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TECHNICAL SPECIFICATIONS

LIST OF DRAWINGS

SECTION 020010 - WORK ITEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 - 9 Specification Sections apply to this Section.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

A. Unit prices stated by Bidder for all Work Items shall include all materials and Work installed and completed in place in accordance with all applicable portions of the Drawings and Specifications, and shall include all costs associated with such items including, but not limited to: materials, labor, supervision, overhead, and profit for General Contractor and/or subcontractors, general conditions, permits, shoring, and other related items.

WI 1.0 GENERAL REQUIREMENTS

A. Scope of Work

1. Work consists of performing all tasks, specifically required and incidental, which are not identified under separate Work Item designation, but necessary to perform the work identified in this project. This work includes, but is not limited to the following items:

   WI 1.1 – Project Mobilization (PS#4, PS#5, and PS#8)
   WI 1.5 - Temporary Signage & Barriers (PS#4, PS#5, and PS#8)

WI 1.1 PROJECT MOBILIZATION

A. Scope of Work

1. Work consists of coordinating, scheduling, obtaining and assembling at construction site all equipment, materials, permits, supplies, manpower and other essentials and incidentals necessary to perform Work defined in this Contract. Payment of lump sum amount for mobilization shall be according to following schedule and shall be based on percentage of original contract amount earned.

2. Contractor shall be responsible to obtain all permits required to perform work as specified, per all authorities having jurisdiction.

3. This Work Item applies to Parking Structures #4, #5, and #8.

B. Materials

1. None

C. Execution

1. At execution of agreement by all parties, mobilization payment shall not be more than 25% of mobilization lump sum amount.
2. When billing amount earned is greater than 10% but less than 25% of original contract amount, total payment for mobilization shall not be more than 50% of mobilization lump sum amount.
3. When billing amount earned is equal to or greater than 25% but less than 50% of original contract amount, total payment for mobilization shall not be more than 75% of mobilization lump sum amount.
4. When billing amount earned is equal to or greater than 50% of original contract amount, total payment for mobilization shall be 100% of mobilization lump sum amount.

WI 1.5 TEMPORARY SIGNAGE & BARRIERS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide, install, and remove following completion of project, Temporary Signage and Barriers as required for protection, safety, dust control, site access, traffic control, user information, and as required by Owner/Engineer during the duration of the project. Temporary Signage and Barriers shall be installed prior to start of work, and shall remain in place until all work is completed.

2. Payment for this item is lump sum at each structure to install all required signage, barriers, and dust control, maintain throughout entire project at all work areas, and remove upon completion of work.

3. This Work Item applies to Parking Structures #4, #5, and #8.

B. Materials

1. Temporary signage shall meet following minimum requirements:

a. Minimum size: As required for proper visibility based on intended audience (pedestrian or vehicle).
b. Backing material: 0.5 in. medium density overlay plywood.
c. Colors:

1) Background: medium orange or white.
2) Symbols/Lettering: black

d. Lettering: silk screened or die-cut.

1) Font Style: Helvetica or similar.
2) Size: 2 in. high minimum for pedestrian information; 4 in. high minimum for traffic information.

2. Barriers shall meet following minimum requirements:

a. Provide positive separation between pedestrians/vehicles and the designated work areas.
b. Contain all construction-generated dust and debris within designated work areas.

C. Execution

1. Mounting height: 5 ft. to bottom of sign. Provide mounting brackets as required.
2. Contractor shall submit shop drawings detailing sign size, layout, colors, and mounting schemes for approval prior to fabricating signs and mounting brackets.
3. Typical regulatory signs (that is, STOP, YIELD, etc.) and "Handicap" signs shall conform to all Federal, state, and local requirements for sizes, materials, and colors.
4. Temporary Signage shall be sufficient to ensure pedestrian and vehicle safety, provide clear and concise user information, and maintain traffic control throughout the entire structure, including:

a. Signage at all pedestrian entrances to the structure informing public of ongoing construction Project, maintained for the duration of the Project.
b. Signage at all vehicle entrances to notify public of ongoing construction Project and closed work areas, etc.
c. Signage in all stair and elevator towers on all levels, indicating which levels/areas are closed and which remain open.
d. Signage at all work area perimeters on all levels where Work is to be performed, clearly defining work area limits and explicitly prohibiting vehicle and pedestrian access, maintained for the duration of the repairs.
e. Signage as necessary to maintain normal traffic flow throughout structure and around closed work areas, including access to all areas of the structure remaining open for public use during repairs. Provide signs indicating route to follow for additional areas of parking, and route to follow to exit structure, at all levels and areas adjacent to work areas.
f. Other signage as required by Owner/Engineer, and as needed throughout the Project.

5. Temporary Barriers shall be sufficient to maintain a positive barrier around all work areas, prevent pedestrian and vehicle access into work areas, and contain all construction-generated dust and debris within the work areas. Barriers shall be installed in a manner to maintain ADA-compliant access to stair/elevator towers and structure exits at all times.
6. Dust control measures shall ensure that all construction-generated dust & debris maintains confined within the work areas, including above and below repair areas. Elevators and stair towers shall be protected from dust, debris, and water at all

times. Contractor shall be responsible for cleaning all construction-generated dust and debris from structure upon completion of repairs, including stair towers and elevators.

7. Submit plan to Engineer for review prior to start of work.

WI 1.6 MEANS OF ACCESS – EXTERIOR FAÇADE (FOR W.I.'S 4.9, 7.1, & 10.8 AT PS#4, FOR ALT. W.I. 11.3 AT PS#5)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide, erect, operate, maintain and remove fixed or suspended scaffolding, work platforms/lifts and/or other similar equipment necessary to access exterior work areas as needed to complete work outlined in Documents and at locations shown on plan sheets.

2. This Work Item applies to Parking Structure #4 (W.I.'s 4.9, 7.1, & 10.8), and Parking Structure #5 (Alt. W.I. 11.3). Payment shall be lump sum to provide access needed to complete all exterior work items.

3. NOTE: An underground structure is present along the east side of Parking Structure #4 between the structure and the sidewalk (size and location of underground structure unknown). Contractor shall not use manlifts or fixed scaffolding on or near this area unless Contractor confirms size and location of underground structure, and hires Professional Engineer licensed in State of Michigan to confirm that proposed access equipment is suitable and will not damage or overload underground structure. Otherwise, contractor shall use suspended scaffolds or other means of access for the work areas on the east exterior of the parking structure to avoid the underground structure. Submit access plan to Owner and Engineer for review/approval prior to start of any Work.

B. Materials

1. Lifts shall be capable of safely carrying out work.
2. Contractor is responsible for obtaining all permits to comply with requirements applicable at project site for constructing/operating access equipment (including for example: street lane closure permits, sidewalk closure permits, etc.).
3. Where suspended scaffolds are used on masonry or non-structural frame parapet/spandrel walls, contractor shall employ an outrigger support system that does not bear on the parapet/spandrel walls.
4. Parapet hooks/clamps shall not be used on non-structural frame parapet/spandrel walls. If parapet hooks/clamps are used, Contractor is responsible for providing calculations by a registered Professional Engineer in the project jurisdiction showing that parapet hook/clamp loads for the project do not exceed the structural capacity of the wall/building element to which they are attached.
5. The contractor is responsible for distributing the staging and support system loads to the structure in a manner which will not damage any part of the roof/slab system, or overload any of the structural elements.

6. Suspended scaffolds and/or buckets shall be of the motorized type (no rope stages allowed), capable of handling labor, equipment and material loads required for the project.
7. Electrical system shall be checked for voltage drop along the power cords for power supply. Special power supply may be needed to assure uninterrupted services.
8. Suitable existing electrical power supply/connection for construction work is not guaranteed by Owner.

    a. Contractor is responsible for determining suitability of existing power supply/connection considered for use during construction, and that use will not cause power disruption to building Owner/occupants.
    b. If suitable power connection does exist, Contractor is responsible for installing, maintaining and removing upon completion of work, suitable connections, meeting all local electrical code requirements.
    c. If existing power supply is inadequate, Contractor is responsible for providing alternate power supply and suitable connections meeting all local electrical code requirements for construction.

C. Execution

1. Erect overhead protection/temporary signage/traffic control as required prior to mobilization of access equipment.
2. Contractor shall verify and provide documentation upon request that verifies erection, maintenance, and removal of scaffolding (fixed or movable), and all rigging is in accordance with OSHA standards.
3. Contractor personnel erecting, operating, maintaining, and removing scaffold and rigging equipment shall be certified/trained according to current standards of the scaffold and construction industry.
4. Upon request by the Owner or Engineer, the Contractor shall submit to Owner and Engineer a detailed action plan for their scaffolding (erection, maintenance, and removal) prior to proceeding for general conformance and informational purposes only.
5. Independent lifelines shall be provided for every person working on suspended scaffolding, per scaffold industry standards. Lifelines shall not be secured to the same points used for suspended scaffold rigging connections.
6. Contractor shall provide access to Architect/Engineer or appointed project representative for performing observations during construction.

WI 3.0 CONCRETE FLOOR REPAIR

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals including shoring necessary to locate existing spalls, locate and remove delaminated and unsound floor concrete, prepare cavities and install new concrete and reinforcing (as required) materials to restore concrete floor to original condition and appearance. Refer to Detail Series 3.0 for specific requirements.

2. This Work applies to Parking Structures #4, #5, and #8.

3. **Contractor required to locate embedded conduit/wiring by GPR scanning or other acceptable means prior to start of saw-cutting or concrete removals. Perform all work in manner to not cut or damage embedded conduit/wiring.**

B. Materials

1. Concrete repair materials shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration.”
2. Conventional steel reinforcement shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration.”

C. Execution

1. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching", Article "Inspection".
2. Procedure for delaminated, spalled, and unsound concrete removal shall be as specified in Section "Surface Preparation for Patching", Article "Preparation". Remove all unsound concrete within marked boundary prior to saw-cutting and preparation of patch edges.
3. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation".
4. All steel exposed within cavities shall be cleaned to bare metal by sandblasting as specified in Section "Surface Preparation for Patching", Article "Cleaning of Reinforcement within Delamination and Spall Cavities", and damaged and defective reinforcement replaced as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas". Exposed steel shall be coated with an approved corrosion inhibitor as specified in Section “Cast-in-Place Concrete Restoration”.
5. Contractor shall prepare cavities for patch placement as specified in Section "Surface Preparation for Patching", Article "Preparation of Cavity for Patch Placement".
6. Patch materials and associated reference specifications are listed in Article “Materials" above. Patch installation procedures shall be in accordance with referenced specifications for selected material.

WI 3.1A FLOOR REPAIR - PARTIAL DEPTH (PC FIELD-TOPPED)

A. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1A for specific requirements.

B. This Work Item applies to Parking Structures #5 and #8.

C. Sound floors to locate deterioration and verify in field with Engineer prior to starting removals.

D. Payment for this Work Item shall be per square foot of repair performed.

WI 3.1C FLOOR REPAIR - PARTIAL DEPTH (P/T)

A. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1C for specific requirements.

B. This Work Item applies to Parking Structure #4.

C. Sound floors to locate deterioration and verify in field with Engineer prior to starting removals.

D. Payment for this Work Item shall be per square foot of repair performed.

WI 3.1D FLOOR REPAIR - PARTIAL DEPTH (ELEVATOR LOBBY)

A. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1D for specific requirements.

B. This Work Item applies to Parking Structure #5.

C. Sound floors to locate deterioration and verify in field with Engineer prior to starting removals.

D. Payment for this Work Item shall be per square foot of repair performed.

E. Perform removals with caution to not damage precast planks or other surrounding construction.

WI 3.1E FLOOR REPAIR - PARTIAL DEPTH (CONCRETE WASHES)

A. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1E for specific requirements.

B. This Work Item applies to Parking Structure #8.

C. Sound floors to locate deterioration and verify in field with Engineer prior to starting removals.

D. Payment for this Work Item shall be per square foot of repair performed.

WI 3.2 FLOOR REPAIR – SLAB-ON-GRADE

A. Refer to Work Item 3.0, "Concrete Floor Repair" for scope of Work, materials and Execution procedure associated with this Work Item. Refer to Detail 3.2 for specific requirements.

B. Payment for this Work Item shall be per square foot of repair performed.

C. This Work Item applies to Parking Structures #4, #5 and #8.

WI 3.3A FLOOR REPAIR - FULL DEPTH (PC FIELD-TOPPED)

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate and remove full depth unsound floor concrete, prepare cavity, install supplemental reinforcement, and install patching material to restore floor to original integrity and appearance. Refer to Detail 3.3A for specific requirements. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of Work, materials, and procedures associated with this Work Item.

2. Installation of supplemental reinforcement required on Detail 3.3A shall be incidental to this Work and NOT payable under other Work Items. This work also includes tooling and sealing entire perimeter of repairs (incidental). See W.I. 11.4.

3. This Work Item applies to Parking Structures #5 and #8. Payment shall be per square foot of repair performed.

B. Materials

1. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete Restoration" and/or Section “Prepackaged Repair Mortar” and on Drawings.
2. Epoxy-coated steel reinforcement shall be as specified in Section "Cast-in-Place Concrete Restoration”.
3. Epoxy adhesive shall be Hilti HIT-HY 200 Safe Set.
4. Sealant shall be as specified in Section “Concrete Joint Sealants”.

C. Execution

1. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching", Article "Inspection".
2. All concrete shall be removed from within marked boundaries until sound concrete is reached on all sides.
3. Sawcut shall then be made approximately 3 in. from edge of cavity. This sawcut shall be to depth of 0.75 in. and all edges shall be straight. Underside of slab shall have its repair edge ground to depth of 0.5 in. Patches shall be as square or rectangular-shaped as practical. All concrete within sawcut shall be removed to minimum depth of 0.75 in. Also see Section “Surface Preparation for Patching", Article "Preparation".
4. Do not cut or damage any existing reinforcement, including WWR.
5. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation".
6. All steel exposed within cavities shall be cleaned to bare metal by sandblasting according to Section "Surface Preparation for Patching", Article "Cleaning of Reinforcement within Delamination and Spall Cavities", and damaged and defective reinforcement replaced as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas". Exposed steel shall receive corrosion inhibitor coating as specified in Section “Cast-in-Place Concrete Restoration”.

7. Contractor shall prepare cavities for patch placement as specified in Section "Surface Preparation for Patching", Article "Preparation of Cavity for Patch Placement".
8. Patch materials and associated reference specifications are listed in Article "Materials" above. Patch installation procedures shall be in accordance with referenced specifications for selected material.

WI 3.3C FLOOR REPAIR - FULL DEPTH (P/T)

A. Refer to Work Item 3.3A, “Floor Repair – Full Depth (PC Field-Topped)” for similar Scope of Work, Material and Execution procedures associated with this Work Item. Refer to Detail 3.3C for specific requirements.

B. This Work Item applies to Parking Structure #4. Payment shall be per square foot of repair performed.

WI 3.3D FLOOR REPAIR - FULL DEPTH (ELEVATOR LOBBY)

A. Refer to Work Item 3.3A, “Floor Repair – Full Depth (PC Field-Topped)” for similar Scope of Work, Material and Execution procedures associated with this Work Item. Refer to Detail 3.3C for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment shall be per square foot of repair performed.

C. Locate repairs in field with Engineer prior to start of work. Protect all existing embedded and surface-mounted conduit/wiring (incidental).

WI 3.3E FLOOR REPAIR - FULL DEPTH AT EXPANSION JOINT

A. Refer to Work Item 3.3A, “Floor Repair – Full Depth (PC Field-Topped)” for similar Scope of Work, Material and Execution procedures associated with this Work Item. Refer to Detail 3.3E for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment shall be per square foot of repair performed.

WI 3.3F FLOOR REPAIR – PC PLANK REPLACEMENT (ELEVATOR LOBBY)

A. Work is to fully replace an individual precast plank and concrete topping at the elevator lobby in PS#5 with a cast-in-place repair slab. Refer to Work Item 3.0, “Concrete Floor Repair for Materials associated with this Work Item. Refer to Detail Series 3.3F for specific requirements and work procedure.

B. This Work Item applies to Parking Structure #5. Payment shall be per square foot of repair performed.

C. Locate repairs in field with Engineer prior to start of work. Protect all existing embedded and surface-mounted conduit/wiring (incidental).

D. Install temporary shoring prior to start of work (incidental). Confirm requirements with Engineer.

WI 3.4 FLOOR REPAIR – CURBS

A. Refer to Work Item 3.0, “Concrete Floor Repair” for Scope of Work, Material and Execution procedures associated with this Work Item. Refer to Detail 3.4 for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment shall be per square foot of repair performed.

WI 3.6 FLOOR REPAIR – SLAB EDGE

A. Refer to Work Item 3.0, “Concrete Floor Repair” for Scope of Work, Material and Execution procedures associated with this Work Item. Refer to Detail 3.6 for specific requirements.

B. This Work Item applies to Parking Structures #4. Payment shall be per square foot of repair performed.

WI 3.9 SUPPLEMENTAL EPOXY-COATED STEEL

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide and install supplemental epoxy-coated reinforcing bars to replace/supplement defective existing reinforcing bars in concrete repair areas as directed by Engineer. Contractor shall verify condition of existing reinforcement with Engineer prior to placing repair material at all concrete repair areas.
2. This Work Item applies to Parking Structures #4 and #5, and is applicable to all concrete repair items. This Work Item shall be used as needed and directed by Engineer based on field conditions. Contractor shall adjust quantities, lengths, and sizes of rebar supplied to Project to meet demands of the Project as work progresses. Verify with Engineer prior to ordering materials.
3. Supplemental reinforcement indicated as incidental to other Work Items shall NOT be applicable for payment under this Work Item.
4. Payment for this Work Item shall be per pound of supplemental reinforcement actually installed, verified in field with Owner/Engineer. Contractor shall submit actual material invoices upon request of Owner.

B. Materials

1. Conventional, epoxy-coated steel reinforcement shall be as specified in Section "Cast-in-Place Concrete Restoration". Confirm size and length of bars with Engineer prior to ordering.

C. Execution

1. Contractor shall allow Engineer to observe existing reinforcement as specified in Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation".
2. Contractor shall furnish and install supplemental epoxy-coated reinforcement to replace defective reinforcement as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas".
3. Replacement of existing reinforcement damaged due to Contractor's removal operations shall be performed at no cost to Owner.
4. Supplemental reinforcement shall be of equal or greater diameter than the original diameter of the reinforcement being replaced. Verify in field with Engineer.

WI 3.10 SUPPLEMENTAL REINFORCING DOWELS

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to dowel and epoxy-anchor supplemental epoxy-coated reinforcing bars as directed by Engineer. Unit price shall be based on 4-ft. long #4 bars, (with 6" hook as needed) with minimum embedment depth as stated in Article "Execution" below.

2. This Work Item applies to Parking Structures #4 and #5. This Work Item is payable per each supplemental dowel installed. Locate and confirm requirements in the field with Engineer.

3. Supplemental dowels or reinforcement indicated as required or incidental on Details, and noted as required or incidental to any other Work Items shall **not** be applicable for payment under this Work Item.

4. Unit price for this Work shall include providing, installing, and epoxy-anchoring each 4-ft. long #4 bar dowel (with or without hook) as stated above. All doweled supplemental reinforcement shall be paid for under this Work Item only, and not double-billed under W.I. 3.9 also. Quantity shall be verified in field with Engineer.

B. Materials

1. Epoxy-coated steel reinforcement shall be as specified in Section "Cast-in-Place Concrete Restoration".
2. Epoxy reinforcement adhesive shall be Hilti HIT-HY200 Safe Set.

C. Execution

1. Contractor shall allow Engineer to observe existing reinforcement as specified in Section “Surface Preparation for Patching”, Article “Inspection of Repair Preparation”.
2. Contractor shall furnish and install supplemental epoxy-coated reinforcement to replace/supplement defective reinforcement as specified in Section “Surface Preparation for Patching and Overlay”, Article “Reinforcement and Embedded Materials in Repair Areas” as directed by Engineer.
3. Replacement/supplementing of existing reinforcement damaged due to Contractor’s removal operations shall be performed at no additional cost to Owner.
4. Reinforcement shall be doweled into existing concrete to minimum depth given in Hilti Engineering Data that provides full development of reinforcement yield strength (but not less than 8”).
5. Verify the need for supplemental dowels with Engineer prior to concrete placement at all concrete repair areas.

WI 4.1 CEILING REPAIR – PARTIAL DEPTH (P/T)

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision and incidentals including shoring necessary to locate existing spalls, locate and remove delaminated and unsound overhead concrete, prepare cavities and install new concrete and reinforcing (as required) materials to restore overhead concrete to original condition and appearance. Refer to Detail 4.1 for specific requirements.

2. This Work Item applies to Parking Structure #4, and is payable per square foot of repairs performed.

B. Materials

1. Repair materials shall be as specified in Section “Prepackaged Repair Mortar” or Section “Shotcrete” Trowel applied patching material not allowed.

