers will be supplied and verified before any award is given for this work.

Access to Work Areas: Provide safe and efficient access to drilling and grouting areas for workers, supervisors, and inspectors, which may involve the erection of scaffolding, installation of guard rails, and any other means required for personnel and equipment to enter, work in, and leave the treatment areas. This requirement shall also include adequate lighting for inspection and performance of the Work. Provide all temporary power within the work area and plan for installation of any outlets, connection boxes, transformers, cables, switches, generators to adequately supply the work crews with electrical power. All Contractor installed electrical devices shall be installed by qualified personnel and removed at the completion of Work.

Injection Waterproofing Concepts: Injection of grout through drilled holes into the cracks requiring treatment is intended to force liquid ungelled grout to flow along the crack for some distance into the concrete structure and along the visible surface of the seam, filling the seam and resulting in a permanent seal when the grout gels. The process anticipates the loss of some grout to surface leaks. Some reappearance of leaks in previously treated areas may also occur. These shall be retreated as directed by the Engineer. The Contractor shall use skill and the best efforts to minimize the loss of grout and to reduce the incidence of recurring leaks, according to the standard of practice of skilled waterproofing injection specialists.

Payment will not be made for retreating leaks that re-leak within seventy-two (72) hours of the previous treatment. Treatment of leaks that start releaking after seventy-two (72) hours of the previous treatment will be paid.

The Contractor shall warrant that any sealed cracks that exhibit renewed leakage within one (1) year after repairs have been performed, shall be resealed at no cost to the State.

Injection Procedures: All grouting work shall be done in accordance with the Contract Documents. The steps for sealing leaks in concrete cracks shall include the following:
Cleaning of Injection Areas: Injection areas covered by mud, rust, and/or water shall be cleaned prior to injection of grout. Mineral deposits on the concrete surface need not be disturbed as they help retain fluid grout inside the crack during the injection process. Temporarily dry floors, walls and roofs with rags, mops, buckets, wet-vacuums, air blowers or any other means required to permit observation of leak sources and direction of water flow along a given crack. This information shall be used in planning the location and injection sequence of grout holes to effectively treat the area. Just prior to injection of grout in a given area, water shall be removed from the area in order to permit visual recognition of grout leaking from the crack and estimation of the relative quantity of grout returning to the surface.

Drilling Grout Holes: Grout holes shall be drilled using percussion or rotary drilling methods so as to intercept the crack to be treated at an angle to the plane of the crack and at a depth of 15 centimeters or more beyond the concrete surface. Grout holes shall be 1.59 centimeters in diameter. Grout holes shall be located so as to provide for complete grout coverage of the affected crack between grout holes. Grout holes encountering reinforcing bars may be relocated once on most occasions. When it appears that to be effective, a grout hole must be drilled through the rebar, the hole shall be advanced using diamond drilling methods. It is expected that grout hole spacing will average about up to 0.3048 m on centers for first pass grouting of cracks. Grout holes may be started at a larger diameter to accommodate packer placement and stepped down to a smaller diameter at greater depths if desired by the Contractor. Care shall be taken not to penetrate any waterproof membrane. A limited number of grout holes may be predrilled ahead of grouting operations, however, no more grout holes shall be drilled by a given grouting crew during a single shift than can be effectively grouted by that crew during the shift. Drill a minimum of one hole per 1 meter of crack measured along the surface of the crack, and inject grout into each hole.

Cleaning Grout Holes: All grout holes shall be confirmed to be clean and free from dust, debris and obstructions prior to grouting. Grout holes drilled by rotary-percussion, or by rotary means without water flushing shall be cleaned of all cuttings, dust and debris prior to placing the packer. Cleaning shall consist of water flushing, vacuuming, or other means, and shall be performed such that grit and debris are not clogging the crack and are shown to be effective in permitting free flow of grout into the crack.

Installation of Packer: A packer shall be installed in the grout hole just prior to injection and fixed in place in such a way that a tight seal is accomplished. Connections to packers shall permit rapid transfer of grout lines to the next hole. Packers shall be left in place until grout has gelled in that hole. Packers shall be cleaned and shown to be open for free grout flow before reuse. Safety measures shall be taken against unexpected expulsion of the packer from the grout hole during high-pressure injection.

