SPECIFICATIONS – CHEMICAL GROUT
SECTION 3G – PINNACLE MUSEUM TOWER

ELASTOMERIC CHEMICAL GROUT

3G1.0 GENERAL REQUIREMENTS

3G1.1 SCOPE

A. The work shall include the furnishings by the Contractor, of all supervision, training, labor, materials, tools and equipment and the performance of all operations necessary for the chemical grouting work indicated in the Contract Drawings, specified herein, and/or as directed by the Engineer.

B. The work consists of the injection of liquid chemical grouts into active and inactive leaks through concrete cracks, joints or holes located in sidewall, floors, rooms, beams and other locations as shown on the Contract Drawings and in other areas designated by the Engineer and located within the limits of the Contract.

C. The work shall be performed in a skillful and workmanlike manner with special care taken to prevent damage to the existing structure, drains and utility components. Damage caused by improper work procedures or failure to maintain lines, equipment or structures shall be the responsibility of the Contractor.

E. In order to judge performance, all sealed work shall be inspected by the Contractor and the Engineer within three (3) days after a greater than 1/2 inch rainfall in one 24-hour period during the remediation phase. The work priorities will be

adjusted according to the results of the survey, at the direction of the Engineer.

3G1.2 CONTRACTOR QUALIFICATIONS

The chemical grouting work specified herein shall be performed by a qualified Contractor with a minimum of five (5) years recent experience in performing chemical grouting work in similar conditions.

3G1.3 FIELD SUPERVISION

The Contractor, if he does not meet the requirements of Paragraph 3G1.2, he shall hire a Grouting Consultant on a full time basis to monitor and supervise all phases of chemical grouting. The grouting consultants shall have a minimum of five (5) years of related recent experience under similar conditions.

3G1.4 SEQUENCE OF WORK

A. Prior to the start of work, the Contractor, at his own cost, is required to make a joint inspection of the affected areas with the Engineer and submit written reports or drawings to the Engineer to: (1) verify the location of the leaks shown on the Contract Drawings and determine the measurements of individual items and (ii) locate new leaks requiring repairs/fixes. The Contractor shall provide a measurement of each item.

B. Operating procedures shall be submitted to the Engineer for approval. Sufficient crews, experienced in this type of work, shall be made available to perform all of the work within the schedule. Utility crews shall be provided to support the grouting work efforts scheduled.

C. It is anticipated that if a particular leak is stopped, the leak may migrate to another location. It is expected that it may not be feasible to stop all the leaks by injection completely. The extent to which the leaks are to be stopped is to be determined by the Engineer.

3G2.0 GROUT MATERIALS

3G2.1 GENERAL

Two chemical grouts are to be used for sealing concrete cracks and joints. The selection of a grout for application at specific locations shall be based on the nature of the crack or joint in relation to the grout's properties. All grouts used shall have a successful history of application for at least four (4) years under conditions similar to the Pinnacle Museum Tower project.

3G2.2 POLYURETHANT GROUT

Polyurethane grout supplied shall be water-reactive liquid polyurethane base solutions which when reacted expand by foaming to at least seven (7) times the initial liquid volume and when set produce a flexible, closed void solid resistant to degradation by wet and dry cycles and chemicals found in concrete construction. Waterproofing grouts marketed by the following manufacturer or approved equal shall be used for the purpose: Stratathane as manufactured by Strata Tech.

3G2.3 PRODUCT VERIFICATION APPROVAL

A. Manufacturer's literature detailing the components, mixing and handling procedures and characteristics of the set time for the particular grout products proposed shall be submitted to the Engineer for approval before actual start of injection work. The

list of approved grouts given in Paragraph 3G2.2 are illustrative but not restrictive.

B. All grout products must 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 must have a chemical makeup of recognized performance.

C. Each alternative candidate grout must be demonstrated to and approved by the Engineer prior to the start of field grouting.

3G2.4 HANDLING, STORAGE AND DISPOSAL OF CHEMICALS

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 local, state and/or federal regulations, codes and ordinances. Spilled, spoiled, or open unused chemicals shall be disposed of in accordance with all applicable Municipal, State, and Federal codes and regulations.