C. Execution

1. Locating, marking, removal, preparation, and inspection of deteriorated concrete and reinforcing steel preparation, repair and installation shall be performed as specified in Division 02 Section "Surface Preparation for Patching.”
2. Final surface preparation, concrete placement, finishing and curing shall be performed as specified in concrete repair material specification. Manufacturer specifications/requirements on these issues shall also be followed in the event proprietary bag mix repair materials are used.
3. Contractor shall take care to protect adjacent areas from overspray if "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.
4. Install supplemental pins/anchors in repair areas as shown on Detail 4.1 (incidental).

WI 4.9 REMOVE LOOSE CONCRETE & COAT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate and remove delaminated and loose overhead concrete, and coat resulting cavities with specified material. Removals shall include physically loose concrete, as well as visibly spalled, cracked, and/or delaminated areas; sound concrete is not to be removed. Removal of loose overhead concrete on exterior facades is included in this Work. See W.I. 1.6 for access requirements.
2. Payment for this Work Item shall be lump sum to remove all sections of loose concrete on all overhead surfaces throughout the structure, on all levels, including exterior facade.
3. Contractor shall verify overhead removal heights and general scope of removal requirements prior to submitting bid.
4. This Work Item applies to Parking Structures #4, #5, and #8.

B. Equipment

1. Removals shall be performed using hand tools. If required, chipping hammers shall be 15-lbs or less, only as directed by Engineer.

C. Materials

1. Sika Armatec 110 EpoCem, or approved equivalent.

D. Execution

1. Contractor shall locate areas for concrete removal in field. Engineer will verify types of removals to be performed by Contractor prior to start of Work. Contractor is responsible for locating and performing all removals on all overhead surfaces (ceilings, beams, stems, walls, etc.) and entire exterior facade.
2. All steel exposed within loose concrete removal areas shall be cleaned to bare metal by sand-blasting or wire brush. Removal area shall be prepared per Section “Surface Preparation for Patching”.
3. Contractor shall coat each removal area with specified epoxy-coating material (incidental).

WI 5.0 CONCRETE BEAM REPAIR

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision and incidentals including shoring necessary to locate existing spalls, locate and remove delaminated and unsound overhead concrete, prepare cavities and install new concrete and reinforcing (as required) materials to restore concrete beams to

original condition and appearance. Refer to Detail Series 5.0 for specific requirements.

2. Installation of supplemental reinforcement and temporary shoring requirements on Detail Series 5.0 shall be incidental to this Work and NOT separate pay items, unless specifically noted otherwise.

B. Materials

1. Repair materials shall be as specified in Sections “Cast-in-Place Concrete Restoration”, “Prepackaged Repair Mortar”, and/or "Shotcrete".
2. Trowel-applied repair materials not allowed.

C. Execution

1. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching", Article "Inspection". Engineer shall verify critical repair area identification prior to start of repairs.
2. Procedure for delaminated, spalled, and unsound concrete removal shall be as specified in Section "Surface Preparation for Patching", Article "Preparation".
3. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation".
4. All steel exposed within cavities shall be cleaned to bare metal by sandblasting according to Section "Surface Preparation for Patching", Article "Cleaning of Reinforcement within Delamination and Spall Cavities", and damaged and defective reinforcement replaced as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas". Exposed steel shall be coated with an approved corrosion inhibitor coating as specified in Section “Cast-in-Place Concrete Restoration”.
5. Contractor shall prepare cavities for patch placement as specified in Section "Surface Preparation for Patching", Article "Preparation of Cavity for Patch Placement".
6. Shoring support shall be provided as necessary and in accordance with Detail Series 5.0 and Section “Cast-in-Place Concrete Restoration”.
7. Patch installation procedures shall be in accordance with referenced specifications for selected material.
8. Contractor shall take care to protect adjacent areas from overspray if Section "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.

WI 5.1 BEAM REPAIR – PARTIAL DEPTH (LEDGE)

A. Refer to Work Item 5.0 "Concrete Beam Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 5.1 for supplemental reinforcement and other specific requirements.

B. At all locations where this Work occurs, Contractor shall provide 25-kip minimum capacity shoring (3 levels below) at both stems of double tees in repair area prior to start of concrete removals (incidental).

C. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per lineal foot of repair performed.

WI 5.2 BEAM REPAIR - PARTIAL DEPTH (SIDE)

A. Refer to Work Item 5.0 "Concrete Beam Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 5.2 for specific requirements.

B. This Work may require concrete to be placed from the topside concurrent with full-depth floor repairs, based on field conditions. Verify in field.

C. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per square foot of repair performed.

D. Temporary Shoring required to perform this Work shall be payable under W.I. 18.1. Verify shoring requirements in field with Engineer.

WI 5.3 BEAM REPAIR - PARTIAL DEPTH (UNDERSIDE)

A. Refer to Work Item 5.0 "Concrete Beam Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 5.3 for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per square foot of repair performed.

C. Temporary Shoring required to perform this Work shall be payable under W.I. 18.1. Verify shoring requirements in field with Engineer.

WI 5.4 BEAM REPAIR - PARTIAL DEPTH

A. Refer to Work Item 5.0 "Concrete Beam Repair" for scope of Work, Materials, and procedures associated with this Work Item. Refer to Detail 5.4 for specific requirements.

B. This Work Item applies to Parking Structure #4, and is payable per square foot of repair performed.

C. Contractor shall install temporary shoring prior to concrete removals. Minimum temporary shoring requirements are shown on Detail 5.4. Contractor is responsible to provide temporary shoring to support all dead and live loads; verify in field with Engineer prior to start of Work. Remove all live loads above and 2 levels below beam repair locations.

WI 5.5 BEAM REPAIR - PARTIAL DEPTH AT HAUNCH

A. Refer to Work Item 5.0 "Concrete Beam Repair" for scope of Work, Materials, and procedures associated with this Work Item. Refer to Detail 5.5 for specific requirements.

B. This Work Item applies to Parking Structure #4, and is payable per square foot of repair performed.

C. Contractor shall install temporary shoring prior to concrete removals. Minimum temporary shoring requirements are shown on Detail 5.5. Contractor is responsible to provide temporary shoring to support all dead and live loads; verify in field with Engineer prior to start of Work. Remove all live loads above and 2 levels below beam being repaired.

WI 6.1 COLUMN REPAIR – PARTIAL DEPTH

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals including shoring necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities and install concrete and reinforcing (as required) materials to restore concrete columns to original condition and appearance. Refer to Detail 6.1 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per square foot of repair performed.

B. Materials

1. Pressure applied concrete repair materials shall be as specified in Division 03 Section "Shotcrete."
2. Cast-in-place concrete repair materials shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration” or “Prepackaged Repair Materials”.
3. Conventional steel reinforcement shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration.”
4. Trowel applied patching material not allowed.

C. Execution

1. Locating, marking, removal, preparation, and inspection of deteriorated concrete and reinforcing steel preparation, repair and installation shall be performed as specified in Division 02 Section "Surface Preparation for Patching.” Install shoring at repair locations where required per the Construction Documents prior to starting removals.
2. Final surface preparation, concrete placement, finishing and curing shall be performed as specified in concrete repair material specification. Manufacturer specifications/requirements on these issues shall also be followed in the event proprietary bag mix repair materials are used.
3. Contractor shall take care to protect adjacent areas from overspray if "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.

WI 7.0 CONCRETE WALL REPAIR

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals including shoring necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities and install concrete and reinforcing (as required) materials to restore concrete walls to original condition and appearance. Refer to Detail Series 7.0 for specific requirements.

B. Materials

1. Pressure applied concrete repair materials shall be as specified in Division 03 Section "Shotcrete."
2. Cast-in-place concrete repair materials shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration.”
3. Conventional steel reinforcement shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration.”
4. Trowel applied patching material not allowed.

C. Execution

1. Locating, marking, removal, preparation, and inspection of deteriorated concrete and reinforcing steel preparation, repair and installation shall be performed as specified in Division 02 Section "Surface Preparation for Patching and Overlay .” Install shoring at repair locations where required per the Construction Documents prior to starting removals.
2. Final surface preparation, concrete placement, finishing and curing shall be performed as specified in concrete repair material specification. Manufacturer specifications/requirements on these issues shall also be followed in the event proprietary bag mix repair materials are used.
3. Contractor shall take care to protect adjacent areas from overspray if "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.

WI 7.1 WALL REPAIR - PARTIAL DEPTH

A. Refer to Work Item 7.0, "Concrete Wall Repair" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 7.1 for specific requirements.

B. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per square foot of repair performed.

WI 7.2 WALL REPAIR – GROUT POCKETS

A. Refer to Work Item 7.0, "Concrete Wall Repair" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 7.2 for specific requirements.

B. This Work Item applies to Parking Structures #5 and #8, and is payable per square foot of repair performed.

WI 8.0 PRECAST TEE STEM REPAIR

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals including shoring necessary to locate, support, and repair damaged or deteriorated tee stems. Refer to Detail Series 8.0 for specific requirements.

2. This Work applies to Parking Structure #5.

B. Materials/Equipment

1. Repair materials shall be as specified in Sections “Cast-in-Place Concrete Restoration”, “Prepackaged Repair Mortar”, or "Shotcrete".
2. Trowel applied repair materials not allowed.
3. Chipping hammers shall be 15 lb. or less unless approved by Engineer.

C. Execution

1. Contractor shall locate and mark tee stem repairs indicated on Drawings according to Section "Surface Preparation for Patching", Article "Inspection".
2. Contractor shall provide shoring as required on Details in accordance with Section "Cast-in-Place Concrete Restoration". Submit Shop Drawings and receive Engineer's approval prior to starting removal operations.
3. Procedure for delaminated, spalled, and unsound concrete removal shall be as specified in Section "Surface Preparation for Patching", Article "Preparation".
4. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation".
5. All steel exposed within cavities shall be cleaned to bare metal by sandblasting as specified in Section "Surface Preparation for Patching", Article "Cleaning of Reinforcement within Delamination and Spall Cavities", and damaged reinforcement replaced as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas". Exposed steel shall be coated with approved corrosion inhibitor coating as specified in Section “Cast-in-Place Concrete Restoration”.
6. Contractor shall prepare cavities for patch placement in accordance with Section "Surface Preparation for Patching", Article "Preparation of Cavity for Patch Placement".
7. Patch materials and associated reference specifications are listed in Article "Materials" above. Patch installation procedures shall be in accordance with referenced specifications for selected material.
8. Contractor shall maintain forms and shores in place until concrete has achieved at least 75% of 28-day strength.
9. Contractor shall take care to protect adjacent areas from overspray if "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.

WI 8.1 TEE STEM REPAIR - PARTIAL DEPTH

A. Refer to Work Item 8.0 "Precast Tee Stem Repair" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 8.1 for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per lineal foot of repair performed as directed by Engineer.

WI 8.2 TEE STEM REPAIR - TEST OPENING

A. Refer to Work Item 8.0 "Precast Tee Stem Repair" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 8.2 for specific requirements.

B. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per each location as directed by Engineer.

C. This work shall be performed at locations noted on plans at start of project. Confirm specific locations in field with Engineer prior to start of removals.

D. Remove all live loads from floor above. Perform removals to not damage any embedded reinforcement or pre-stressing strands (including WWR). Allow Engineer to observe cavities and exposed pre-stressing strands prior to proceeding. Engineer will direct Contractor to complete tee stem repairs as needed per W.I. series 8.0 as applicable.

WI 8.3 TEE STEM REPAIR – PARTIALLY ENCASED STEM

A. Refer to Detail Series 8.3 for scope of Work, materials and procedure associated with this Work Item. See Drawing R-505.

B. Work occurs as needed at Parking Structure #5, based on findings at test openings per W.I. 8.2. Verify requirements in field with Engineer prior to start of Work.

C. Payment shall be per each location (24’-0” total repair length). See W.I. 8.3A if longer repair length is required due to amount of deterioration to pre-stressing strands. See notes on Detail 8.3.

D. Allow Engineer to observe reinforcing steel placement/installation prior to installing formwork or placing repair material.

E. Do not apply tension to the thread bars unless Engineer is present onsite. Calibrated equipment shall be utilized for tensioning to document amount of tension applied to bars. Coordinate with tensioning equipment manufacturer. Contractor responsible to procure tensioning equipment suitable for the repairs as detailed.

F. See Drawing R-505 for Detail Series 8.3 for PS#5.

WI 8.3A TEE STEM REPAIR – PARTIALLY ENCASED STEM (ADDITIONAL LENGTH)

A. Work Item 8.3A applies where longer repair length is required for W.I. 8.3 due to amount/location of deterioration to pre-stressing strands.

B. Payment shall be per linear foot of repairs performed beyond the 24'-0" repair length required per W.I. 8.3, only as directed by Engineer. See notes on Detail 8.3.

WI 8.4 TEE STEM REPAIR – END ENCASEMENT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate extensively cracked or spalled and delaminated tee stems, install temporary shoring, remove loose or deteriorated concrete, prepare cavity and install reinforced concrete tee stem encasement at end of stems. Refer to Detail Series 8.4 for specific requirements.

2. This Work Item applies to Parking Structure #5. Payment for this Work Item shall be per each location of repair performed (required length of repair shown on Detail).

B. Materials/ Equipment

1. Repair materials shall be as specified in Sections "Cast-in-Place Concrete Restoration" and/or "Prepackaged Repair Mortar".
2. Epoxy-coated steel reinforcing shall be as specified in Section "Cast-in-Place Concrete Restoration".
3. Chipping hammers shall be 15 lb. or less as directed by Engineer. Only sections of loose concrete shall be removed; do not remove sound concrete or expose embedded reinforcement without prior direction from Engineer.
4. Temporary Shoring requirements are shown on Detail 8.4.

C. Execution

1. Contractor shall locate and mark Work areas. General locations of tee stems requiring encasement repairs are shown on Drawings. Engineer shall verify Work areas with Contractor prior to start of repairs.
2. Remove live loads from floors above and below repair area. Both stems of double tee being repaired shall be shored as required on Detail Series 8.4 and in accordance with Section "Cast-in-Place Concrete Restoration".
    a. Install 25-kip minimum capacity temporary shoring (2 levels below) beneath both stems of affected double tee prior to start of concrete removals (incidental).
3. Existing location of pre-stressing strands shall be determined before Work commences.
4. Tee flange concrete shall be removed as needed to place repairs from above (incidental).

5. Cracked tee stem concrete shall remain in place. Do not completely remove concrete from around reinforcement. Verify concrete removal requirements with Engineer prior to start of Work.
6. Following necessary concrete removals, concrete stem surface shall be roughened to 0.25 in. amplitude.
7. Drill holes in stem for #4 bent bars. Exercise caution to avoid damage to pre-stressing strand and other reinforcement.
8. Install epoxy-coated steel reinforcing in accordance with Section "Cast-in-Place Concrete Restoration" and Drawings.
9. Install formwork as required to conform to dimensions as shown on Details.
10. Patch materials and associated reference specifications are listed in Article "Materials" above. Patch installation procedures shall be in accordance with referenced specifications for selected material.
11. Shop drawings for Work shall be submitted and approved by Engineer prior to start of Work.

WI 8.5 SUPPLEMENTAL BEARING SUPPORT @ STEM

A. Refer to Work Item Detail 8.5, "Supplemental Bearing Angle @ Stem" for scope of Work, materials, procedure and specific requirements associated with this Work Item.

B. This Work Item applies to Parking Structure #5 and is payable on an each basis for angles installed.

WI 9.1 EXPANSION JOINT – NEW CONCRETE WASH W/ BLOCKOUT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate Work area, remove existing expansion joint materials, remove sound floor slab concrete, prepare cavity surface, install formwork, and install concrete wash and expansion joint blockout. Refer to Detail 9.1 for specific requirements. This Work shall be coordinated with Work Items 10.3 and 16.1, and other Series 9.0 Work Items as applicable.

2. This Work Item applies to Parking Structure #4, and is payable per lineal foot of concrete wash installed at width shown on Detail. General locations are identified on plan sheets, verify in field with Engineer.

3. Coat all exposed reinforcement, including P/T elements, with approved corrosion inhibitor (incidental). Repair damaged sheathing on exposed tendons (incidental).

B. Material

1. Concrete repair materials shall be as specified in Section “Cast-in-Place Concrete Restoration.”

C. Execution

1. All P/T inspection work (W.I. 21.1) and associated P/T repairs (W.I. Series 21.0) shall be completed in the same bay/level prior to start of this Work. Confirm in field with Engineer.
2. Contractor shall remove existing expansion joint materials in manner that minimizes damage to existing blockout and adjacent concrete. Removals shall be performed with caution to avoid damaging embedded P/T system elements. P/T anchors are present along expansion joints; verify location of embedded P/T anchors and tendons prior to performing concrete removals.
3. Alterations to existing expansion joint blockout required for installation of new expansion joint system shall be performed in accordance with Work Items 3.1C / 9.2 / 9.3 / 9.4 as applicable, and Section "Surface Preparation for Patching."
4. Contractor shall locate and mark concrete wash installation areas as located on Drawings. Confirm in field with Engineer.
5. Removal of existing expansion joint system shall be performed with caution to minimize damage to existing blockout on side of joint not receiving concrete wash (see Detail 9.1).
6. All sound and unsound concrete shall be removed from within marked boundaries by saw-cutting and chipping to sufficient width and depth as described in Detail 9.1. Caution shall be exercised during saw-cutting and concrete removal operations to avoid damaging existing P/T system elements and embedded reinforcement.
7. Spalls and delaminations located within the wash areas requiring removals beyond the requirements shown on Detail 9.1 shall be patched in accordance with Work Item 3.1C. Perform other blockout repairs as necessary per W.I.s 9.2 / 9.3 / 9.4 as directed by Engineer and approved by expansion joint manufacturer.
8. Repair materials and associated reference specifications are listed in Article “Materials” above. Repair installation procedures shall be in accordance with referenced specifications for selected material.
9. Elevation of new concrete wash shall match existing elevation of slab on other side of expansion joint (typical).
10. New expansion joint system shall be installed (and paid for) per W.I. 10.3.
11. New traffic coating at concrete wash area shall be installed per requirements of W.I. 16.1 (incidental). Overlap existing coating 4” minimum.

WI 9.2 EXPANSION JOINT – NEW CONCRETE BLOCKOUT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate the Work area, remove sound and unsound floor slab concrete as required, install supplemental reinforcement, install formwork, and pour repair material to create new blockout ready to receive new expansion joint systems. Refer to Detail 9.2 for specific requirements and installation conditions. This Work shall be coordinated with other related expansion joint and blockout W.I.s.

2. This Work Item applies to Parking Structure #4 and #5, and is payable per lineal foot of repair performed along one side of joint. Blockout replacement required per W.I. 9.1 is incidental to that work and not applicable for payment under this item.

B. Materials

1. Cast-in-place concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and/or "Pre-packaged Repair Mortar".

C. Execution

1. Contractor shall remove existing expansion joint materials in manner that minimizes damage to adjacent concrete. Intent is to reuse existing sound concrete blockouts where possible in lieu of rebuilding per this Work Item. Confirm in field with Engineer and expansion joint manufacturer.
2. Where concrete deterioration is present and existing concrete blockouts cannot be salvaged, perform concrete removals as shown on Detail 9.2 in accordance with Section "Surface Preparation for Patching and Overlay".
3. Removals shall be performed with caution to avoid damaging embedded P/T system elements. P/T anchors are present along expansion joints; verify location of embedded P/T anchors and tendons prior to performing concrete removals.
4. All concrete requiring removal shall be square sawcut and chipped to limits/dimensions detailed. Caution shall be exercised during saw-cutting operations to avoid damaging existing embedded post-tensioning system elements and embedded reinforcement.
5. Adjacent spalls and delaminations located beyond the limits shown on Detail 9.2 shall be repaired in accordance with Work Item Series 3.0 as applicable.
6. Contractor shall allow for Engineer inspection of all cavities for condition as specified.
7. Contractor shall arrange for expansion joint manufacturer's representative to be onsite to review and approve all blockout dimensions and repair procedures prior to placing concrete.
8. Final surface preparation, concrete placement, finishing and curing shall be performed as specified in concrete repair material specification. Manufacturer specifications/requirements for these issues shall also be followed in the event proprietary bag mix repair materials are used.
9. Perform all work in accordance with Section "Expansion Joint Assemblies" and expansion joint manufacturer's written instructions/recommendations.

WI 9.3 EXPANSION JOINT – NEW BLOCKOUT AT ENDS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate the Work area, remove sound and unsound floor slab concrete as required, install supplemental reinforcement, install formwork, and pour repair material to create new blockout ready to receive new expansion joint systems. Refer to Detail 9.2 for specific requirements and installation

conditions. This Work shall be coordinated with other related expansion joint and blockout W.I.s.

2. This Work Item applies to Parking Structure #4, and is payable per each location. This Work occurs at both ends of all expansion joints being repaired/replaced per W.I. 10.3.

B. Materials

1. Cast-in-place concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and/or "Pre-packaged Repair Mortar".

C. Execution

1. Perform concrete removal and replacement at the locations shown in Detail 9.3. Reference Work Item 9.2 for similar concrete removal and replacement procedure.