Grout Injection: Injection of the selected grout shall commence immediately after installation of the packer and shall be done using the equipment, materials, and procedures specified. Pumping shall proceed as long as all of the following conditions are fulfilled: (a) grout is entering the crack; (b) the observable loss of grout returning from the crack is estimated to be less than 25% of the volume of grout being pumped; (c) damage is not being done to the structure; (d) the total volume of grout injected in the current hole does not exceed 11.36 Liters; (e) the grout has not extended for more than 1.524 Meters along the crack away from the grout hole; and (f) the Engineer has not indicated that grouting should stop.

Post Injection Procedures: After removal of the packer the grout hole shall be cleaned to a depth of at least 7.64 centimeters and plugged with moist-pack non-shrink mortar. Mortar shall consist of a mixture of fine sand, cement and water with a water/cement ratio not greater than 0.35 and shall be tightly pressed or driven into the hole until the hole is completely filled and tightly sealed. Leaked grout and other debris resulting from the Work shall be completely removed from the area and properly disposed of on a daily basis. Complete cleanup of all materials used in the process, including temporary packing of cracks shall be removed and the location...
restored to a clean and tidy condition.

Provide direct oral communication between the worker at the point of injection and grout pump operator and the Engineer. The Engineer shall have access at all times to injection locations.

Control of the grout setting times is a critical aspect of successful waterproofing grouting. Gel times shall be as short as practical and as short as 2 minutes for Polyurethane Grouts, in accordance with the manufacturer's recommendations. For sealing leaks from fine cracks, it may be necessary to preheat the grout to improve the gel time and/or select a grout of lower viscosity. The manufacturer's recommendations shall be strictly followed.

Observe all weep holes, drains, and utility lines during injection operations and control the Work to prevent clogging with grout. All drilling debris, grout and contaminated water shall be contained and removed by the Contractor and surfaces restored to their original condition.

Provide for adequate disposal of packing/barrier materials, washing chemicals, wasted or leaked grout, drill cuttings and other debris resulting from the Work, prior to leaving a work area. The grouting crew shall wipe off all excess visible grout on top of concrete surfaces, and restore the surface to a clean and tidy condition.

A sufficient quantity of grout materials shall be stored at or near the Work Site to insure that grouting operations will not be delayed due to shortages of grout materials. All chemical containers shall be clearly marked indicating any safety hazards associated with use or exposure to the grout materials and any precautions that shall be taken to prevent injury to those handling the products.

Provide temporary waterproof coverings necessary to protect structure, walls, floors, equipment and finishes from leaking grout that may drip or flow away from the injection points. Adequate provision shall also be made for the exclusion of wet or dry debris from the atmosphere near electrical or electronic equipment, or on or in such equipment, including wet or dry vacuuming, as appropriate. Any construction finishes that are damaged by grout shall be cleaned, repaired and retouched. Marred surfaces shall be retouched with a one-coat application of paint that shall match the existing color and type as closely as practical.

In order to judge performance, all grouting work shall be inspected by the Contractor with the Engineer within 3 days after a greater than 1.25 centimeters rainfall has occurred in one 24-hour period during the construction phase. Work priorities shall be adjusted according to the results of the inspection, at the direction of the Engineer.

Safety Precautions.

Responsibility for all aspects of the safety of this Work is vested entirely in the Contractor. Exercise all control over operations, materials, employees, and all other factors respecting safety.

Each employee who works with the grout products, including the DOT employees, shall wear chemical goggles, face shields, NBR gloves (Edmont or equal), foul weather gear, boots and Wilson 1200 series respirator with R-21 organic vapor cartridge and R-13 filter.

A pressurized source of water such as a garden-type sprayer shall be provided at each Work Site and be available for immediate first aid in the event the chemicals contact an employee's skin.

A portable eye wash unit shall be provided at each Work Site and be available for immediate use in an emergency.
Provide any additional safety measures required by the grout manufacturer.

Post legible copies of the safety data sheets for each chemical at conspicuous locations within the Work Site. Contractor shall adhere to all recommendations referenced or contained in the safety data sheets, and shall advise all personnel connected with the Project of all necessary safety information so as to conduct a completely safe operation.

Empty containers, bags, drums and the like, shall be promptly removed from the Work Site at the end of each work period or shift and disposed of in a safe, orderly and legal manner.