3G3.0 CONSTRUCTION METHODS

3G3.1 EQUIPMENT

A. GENERAL

1. The Contractor shall supply all equipment, including pumps, containers, hoses, gages, packers, drills, bits, scaffolds, compressors, generators, vacuums, accessories, and all other items required to perform the work and accomplish the goals outlined in the specifications.

2. The equipment shall be of a type, capacity, and mechanical condition suitable for doing the work in an effective and efficient manner. All equipment, including all power sources, cables, chemical containers, scaffolds, and anything used in the performance of the work, shall meet all applicable safety and other requirements of Local, State, and Federal ordinances, laws, regulations and codes.

3. 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 the immediate one (1) hour repair of essential operating items.

4. Each grout crew shall maintain it's own equipment items required herein in order to operate independently of, and separate from, other grout crews.

B. POLYURETHANE GROUT PUMPS

Grout pumps for polyurethane grout injection shall be 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.

C. PACKERS

Packers which are specifically designed for the grouting operation shall be supplied and used capable of safely sealing and packing grout holes drilled into concrete and injected at pressure of up to 3,000 psi, and as recommended by the manufacture of the grout. Packers shall be of the

removable type such that the drilled hole can be cleaned and patched to at least 3 inches deep.

D. DRILLS

Hand drills capable of drilling small diameter holes of 1/2 to 1 inch in diameter in concrete shall be supplied and operated. 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 or joint as specified. Damaged or worn bits shall not be used. Backup drills and bits shall be supplied in sufficient numbers so that two drills or either type can be used simultaneously.

E. WATER REMOVAL EQUIPMENT AND SUPPLIES

Sufficient equipment and supplies shall be provided as necessary to remove water from walls 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: wet-dry vacuum, pumps, air blowers, mops and rags. Temporary dams shall be constructed as needed using sand bags or other suitable materials to keep water out of areas being actively grouted.

F. SCAFFOLDING

The contractor shall supply scaffolding to facilitate access for grouting crews to the indicted work areas.

3G3.2 WORK PROCEDURES

A. GENERAL

The injection work shall be performed with the skill and expertise typical of a specialty contractor experienced in waterproofing chemical grouting of concrete cracks and joints. The planning of the work and direction of the grouting crews shall be so managed by the contractor as to provide for orderly progress of the work and to accomplish the Contract goals.

B. ACCESS TO WORK AREAS

The contractor shall 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 lighting for inspection and performance of work.

C. INJECTION PROCEDURES

1. Step (1) 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 shall not be disturbed as they help retain fluid grout inside the crack or joint during the injection process. The Contractor shall 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 or joint. 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.

2. Step (2) Drilling Grout Holes: Grout holes shall be drilled using percussion or rotary drilling methods so as to intercept the crack or joint to be treated at an angle to the plane of the crack or joint and at mid-slab depth. Grout holes shall be 5/8 inch in diameter or less and match the injection nozzles. Grout holes shall be located so as to provide for complete grout coverage of the affected crack or joint 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. Grout holes may be started at a larger distance to accommodate packer placement and stepped down to a small diameter, and great depths if desired by the Contractor. Care will be taken not to penetrate any waterproof membrane. A limited number of grout holes may be pre-drilled 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. The Contractor shall drill a minimum of one hole per three (3) lineal feet of crack measured along the surface of the cracks, and inject chemical grout into each hole.

3. Step (3) Cleaning Grout Holes All grout holes shall be confirmed to be clean and free from dust, debris and obstruction 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, performed such that grit and debris are not permitted to clog the crack and are shown to be effective in permitting free flow of grout into the crack or joint. Associated with the cleaning of grout holes prior to grouting shall be the requirement to seal large cracks and open joints to reduce the loss of grout to the surface. This shall be done using oakum or rags driven into place with narrow chisels or screwdrivers; oakum and rags my be saturated with instant setting grout if needed for better sealing.

4. Step (4) Installation of Packer: A packer shall be installed in the grout hole just prior to injection and fixed in a way that a tight seal in 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 to free grout flow before reuse. Safety measures shall be taken against unexpected expulsion of the packer from the grout hole during high pressure injection.