WI 9.4 EXPANSION JOINT – BLOCKOUT REPAIR (E/S)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate the Work area, prepare surfaces, and install epoxy/sand material to fill voids and repair existing concrete expansion joint blockouts. This work is only to be performed if recommended/approved by expansion joint manufacturer, otherwise blockouts are to be repaired per other Work Items.

2. This Work Item applies to Parking Structure #4, and is payable per square foot of repair performed.

3. If approved by expansion joint manufacturer, this Work Item shall be utilized to perform minor patching and filling of voids on existing concrete blockouts that are otherwise sound. Any repair work needed at new blockouts poured by Contractor per W.I.'s 9.1 or 9.2 shall be incidental to those items, and is not applicable for payment under this item.

4. Refer to W.I. 16.9 for epoxy/sand repair material requirements/procedures.

WI 10.0 EXPANSION JOINT REPAIR AND REPLACEMENT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing expansion joints, prepare adjacent concrete and furnish and install new expansion joint system. Refer to Detail Series 10.0 for specific requirements.

B. Materials

1. Expansion joint system materials shall be as specified in Division 07 Section "Expansion Joint Assemblies," installed in strict accordance with manufacturer's recommendations.
2. Cast-in-place concrete repair materials shall be as specified in Division 03 Section “Cast-in-Place Concrete Restoration”, and/or “Prepackaged Repair Mortar.”
3. Trowel applied patching material not allowed.

C. Execution

1. Contractor shall remove existing expansion materials in manner that minimizes damage to adjacent concrete.
2. Alterations to existing expansion joint blockout required for installation of new expansion joint system shall be performed in accordance with Work Item Series 9.0, "Expansion Joint Preparation."
3. Joint installation procedures shall be in accordance with referenced specifications and manufacturer's recommendations.
4. In-place testing: Prior to opening to traffic, test joint seal for leaks. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hrs.

WI 10.3 EXPANSION JOINT – ELASTOMERIC CONCRETE EDGED

A. Refer to Work Item 10.0, "Expansion Joint Repair and Replacement" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 10.3 for specific requirements.

B. This Work Item applies to Parking Structures #4 and #5, and is payable per linear foot of installed expansion joints.

C. Expansion joints shall be installed into wall openings at ends and turned up to promote positive drainage (incidental).

D. Submit shop drawings for approval, detailing all pertinent information including condition around interior columns and condition at exterior walls/columns. Utilize manufacturer’s standard horizontal-to-vertical termination/installation procedures as applicable.

WI 10.6 REPLACE STAIR TOWER ISOLATION JOINT

A. Refer to Work Item 10.0 "Expansion Joint Repair and Replacement" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 10.6 for specific requirements.

B. This Work Item applies to Parking Structures #4 and #5.

C. Payment for this Work shall be per lineal foot of repair performed. Contractor required to provide and install aluminum non-slip plates at doorways within repair areas (or

remove and re-install existing plates as applicable) incidental to this Work Item. Verify requirements in field prior to submitting Bid.

D. Materials

1. Expanding foam sealants:

a. 1200 Series Foam Seal, Jointmaster.
b. ColorJoint Silicone Sealing System, ESS Series, MM.
c. Seismic Colorseal or DSM, Emseal.
d. Iso-Flex Precom “C”, LymTal.
e. Wabo Seismic WeatherSeal, WBA.
f. Joint widths vary, confirm in field prior to ordering materials.

2. New aluminum non-slip cover plates shall be 3/16”, Grade 2, with center crown and beveled edges from SlipNOT, or Engineer-approved equivalent. Length and width shall be customized to span joint and fit within existing door openings. Contractor required to verify dimensions in field. Secure to stair/elevator tower side of joint with countersunk stainless steel anchors. Installation shall be ADA-compliant.

E. Submit shop drawings of new aluminum non-slip cover plates for Engineer approval prior to ordering/fabricating.

F. Repair blockout as needed per other work items to provide suitable blockout per expansion joint manufacturer’s requirements.

G. Expansion joint installation shall comply with all written requirements of expansion joint manufacturer.

WI 10.7 SEAL ROOF LEVEL JOINT BETWEEN BAYS (ALTERNATE)

A. Work is to seal gap between ramped and flat bays at the roof level of PS#5. Refer to Work Item 10.8, "Expansion Joint – Precompressed Vertical Seal" for materials and similar procedure associated with this Work Item. Refer to Detail 10.7 for specific requirements, and see plan sheets for locations.

B. This Work Item applies to Parking Structure #5, and is payable on a lineal foot basis for installed pre-compressed joint.

C. Materials

1. Expanding foam sealants:

a. 1200 Series Foam Seal, Jointmaster.
b. ColorJoint Silicone Sealing System, ESS Series, MM.
c. Seismic Colorseal or DSM, Emseal.
d. Iso-Flex Precom “C”, LymTal.
e. Wabo Seismic WeatherSeal, WBA.

2. Joint widths vary. Confirm in field prior to ordering materials.

WI 10.8 EXPANSION JOINT – PRECOMPRESSED VERTICAL SEAL

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare adjacent concrete surfaces and furnish and install new pre-compressed silicone expansion joint system. Refer to Detail 10.8 for specific requirements. WSU to approve sealant color selection prior to ordering.

2. This Work Item applies to Parking Structure #4, and is payable on a lineal foot basis for installed pre-compressed joint installed.

3. Access for this work shall be per W.I. 1.6.

B. Materials

1. Expanding foam sealants:

   a. 1200 Series Foam Seal, Jointmaster.
   b. ColorJoint Silicone Sealing System, ESS Series, MM.
   c. Seismic Colorseal or DSM, Emseal.
   d. Iso-Flex Precom “C”, LymTal.
   e. Wabo Seismic WeatherSeal, WBA.

C. Execution

1. Contractor shall remove existing expansion materials (where existing) in manner that minimizes damage to adjacent concrete.
2. Contractor shall perform any necessary concrete repairs per applicable concrete work items. Repairs required due to contractor-caused damage during removal of existing expansion materials is incidental.
3. Joint installation procedures shall be in accordance with manufacturer's recommendations.

WI 11.1 SEAL FLOOR CRACKS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, prepare and seal random cracks and control joints in concrete floor and/or topping. Refer to Detail 11.1 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per lineal foot of sealant installed.

B. Materials

1. Approved materials for use in this Work are specified in Division 07 Section "Concrete Joint Sealants."

C. Execution

1. Contractor shall thoroughly clean and inspect concrete slabs and/or topping for cracks and unsealed construction and control joints. Those identified as either greater than 0.03 in. wide or showing evidence of water leakage and/or salt staining on ceiling below shall be sealed. All cracks and joints identified for repair shall be marked with chalk to aid in precision routing. Obtain depths to top reinforcing bars and P-T tendons in area of repair by use of a pachometer (rebar locator). Determine depth of electrical conduit (metal or plastic). Do not exceed this depth of routing where the crack to be repaired crosses the embedded items. Damage to embedded items will require repair or replacement at no cost to the Owner.
2. Cracks and construction joints shall be ground or sawcut to an adequate width and depth as required by Work Item Detail. Routing shall be performed by mechanized device that has positive mechanical control over depth and alignment of cut. Handheld power grinders with abrasive disks shall not be used on control/construction joints, but may be used on random cracks.
3. Cavities shall be thoroughly cleaned by either sandblasting or grinding to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion. Groove shall be air blasted to remove remaining debris.
4. Sealant materials and installation procedures shall be in accordance with referenced specifications for selected material.
5. Traffic topping manufacturer shall verify in writing that joint sealant is compatible with traffic topping. Crack and joint sealant work shall be incidental to traffic topping system.

WI 11.2A REPLACE JOINT SEALANT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate and mark failed joint sealant, remove existing sealant, prepare edges and reseal joints and cracks. Refer to Detail 11.2A for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per lineal foot of sealant installed.

B. Materials

1. Approved materials for use in this Work are specified in Division 07 Section "Concrete Joint Sealants."

C. Execution

1. Contractor shall locate failed crack/joint sealant by visual inspection.
2. Contractor shall remove existing sealant from joints and/or cracks.
3. When existing joint dimensions do not conform to Detail 11.2, joints shall be routed or sawcut to an adequate width and depth to match Work Item Detail. Routing shall be performed by mechanized device that has positive mechanical control over depth and alignment of cut.
4. Cavities shall be thoroughly cleaned by either sandblasting or grinding to remove all remaining sealant and unsound concrete which may interfere with adhesion. Groove shall also be air blasted to remove remaining debris.
5. Sealant materials and installation procedures shall be in accordance with referenced specifications for selected material.
6. Traffic topping manufacturer shall verify in writing that joint sealant is compatible with traffic topping.

WI 11.3 VERTICAL JOINT SEALANT (ROOF LEVEL) (ALTERNATE AT PS#5)
WI 11.3 VERTICAL JOINT SEALANT (FAÇADE) (ALTERNATE AT PS#5)
WI 11.3 VERTICAL JOINT SEALANT (BASE BID AT PS#8)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate and mark failed vertical joint sealant, remove existing sealant, prepare edges and reseal vertical joints. Refer to Detail 11.3 for specific requirements.

2. This Work applies to Parking Structures #5 and #8, and is payable per lineal foot of sealant installed.

B. Materials

1. Silicone, S, NS, 100/50, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) GE Construction Sealants; Momentive Performance Materials Inc.
        2) Sika Corporation.
        3) Dow Corning Corporation.

C. Execution

1. Contractor shall locate failed crack/joint sealant by visual inspection.
2. Contractor shall remove existing sealant from joints and/or cracks.
3. When existing joint dimensions do not conform to Detail 11.3, joints shall be routed or sawcut to an adequate width and depth to match Work Item Detail. Routing shall

be performed by mechanized device that has positive mechanical control over depth and alignment of cut.
4. Cavities shall be thoroughly cleaned by either sandblasting or grinding to remove all remaining sealant and unsound concrete which may interfere with adhesion. Groove shall also be air blasted to remove remaining debris.
5. Sealant materials and installation procedures shall be in accordance with referenced specifications for selected material.
6. If traffic topping will contact vertical joint sealant, traffic topping manufacturer shall verify in writing that joint sealant is compatible with traffic topping.

WI 11.4 TOOL AND SEAL CONTROL JOINTS (FOR REFERENCE ONLY)

A. Scope of Work

1. Work consists of providing all labor, materials, equipment, supervision and incidentals necessary to provide tooled and sealed control joints in concrete as shown on Drawings. Refer to Detail 11.4 for specific requirements.

2. This Work Item is incidental to concrete floor repair items and is NOT a separate pay item.

3. This Work Item applies to Parking Structures #4, #5, and #8.

B. Materials

1. Sealant materials shall be as specified in Division 07 Section "Concrete Joint Sealants."

C. Execution

1. Contractor shall locate and provide control joints in repair areas to maintain existing joint configuration. This work also applies to the perimeter of full-depth floor repairs per W.I. 3.3A/3.3C. Verify in field with Engineer prior to placing repairs.
2. Control joints shall be tooled and formed in plastic concrete. Saw-cutting joints after concrete sets will not be allowed.
3. Tooled joints shall be of proper dimension in plastic concrete.
4. Approved joint materials shall be installed as specified in Article "Materials" above.

WI 11.5 EPOXY INJECTION

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate cracks, prepare and pressure inject cracks with an epoxy resin so as to create waterproof barrier and/or structural repair as indicated in the Drawings. Refer to Detail 11.5 for specific requirements.

2. This Work Item applies to Parking Structure #5, and is payable per lineal foot of injected crack.

B. Materials

1. Epoxy injection materials shall be as specified in Division 03 Section “Epoxy Injection Systems.”

C. Execution

1. Epoxy injection work and materials shall be performed in accordance with Division 03 Section "Epoxy Injection Systems."
2. Contractor is responsible for location of all locations requiring epoxy injection prior to start of Work.
3. Contractor shall allow for Engineer/Architect inspection of all epoxy injection sites for condition as specified.
4. No payment will be allowed for Work executed without Engineer/Architect inspection and verification.
5. Remove and patch all ports, holes, temporary seal materials to match existing conditions. This is considered incidental to the Work.
6. Clean and paint the repair area limited to the disturbed surfaces to match existing surfaces.

WI 11.7 COVE SEALANT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare concrete surfaces and install cove sealant between floor and vertical surfaces as shown on Drawings. Refer to Detail 11.7 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per lineal foot of sealant installed.

B. Materials

1. Joint sealant materials shall be as specified in Division 07 Section Concrete Joint Sealants."

C. Execution

1. Intersection to be sealed shall be thoroughly cleaned by sandblasting to remove all contaminants and foreign material.
2. Entire Work area shall then be cleaned with compressed air to assure that all loose particles have been removed and that intersection is dry.
3. Properly prepared intersection shall be coated evenly and completely with joint primer material on each of intersecting faces in accordance with sealant manufacturer's recommendations.

4. After primer has cured, apply cove sealant to intersection such that sealant extends 0.75 in. onto each of intersecting faces.
5. Work cove sealant into joint so that all air is removed and tool to concave shape such that minimum throat dimension of no less than 0.5 in. is maintained.
6. Remove excess sealant and allow to cure.

WI 15.0 PROTECTIVE SEALER

A. Scope of Work

1. Work consists of providing all labor, materials, equipment, supervision and incidentals necessary to prepare surfaces and install protective sealer system on concrete surfaces.

B. Materials

1. Protective sealer system materials shall be as specified in Division 07 Section "Water Repellents."

C. Execution

1. All surfaces scheduled to receive protective sealer system shall be identified by Contractor. Mark with chalk all areas other than floor surfaces which are to be treated.
2. Floor surfaces shall be prepared by shot-blast in accordance with referenced specification section and manufacturer’s requirements.
3. All other surfaces to be treated shall be mechanically brushed, water-blasted, or sand-blasted as required and then air-blasted prior to application. Use of water-blasting requires adequate drying time before application to achieve proper penetration. Check moisture content with moisture meter and ensure moisture content is below maximum allowable by material manufacturer.
4. Sealer application shall be as specified in referenced specification section. Overhead and vertical surface application shall be by brush or pressure sprayer.

WI 15.1 CONCRETE SEALER

A. Refer to Work Item 15.0, "Protective Sealer" for scope of Work, materials and procedure associated with this Work Item.

B. This Work Item applies to Parking Structure #8, and is payable per square foot of sealer applied.

WI 16.0 TRAFFIC TOPPING

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare existing floor surfaces and install traffic topping. Coating of all vertical surfaces within Work limits shall be incidental to installation of traffic topping. Refer to Detail series 16.0 for specific requirements.

B. Materials

1. Traffic topping materials shall be as specified in Division 07 Section "Traffic Coatings."

C. Execution

1. Floor surface preparation shall be performed by coating system licensed applicator or under its direct supervision.
2. Shot-blast surface preparation is required for floors.
3. Coating system shall be installed by licensed applicators in strict accordance with manufacturer's recommendations and referenced specification section.
4. Crack preparation, including installation of sealant material where required, are separate paid items.
5. Detail coat along cracks and joints as shown on Detail 16.1 is incidental to traffic topping work.
6. Coating system shall be thoroughly cured prior to Work areas being returned to service.

WI 16.1 TRAFFIC TOPPING – NEW SYSTEM

A. Refer to Work Item 16.0, "Traffic Topping" for Scope of Work, materials and procedure associated with this Work Item. Refer to Detail 16.1 for specific requirements.

B. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per square foot of coating installed at PS#5 and PS#8.

1. PS#4: Coating application is **incidental** to install new system to match thickness of surrounding coating at all new concrete floor patches and concrete wash repairs.
2. PS#5: New coating application at Levels 2 and 3 (base bid), payable per square foot.
3. PS#8: New coating application at Levels 2 and 4 (base bid). New coating application at Level 3 (alternate). Payable per square foot.

WI 16.2 TRAFFIC TOPPING – REPLACE EXISTING SYSTEM

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing delaminated, unbonded, and bonded coating system from slab surface, prepare surface, and install new traffic topping system per requirements of W.I. 16.1 (incidental to this work).

2. Removal of existing coating, and installation of complete new coating system shall be included in this work.

3. This Work Item applies to Parking Structure #4, and is payable per square foot of coating installed. Removal of existing coating system shall be incidental.

B. Materials/Equipment

1. Approved traffic topping materials shall be as specified in Division 07 Section “Traffic Coatings”.
2. Contractor shall be responsible for examining site to determine required method to remove existing delaminated, unbonded, and bonded coating prior to submitting bid. In some areas, the delaminated coating is unbonded and can be removed in large sections by hand; other areas may be bonded and require more extensive labor and/or equipment to be used. No extras will be allowed for failure to examine site to determine existing coating removal requirements. Scarification or other methods that may damage concrete slab surface not allowed.

C. Execution

1. Repair areas shall be located in field with Engineer prior to start of Work.
2. Contractor shall remove existing delaminated/unbonded coating to bare concrete surface. Removals shall be performed in manner to not damage slab surface.
3. Removal areas shall be as square or rectangular-shaped as practical. At large delaminated areas, removals may be required in the entire drive lanes or complete bays. Intent is to remove all delaminated coating in a work area until sound, bonded coating is reached. Verify in field with Engineer.
4. Bare concrete surface shall then be prepared by shot-blasting.
5. Refer to requirements of W.I. 16.1 for installation of new traffic topping system (to be included as incidental to this Work). Provide primer, base coat, intermediate coat(s) with aggregate, and topcoat.

WI 16.3 TRAFFIC TOPPING – REPAIR (FOR REFERENCE ONLY)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove loose/delaminated coating, prepare surface of exposed existing concrete and adjacent traffic topped areas, and install traffic

topping on prepared concrete and existing traffic topping. Refer to Detail 16.3 for specific requirements.

2. This Work Item is **incidental** and applies to Parking Structures #4 and #5, and shall be performed as needed to repair existing coating system prior to recoating per other W.I.'s.

B. Materials

1. Traffic topping materials shall be as specified in Division 07 Section "Traffic Coatings" and shall be compatible with existing system. Obtain written approval from new traffic topping manufacturer that existing coating surface is acceptable for installing new coating before beginning Work.

C. Execution

1. All loose existing coating shall be removed and exposed existing concrete surfaces prepared in accordance with manufacturer's recommendations and referenced specifications.
2. Completely solvent wash all existing traffic coating within work limits that is to receive new coating material. Ensure existing coating to remain is adequately bonded to existing concrete slab.
3. Install primer, base coat, and intermediate coat(s) as needed to build up system to match thickness of adjacent intact coating, prior to recoating per other Work Items.

WI 16.4 TRAFFIC TOPPING – RECOAT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare and recoat the existing traffic topping as shown on Drawings. Refer to Detail 16.4 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8, and is payable per square foot of repair performed (except Alternate W.I. 16.4 at PS#5 which is payable per each stair tower).

B. Materials

1. Traffic topping materials shall be as specified in Division 07 Section "Traffic Coatings" and shall be compatible with existing system. Obtain written approval from new traffic topping manufacturer that existing coating surface is acceptable for installing new coating before beginning Work.

C. Execution

1. Preparation of existing traffic topping membrane surfaces shall be in strict accordance with manufacturer's recommendations and referenced specification

section. Floor surface preparation shall be performed by coating system licensed applicator or under its direct supervision.
2. Solvent washing is required for all existing coating surfaces.
3. Coating system shall be installed by licensed applicators in strict accordance with manufacturer's recommendations and referenced specification section.
4. Prior to recoating the area, any patches and/or bare concrete areas shall be coated with a base coat and an appropriate number of intermediate coats to bring the new membrane up to the level of the existing membrane per other W.I.s. After this has been completed, the entire area shall be recoated per this Work Item.
5. Existing prepared traffic topping membrane shall be recoated with a minimum of one intermediate coat with aggregate and one topcoat per this Work Item.
6. Coating system shall be thoroughly cured and traffic marking completed prior to returning work areas to service.

WI 16.9 SCALED SURFACE REPAIR (EPOXY/SAND)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to scarify, shotblast, and prepare surface of concrete topping and install epoxy/sand overlay on prepared concrete surface. Refer to Detail 16.9 for specific requirements.

2. This Work Item applies to Parking Structure #8. Payment for this Work Item shall be per square foot of repairs performed.

3. Complete concrete floor repairs per other W.I.'s prior to performing this Work. Replace cove and tee-to-tee sealants per other W.I.'s after installation of epoxy/sand repair material, per manufacturer's requirements.

B. Materials

1. See Section "Epoxy Broadcast Overlay Systems".
2. For any selected product:
   a. Submit color sample for Owner approval.
   b. Sand shall be 12-20 size minimum (or equivalent) unless noted otherwise. Submit samples of various sizes and colors for Owner/Engineer approval.
   c. Provide non-sag additive as required to prevent epoxy/sand from sagging. Seed stone until rejection.
   d. For the topcoat, provide manufacturer's compatible polyurethane topcoat (incidental).

C. Execution

1. Contractor shall locate scaled surface repair areas in field with Engineer prior to start of Work.
2. All loose/delaminated existing concrete shall be removed by scarifying up to ½" amplitude.