If grout solutions are spilled or splashed on parts of the Work Site, such area shall be promptly washed down with water. If grout powder is spilled on parts of the work area, such area shall be swept broom clean and washed down with water. Spilled grout powder will under no conditions be permitted to be used or remain at the Work Site but shall promptly be removed from the Work Site and disposed of in accordance with all applicable Federal, State and Local laws, regulations and codes.

All duct lines and drainage systems within the structure, in the vicinity of the grouting work, shall be inspected during the injection of the grout and the duct lines or drainage systems shall be thoroughly cleaned and cleared of all grout if contaminated. The work shall be performed with precautions to prevent damage to existing structures, drains and utility lines.

Alert all personnel to:

- Avoid contact of chemicals with skin, eyes, and clothing.
- Avoid breathing chemical vapor or mist.
- Wash thoroughly after handling chemicals.
- Keep chemical containers closed to prevent contamination.

Educate and train employees working with the chemicals of the potential hazard and proper handling practices.

Materials in their final state shall be non-toxic, non-corrosive and non-flammable.

Handle materials in the manner prescribed by the manufacturer, with additional precautions as required by applicable public laws and jurisdictive controls. Applicators shall wear protective gear as necessary to provide adequate protection from any potential harmful effects of the materials used.

Provide lids or secure covers for tanks containing chemical solutions.
Provide adequate local ventilation in the Work Areas.

In addition to any and all other safety procedures on the job, special attention is called to the additional precautions that are necessary when working with chemicals. Promulgate a detailed safety plan to envision and deal with all foreseeable safety contingencies, and shall communicate the plan to all personnel connected with the Work.

Records.

Maintain accurate and complete up-to-date records of the Work, including specific daily grout crew reports.
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detailing the locations of cracks and grout holes, types and amounts injected at each hole, observations of grout
tavel and leakage, pressures used, and all other pertinent observations of the grouting process.

Devise an Identification and Daily Reporting System for leaks, leak treatment and grout holes. Upon the
completion of the Contract, submit a summary of all activities on a weekly basis, as an "as-built" record of the
Work. Reports shall be submitted to the Engineer on a weekly basis, reflecting the work of the previous week.

Drip Pan Removal.

Remove and dispose of all existing drip pans, piping and appurtenances to permit grouting work.

Tile Removal.

Remove existing tiles as necessary to permit grouting work.

METHOD OF MEASUREMENT.

Measurement for payment will be made on the basis of the following:

Cracks Treated with Grout: Cracks successfully treated with grout as specified in this Section, shall be measured
for payment by the lineal meter measured along the surface of the crack in 150 mm chords between the drilled
holes at the extreme ends of the crack rounded up to the nearest lineal meter, which includes additional length to
account for treatment extending beyond the holes at the extreme ends of the crack measured. Any treated crack
shorter than 0.610 meters in length, and which can be successfully treated by drilling only one hole, will be
measured as 1 meter in length. The cost of Polyurethane Grout shall be included in the payment for the lineal
measure of crack repair. An experienced contractor should know an average volume of grout per length of crack
to be used. This shall include the amount of base grout, measured at the pump and excluding reactants and
catalysts, that are properly prepared and injected into leaks. Catalysts, accelerator, inhibitors, buffers, cleaning
solutions, and other additives required to obtain the desired grout performance shall not be measured for payment.
Included in the measured quantities of grout shall be amounts wasted in the normal sequence of grouting, but
not grout quantities improperly mixed or wasted due to the negligence of the Contractor.
BASIS OF PAYMENT

Payment For Treating Cracks With Grout.

Payment for treating cracks with grout in accordance with the Contract Drawings and Specifications shall include the cost of performing all work including drilling holes, cleaning cracks, and providing all equipment required for the performance of the work and of all other work, labor and equipment required for treatment of all cracks in the Contract. Also included is payment for furnishing and delivering polyurethane grout including the cost of all catalysts, accelerators, inhibitors, buffers, cleaning solutions and other additives and all other materials, labor and equipment necessary therefore and incidental thereto. Payment for removal and disposal of drip pans shall also be included.

Payment for Removal of Tiles.

The cost of removal and replacement of existing tiles is deemed to be included in items 11560.2003 and 11560.2004.