5. Step (5) Grout Injection: Injection of the selected grout shall commence immediately after installation of the packers and shall be done using the equipment, materials, and procedures specified elsewhere in this

Paragraph 3G3.0 Pumping shall proceed as long as all of the following conditions are fulfilled: (I) grout is entering the crack of joint; (ii) the observable loss of grout returning from the crack is estimated to be less than 25% of the volume polyurethane grout being pumped; (iii) damage is not being done to the structure; (iv) the grout has not extended for more than five (5) feet along the crack or joint away from the grout hole.

6. Step (6) Post Injection Procedures After removal of the packer the grout hole shall be cleaned to a depth of at lease three (3) inches 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 disposed of properly on a current daily basis. Complete clean-up of all materials used in the process, including temporary packing of cracks and joints shall be removed and the location restored to a clean and tidy condition.

D. The Contractor shall provide direct oral communications between the worker at the point of injection and group pump operator and the Engineer's representative. The Engineer shall have access at all times to injection locations.

E. Control of the grout gel times are a critical aspect of successful waterproofing grouting. Gel times shall be short as practical and as short as two (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. It is essential that the manufacturer's recommendations are strictly followed.

F. The Contractor shall observe all weep holes, drains, and utility lines during injection operations and control the work to prevent clogging of same with grout. All drilling debris, grout and contaminated water will be contained and removed by the contractor and restore surfaces to original condition.

G. The Contractor shall provide for adequate disposal of packings, washing chemicals, wasted or leaked grout, drill cuttings, and other debris resulting from this work, prior to leaving a work area. The grouting crew shall wipe off visible grout on concrete surfaces, and restore the surface to a clean and tidy condition.

H. A sufficient quantity of basic chemical materials shall be stored at or near the work site to insure that the grouting operations will not be delayed due to shortage of grout materials. All chemical containers shall be clearly marked indicting any safety hazards associated with use or exposure to the grout materials and any precautions that should be taken to prevent injury to those handling the products.

I. The Contractor shall 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, on or in such equipment, including wet or electronic equipment, on or in such equipment including wet and dry vacuuming, as appropriate. Any construction finishes that are damaged by grout shall be cleaned, repaired and retouched by the Contractor. Marred surfaces shall be repaired in a manner which shall match the existing color and type as closely as possible.

3G3.3 SAFETY PRECAUTIONS

GENERAL RESPONSIBILITY

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

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

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

C. A portable eye wash unit shall be provided at each immediate work site and be available for immediate use in a emergency.

D. The Contractor shall provide any additional safety measures required by the manufacturer of the grout.

E. The Contractor shall post legible copies of the safety data sheets for each chemical at all necessary conspicuous locations within the work area. The 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.

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

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

H. All duct lines and drainage systems within the structure, in the vicinity of the chemical grouting work shall be inspected during the injection of the chemical grout into the duct lines or drainage systems, and the duct lines or drainage systems shall be thoroughly cleaned and cleared of all chemical grout if contaminated. The methods employed by the Contractor in preventing the

entrance of grouts and other deleterious materials and, if needed, cleaning the duct or drain lines or drainage systems shall be approved by the Engineer.

I. The Contractor must inspect the work site prior to bidding. All items necessary to perform the work, to comply with this specification, and to observe safety requirements shall be the Contractor's responsibility and shall be included as part of his proposal and included in the various prices for the work at no additional or separate cost.

J. The Contractor must alert all personnel to:
   1. Avoid contact of chemicals with skin, eyes, and clothing.
   2. Avoid breathing chemical vapor or mist.
   3. Wash thoroughly after handling chemicals.
   4. Keep chemical containers closed to prevent contamination.

K. Contractor must educate and train employees working with the chemicals of the potential hazard and proper handling practices.

L. Materials in the final state shall be none-toxic, non-corrosive and non-flammable.

M. 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 materials used.

N. Provide lids or secure covers for tanks containing chemical solutions.

O. The Contractor shall provide adequate local ventilation in the work areas.

P. 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. The Contractor shall 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 project.

Q. Repair and seal leaks or waterproofing failures in accordance with the specification as indicated on the drawings, or as otherwise directed.

3G3.4 RECORDS

The Contractor shall remain accurate and complete up-to-date records of the work, including specific daily grout crew reports detailing the locations of cracks and grout holes, types and amounts injected, observations of grout travel and leakage, pressures used, and any pertinent observations of the grouting process.