3. After scarification, shotblast surface per manufacturer's recommendations. Sand-blasting and/or water-blasting shall then be performed to remove all dust/debris/laitance. Additional surface preparation shall be performed as needed in strict accordance with manufacturer's recommendations.
4. Install the epoxy/sand overlay per manufacturer's recommendations to minimum depth shown on Detail (in multiple lifts as required).
5. Manufacturer's technical representative shall be onsite during surface preparation and epoxy/sand installation.
6. Provide 5-year warranty for labor and material for any material and adhesion/bonding failures.
7. Replace joint sealants per other W.I.'s after installation of epoxy/sand material, but prior to installation of polyurethane topcoat. Confirm with material manufacturer.

WI 18.1 TEMPORARY SHORING

A. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide, install, maintain for duration of Project, and remove upon completion of Work, Temporary Shores at localized concrete repair areas, and remove upon completion of Work.

B. Payment for this Work Item shall be per each post shore installed at repair areas as directed by Engineer.

C. Temporary shoring required on Details, and/or indicated as incidental to other Work Items NOT eligible for payment under this Item.

D. If Contractor is unsure whether a particular repair requires temporary shoring (or how much shoring is required), verify in field with Engineer prior to concrete removals. Engineer shall review proposed localized shoring procedures prior to start of Work. Contractor shall not be compensated for excessive use of shores per this Work Item.

E. To be eligible for payment under this Work Item, amount and location of temporary shoring must be approved by Engineer prior to installation.

F. This Work Item applies to Parking Structures #4 and #5.

WI 21.0 P/T SYSTEM REPAIR – MONOSTRAND

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to perform P/T tendon splice repairs and P/T end anchorage repairs to the monostrand post-tensioning system. Refer to Detail series 21.0 for specific requirements. Refer to Division 03 Section "Unbonded Post-Tensioning Repairs" for further requirements.

2. All work performed per W.I. Series 21.0 shall be performed and supervised by Firm and personnel certified by PTI. Submit certifications to Owner for record prior

to start of Work. PTI-certified superintendent or foreman shall be onsite at all times to supervise all aspects of post-tensioning repair work.

3. Contractor shall document all P/T repairs on as-built drawings, and shall document and provide stressing log for all P/T repairs.

4. The furnishing and installing of reinforcing steel shall be as shown on the Details. Concrete removals and replacement are not included in this work and shall be performed and paid for under Work Item series 3.0 as applicable.

5. P/T System Repair Work Items apply to Parking Structure #4.

6. Work/Repair Sequence:

    a. Allow Engineer to observe condition of all tendons/anchors exposed during concrete repair work. Perform additional inspection openings (W.I. 21.1) as directed by Engineer.
    b. Coordinate with Engineer to determine required repairs and repair procedures.
    c. Perform P/T repairs as needed per W.I. Series 21.0 and 3.0 as applicable.

B. Materials

1. Post-Tensioning materials and related materials shall be as specified in Division 03 Section “Unbonded Post-Tensioning Repairs.”
2. Conventional steel reinforcement shall be as specified in Division 03 Section “Cast-in-Place Concrete”.
3. Epoxy adhesive for reinforcing dowels shall be Hilti HY-200 Safe Set.

C. Prequalified Suppliers:

1. Refer to Division 03 Section “Unbonded Post-Tensioning Repairs.”

D. Execution

1. Prior to concrete removals, submit shoring and bracing plan for Engineer review. Engineer review does not absolve contractor’s total responsibility for providing the necessary shoring and bracing to maintain the stability of the structure and individual elements. Required post shores shall be paid for under Work Item 18.1.
2. Refer to Work Item series 21.0 and “P/T General Notes” on drawings for additional requirements.
3. Below is a general procedure for P/T tendon repairs. The actual repair procedure for each repair location may vary depending on existing conditions and shall be reviewed by the Engineer. Contractor shall coordinate with Engineer.

    a. Locate damaged tendon, measure and record length between anchor points.
    b. Measure and record cable separation, failure point and offset from nearest column/beam face. Mark adjacent floor slab beyond concrete removal boundary to reference the failed tendon end points.
    c. Mark cable path on floor surface between anchors with marking paint.

d. Inspect floor slab top and bottom for cracks, delaminations, and spalls.
e. Remove all unsound and delaminated concrete only from floor and ceiling surfaces along tendon path (see item 1 above).

    1) Closely inspect the exposed tendon for damage at all concrete removal sites. If no damage is observed, proceed to step F. If damage is observed, comply with step 2 below.
    2) Mark all damaged points for inspection by Engineer. Do not proceed with further concrete removals until after Engineer's inspection and approval.

f. As directed by the Engineer, perform full depth removal at tendon anchorage to expose only the non-stressed side of the anchor plate. Excavate the anchorage nearest the failure point first then, excavate the opposite end. Inspect the anchorage for damage. Note that the tendon will probably retain some residual stress from corrosion lock up at the tendon high points. Continue to use extra caution during concrete removals**.**
g. Coordinate inspection of end anchors by Engineer.
h. As directed by the Engineer, continue partial concrete removals at tendon high points adjacent to the tendon failure locations. Removal should begin at the high point (closest to the failure) and work successively towards the nearest exposed anchor. Perform removals a safe distance away from end anchors and intermediate anchors. Perform removals so as to systematically de-tension and free up each tendon in small sections between removal points. The Engineer may direct termination of concrete removals if exposed tendons are found to be relaxed and free of corrosion. Cease removals as the Engineer directs, or when damaged tendon is released along its entire length.
i. Perform remaining concrete removals both partial and full depth to accommodate tendon splicing and new end anchor installation.
j. Engineer will determine location, type and extent of tendon repair.
k. Install splice couplings, end anchors, sheathing, new tendons and reinforcing steel per the applicable Work Item and in accordance with Division 03 Section "Unbonded Post-Tensioning Repairs." Cleaning and epoxy coating of all exposed reinforcing steel and P/T materials is incidental to concrete work.
l. Install patch concrete both partial and full depth at all locations except at stressing pockets and splice couplings. Concrete work shall be performed and paid for under Work Item series 3.0 or 4.0 as applicable.
m. Stress tendon when concrete has achieved 75 percent of required 28-day compression strength. Do not trim tendons until Engineer has approved stressing logs. Additional stressing shall be performed as required by Engineer and is incidental to the work.
n. Install patch concrete at stressing pocket and splice coupling locations.
o. Refer to Division 03 Section "Unbonded Post-Tensioned Concrete" for additional requirements.

WI 21.1 INSPECT P/T TENDONS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove and restore concrete slabs to their original condition to provide an inspection opening and expose existing tendons as identified on Detail 21.1 for Engineer review of damage or deterioration. Each inspection opening shall be approximately 3’ in length and approximately 1’ wide. Refer to Detail 21.1 for specific requirements.
2. All concrete work associated with the inspection is incidental to W.I 21.1. Refer to W.I. series 3.0 for similar concrete requirements. Contractors shall not be reimbursed for inspection openings that are larger than 3’ x 1’, and shall not be double paid under W.I. series 3.0.
3. Engineer shall observe all inspection openings prior to continuing with large scale concrete removals or post-tensioning repairs. Contractor shall include labor for a P/T superintendent, who will be performing the P/T repairs, to review and test each tendon exposed within each inspection opening with the Engineer to determine the final P/T repair work scope. Coordinate all inspections with the Engineer and P/T Superintendent.
4. This work shall be performed and paid for on a per Each inspection opening basis. Each inspection opening could have one or multiple tendons within the inspection opening. Contractor will not be paid for each tendon within the inspection openings. Obtain Engineer approval of inspection openings prior to start of Work. Contractor will not be compensated for excessive use of this Work Item.

B. Materials

1. Concrete and Reinforcing Materials shall be as specified in Section “Cast-in-Place Concrete”.
2. Refer to Section “Unbonded Post-Tensioning Repairs”.

C. Execution

1. Remove concrete at tendon locations in accordance with Work Item series 3.0 sufficient to permit clear viewing of the tendons. Remove concrete only to expose tendons, do not remove concrete below tendons.
2. Remove existing plastic sheathing, clean exposed tendon and apply marking paint as directed by the Engineer in the field for inspection and document all P/T conditions. Notify Engineer at least 48 hours before exposing tendons, do not patch exposed tendon until Engineer’s inspection is complete and Engineer gives approval to proceed with patching.
3. Clean and epoxy coat exposed reinforcing steel and anchor plate per Work Item Series 3.0.
4. Repairing damaged P/T sheathing and greasing exposed tendons after Engineering inspection is incidental. Refer to W.I. 21.2.
5. Re-cast concrete at inspection locations in accordance with Work Item series 3.0 to match surrounding concrete. Concrete work is performed and paid for under this work item.

WI 21.2 PROTECT EXPOSED P/T TENDON(S) (INCIDENTAL)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove damaged tendon sheathing, re-grease (or epoxy coat tendons as approved by Engineer) in damaged area and install new sheathing. Concrete work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail 21.20 for specific requirements.

2. This Work Item applies to Parking Structure #4, and is incidental to all other related P/T and concrete floor repair work and is not a separate pay item.

B. Materials

1. Material shall be as specified in Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. Remove damaged sheathing materials from exposed tendon.
2. Grease coating:

   a. Apply additional corrosion-inhibiting grease over the damaged area to completely fill any void or surface depression caused by the sheathing damage.

3. Epoxy coating option (use only as approved by Engineer).

   a. Clean tendon to remove grease residue from exposed tendon.
   b. Apply uniform coating of epoxy to exposed tendon.

4. Install split sheathing over exposed tendon. Sheathing shall overlap existing sheathing by at least two inches at each end. Sheathing shall be oriented such that the split is toward the bottom.
5. Tape entire length of repair, spirally wrapping tape around sheathing to provide at least two layers of tape. Taping shall overlap existing sheathing by 2 in. at each end.

WI 21.3 P/T TENDON END ANCHORAGE (LIVE) (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing tendon anchorage system, install new reinforcement, install new tendon anchorage system, and re-tension tendon to required stresses. Concrete repair work is not part of this Work Item. Concrete

work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail series 21.3 for specific requirements.

2. This Work Item applies to PS#4, and is payable per each live-end anchor repaired.

B. Materials

1. Refer to Work Item 21.0 “P/T System Repair - Monostrand”, Article “Materials” and Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. De-tension any remaining wires in tendons designated for repair. Remove existing end anchorage system.
2. Install new plastic-coated steel end anchor and install epoxy coated reinforcement as shown in Details at stressing side of end anchor.
3. Grease and wrap new or existing tendon at end anchor repair area in accordance with Work Item 21.2 and is incidental to this work.
4. Place concrete at stressing side of end anchor. After concrete has reached specified strength, tension tendon to specified stresses and lock off. (Restressing due to tendon lock-up or additional tendon failures during stressing is payable per W.I. 21.5).
5. After Engineer has approved stressing records, install epoxy coated reinforcement and place concrete at non-stressing side of end anchor.
6. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioned Concrete” for additional requirements.

WI 21.4 P/T TENDON END ANCHORAGE (DEAD) (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing al labor, materials, equipment, supervision and incidentals necessary to remove existing tendon anchorage system, install reinforcement, and install new tendon anchorage system. Stressing of the tendon is not part of this work but will occur at a different location along the tendon per Work Item 21.3 or Work Item 21.6. Concrete work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail series 21.4 for specific requirements.

2. This Work Item applies to PS#4, and is payable per each dead-end anchor repaired.

B. Materials

1. Refer to Work Item 21.0 “P/T System Repair - Monostrand” and Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. De-tension any remaining wires in tendons designated for repair. Remove existing end anchor.
2. Install new plastic-coated end anchor and install epoxy coated reinforcement as shown in Details.
3. Grease and wrap new or existing tendon at end anchor repair area in accordance with Work Item 21.2 and is incidental to this work.
4. Place concrete in repair area. After concrete has reached specified strength, tension tendon to specified stresses. Stressing operations is not included in Work Item 21.4.
5. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioning Repairs” for additional requirements.

WI 21.5 P/T TENDON ANCHORAGE – RESTRESSING (ALTERNATE)

A. This Work item applies when cable being stressed per W.I. 21.3 or 21.6 fails. Restressing shall be performed and paid for under this Work Item.

B. No repair hardware installation is associated with this work item. This Work includes labor and equipment to re-stress tendons that were stressed per W.I. 21.3 or 21.6, and failed or locked up.

C. See W.I.s 21.3 and 21.6 for stressing requirements.

WI 21.6 TENDON SPLICE COUPLING (CENTER-PULL) (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install a center-pull splice coupling for splicing and stressing of a tendon. Concrete work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail series 21.6 for specific requirements.

2. This Work Item applies to PS#4, and is payable per each center-pull coupling repair.

B. Materials

1. Refer to Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. De-tension any remaining wires in tendons designated for repair.
2. Install center-pull splice coupling onto tendon with required overlap/extension and then stress tendon to specified stress. If this Work Item is performed in combination with other P/T repairs along same tendon, then stress tendon after

concrete anchor blocks and patches have achieved the specified compressive strength. Refer to Detail series 21.6 for specific requirements.
3. Epoxy coat coupling prior to installation of repair concrete.
4. Grease and wrap new and existing tendons in repair area in accordance with Work Item 21.2 and is incidental to this work.
5. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioning Repairs” or additional requirements.

WI 21.7 TENDON SPLICE COUPLING (SINGLE) (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install one tendon splice coupling and a length of new P/T tendon as Detailed. Concrete work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail series 21.7 for specific requirements. This work is performed in conjunction with either Work Item 21.3 or Work Item 21.6.

2. This Work Item applies to PS#4, and is payable per each single splice coupling repair.

B. Materials

1. Refer to Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. Install new splice coupling assembly onto unstressed existing tendon. Extend the new tendon to the stressing location. If tendon splice length is greater than that indicated on Detail, then Contractor shall be paid for additional length of Tendon per Work Item 21.9.
2. Epoxy coat all exposed splice coupling assembly prior to installation of repair concrete.
3. Grease and wrap new and existing tendon at tendon splice repair area in accordance with Work Item 21.2 and is incidental to this work.
4. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioning Repairs” for additional requirements.

WI 21.8 TENDON SPLICE COUPLING (DOUBLE) (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install two tendon splice couplings and a length of new P/T tendon as Detailed. Concrete work performed in association with this work will be paid separately under Work Item series 3.0. Refer to Detail series 21.8 for

specific requirements. This work is performed in conjunction with either Work Items 21.3, 21.5 or 21.6.

2. This Work Item applies to PS#4, and is payable per each double splice coupling repair.

B. Materials

1. Refer to Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. Install new splice couplings onto unstressed existing tendons and connect to new tendon. If tendon splice length is greater than that indicated on Detail, then Contractor shall be paid for additional length of Tendon per Work Item 21.9.
2. Epoxy coat all exposed splice couplings prior to installation of repair concrete.
3. Grease and wrap new and existing tendon at tendon splice repair area in accordance with Work Item 21.2 and is incidental to this work.
4. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioning Repairs” for additional requirements.

WI 21.9 P/T TENDON MATERIAL (ALTERNATE)

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install new P/T monostrand tendon in Work Items 21.7 and 21.8 where splice lengths are greater than that indicated on Details.

2. This Work Item applies to PS#4, and is payable per lineal foot of qualifying P/T tendon material. Length of P/T tendon material required as incidental to other W.I.s is not applicable for payment under this item.

B. Materials

1. Refer to Division 03 Section “Unbonded Post-Tensioning Repairs.”

C. Execution

1. Install new tendon within concrete removal area as needed to replace damaged or defective tendon.
2. Tendon profile shall match existing. Use chairs and tie wire to maintain Tendon position during concrete placement.
3. Refer to Work Item 21.0 and Division 03 Section “Unbonded Post-Tensioning Repairs” for additional requirements.
4. Payment under this Work Item not applicable for new tendon indicated as incidental to other Work Items.

WI 25.1 MECHANICAL / ELECTRICAL ALLOWANCE

A. Scope of Work

1. Mechanical / electrical allowance shall be all related utility work (drain lines, sprinkler lines, electrical conduit, junction boxes, etc.) associated with interruptions of these utilities to repair existing structural areas.

2. All utilities removed during Work shall be reinstalled in accordance with latest edition of electrical and mechanical codes in effect. Work ineligible for allowance includes Work covered by or incidental to Work Items within this Specification or for Work required through Contractor's negligence.

3. This Work Item applies to Parking Structures #4 and #5.

B. Method of Payment

1. Mechanical/electrical Work, as approved in writing by Owner prior to implementation, shall be paid for by Contractor. Contractor shall forward actual invoices from mechanical/electrical contractors and General Contractor's markup to Engineer with each pay request. Contractor shall attach actual invoices to written authorization. At completion of project, any variation between mechanical allowance and actual payment receipts will be reflected in an adjustment of allowance amount.

2. Contractor shall not perform any Work that is to be billed under this Allowance without prior written approval from Owner.

3. Contractor shall provide weekly written reports summarizing all current and anticipated work and costs associated with this Allowance for WSU review.

WI 25.2 MECHANICAL – REPLACE FLOOR DRAINS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing drains and install new drains at locations where concrete repairs necessitate drain removal/replacement and as directed by Engineer. Work Item 25.3 is directly related to this Work Item. Refer to Detail 25.2 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8. Payment shall be per each drain replaced.

B. Materials

1. Approved materials for this Work are as shown on Detail 25.2.
2. Sealant materials shall be as specified in Section "Concrete Joint Sealants".

C. Execution

1. Replacement drains shall be set at same elevation as existing drains (or lower) as necessary to ensure proper drainage (no trip hazards). Contractor shall verify proper drainage by ponding or elevation survey. Maintain minimum concrete cover as specified at all drain locations.
2. Perform removals with chipping hammers; no coring allowed. Do not cut or damage existing embedded reinforcement or conduit/wiring.
3. Concrete removals and surface preparation shall be as shown on Detail 25.2 and per requirements of Section “Surface Preparation for Patching”.
4. Drains shall be installed as shown on Detail 25.2.
5. Installation of sealant around perimeter of drains shall be incidental to this work.

WI 25.3 MECHANICAL - PIPE AND HANGERS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to supplement existing floor drain system by installing pipe and hangers. Work Items 25.2, "Mechanical - Replace Floor Drains" and 25.4, “Mechanical – Supplemental Floor Drain” are directly related to this Work Item. Refer to Detail 25.3 for specific requirements.

2. This Work Item applies to Parking Structures #4, #5, and #8. Payment shall be per lineal foot of pipe installed (removal of any existing deteriorated pipe is incidental).

B. Materials

1. Approved materials for this Work are as shown on Detail 25.3 and in Division 22 Section "Common Work Results for Plumbing" and Division 22 Section “Facility Storm Drainage Piping.”

C. Execution

1. Contractor shall locate and mark all areas where supplemental floor drain piping is to be installed.
2. Pipes and hangers shall be installed with adequate positive drainage slope at all locations along pipe runs.
3. Pipes and hangers shall be installed as shown on Detail 25.3 and in accordance with referenced specification section.

WI 25.4 MECHANICAL - SUPPLEMENTAL FLOOR DRAIN

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to supplement existing floor drain system by installing

additional drain. Work Item 25.3, "Mechanical - Pipe and Hangers" is directly related to this Work Item. Refer to Detail 25.4 for specific requirements.

2. This Work Item applies to Parking Structure #8. Payment shall be per each drain installed.

B. Materials

1. Approved materials for this Work are as shown on Detail 25.4.
2. Sealant materials shall be as specified in Division 07 Section "Concrete Joint Sealants."

C. Execution

1. Contractor shall locate and mark all areas where supplemental floor drains are to be installed.
2. Contractor shall verify low points on slab by ponding or elevation survey prior to locating drains.
3. Perform removals with chipping hammers; no coring allowed. Do not cut or damage existing embedded reinforcement or conduit/wiring.
4. Concrete work shall be as shown on Detail 25.4 and paid for under Work Item Series 3.0.
5. Drains shall be installed as shown on Detail 25.4.

WI 37.1 REPLACE STAIR TOWER DOOR & FRAME (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing steel door and frame and install new steel door and frame to match existing. Door and frame shall be completely installed level and plumb, and all surrounding joints sealed and finished. Door shall be provided in galvanized finish, painted to match existing color, including level designations (incidental).

2. This Alternate Work Item, if accepted, applies to Parking Structure #4, and applies to all roof level doors. Payment shall be per each location.

B. Materials

1. Metallic-Coated Steel Sheets: ASTM A 653, Commercial Steel, Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
2. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
3. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model.
4. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

5. Frames of 0.053-inch thick steel.
6. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.
7. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.
8. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.
9. Provide lever-type door hardware per ADA requirements.
10. Steel Doors and Frames – acceptable manufacturers:

    a. Amweld Building Products, Inc.
    b. Benchmark Commercial Doors; a division of General Products Co., Inc.
    c. Ceco Door Products; a United Dominion Company.
    d. Copco Door Co.
    e. Curries Company.
    f. Deansteel Manufacturing, Inc.
    g. Kewanee Corporation (The).
    h. Mesker Door, Inc.
    i. Pioneer Industries Inc.
    j. Republic Builders Products.
    k. Steelcraft; a division of Ingersoll-Rand.

11. Verify existing door and frame dimensions in field prior to ordering/fabrication.

C. Execution

1. Contractor shall coordinate door and door frame replacement work with Owner.
2. Contractor is responsible for securing stair tower work areas during work. Do not allow public access to work area, but keep stair tower open to traffic during work.
3. Contractor shall install and finish door completely, including final painting. Door shall be installed plumb and level, and shall be permanently fixed in door opening with appropriate anchors, shims, necessary hardware, sealant, etc.
4. Replacement door hardware to match existing.
5. Submit shop drawings and samples for Owner/Engineer approval of all materials, hardware, anchors, colors, etc. prior to ordering or fabricating.

WI 37.2 REPLACE STAIR TOWER FRAME (ALTERNATE)

A. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing steel door and frame and replace door frame only. Frame shall be completely installed level and plumb, painted to match existing color, and all surrounding joints shall be sealed and finished. Refer to W.I. 37.1 “Replace Stair Tower Door and Frame” (similar) for material and other applicable procedural requirements.

B. This Alternate Work Item, if accepted, applies to Parking Structures #4 and #5 at door frames as indicated on Drawings. Payment shall be per each location.

WI 40.1 REPLACE SHEAR TRANSFER ANGLES

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, shoring and jacking, supervision and incidentals necessary to install shear transfer connection at expansion joints as indicated on the Drawings. Refer to Detail 40.1 for specific requirements.

2. This Work Item applies to Parking Structure #5. Payment shall be per each pair of shear transfer angles replaced (2 individual angles at one location shall be counted as one pay unit).

B. Materials

1. Angle shall be galvanized ASTM A36 steel or Grade 304 stainless steel.
2. Anchor bolts and all hardware shall be as shown on Detail 40.1.
3. Anchoring system shall be as shown on the referenced detail.
4. Slide Bearing Pads: Ultrahigh molecular weight, high-density polyethylene resin. Acceptable material is "Korolath PE" by Koro Corporation, Hudson, MA.

C. Execution

1. Contractor shall provide and install shear transfer connections as indicated on the Drawings and Detail 40.1. Do not allow vehicle traffic across expansion joint without shear transfer angles in place.

WI 40.3 RE-WELD SHEAR CONNECTOR

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, shoring and jacking, supervision and incidentals necessary to re-weld existing tee-to-tee shear connector as indicated on the Drawings.

2. This Work Item applies to Parking Structure #8. Payment shall be per each shear connector re-welded.

B. Materials

1. Welds shall be made using E70XX electrodes.
2. If not galvanized, provide corrosion inhibiting coating for shear connector:

   a. “Sikadur 32 Hi-Mod," by Sika Corporation, Lyndhurst, NJ.
   b. “MasterEmaco ADH 326,” by BASF Building Systems, Shakopee, MN.
   c. “Armatec 110,” Sika Corporation, Lyndhurst NJ.
   d. “Euco 452,” The Euclid Chemical Company, Cleveland, OH.

C. Execution

1. Contractor shall locate and mark broken shear connectors exposed by concrete excavation, by visual inspection or by testing for movement under wheel loading.
2. Contractor shall verify locations with Engineer/Architect prior to starting Work.
3. Contractor shall sandblast shear connector to bare metal prior to welding. Confirm in field with Engineer.
4. Following welding, Contractor shall apply corrosion inhibitor coating on exposed connector steel in accordance with Division 02 Section "Surface Preparation for Patching and Overlay.", or touchup with cold-galvanizing product.

WI 41.1 STAIR REPAIR - LANDINGS

A. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove and replace deteriorated stair landing concrete. Refer to W.I. 3.0 for similar material and procedural requirements. Refer to Detail 41.1 for specific requirements.

B. This Work Item applies to Parking Structure #8, and shall be payable per square foot of repair performed.

WI 41.2 STAIR REPAIR - TREADS

A. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove and replace deteriorated stair tread concrete. Refer to W.I. 3.0 for similar material and procedural requirements. Refer to Detail 41.2 for specific requirements.

B. This Work Item applies to Parking Structure #8, and shall be payable per lineal foot of repair performed.

WI 41.3 STAIRS - REPLACE METAL PAN LANDING/CONCRETE

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate the work area, install temporary shoring/bracing, remove landing concrete, remove steel landing plate (and adjacent bottom/top tread/riser plates as needed), install new galvanized steel landing and tread/riser plates, install welded-wire reinforcement, pour new concrete infill, and install cove sealants and coating (incidental). Provide shop drawings for Engineer review prior to ordering materials and hold a pre-installation meeting on-site with Engineer prior to beginning work.

2. This Work Item applies to Parking Structures #4 and #5, and is payable per each metal/concrete landing replaced.

B. Materials

1. Concrete materials shall be as specified in Section “Cast-in-Place Concrete Restoration” and on Drawings.
2. Welded wire reinforcement shall be 4x4–W2.9xW2.9.
3. New steel landing plate, tread/riser plates, and any support steel shall be hot-dipped galvanized, with dimensions and minimum thickness to match existing. Contractor shall be responsible to verify size, length, and thickness prior to submitting bid. Submit shop drawings for Engineer approval prior to fabrication.
4. Hot-dipped galvanized steel shall be air-quenched as required to provide suitable substrate for painting.
5. Weld electrodes shall be E70XX. All welding materials and procedures shall be per AWS D1.1, latest edition.
6. Sealants shall be as specified in Division 07 Section “Concrete Joint Sealants”.
7. Coating shall be as specified in Division 07 Section “Traffic Coatings”.

C. Execution

1. Completely close stair tower to pedestrians on all levels prior to start of work. Provide signage and barriers as necessary to inform public and provide barrier between pedestrians and work area. Refer to W.I. 1.5 for specific requirements.
2. Provide and maintain temporary shoring/bracing as necessary to maintain stability to existing stair sections at all times during repairs (incidental).
3. This work shall be performed with caution to not damage existing elements to remain including, but not limited to: existing structural steel stringers and landings, existing railing system, concrete and CMU walls, windows and frames, lights, doors and frames, and existing concrete infill to remain at landings and treads.
4. Contractor shall remove existing concrete landing, steel landing plate, (and bottom/top stair tread/riser plates as needed). All other existing elements shall remain.
5. Install new hot-dipped galvanized landing plate and tread/riser plate to match existing size, layout, and configuration. Verify layout and dimensions in field prior to fabrication.
6. New landing plate and tread/riser plate shall be welded into position with periodic 2” long ¼” fillet welds on all abutting edges. Layout and quantity of new welds shall match existing, at a minimum. Verify in field with Engineer.
7. After installation and welding is performed, touchup all hot-dipped galvanized elements with approved cold-galvanizing product at all welded locations and other scratches/nicks due to installation.
8. Install welded-wire reinforcement on new concrete landing as directed by Engineer. Welded-wire reinforcement shall be installed within 1-½” of perimeter of repair areas at slab mid-depth. Verify in field with Engineer.
9. Provide concrete infill per requirements of Section “Cast-in-Place Concrete Restoration”.
10. Concrete surfaces shall be finished to match existing elevations. Provide 1% slope to provide positive drainage (typical). Ponding on new concrete surfaces shall be repaired by Contractor at no additional cost to Owner. Provide light broom finish perpendicular to path of pedestrian travel.
11. Install cove sealants and coating per requirements of W.I. Series 11.0 and 16.0 (incidental to this Work).

WI 41.4 STAIRS - REPLACE CHANNEL

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate the work area, install temporary shoring/bracing as necessary, and perform replacement of the existing steel landing support channels. Provide shop drawings for Engineer review prior to ordering materials and hold a pre-installation meeting on-site with Engineer prior to beginning work.

2. This Work Item applies to Parking Structure #5, and is payable per each channel replaced.

B. Materials

1. New steel support channels shall be hot-dipped galvanized, with dimensions and minimum thickness to match existing. Contractor shall be responsible to verify size and thickness prior to submitting bid. Submit shop drawings for Engineer approval prior to fabrication.
2. Hot-dipped galvanized steel shall be air-quenched as required to provide suitable substrate for painting.
3. Weld electrodes shall be E70XX. All welding materials and procedures shall be per AWS D1.1, latest edition.
4. Bolts shall be ASTM A325.

C. Execution

1. Contractor shall locate deteriorated landing support channels throughout the stair towers in field with Engineer (typically associated with landings to be replaced per W.I. 41.3).
2. Provide temporary shoring/bracing as necessary to maintain stability to existing stair sections at all times during repairs.
3. This work shall be performed with caution to not damage existing elements to remain including, but not limited to: existing structural steel stringers, landings and treads, existing railing system, concrete and CMU walls, windows and frames, lights, doors and frames, and existing concrete infill to remain at landings.
4. Remove the existing steel support channel and install new channel. At a minimum, match the existing bolted and welded connections of the support channel. (This Work may require removal/replacement of CMU units per W.I. 80.3, verify in field).
5. After installation and welding is performed, touchup all hot-dipped galvanized elements with approved cold-galvanizing product at all welded locations and other scratches/nicks due to installation.

WI 41.5 STAIRS - INSTALL STAIR TREAD PLATES

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to install stair tread covers over existing stair treads. **New**

tread plates shall match existing in size, material, finish, etc. Submit shop drawing for Engineer approval prior to ordering. See Detail 41.1 for specific requirements.

2. This Work Item applies to Parking Structure #4, and payment for this Work Item shall be per each stair tread plate installed.

B. Materials

1. Galvanized steel stair tread cover by SlipNOT Safety Flooring, Detroit, MI (313-923-0400), or Engineer approved equivalent.
2. Welding Electrodes shall be E70XX. All welding shall be per AWS D1.1, latest edition.
3. Touch-up paint for tread plate shall be ZRC Cold Galvanizing compound, or approved equivalent.
4. Paint for existing stringers shall be exterior/industrial grade primer and paint. Color to match existing. Submit sample to Owner for approval prior to start of Work.
5. Sealants shall be per Section “Concrete Joint Sealants”.

C. Execution

1. Location of repairs shall be determined in field with Engineer.
2. Prepare and submit shop drawings for Engineer review prior to ordering. New tread plates shall match existing in size, material, finish, etc.
3. Clean steel stair stringer of all surface rust and paint at areas to be welded to provide clean welding surface.
4. Contractor shall be responsible to field-bend and/or remove existing deteriorated steel tread nosings as needed to install new treads (incidental). Verify in field with Engineer prior to performing repairs.
5. Install stair cover over existing tread tight to riser and tread surface.
6. Stitch weld stair cover to stringer using electrodes for welding galvanized steel. Clean welds by grinding and provide paint to match existing. Cover all exposed stringer steel with industrial/exterior rated paint, intended for steel.
7. Touchup paint steel stringers at welded areas to match existing color.
8. Install sealant around perimeter of new tread plates (incidental).

WI 41.6 STAIRS – REPLACE CONCRETE TREAD INFILL

A. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove and replace concrete infill at metal pan stair treads. Refer to W.I. 3.0 for similar material and procedural requirements. Locate work in field with Engineer.

B. This Work Item applies to Parking Structure #4, and shall be payable per each tread.

C. This Work only includes removal/replacement of tread concrete infill, and does not include any steel repair or replacement.

D. Perform removals in manner to not damage stair steel.

E. Provide WWR in new concrete tread infill at mid-depth. New concrete tread surface shall be flat or slightly sloped towards front of tread. Do not exceed 1% slope. Install cove sealant around perimeter of new concrete tread infill.

WI 42.2 REPLACE BEARING ANGLE

A. Refer to Work Item Detail 42.2 for scope of Work, materials, procedure and specific requirements associated with this Work Item.

B. This Work Item applies to Parking Structure #5 and is payable per lineal foot to replace the existing bearing angle at location shown on plans. Part of this work occurs inside mechanical/storage rooms, coordinate access with WSU.

C. Remove live loads prior to start of Work and until new bearing angle is completely installed.

D. Repair retaining wall as needed per W.I. 7.1 prior to installing new anchors.

E. See Detail 42.2 for further requirements.

WI 45.1 PAINT TRAFFIC MARKINGS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, layout, and paint parking stall stripes, traffic arrows, crosswalks, accessible stall access aisles, curbs, symbols, stop bars and all other existing pavement markings upon completion of all repairs.

2. Payment for this Work Item shall be lump sum at Parking Structures #4, #5, and #8 to perform traffic marking installation in all areas of the structures, all levels.

3. Traffic markings shall match all existing markings and be provided at same locations. Contractor shall be responsible for verifying and recording existing traffic marking layout prior to start of Work.

4. Perform this work during off-hours and/or on weekends (incidental) after all other repairs have been completed as necessary to not close additional parking spaces during normal daytime hours. Comply with parking space closure requirements as specified on Drawings.

5. New traffic markings shall be installed in all work areas prior to re-opening to public for normal use.

6. Remove existing stripes in those locations where they conflict with new striping layout.

7. Any traffic markings required due to Alternate Work, if accepted, shall be incidental and included in the unit price of the Alternate Work Items. No extras allowed.

B. Materials

1. Traffic marking materials shall be as specified in Section "Pavement Marking - Restoration".

C. Execution

1. Contractor shall prepare drawing of existing parking and traffic marking layout in repair areas prior to starting with repairs. Contractor shall note stall width, angle of parking, directional traffic arrows and all other existing pavement markings.
2. Contractor shall submit traffic marking plan for Owner/Engineer's approval.
3. Contractor shall match existing traffic marking layout, except as directed otherwise by Owner/Engineer.
4. Where existing pavement markings conflict with new striping layout, remove conflicting pavement markings as indicated in Division 9 Section “Pavement Marking - Restoration”.
5. Engineer shall inspect all layout and surface preparation for conditions in accordance with Section "Pavement Marking - Restoration."
6. All procedures shall be in accordance with Section “Pavement Marking - Restoration”.
7. Contractor shall submit striping plan for Engineer/Architect's review.
8. Engineer/Architect may inspect all layout and surface preparation for conditions in accordance with Division 09 Section "Pavement Marking."

WI 45.2 PAINT – STANDPIPES

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint existing standpipe systems (both horizontal and vertical piping).

2. This work applies to the following: Parking Structures #4 and #5 (alternate Work Item) and Parking Structure #8 (base bid Work Item).

3. Work is payable per lineal foot of piping painted.

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.

3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 45.3 PAINT – STAIR TOWER INTERIORS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint stair tower interiors, including all steel, concrete and CMU surfaces. Confirm work areas in field with Engineer.

2. This Alternate Work Item, if accepted, applies to Parking Structures #5 and #8, and is payable per each stair tower.

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.
3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 45.4 PAINT – ROOF LEVEL PANELS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint precast concrete wall panels at the roof level of Parking Structure #8. These panels are exhibiting map cracking.

2. This Alternate Work Item, if accepted, applies to Parking Structure #8, and is payable per square foot.

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.

3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 45.5 PAINT – CONCRETE WALLS & BEAMS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint concrete walls and beams.

2. This Work Item applies to Parking Structure #4, and is payable per square foot of surface painted.

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.
3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 45.6 PAINT – STEEL CONNECTIONS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint steel connections between precast members.

2. This Alternate Work Item, if accepted, applies to Parking Structures #4 and #5, and is payable per each connection painted.

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.
3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 45.7 CLEAN / PAINT SHEAR TRANSFER ANGLES

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout and paint shear transfer angles at the expansion joints.

2. This Work Item applies to Parking Structure #5, and is payable per each pair of shear transfer angles painted (2 individual angles per payment unit).

B. Materials

1. Paint materials shall be as specified in Division 09 Section “Exterior Painting.”

C. Execution

1. Contractor shall locate and confirm Work areas in field with Engineer.
2. Contractor shall prepare surface to be painted in accordance with Division 09 Section "Exterior Painting" and manufacturer's recommendations.
3. Submit samples for Owner approval of color. Install mockups for approval prior to proceeding with full scale operations.

WI 50.1 REPLACE EXIT SIGNS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install new exit signs at locations indicated on Drawings and as directed by Engineer. Removal and disposal of existing signs is incidental to this work.

2. This Work Item applies to Parking Structure #5. Payment for this Alternate Work Item, if accepted, shall be per each exit sign.

B. Exit Signs: Single Face Back Mounted with side conduit entry LED Exit Light with self-contained emergency battery pack, fused, 277V, vandal-resistant, with two tamperproof tools, with arrows as applicable. UL-listed for wet locations:

1. Lithonia: LV-S-WB-1-R-277-ELN-4X-CW.
2. Pathway: JSLEXIR-277-WL-TP.

C. Remove and dispose of all existing exit signs if this Alternate work is accepted (incidental).

D. Any conduit/wiring repair or replacement required to disconnect existing exit signs and connect new exit signs is incidental. Contractor to verify requirements in field.

E. All work shall comply with manufacturer's written requirements and all applicable laws, codes, and ordinances. PVC conduit shall be schedule 80.

WI 80.3 REPLACE CONCRETE MASONRY UNITS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary for local concrete masonry unit (CMU) removal and replacement due to fractures, cracks, broken or deteriorated CMU. Refer to Detail 80.3 for specific requirements. Painting of new CMU units to match color of surrounding existing CMU is incidental to this Work.

2. This Work Item applies to Parking Structures #4 and #5, and is payable per each CMU block replaced.

B. Materials

1. Concrete Masonry Units: ASTM C 90; Weight Classification.

   a. Special shapes for lintels, corners, jambs, sash, control joints, and other special conditions.

2. Mortar: ASTM C 1142 for ready-mixed mortar

   a. Masonry Cement: Do not use masonry cement.
   b. Do not use calcium chloride in mortar.
   c. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions, and for other applications where another type is not indicated, use Type N.

C. Execution

1. Contractor shall locate and mark all CMU to be replaced. Engineer/Architect shall verify replacement locations prior to start of Work.
2. Contractor shall remove all existing fractured, cracked, spalled, broken or structurally unsound CMU and all CMU damaged during removal and toothing work.
3. Internal structural steel exposed during removal process shall be cleaned to bare metal per SSPC-SP-11, and coated with high performance coating. Coat with one coat of corrosion resistant paint prior to CMU replacement.
4. Entire cavity of removed CMU shall be thoroughly cleaned of all mortar from top, bottom, and both sides of all CMU surrounding new CMU work. Do not allow mortar droppings to accumulate in cavity space, in weep holes, or on flashing. Engineer/Architect shall inspect all cavities for condition prior to commencement of new construction.

5. Flush cavity thoroughly with water to remove all dust and laitance prior to CMU replacement. Allow excess water to run off. All CMU repair work shall be flush with existing.
6. New CMU work is to be toothed into existing CMU work.
7. All bed and head joints shall be fully filled with mortar.
8. Prior to initial set of mortar, tool joints to match existing.
9. Adequate weather protection shall be installed over all areas left open at completion of each day's work.
10. Allow 3 to 7 days for mortar to harden prior to cleaning of CMU wall.
11. Dispose of all accumulated material and leave premises in clean condition.
12. Masonry surfaces that become dirty or smeared during joint cutting and repointing of joint surfaces shall be cleaned with bristle brushes and plain water.
13. Unnecessary damage to surrounding CMU shall be repaired by Contractor at no cost to Owner.

WI 90.2 BIRD DETERRENT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install bird deterrent spikes at the following designated areas:

    a. Parking Structure #8: At the top of the roof level wall in the Northeast corner of the deck.

2. This Work Item applies to Parking Structure #8, and is payable per lineal foot of bird spikes installed. Verify installation location in field prior to submitting bid.

B. Materials

1. Bird deterrent products from one of the following manufacturers:

    a. Bird Barrier.
    b. Bird-B-Gone.

2. Contractor shall work with manufacturer’s representative to determine the type of product and installation procedures to use for this application. Manufacturer to submit written recommendation with Contractor’s product submittal.

C. Execution

1. Submit manufacturer-recommended product for review by Engineer and WSU.
2. Install approved product following manufacturer’s guidelines/requirements.

END OF SECTION 020010

SECTION 025130 - GENERAL CONCRETE SURFACE PREPARATION

PART 1 - GENERAL

1.1 DEFINITIONS

A. **DELAMINATIONS**: Fracture planes, "internal cracks," within concrete. Typically these fractures are parallel to the member face and vary in depth.

B. **NEAR-VERTICAL CHIPPED EDGES:** Provide an edge dressed to within 20^{o} of perpendicular of finished surface.

C. **SPALLS:** Potholes, cavities or voids in concrete. Usually result of delamination migrating to face of concrete member. When fracture finally reaches surface, concrete encompassed by delamination breaks away, resulting in spall.

D. **UNSOUND CONCRETE:** Concrete exhibiting one or more of:

1. Incipient fractures present beneath existing delaminated or spalled surfaces.
2. Honeycombing.
3. Friable or punky areas.
4. Deterioration from freeze-thaw action.

E. **SCALING:** Deterioration which attacks mortar fraction (paste) of concrete mix. First appears as minor flaking and disintegration of concrete surface. Scaling eventually progresses deeper into concrete, exposing aggregate which breaks away.

F. **SHOTBLASTING:** Scarification of concrete surfaces using an abraded metal shot-rebound. See ICRI Guideline 03732 “Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.”

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 025130

SECTION 025140 - SURFACE PREPARATION FOR PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the provision of all labor, materials, equipment, supervision and incidentals necessary to locate and remove all delaminated and unsound concrete, all existing failed patches, all existing surface spalls and potholes, and preparation of cavities created by removal to receive concrete patching material.

B. This Section includes the provision of all labor, materials, equipment, supervision and incidentals necessary to prepare existing sound concrete slab surfaces to receive bonded concrete overlay.

C. Related Sections: Following Sections contain requirements that relate to this Section:

1. Division 03 Section “Cast-in-Place Concrete – Restoration”
2. Division 03 Section “Prepackaged Repair Mortar”
3. Division 03 Section "Shotcrete"
4. Division 03 Section “Unbonded Post-Tensioning Repairs”

1.3 REFERENCES

A. "Specifications for Structural Concrete for Buildings" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.

B. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:

1. ”Concrete Repair Guide” (ACI 546R-04)

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 INSPECTION

A. Floor Slabs:

1. Floor Slab Delaminations: Locate by sounding surface with hammer, rod, or chain drag.
2. When delaminated area is struck, distinct hollow sound is heard.
3. Contractor: Sound all designated floors for delaminations.
4. Certain structural systems that contain thin slab thicknesses with Welded Wire Reinforcement or other small diameter reinforcing, such as waffle slab or precast tees, may have significant deterioration without evidence of delaminations. These structural systems require qualified personnel to provide additional inspections, primarily visual in nature, to define the extent of deterioration.
5. Contractor: Visually inspect thin slab thicknesses with small diameter reinforcing for deterioration.

B. Vertical and Overhead Surfaces:

1. Vertical and Overhead Surface Delaminations: Locate by sounding appropriate member with hammer or rod.
2. Cracks, usually horizontal in orientation along beam faces, and vertical in orientation near column corners are indicators of delaminated concrete.
3. Contractor: Sound only vertical and overhead surfaces that show evidence of cracking and/or salt and water staining.

C. Delaminated areas, once located by Contractor, shall be further sounded to define limits. Mark limits with chalk or paint.

D. Contractor: Locate spalls by visual inspection and mark boundaries with chalk or paint after sounding surface.

E. Engineer/Architect will define and mark additional unsound concrete areas for removal, if required.

F. Areas to be removed shall be as straight and rectangular as practical to encompass repair and provide neat patch.

G. Contractor: Locate and determine depth of all embedded REINFORCEMENT, POST-TENSIONING TENDONS, and ELECTRICAL CONDUIT/WIRING in repair area and mark these locations for reference during concrete removal. Do **NOT** nick or cut any embeds unless approved by Engineer/Architect.

H. Boundaries of repair areas will be as defined in project drawings and verified by Engineer/Architect.

3.2 PREPARATION

A. **Temporary shoring may be required at concrete floor repair areas and at any other concrete repairs such as beams, stems, joists, or columns. Contractor: Review all removal and preparation areas and request clarification by Engineer/Architect of shoring requirements in questionable areas. Shores shall be in place prior to concrete removal and cavity preparation in any area requiring shores**.

B. Delaminated, Spalled and Unsound Concrete Floor Areas: Mark boundaries. All concrete shall be removed from within marked boundary to minimum depth of 0.75 in. using 15 to 30 lb. chipping hammers equipped with chisel point bits. When directed by Engineer/Architect, chipping hammers less than 15 lb. shall be used to minimize damage to sound concrete. Near vertical chipped edge shall be provided along perimeter of repair area where shown on drawings. Areas to be removed shall encompass repair and provide uniform cavity surface. If delaminations exist beyond minimum removal depth, chipping shall continue until all unsound and delaminated concrete has been removed from cavity.

C. Where embedded reinforcement or electrical conduit/wiring is exposed by concrete removal, exercise extra caution to avoid damaging it during removal of unsound concrete. If bond between exposed embedded reinforcement and adjacent concrete is impaired by Contractor's removal operations, Contractor shall perform additional removal around and beyond perimeter of reinforcement for minimum of 0.75 in. along entire length affected at no cost to Owner.

D. If rust is present on embedded reinforcement where it enters sound concrete, additional removal of concrete along and beneath reinforcement required. Additional removal shall continue until non-rusted reinforcement is exposed, or may be terminated as Engineer/Architect directs.

E. Sawcut patch and overlay boundaries to depth of 0.75 in. into floor slab, unless otherwise noted. No saw-cutting required at overlay boundaries abutting existing vertical surface (wall, beam, curb, etc.).For vertical and overhead surfaces marked boundary may be sawcut, ground or chipped to depth of 0.5 in. to 0.625 in. into existing concrete, measured from original surface. All edges shall be straight and patch areas square or rectangular-shaped. Diamond blade saw or grinder with abrasive disk suitable for cutting concrete is acceptable for performing work. Edge cut at boundary shall be dressed perpendicular to member face. It shall also be of uniform depth, for entire length of cut. Exercise extra caution during saw-cutting to avoid damaging existing reinforcement (ESPECIALLY POST-TENSIONING TENDONS AND SHEATHING) and electrical conduit and any other embedded items near surface of concrete. Any damage to existing reinforcement, post-tensioning tendons or sheathing during removals shall be repaired by Contractor with Engineer/Architect-approved methods at no additional cost to Owner.

F. All sound surfaces (surfaces not requiring spall or delamination repair as previously discussed in this section) to receive repair material shall be heavy abrasive blasted or heavy shotblasted prior to placement of repair material, to produce a final concrete surface profile matching ICRI CSP 8 or above.

3.3 INSPECTION OF REPAIR PREPARATION

A. After removals are complete, but prior to final cleaning, exposed concrete surfaces and exposed reinforcement shall be inspected by Contractor and verified by Engineer/Architect for compliance with requirements of this Section. Where Engineer/Architect finds unsatisfactory surface or cavity preparation, Engineer/ Architect shall direct Contractor to perform additional removals. Engineer/Architect shall verify areas after additional removals.

B. Contractor shall inspect embedded reinforcement and conduits exposed within cavity for defects due to corrosion or damage resulting from removal operations. Contractor shall notify Engineer/Architect of all defective and damaged reinforcement or conduits. Replacement of damaged or defective reinforcement or conduits shall be performed according to this Section and as directed by Engineer/Architect.

C. After inspections of exposed surfaces and reinforcement are complete, Engineer/ Architect and Contractor shall measure and document removal and replacement quantities for payment, as required.

3.4 REINFORCEMENT AND EMBEDDED MATERIALS IN REPAIR AREAS

A. All embedded reinforcement exposed during surface preparation that has lost more than 15% (10% if 2 or more consecutive parallel bars and/or tendons are affected) of original cross-section due to corrosion shall be considered DEFECTIVE. All non-defective exposed reinforcement that has lost section to extent specified above as direct result of Contractor's removal operations shall be considered DAMAGED.

B. **Embedded materials** including, but not limited to, reinforcement, electrical conduit/wiring, corrosion protection systems and snow/ice melting equipment **shall be protected by Contractor** during removal operations, and shall be located by contractor prior to start of removal operations. **Damage due to removal operations shall be repaired by Contractor in accordance with national code requirements at no cost to Owner.** Embedded materials which are defective due to pre-existing conditions may be repaired or replaced by Contractor or abandoned at Owner's option and cost.

C. Supplement defective or damaged embedded reinforcement by addition of reinforcement of equal diameter with Class "B" minimum splice per ACI 318 beyond damaged portion of reinforcement. Secure new reinforcement to existing reinforcement with wire ties and/or approved anchors. Supplemental reinforcement shall be ASTM A615 Grade 60 steel installed in accordance with Division 03 specification Sections. Tendon supplement or repair materials, when applicable, shall be as required by Section "Work Items."

D. Loose and supplemental reinforcement exposed during surface preparation shall be securely anchored prior to concrete placement. Loose reinforcement shall be adequately secured by wire ties to bonded reinforcement or shall have drilled-in anchors installed to original concrete substrate. Drilled-in anchors shall be Powers “Tie-Wire Lok-Bolt” anchors, ITW Ramset/Red Head “TW-1400” anchor, or approved

equivalent. Supplemental reinforcing needed to be held off substrate shall be adequately secured by drilled-in anchors installed to original concrete substrate with Powers “Tie-Wire Spike”, ITW Ramset/Red Head Redi-Drive “TD4-112” anchors, or approved equivalent. Engineer/Architect will determine adequacy of wire ties and approve other anchoring devices prior to their use. Securing loose and supplemental reinforcement is incidental to surface preparation and no extras will be allowed for this Work.

E. Concrete shall be removed to provide minimum of 3/4 in. clearance on all sides of defective or damaged exposed embedded reinforcement that is left in place. Minimum of 1.5-in. concrete cover shall be provided over all new and existing reinforcement. Concrete cover over reinforcement may be reduced to 1 in. with Engineer/Architect's approval if coated with an approved epoxy resin.

F. Supplemental reinforcement and concrete removals required for repairs of defective or damaged reinforcement shall be paid for as follows:

1. Concrete removals and supplemental reinforcement required for repairs of DEFECTIVE reinforcement shall be paid for by Owner at unit price bid.
2. Concrete removals and supplemental reinforcement required for repairs of DAMAGED reinforcement shall be paid for by Contractor.

3.5 CLEANING OF REINFORCEMENT WITH DELAMINATION AND SPALL CAVITIES

A. All exposed steel shall be cleaned of rust to bare metal by sandblasting. Cleaning shall be completed immediately before concrete placement to ensure that base metal is not exposed to elements and further rusting for extended periods of time. Entire bar diameter is to be cleaned.

B. After all sandblasting operations and cleanup are completed, paint all exposed steel with an approved epoxy. Protect prepared surfaces from damage prior to and during concrete placement.

3.6 PREPARATION OF CAVITY FOR PATCH PLACEMENT

A. Floor slab and cavity surfaces will be examined prior to commencement of concrete placement operations. Sounding surface shall be part of examination. Any delamination noted during sounding shall be removed as specified in this Section.

B. Cavities prepared by chipping or other impact methods shall be sandblasted to remove material that may impair concrete bonding. Sound concrete surfaces shall be prepared by shot-blasting as previously specified in this section. Air-blasting is required as final step to remove all debris including sand and dust. All debris shall be removed from site prior to commencement of concrete placement, bonding agent preparation, etc. as specified in Division 03 Sections.

END OF SECTION 025140

SECTION 03 30 21 - CAST-IN-PLACE CONCRETE RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix. Use form at end of this Section.

D. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.

E. Testing Agency Qualifications:

1. Independent agency, acceptable to authorities having jurisdiction, and acceptable to engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

F. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to Contractor's authorized on-site representative and to Owner's authorized on-site representative.

G. Testing Agency: Submit following Field Test information for Project Concrete unless modified in writing by Engineer:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address, and phone number.
4. Concrete supplier.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.
8. Time of batching.
9. Time of testing.
10. Elapsed time from batching at plant to discharge from truck at site.
11. Concrete mixture identification number.
12. Weather data:

    a. Air temperatures.
    b. Weather.

13. Field test data:

    a. Date, time, and place of test.
    b. Slump.
    c. Concrete Temperature.
    d. Slump flow (for SCC).
    e. Air content.

14. Compressive test data:

    a. Cylinder number.
    b. Age of concrete when tested.
    c. Date and time of cylinder test.
    d. Curing time (field and lab).
    e. Cross-sectional area of cylinder.
    f. Compressive strength.
    g. Type of failure (at break).

1.6 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117, “Standard Specifications for Tolerances for Concrete Construction and Materials.”
2. ACI 214R, “Evaluation of Strength Test Results of Concrete.”
3. ACI 301, “Specifications for Structural Concrete.”
4. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
5. ACI 305R, “Hot Weather Concreting.”
6. ACI 306.1, “Cold Weather Concreting.”
7. ACI 308R, “Guide to Curing Concrete.”
8. ACI 308.1, “Standard Specifications for Curing Concrete.”
9. ACI 318, “Building Code Requirements for Structural Concrete & Commentary.”
10. ACI 347, “Guide to Formwork for Concrete.”
11. ACI 347.2 “Guide to Shoring/Reshoring of Concrete Multistory Buildings.”

B. American Society for Testing and Materials (ASTM):

1. ASTM A 36, “Standard Specification for Carbon Structural Steel.”
2. ASTM A 615, “Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement.”
3. ASTM A 706, “Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.”
4. ASTM A 775, “Standard Specification for Epoxy-Coated Steel Reinforcing Bars.”
5. ASTM A 884, “Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement for Reinforcement.”
6. ASTM A1064, “Standard Specification for Carbon-Steel Wire and Welded Wire Steel Reinforcement, Plain and Deformed, for concrete.”
7. ASTM C 31, “Standard Practice for Making and Curing Concrete Test Specimens in the Field.”
8. ASTM C 33, “Standard Specification for Concrete Aggregates.”
9. ASTM C 39, “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
10. ASTM C 94, “Standard Specification for Ready-Mixed Concrete.”
11. ASTM C 138, “Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.”
12. ASTM C 143, “Standard Test Method for Slump of Hydraulic Cement Concrete.”
13. ASTM C 150, “Standard Specification for Portland Cement.”

14. ASTM C 171, “Standard Specification for Sheet Materials for Curing Concrete.”
15. ASTM C 172, “Standard Practice for Sampling Freshly Mixed Concrete.”
16. ASTM C 173, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.”
17. ASTM C 231, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.”
18. ASTM C 260, “Standard Specification for Air-Entraining Admixtures for Concrete.”
19. ASTM C 309, “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
20. ASTM C 494, “Standard Specifications for Chemical Admixtures for Concrete.”
21. ASTM C 567, “Standard Test Method for Determining the Density of Structural Lightweight Concrete.”
22. ASTM C 618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”
23. ASTM C 989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
24. ASTM C 1218, “Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete.”
25. ASTM C 1315, “Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.”
26. ASTM C 1611/C 1611M, “Standard Test Method for Slump Flow of Self-Consolidating Concrete.”

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and form accessories according to ACI 301, ACI 347, and ACI 347.2.

2.2 STEEL REINFORCEMENT

A. Epoxy-coated Reinforcing Bars: ASTM A775

B. Plain-Steel Welded Wire Fabric: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets, mats only. Roll stock prohibited.

C. Post-tensioned Reinforcement: See Division 03, Section “Unbonded Post-tensioning Repairs”.

D. Provide bar supports according to CRSI’s “Manual of Standard Practice.” Use all-plastic bar supports when in contact with exposed concrete surface.

2.3 CONCRETE MATERIALS

A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:

1. Concrete Materials Engineering Council.
2. Michigan Department of Transportation.
3. National Ready Mixed Concrete Association.
4. Prestressed Concrete Institute.

B. Portland Cement: ASTM C 150, Types I or II or Type I/II.

C. Fly Ash: ASTM C618, Class F.

D. Ground-Granulated Blast Furnace Slag: ASTM C989, Gr. 100 or higher.

E. Silica Fume: ASTM C1240.

F. Normal-Weight Coarse Aggregate: ASTM C 33, Crushed and graded limestone or approved equivalent, Class 5S uniformly graded, not exceeding ¾ inch nominal size. No cherts, opaline or crushed hydraulic-cement concrete is permitted.

1. Combine Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer that No. 50.

G. Normal-Weight Fine Aggregate: Natural or manufactured sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.

H. Water: Potable and complying with ASTM C 1602.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.

B. General: Admixtures certified by manufacturer that all admixtures used are mutually compatible.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or high-range water reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, fiber reinforced concrete, parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.45.
4. Use non-corrosive accelerator for all concrete, less than 8 inches thick, placed at air temperatures below 50 degrees Fahrenheit.

5. Use corrosion-inhibiting admixture in parking structure slabs and other areas noted on drawings.
6. Use alkali-silica reactivity inhibitor unless ready mix company confirms that the aggregates to be used on the job are non-reactive.

D. Normal Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon Series,” Euclid Chemical Co.
b. “WRDA Series,” W.R. Grace & Co.
c. “Master Pozzolith Series,” or “Master PolyHeed Series,” BASF Corporation.
d. “Plastocrete Series”, Sika Corporation.
e. “OptiFlo Series” or “EcoFlo Series,” Premiere Concrete Admixtures.
f. “Polychem Series” or “KB Series,” General Resource Technology.
g. “LC-400 Series” or “LC-500 Series,” Russ Tech Admixtures, Inc.

E. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A.

1. Subject to compliance with requirements, provide one of following:

a. “Eucon MR” or “Eucon X-15 and X-20,” Euclid Chemical Co.
b. “Daracem Series” or “MIRA Series,” W.R. Grace & Co.
c. “Master Polyheed Series,” BASF Corporation.
d. “Sikaplast Series” or “Plastocrete Series”, Sika Corporation.
e. “Polychem 1000” or “KB Series,” General Resource Technology.
f. “Finishease-NC,” Russ Tech Admixtures, Inc.
g. “OptiFlo Series” or “EcoFlo Series,” Premiere Concrete Admixtures.

F. High-Range, Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon 37” or “Eucon SP-Series” or “Plastol Series,” Euclid Chemical Co.
b. “Daracem Series” or “ADVA Series,” W.R. Grace & Co.
c. “Master Rheobuild 1000”, “PS 1466” or “Master Glenium Series,” BASF Corporation.
d. “Sikament Series” or “Sika ViscoCrete Series,” Sika Corporation.
e. “Melchem Series,” General Resource Technology.
f. “Superflo 443” or “Superflo 2000 Series,” Russ Tech Admixtures, Inc.
g. “EcoFlo Series” or “UltraFlo Series,” Premiere Concrete Admixtures.

G. Water-Reducing and Retarding Admixture: ASTM C 494, Type B or D.

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon Retarder-75”, “Eucon DS” or “Eucon Stasis.” Euclid Chemical Co.
b. “Daratard-17” or “Recover,” W.R. Grace & Co.
c. “MasterSet R Series” or “MasterSet Delvo Series,” BASF Corporation.

d. "Sikatard Series," or "Plastiment Series" or "Plastocrete Series," Sika Corporation.
e. "Polychem R," General Resource Technology.
f. "LC-400 Series" or "LC-500 Series," Russ Tech Admixtures, Inc.
g. "OptiFlo Series," Premiere Concrete Admixtures.

H. Air Entraining Admixture: ASTM C260.

1. Products: Subject to compliance with requirements, provide one of following:

a. "Air-Mix," "Eucon Air-Series" or "AEA-92," Euclid Chemical Co.
b. "Daravair Series" or "Darex Series," W.R. Grace & Co.
c. "Master Air AE90", or Master Air AE 200", or "Master Air VR10," BASF Corporation.
d. "Sika AEA Series," or "Sika AIR Series," Sika Corporation.
e. "ConAir Series," Premiere Concrete Admixtures.
f. Polychem "VR" or "VRC" or "Polychem AE," General Resource Technology.
g. "RSA-10," Russ Tech Admixtures, Inc.

I. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.

1. Products: Subject to compliance with requirements, provide one of following:

a. "Eucon AcN-Series," "Accelguard 80," "Accelguard NCA," or "Accelguard 90," by Euclid Chemical Company.
b. "DCI," "PolaraSet," "Lubricon NCA," "Daraset" or "Gilco," by W.R. Grace & Co.
c. "MasterSet FP 20" or "MasterSet AC 534," by BASF Corporation.
d. "Sika Set NC," "Plastocrete 161FL", or "Sika Rapid-1," by Sika Corporation.
e. "Catexol 2000 RHE," by Axim Concrete Technologies.
f. "Polychem NCA" or "Polychem Super Set," General Resource Technology.
g. "LCNC-166," Russ Tech Admixtures, Inc.

J. Corrosion Inhibiting Admixture shall be capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Eucon CIA" or "Eucon BCN," Euclid Chemical Company.
b. "DCI" or "DCI-S," W.R. Grace.
c. "MasterLife CI 30," BASF Corporation.
d. "Sika CNI," Sika Corporation.
e. "Catexol 1000 CN-CI," Axim Concrete Technologies.
f. "Polychem CI," General Resource Technology.
g. "Russ Tech RCI," Russ Tech Admixtures, Inc.

2. Add at rate of 3 gal/cu yd. of concrete, which shall inhibit corrosion to 9.9 lb of chloride ions per cu. yd. of concrete. Calcium Nitrite based corrosion inhibitor shall have a concentration of 30 percent, plus or minus 2 percent of solids content.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry. Materials must be free of harmful substances, such as sugar or fertilizer, or substances that may discolor the concrete. To remove soluble substances, burlap should be thoroughly rinsed in water before placing it on the concrete.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Curing Compound: Not allowed.

2.6 CONCRETE MIXTURES

A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
2. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.

B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.

C. Requirements for normal-weight concrete mix are shown on Drawings:

1. Compressive strength.
2. Slump.
3. Water-cementitious materials ratio.
4. Air content.

D. Supplementary cementitious materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials according to ACI 318 requirements.

E. Air Entrainment:

1. See General Notes on Drawings for total average air content (percent by volume).
2. Average air content shall exceed value stated in General Notes on Drawings.
3. Permissible variation for any one test result from specified average total air content: plus or minus 1.5 percent unless noted otherwise on General Notes on Drawings.
4. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in^2 per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer."

F. Chloride Ion Content of Mixture:

1. Water soluble chloride ion content of concrete shall not exceed 0.06 percent by weight of cement for pre-stressed concrete and 0.15 percent for reinforced concrete. (ACI 318 Chapter 4 Table 4.4.1"Maximum Chloride Ion Content for Corrosion Protection of Reinforcement") Testing procedure to determine chloride ion content shall conform to ASTM C 1218.
2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
3. Concrete not meeting the requirements of paragraph "Water soluble chloride ion content of concrete…" above, shall contain appropriate amount of calcium nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30 percent, plus or minus 2 percent, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb. of excess chloride ion). Calcium nitrite used to offset chloride ions is in addition to calcium nitrite used as a corrosion inhibitor. Maximum of 1.5 lb. of chloride ion per cubic yard may be offset in this manner.

G. Alkali-Aggregate Reactivity Resistance: Provide one of the following:

1. Total equivalent alkali content of mixture less than 5 lb. /cu. yd.
2. ASTM C1293: Expansion less than 0.04 % after 1 year for each of the aggregates (both coarse and fine) in the proposed concrete mixture. This data shall be less than 1 year old.
3. ASTM C1260 or AASHTO T303: Expansion less than 0.1 % after 14 days for each of the aggregates (both coarse and fine) in the proposed concrete mixture.
4. ASTM C1567: Expansion less than 0.1 % after 14 days with each of the aggregates (both coarse and fine) and the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design. Alternatively, if satisfactory ASTM C1260 or AASHTO T303 test results can be provided for one of the aggregates that are being used, ASTM C1567 testing does not need to be provided for that aggregate.
5. CE CRD-C662: Expansion less than 0.1 % after 28 days with the each of the aggregates (both coarse and fine), the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design and the lithium admixture source and dosage level of the proposed mixture design. Alternatively, if satisfactory ASTM C1260 or AASHTO T303 test results can be provided for one of the aggregates that are being used, CRD-C662 testing does not need to be provided for that aggregate.

H. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Consider using water-reducing admixture or high-range water-reducing admixture (Superplasticizers), OR admixtures that achieve self-consolidating concrete, as required, for placement, workability, finishing and when required, increased flowability.

2. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.
4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

I. When concrete mixture contains calcium nitrite admixture, (or other ionic salts that affect the chloride permeability test), perform rapid chloride permeability test for submitted mixture and for control sample. Control sample shall have the same mixture and water-cementitious materials ratio as submitted mixture, except calcium nitrite admixture shall not be used.

J. Slump (ACI 301, Part 4 header “Slump”):

1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of high range water reducers (superplasticizers) only, and Contractor shall obtain written acceptance from Engineer who may require an adjustment to mix.
2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2-3 in. Final slump after the addition of the superplasticizer shall be 6-9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:

    a. Submit letter from testing laboratory which developed original mixture proportions, for each super plasticized mixture, certifying volume of mix water which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.
    b. Submit plant computer printout of mixture ingredients for each truckload of super plasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
    c. Over-retarding or crusting of flatwork surface: cause for concrete rejection.
    d. Segregation or rapid slump loss (superplasticizer life) due to incompatibility or under-dosing: cause for concrete rejection.

K. Self-Consolidating Concrete:

1. Minimum flow of 24 in. to 28 in. or as required by the successful test placement. All self-consolidating concrete shall contain the specified high-range water-reducing admixture and viscosity-modifying admixture as required.
2. Measure slump flow using slump cone upright or inverted in accordance with ASTM C1611. Measured flow shall be greater than 24 inches and consistent with submitted mixture test parameters plus or minus 2 in.
3. Measure passing ability in accordance with ASTM C 1621/C 1621M. Use the slump cone in the same way as in the slump flow test. Difference in average slump flow between slump flow and passing ability tests shall not exceed 2 in.

4. Determine the static segregation (stability) in accordance with ASTM C 1610/C 1610M. Segregation factor of the mixture shall not be more than 15 percent.

L. Engineer's acceptance of mixture proportions shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at time of submission and Engineer has given written approval of each such variation.

M. Adjustment to Concrete Mixtures: Adjustments to mixture proportions may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mixture and strength results shall be submitted to and accepted by Engineer before using in work.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch plant-printed ticket information at delivery to site.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.8 MATERIAL ACCESSORIES

A. Extended Open Time Epoxy Bonding Agent: Three component, water based, epoxy modified portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer's open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.

1. Acceptable materials for this Work are:

    a. “Duralprep A.C.” by The Euclid Chemical Company, Cleveland, OH.
    b. “Sika Armatec 110 EpoCem”, by Sika Corporation, Lyndhurst, NJ.
    c. Other types may be used only with Engineer/Architect's approval in writing prior to bidding.

B. Epoxy Adhesive: 2 or 3 component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Product shall be capable of achieving bond strength of 1,800 psi per ASTM C 882.

1. Acceptable materials for this Work are:

    a. “MasterEmaco P 124” or “MasterEmaco ADH 326,” by BASF Corporation.
    b. “Kemko 001 or 008”, by ChemCo Systems, Inc., Redwood City, CA.
    c. “Dural #452 and Dural Series”, by The Euclid Chemical Company, Cleveland, OH.
    d. Sikadur 32 Hi-Mod LPL”, by Sika Corporation, Lyndhurst, NJ.
    e. Other types may be used only with Engineer/Architect's approval in writing prior to bidding.

C. Epoxy Coating for Existing Exposed Non-prestressed Steel Reinforcement or Welded Wire Reinforcement:

1. Provide one of following epoxy coatings:

    a. “Sikadur 32 Hi-Mod,” Sika Chemical Corp.
    b. “MasterEmaco ADH 326,” BASF Corporation.
    c. “Scotchkote 413 PC,” 3M Company.
    d. “Dural 452 MV,” The Euclid Chemical Company.
    e. “Resi-Bond (J-58),” Dayton Superior Corporation.

D. For mechanical tension splices of reinforcement:

1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:

    a. Bar-Lock Rebar Coupler, by Dayton Superior.
    b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
    c. Extender HRC 500 Series Coupler, by Headed Reinforcement Corp.
    d. Splice Sleeve, by NMB.
    e. LENTON Splices, by Erico.

E. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

F. Joint Fillers

1. Joint filler in slabs and curbs per ASTM D1751 Asphalt impregnated fiber board; as shown on Drawings. Acceptable products as follows:

a. “Flexcell,” Knight-Celotex Corp.
b. “Fibre Expansion Joint,” W.R. Meadows, Inc.

2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene bead board type.

3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:

a. “Sealtight Premoulded Membrane Vapor Seal,” W.R. Meadows, Inc., Elgin, Illinois.
b. “Sealtight Melgard,” W.R. Meadows, Inc., Elgin, Illinois and shall be applied according to manufacturer’s instructions.

2.9 TOOLS

A. Slab Jointing

1. Concrete Groovers: For tooled joints in concrete:

a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.

2. Saw Cut Joints: Not allowed.

B. All joints subject to acceptance by sealant installer/manufacturer. Concrete contractor to rework rejected joints until acceptable to sealant installer.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

A. Conduct a preconstruction meeting addressing the concrete preparation, installation, protection, quality control, and acceptance of Work.

3.2 FORMWORK

A. Design, construct, erect, shore, brace, and maintain formwork according to ACI 301 and ACI 347.

3.3 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Engineer.

C. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint filler full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

D. Cold Weather Placement: Comply with ACI 306.1.

E. Hot Weather Placement: Comply with ACI 305 R.

3.6 FINISHING FORMED SURFACE.

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.

1. Acceptable only for concrete surfaces not exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

A. Flatwork in Horizontal Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish":

1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:

    a. Use minimal passes so as to not overwork the concrete.
    b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.

2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
3. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
4. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.

B. Flatwork subject to pedestrian traffic:

1. Concrete surfaces at all walking areas subject to pedestrian traffic shall provide a smooth, slip-resistant walking surface for pedestrians with these minimum requirements:

    a. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces and "2010 ADA Standards for Accessible Design" and ICC A117.1.
    b. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:

        1) Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2.
        2) Changes in Level between ¼ inch and ½ inch height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3.
        3) Changes in level greater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp within minimum ADA guidelines.
        4) Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3.

c. Walkway surfaces shall provide a slip-resistant surface.

1) Concrete surfaces shall be troweled and finished to provide a slip resistant finish.
2) Contractor shall provide sample area with slip resistant surface finish.
3) Static coefficient of friction for walking surfaces shall be measured on a dry surface by the NBS – Brungraber machine using a silastic sensor shoe and shall be 0.6 or larger for a level surface and 0.8 or larger for ramps.

3.8 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.9 CONCRETE PROTECTION AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305R for hot-weather protection during placement. Keep concrete continually moist prior to final curing by evaporation retarder, misting, sprinkling, or using absorptive mat or fabric covering kept continually moist.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.1 lb/sq. ft. x h before and during finishing operations. Apply material according to manufacturer's written instructions one or more times after placement, screeding and bull floating concrete, but prior to float finishing. Repeated applications are prohibited after float finishing has begun.

1. Acceptable evaporation retarder materials for this Work are:

a. "Cimfilm", by Axim Concrete Technologies.
b. "MasterKure ER 50," by BASF Corporation.
c. "Aquafilm", by Conspec Marketing & Manufacturing Co., Inc.
d. "Sure-Film (J-74)', by Dayton Superior Corporation.
e. "Eucobar", or "Tamms Surface Retarder", by The Euclid Chemical Company, Cleveland, OH.
f. "E-Con", by L&M Construction Chemicals, Inc.
g. "EVRT", by Russ Tech Admixtures, Inc.
h. "SikaFilm", by Sika Corporation, Lyndhurst, NJ.

C. Immediate upon conclusion of finishing operation cure concrete in accordance with ACI 308 for duration of at least seven days by moisture curing or moisture retaining covering. Provide additional curing immediately following initial curing and before concrete has dried.

1. Continue method used in initial curing.

2. Material conforming to ASTM C171.
3. Other moisture retaining covering as approved by Engineer/Architect.
4. During initial and final curing periods maintain concrete above 50°.
5. Prevent rapid drying at end of curing period.

D. Concrete surfaces to receive slab coatings or penetrating sealers shall be cured with moisture curing or moisture-retaining cover**.**

E. Curing Methods: Cure formed and non-formed concrete moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency acceptable to the Engineer to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Perform tests according to ACI 301.

B. Sample concrete in accordance with ASTM C 172.

C. Epoxy Coated Material:

1. Perform field inspection of installed epoxy coated material under provisions of Division 01 Section “Quality Control.”
2. Repair all epoxy coating damage due to fabrication and handling, using a mirror to find any damage on undersides.
3. Repair all damaged areas using manufacturer’s recommended patching material and method.
4. No damaged area shall be left uncorrected.

D. Temperature:

1. Test temperature of concrete in accordance with ASTM C 1064/C 1064M and ACI 301 each time cylinders are taken or as directed by the Engineer.

E. Slump Test:

1. Conduct one slump test in accordance with ASTM C 143/C 143M per truck load of ready-mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump test in accordance with ASTM C143/C 143M and ACI 301 for foundation concrete.
3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.

F. Water Content:

1. Water content or water-cementitious materials ratio shall be verified by use of the Microwave Test in accordance with AASHTO T 318.
2. Conduct test each time test cylinders are taken and as directed by Engineer.

G. Air Content:

1. General Contractor: Coordinate all parties involved to produce conforming concrete.
2. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172 and **conduct one air content test** in accordance with ASTM C 231 or ASTM C 173 **for each truck** of ready-mix, air entrained concrete delivered to Project.

H. Concrete Compressive Strength:

1. Make test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 39 as follows:

    a. Take minimum of three sets of cylinders for each 100 cu yds. or fraction thereof, of each Mixture of concrete placed in any one day.
    b. A set of cylinders shall be comprised of two 6 inch by 12 inch cylinders or three 4 inch by 8 inch cylinders.
    c. At Contractor’s option and cost, cylinders may be taken to verify concrete strength prior to form removal.
    d. Testing Agency: Provide and maintain site cure box for cylinders.

2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated. Sample concrete for test cylinders to be used to verify concrete compressive strength for post-tensioning as near as possible to actual tendon anchorages.
3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.

4. Cure test cylinders per ASTM C 31 as follows:

    a. To verify compressive strength prior to post-tensioning or form removal or for additional test cylinders required due to cold weather concreting conditions:

        1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
        2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.

    b. To verify 28-day compressive strength:

        1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
        2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.

5. Compression testing:

    a. Test one set of cylinders at 4 days.

        1) For post-tensioned concrete, test one set of cylinders immediately before tensioning.

    b. Test one set of cylinders at 7 days.
    c. Test one set of cylinders at 28 days.
    d. Hold one set of cylinders in reserve for use as Engineer directs.
    e. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.

I. Report all nonconforming test results immediately to Engineer and others on distribution lists via email, and flag the non-conformances on the testing reports.

J. Monthly, submit a graph showing distribution of compressive strength test results and air content test results. Include microwave test results for concretes with a water cementitious ratio less than or equal to 0.40 concrete.

3.11 EVALUATION AND ACCEPTANCE OF WORK

A. Acceptance of Repairs (ACI 301):

1. Acceptance of completed concrete Work will be according to provisions of ACI 301.
2. Repair areas shall be sounded by Engineer and Contractor with hammer or rod after curing for 72 hours. Contractor shall repair all hollowness detected by removing and replacing patch or affected area at no extra cost to Owner.

3. If shrinkage cracks appear in repair area when initial curing period is completed, repair shall be considered defective, and it shall be removed and replaced by Contractor at no extra cost.

3.12 CONCRETE MIX DESIGN FORM

A. See appendix to this Section for concrete mix design form.

END OF SECTION 03 30 21

APPENDIX: Concrete Mix Design Submittal Form

I. GENERAL INFORMATION	
Project:	City:
General Contractor:	
Concrete Supplier:	
Mixture Identification No.:	Concrete Grade:
Use (Describe)[1]:	

[1] example: floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA		
Proportioning Based on (Check only one): Standard Deviation Analysis: _____ or Trial Mix Test Data: _____		
Mixture Characteristics: (see Mixtures in Drawings General Notes)	Density: pcf;	Air: % specified
	Slump ____ in. before superplasticizer	Slump ____ in. after superplasticizer Or for SCC: Spread ____ in.
	Strength: _____ psi (28 day);	

WALKER SUBMITTAL STAMP _____
CONTRACTOR SUBMITTAL STAMP

III. MATERIALS		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	Type	Product-Manufacturer (Source)
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

IV. MIX PROPORTIONS (2)		
	WEIGHT (lbs.) (per yd^3)	ABSOLUTE VOL. (cu. ft.) (per yd^3)
Cement:		
Fine Aggregate: (3)		
Coarse Aggregate: (3)		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processes Ultra-Fine Fly Ash		
HRM		
Water: (.4) (gals. & lbs.)		
Entrained Air: (oz.)		
Fibers:		
(Other) _____:		

TOTALS:		

NOTES:
(2) Mix proportions indicated shall be based on data used in section VII or IX.
(3) Based on saturated surface dry weights of aggregates.
(4) Includes ALL WATER, including added water and free water contained on aggregates.

V. RATIOS			VI. SPECIFIC GRAVITIES
Water[(1)]	=	lb. =	Fine Aggregate:
Cementitious Material[(2)]		lb.	Coarse Aggregate:
Fine Agg.	=	lb. =	
Total Agg.		lb.	

NOTES:
(1) Includes ALL water, including added water and free water contained on aggregates.
(2) Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra-Fine Fly Ash or other pozzolan.

VII. ADMIXTURES				
Air Entraining Agent (A.E.A.):	___ oz.	per yd^3	___ oz.	per 100# cement
Superplasticizer	___ oz.	per yd^3	___ oz.	per 100# cement
Water Reducer	___ oz.	per yd^3	___ oz.	per 100# cement
Non-corrosive Accelerator	___ oz.	per yd^3	___ oz.	per 100# cement
Retarder	___ oz.	per yd^3	___ oz.	per 100# cement
Other	___ oz.	per yd^3	___ oz.	per 100# cement
Lithium Nitrate	___ gal.	per yd^3		

VIII. STANDARD DEVIATION ANALYSIS:	Yes	N/A
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)		
Number of Tests Evaluated: (One test is average of two cylinder breaks) Attach copy of test data considered:	Standard Deviation: (Single Group) Standard Deviation: (Two Groups)	
Required average compressive strength: f'cr = f'c + _____ psi		
NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations: (4.-3) f'cr = f'c + 1.34ks [s= calculated standard deviation] or (4-4) f'cr = f'c + 2.33ks – 500 or (4-5) f'cr = 0.9f'c + 2.33ks (for f'c> 5,000 psi) (Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)		

MIXTURE CHARACTERISTICS (As shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

IX. TRIAL MIXTURE TEST DATA:	Yes	N/A
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)		

Age (days)	Mix #1 (comp. str.)	Mix #2 (comp. str.)	Mix #3 (comp. str.)
7			
7			
28			
28			
28			
28 day average compressive strength, psi			

NOTE:
Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations:

(Less than 3000) f'cr = f'c + 1000
or
(3000 to 5000) f'cr = f'c + 1200
or
(Over 5000) f'cr = 1.1f'c + 700

For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.

MIXTURE CHARACTERISTICS (as shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

X. OTHER TEST DATA		
Water Soluble Chloride Ion Content of mix:	_____ %(by weight of cement)	ASTM C 1218
Hardened Air Content (per ASTM C457):		
Air content: _____%	Air void spacing Factor ____in.	Specific surface: ____in^2/in^3
Chloride Ion Content of Concrete Mixture: ASTM C 1218		
Shrinkage (Length Change, Average) per ASTM C157:		
_____% @ 4 days	_____% @ 7 days	_____% @ 14 days
_____% @21 days	_____% @28 days	

XI. Remarks:

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.

Signature _____

Typed or Printed Name _____

REQUIRED ATTACHMENTS	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for calculation of required average strength and for calculation of standard deviation
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157
	ASTM C 457
	Alkali Content Data and Calculations OR ASTM C1293, ASTM C1260, ASTM C 1567 or CE CRD-C662 Test report for each aggregate

SECTION 03 37 13 - SHOTCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes shotcrete applied by the dry-mix or wet-mix process.

B. This Section includes the provision of all labor, materials, supervision and incidentals necessary to install shotcrete to horizontal, vertical and overhead surfaces to restore original surface condition and integrity.

1.3 DEFINITIONS

A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.

B. Dry-Mix Shotcrete: Shotcrete with most of the water added at nozzle.

C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 SUBMITTALS

A. Product Data: For manufactured materials and products including reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.

B. Shop Drawings: For details of fabricating, bending, and placing reinforcement. Include support and anchor details, number and location of splices, and special reinforcement required for openings through shotcrete structures.

C. Samples: Approximately 24 by 24 by 2 inches (600 by 600 by 50 mm), to illustrate quality of finishes, colors, and textures of exposed surfaces of shotcrete. Approved samples may be incorporated into the final Work. Rejected samples shall be removed and replaced at no additional cost.

D. Design Mixes: For each shotcrete mix.

E. Material Test Reports: For shotcrete materials.

F. Material Certificates: For each material item, signed by manufacturers.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Shotcrete contractor shall have a minimum of three (3) years experience in the application performed. All Nozzlemen to perform work shall have a current ACI / ASA Nozzlemen Certification. A qualified installer employing nozzle operators who attain mean core grades not exceeding 2.5, according to ACI 506.2, on preconstruction tests.

B. Testing Agency Qualifications: Independent and qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548, and acceptable to authorities having jurisdiction.

C. Comply with provisions of the following, unless more stringent requirements are indicated:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 506.2, "Specification for Shotcrete."
3. CRSI's "Manual of Standard Practice."

D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing and inspections indicated below:

1. Produce test panels before shotcrete placement according to requirements in ACI 506.2 and ASTM C 1140 for each design mix, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 3-1/2 inches (90 mm). From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced. Agency will perform the following:

    a. Test each set of unreinforced specimens for compressive strength according to ASTM C 42.
    b. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

E. Mockups: Before installing shotcrete, construct mockups for each finish required and for each design mix, shooting orientation, and nozzle operator to demonstrate aesthetic effects and set quality standard for installation.

F. Pre-installation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Cold-Weather Shotcreting: Protect shotcrete work from physical damage or reduced strength caused by frost, freezing, or low temperatures according to ACI 306.1 and as follows:

1. Discontinue shotcreting when ambient temperature is 40 deg F (4.4 deg C) and falling. Uniformly heat water and aggregates before mixing to obtain a shotcrete

shooting temperature of not less than 50 deg F (10 deg C) and not more than 90 deg F (32 deg C).
2. Do not use frozen materials or materials containing ice or snow.
3. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
4. Do not use calcium chloride, salt, and other materials containing antifreeze agents.

B. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 305R when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:

1. Cool ingredients before mixing to maintain shotcrete temperature at time of placement below 100 deg F (38 deg C) for dry mix or 90 deg F (32 deg C) for wet mix.
2. Decrease temperature of reinforcing steel and receiving surfaces below 100 deg F (38 deg C) before shotcreting.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms: Form-facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practicable sizes to minimize number of joints.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel-Welded Wire Reinforcement: ASTM A 1064, fabricated from as-drawn wire into flat sheets.

C. Supports: Bolsters, chairs, spacers, ties, and other devices for spacing, supporting, and fastening reinforcing steel in place according to CRSI's "Manual of Standard Practice" and as follows:

1. Use all plastic bar supports.

D. Reinforcing Anchors: ASTM A 36/A 36M, un-headed rods or ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), hex-head bolts; carbon steel; and carbon-steel nuts.

1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

2.3 SHOTCRETE MATERIALS

A. Shotcrete Cement and Blended Cements

1. Portland Cement: ASTM C 150, Type I, I/II, or III. Use only one brand and type of cement for Project. Select supplementary cementing materials from

subparagraphs below, if permitted. Blending of fly ash, slag, silica fume with Portland cement is done at ready-mix plant.

2. Fly Ash: ASTM C 618, Class F.
3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
4. Silica Fume: ASTM C 1240, amorphous silica.

B. Acceptable Blended Shotcrete Cement

1. Gun-Rite Cement: JE Tomes, Blue Island, IL

C. Normal-Weight Aggregates: ASTM C 33, from a single source, and as follows:

1. Aggregate Gradation: ACI 506R, Gradation No. 2 with 100 percent passing 1/2-inch (13-mm) sieve.
2. Coarse-Aggregate Class: 3S.

D. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored, water-reducing admixtures, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.

1. Color: Match existing adjacent surfaces to satisfaction of Owner.

E. Water: Potable, complying with ASTM C 94, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.

F. Carbon-Steel Fiber: ASTM C 1116, Type 1, carbon-steel fiber and ASTM A 820, Type 1, cold-drawn wire, not less than 1 inch (25 mm) long.

G. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in shotcrete, complying with ASTM C 1116, Type III, not less than 1/2 inch(12 mm) long.

H. Ground Wire: High-strength steel wire, 0.8 to 1 mm in diameter.

2.4 CHEMICAL ADMIXTURES

A. General: ASTM C 1141, Class A or B, but limited to the following admixture materials. Provide admixtures for dry-mix or wet-mix shotcrete that contains not more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494, Type A.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
6. Accelerating Admixture: ASTM C 494, Type C.

B. Blended Admixture

1. Gun-Rite HP, JE Tomes, Blue Island, IL
2. Other types may be used only with Engineer's approval in writing prior to bidding.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B. Not allowed on surfaces to received coatings/sealers/paint/etc.

2.6 SHOTCRETE MIXES, GENERAL

A. Prepare design mixes for each type and strength of shotcrete.

1. Limit use of fly ash, ground granulated blast-furnace slag, and silica fume to not exceed, in combination, 25 percent of portland cement by weight.

B. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.

C. Admixtures: When included in shotcrete design mixes, use admixtures and retarding admixtures according to manufacturer's written instructions.

D. Carbon-Steel or Synthetic Fiber (if used): Uniformly disperse in shotcrete mix, according to manufacturer's written instructions.

E. Design-Mix Adjustments: Subject to compliance with requirements, shotcrete design-mix adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.7 NORMAL-WEIGHT SHOTCRETE MIXES

A. Proportion dry mixes by field test data methods and wet mixes according to ACI 211.1 and ACI 301, using materials to be used on Project, to provide normal-weight shotcrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
2. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight, wet-mix shotcrete having an air content before pumping of 7 percent with a tolerance of plus or minus 1-1/2 percent.

B. Acceptable pre-packaged fiber reinforced shotcrete mixes:

1. “Eucoshot F”, (Dry or Wet Method) by The Euclid Chemical Company, Cleveland, OH.
2. “Gun-Rite 5000” (Wet Method), by JE Tomes & Associates, Blue Island, IL.
3. “Gun-Rite HP”, (Wet Method), by JE Tomes & Associates, Blue Island, IL.
4. “Gun-Rite DS-1”, (Dry Method) by JE Tomes & Associates, Blue Island, IL.
5. “MS-D1 Shotcrete”, (Dry Method), by King Packaged Materials Company, Burlington, ON.
6. “MasterEmaco S 211 SP”, Dry or Wet Method), by BASF Corporation, Shakopee, MN.
7. “Sikacem 103F”, (Dry or Wet Method) by Sika Corporation, Lyndhurst, NJ.
8. “Sikacem 133F”, (Dry Method) by Sika Corporation, Lyndhurst, NJ.
9. Other types may be used only with Engineer's approval in writing prior to bidding.

2.8 SHOTCRETE EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.

B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.

1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.

C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.9 BATCHING AND MIXING

A. Dry-Mix Process: Measure mix proportions by weight batching according to ASTM C 94 or by volume batching complying with ASTM C 685 requirements.

1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
2. Prepackaged shotcrete materials may be used at Contractor's option. Predampen prepackaged shotcrete materials and mix before use.

B. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information if ready mix is used.

1. Comply with ASTM C 685 when shotcrete ingredients are delivered dry and proportioned and mixed on-site.
2. Prepackaged shotcrete materials may be used at Contractor's option.

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete or Masonry: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces before shotcreting.

1. Abrasive blast or hydro-blast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.

B. Steel: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 FORMS

A. General: Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.

1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.

B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

C. Securely embed reinforcing anchors into existing substrates, located as required.

D. Accurately position, support, and rigidly secure reinforcement against displacement by formwork, construction, or shotcreting. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

E. Place reinforcement to obtain minimum coverages for shotcrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during shotcreting. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.

F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. Construction Joints: Locate and install construction joints tapered to a 1:1 slope where joint is not subject to compression loads and square where joint is perpendicular to main reinforcement. Continue reinforcement through construction joints, unless otherwise indicated.

B. Contraction Joints: Construct contraction joints in shotcrete using saw cuts 1/8-inch- (3-mm-) wide-by-1/3 slab depth or premolded plastic, hardboard, or fiberboard strip inserts 1/4-inch- (6-mm-) wide-by-1/3 shotcrete depth, unless otherwise indicated.

1. After shotcrete has cured, remove strip inserts and clean groove of loose debris.
2. Confirm joint spacing in field with engineer.
3. Tool edges round on each side of strip inserts if floated or troweled finishes are required.

3.5 ALIGNMENT CONTROL

A. Ground Wires: Install ground wires to establish thickness and planes of shotcrete surfaces. Install ground wires at corners and offsets not established by forms. Pull ground wires taut and position adjustment devices to permit additional tightening.

3.6 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by shotcrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.7 APPLICATION

A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.

B. Moisten wood forms immediately before placing shotcrete where form coatings are not used.

C. Apply shotcrete according to ACI 506.2.

D. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.

E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.

1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.

F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray and prevent build-up against front face during shotcreting.

G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.

H. Do not permit shotcrete to sag, slough, or dislodge.

I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.

J. Do not disturb shotcrete surfaces before beginning finishing operations.

K. Remove ground wires or other alignment control devices after shotcrete placement.

L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.

M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117R, increased by a factor of 2.

3.8 SURFACE FINISHES

A. Finish Coat: After screeding to natural rod finish, apply shotcrete finish coat, 1/4 to 1 inch (6 to 25 mm) thick, using ACI 506R, No. 1 gradation, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve and apply steel-trowel, smooth, hard finish.

3.9 CURING

A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.

B. Start initial curing as soon as free water has disappeared from shotcrete surface after placing and finishing.

C. Curing Exposed Surfaces: Cure shotcrete by the following methods:

1. Moisture Curing: Keep surfaces continuously moist for at least seven days with water, continuous water-fog spray, water-saturated absorptive covers, or moisture-retaining covers. Lap and seal sides and ends of covers.
2. Curing Compound: Apply curing compound uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Apply curing compound to natural- or gun-finished shotcrete at rate of 1 gal./100 sq. ft. (1 L/2.5 sq. m).

D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.10 FORM REMOVAL

A. Forms not supporting weight of shotcrete may be removed after curing at not less than 50 deg F (10 deg C) for 24 consecutive hours after gunning, provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.

1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to sample materials, visually grade cores, perform tests, and submit reports during shotcreting.

B. Air Content: ASTM C 173, volumetric method or ASTM C 231, pressure method; 1 test for each compressive-strength test for each mix of air-entrained, wet-mix shotcrete measured before pumping.

C. Shotcrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and 1 test for each set of compressive-strength specimens.

D. Test Panels: Make a test panel, reinforced as in structure, for each shotcrete mix and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 4-1/2 inches (115 mm). From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced.

1. Test each set of unreinforced specimens for compressive strength according to ASTM C 1140 and construction testing requirements in ACI 506.2.
2. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

E. In-Place Shotcrete: Take a set of 3 unreinforced cores for each mix and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C 42. Do not cut steel reinforcement.

F. Strength of shotcrete will be considered satisfactory when mean compressive strength of each set of 3 unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.

1. Mean compressive strength of each set of 3 unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

3.12 REPAIRS

A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.

1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces and apply new shotcrete.

B. Repair core holes from in-place testing according to repair provisions in ACI 301 and match adjacent finish, texture, and color.

3.13 CLEANING

A. Remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement. All surfaces shall be cleaned and/or repainted to Owner's satisfaction at no cost to the Owner.

END OF SECTION 03 37 13

SECTION 03 37 60 – PREPACKAGED REPAIR MORTAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the provision of all labor, materials, supervision and incidentals necessary to prepare deteriorated or damaged concrete surfaces and install prepackaged concrete repair mortar to formed horizontal, vertical and overhead surfaces to restore original surface condition and integrity.

1.3 QUALITY ASSURANCE

A. Work shall conform to requirements of ACI 301 as applicable except where more stringent requirements are shown on Drawings or specified in this Section.

B. Testing Agency:

1. Independent testing laboratory employed by Owner and acceptable to Engineer.
2. Accredited by AASHTO under ASTM C1077. Testing laboratory shall submit documented proof of ability to perform required tests.

C. Sampling and testing of mortar shall be performed by ACI certified Concrete Field Technicians Grade I. Certification shall be no more than three years old.

D. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency has authority to reject mortar not meeting Specifications. Testing Agency does not have the authority to accept mortar that does not meet specifications.

E. Testing Agency shall submit the following information for Field Testing of Concrete unless modified in writing by Engineer:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address and phone number.
4. Mortar manufacturer.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.

8. Weather data:

    a. Air temperatures.
    b. Weather.
    c. Wind speed.

9. Date, time, and place of test.
10. Compressive test data:

    a. Cube or cylinder number.
    b. Age of sample when tested.
    c. Date and time of test.
    d. Compressive strength.

1.4 REFERENCES

A. "Standard Specification for Structural Concrete" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.

B. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:

1. "Building Code Requirements for Structural Concrete" (ACI 318), American Concrete Institute, herein referred to as ACI 318.
2. "Specification for Hot Weather Concreting," ACI 305.1.
3. "Standard Specification for Cold Weather Concreting," ACI 306.1.
4. “Standard Specification for Curing Concrete” (ACI 308.1)

C. Contractor shall have following ACI publications at Project construction site at all times:

1. "Standard Specifications for Structural Concrete (ACI 301) with Selected ACI and ASTM References," ACI Field Reference Manual, SP15.
2. "Specification for Hot Weather Concreting," ACI 305.1.
3. "Standard Specification for Cold Weather Concreting," ACI 306.1.

D. ASTM International (ASTM):

1. ASTM C109, "Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)."
2. ASTM C31, “Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
3. ASTM C1583, “Standard Test Method for the Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)”.

1.5 SUBMITTALS

A. Make submittals in accordance with requirements of Division 01 and as specified in this Section.

B. Contractor: At preconstruction meeting, submit procedures for demolition, surface preparation, material batching, placement, finishing, and curing of application. Provide procedure to protect fresh patches from severe weather conditions.

C. Testing Agency: Promptly report all mortar test results to Engineer and Contractor. Include following information:

1. See Article "Quality Assurance," paragraph "Testing Agency shall submit...."
2. Strength determined in accordance with ASTM C109.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN
2. Euclid Chemical Corporation (Euclid), Cleveland, OH
3. King Construction Products (King), Burlington, ON
4. Mapei Corporation (MAPEI), Deerfield Beach, FL
5. Sika Corporation (Sika), Lyndhurst, NJ.
6. J.E. Tomes (Tomes), Blue Island, IL

2.2 MATERIALS

A. Contractor shall state on project submittals for approval the intended use(s) for proposed repair products. The products listed in this Section are not approved for <u>all</u> types of repairs (i.e. full depth/partial depth/horizontal/vertical/overhead/etc.).

B. Horizontal Repair and Form and Pour Mortar: Shall be prepackaged cementitious repair mortar capable of horizontal and form and pour partial depth applications**,** achieving a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C39 as certified by manufacturer with maximum lineal shrinkage of 0.10% at 28 days. Extend per manufacturer’s instructions as required for deeper placements.

1. Acceptable cementitious repair materials for this Work are as follows:

a. “MasterEmaco S440,” by BASF Corporation.
b. “Eucocrete,” by Euclid.
c. “FA-S10 Concrete,” by King.

d. “Planitop 11,” by MAPEI.
e. “Sikacrete 211,” by Sika.
f. Other types may be used only with Engineer's approval in writing prior to bidding.

2. Acceptable polymer modified materials for this Work are as follows:

a. “MasterEmaco T310 CI” by BASF Corporation.
b. “Sika Repair 222 with Latex R,” “SikaTop 111 Plus”, or “Sikacrete 211 SCC+,” by Sika
c. “Duraltop” by Euclid
d. Form-Flo P-38 by Tomes
e. Other types may be used only with Engineer/Architect's approval in writing prior to bidding.

C. Rapid Strength Repair Mortar: Shall be prepackaged, cementitious repair mortar. Repair mortar shall be capable of application achieving a minimum 3,500 psi compressive strength at 1 day and 5,000 psi compressive strength at 28 days per ASTM C39 as certified by manufacturer. Extend per manufacturer’s instructions as required for deeper placements.

1. Acceptable materials for this Work are as follows:

a. “MasterEmaco T430,” by BASF Corporation.
b. “Speedcrete 2028,” by Euclid.
c. “HP-S10 Concrete,” by King.
d. “Planitop 18 ES” by MAPEI.
e. “Sikaquick 1000,” by Sika.
f. “Aprisa P-80,” by Tomes.
g. Other types may be used only with Engineer's approval in writing prior to bidding.

D. Trowel Applied Repair Mortar **(not allowed for structural repairs**, only allowed for minor repairs of honey-combing, bugholes, etc.): Shall be prepackaged, cementitious repair mortar capable of vertical/overhead application by trowel achieving a minimum 3,000 psi compressive strength at 7 days and 4,500 psi compressive strength at 28 days per ASTM C 109 as certified by manufacturer.

1. Acceptable materials for this Work are as follows:

a. “MasterEmaco N425,” by BASF Corporation.
b. “Verticoat Supreme,” by Euclid.
c. “Super-Top,” by King.
d. “Planitop XS,” by MAPEI
e. “Sikaquick VOH,” by Sika.
f. “CT-40 Do All Mortar,” by Tomes.
g. Other types may be used only with Engineer's approval in writing prior to bidding.

2.3

1. Acceptable polymer modified materials for this Work are as follows:

    a. “MasterEmaco N 400 RS,” “MasterEmaco N 400,” “MasterEmaco N 426,” or “MasterEmaco N 300 CI” by.
    b. “Verticoat,” “Speedcrete PM,” or “Duraltop Gel” by The Euclid.
    c. “SikaRepair 223 with Latex R”, “SikaRepair SHB with Latex R”, or “SikaRepair SHA with Latex R,” by.
    d. “Super-Top OV” by King
    e. Other types may be used only with Engineer's approval in writing prior to bidding.

2.4 MATERIAL ACCESSORIES

A. Extended Open Time Epoxy Bonding Agent: Three component, water based, epoxy modified portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer’s open time in which to apply repair mortar.

1. Acceptable materials for this Work are:

    a. “MasterEmaco P124,” by BASF.
    b. “Duralprep A.C.,” by Euclid.
    c. “Planibond 3C,” by MAPEI.
    d. “Armatec 110 EpoCem”, by Sika.
    e. “B-1 Rebar Coating,” by Tomes.

B. Bonding Grout: Bonding grout shall consist of prepackage repair material mixed with sufficient water to form stiff slurry to achieve consistency of "pancake batter."

C. Clear, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Epoxy Bonding Agent Extended Open Time**:**

1. In strict accordance with manufacturer’s recommendations, mix and apply epoxy bonding agent to all areas as indicated on Drawings**.**
2. Allow epoxy bonding agent to dry a minimum 2 hours, but no more than the Manufacturer’s recommended open time prior to placing repair mortar.

B. Bonding Grout:

1. Mix bonding grout and scrub into SSD repair substrate with a stiff broom to all areas as indicated on Drawings.

2. Place repair material prior to initial set of grout. If grout sets prior to placement of repair material, complete remove grout from surface and re-clean prior to proceeding with new grout placement and repair mortar.

C. Mortar Placement: Mortar materials shall be placed in strict accordance with manufacturer's instructions. Properly proportioned and mixed mortar material shall be placed using tools to consolidate mortar so that no voids exist within new material and continuous contact with base concrete is achieved.

D. Form and Pour Repair Mortar Placement: Mix and apply in strict accordance with manufacturer's written instructions, to achieve a maximum 9" slump. Consolidate mortar so that no voids exist and continuous contact with base concrete is achieved.

E. Vertical and Overhead Repairs: Mortar materials shall be placed in strict accordance with manufacturer's instructions. Properly proportioned and mixed mortar material shall be placed using tools to consolidate mortar so that no voids exist within new material and continuous contact with base concrete is achieved. Supplemental wire mesh shall be required for delamination and spall repairs greater than two inches in depth. Fresh bonding grout/bonding agent is required between successive lifts of patching material, if recommended by manufacturer.

F. Finishing:

1. Apply a nonslip broom finish to top of floor patches and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Provide a surface finish similar to adjacent surfaces for vertical and overhead partial depth repairs.
3. Finish formed surfaces similar to adjacent surfaces.

3.2 CONCRETE PROTECTION AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305R for hot-weather protection during placement. Keep concrete continually moist prior to final curing by evaporation retarder, misting, sprinkling, or using absorptive mat or fabric covering kept continually moist.

B. Immediate upon conclusion of finishing operation cure concrete in accordance with ACI 308.1 for duration of at least seven days by curing methods listed below. Provide additional curing immediately following initial curing and before concrete has dried.

1. During initial and final curing periods maintain concrete above 50 deg F.
2. Prevent rapid drying at end of curing period.

C. Concrete surfaces to receive slab coatings or penetrating sealers shall be cured with moisture curing or moisture-retaining-cover curing.

D. Curing Methods: Cure formed and non-formed concrete moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing compound: Apply curing compound in accordance with manufacturer's instructions. Not allowed on surfaces to receive coating/sealer/paint/etc.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency acceptable to the Engineer to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Perform tests according to ACI 301.

B. Testing Frequency: Perform one set of strength testing and one bond test for each product used for each day's work. Prepare samples in accordance with ASTM C31.

C. Compressive Strength Testing: Determine strength at 7 and 28 days, and at other time frames per Contractor's discretion. Each test shall consist of two 6-inch diameter cylinders or three 4-inch diameter cylinders. Testing shall be in accordance with ASTM C39.

D. Bond Testing: Bond testing shall be performed at 7 days in accordance with ASTM C1583.

3.4 EVALUATION AND ACCEPTANCE OF WORK

A. Acceptance of Repairs (ACI 301):

1. Acceptance of completed concrete Work will be according to provisions of ACI 301.
2. Repair areas shall be sounded by Engineer and Contractor with hammer or rod after curing for 72 hours. Contractor shall repair all hollowness detected by removing and replacing patch or affected area at no extra cost to Owner.

3. If shrinkage cracks appear in repair area when initial curing period is completed, repair shall be considered defective, and it shall be removed and replaced by Contractor at no extra cost.
4. Patches shall be considered defective if average strength does not meet minimum strength at 28 days or if average bond strength does not meet minimum requirements of 150 psi.

END OF SECTION 03 37 60

SECTION 03 38 18 - UNBONDED POST-TENSIONING REPAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. In accordance with Contract Documents, provide all materials, labor, equipment, and supervision to fabricate and install all post-tensioning repair Work. Non-prestressed reinforcement shall conform to Division 03 Section, "Cast-in-Place Concrete Restoration."

B. Meet the requirements of ACI 301, ACI 318, ACI 423.7, CRSI MSP-2, and Contract Documents. In case of a conflict, meet the more stringent requirement.

C. Related work in other Sections related to Post-Tensioned Concrete:

1. Division 03 Section "Cast-in-Place Concrete Restoration."

1.3 REFERENCES

A. Field Reference: Keep a copy of the following reference in the Contractor’s field office.

1. PTI’s “Field Procedures Manual for Unbonded Single Strand Tendons”

B. American Concrete Institute (ACI):

1. ACI 301, “Specification for Structural Concrete.”
2. ACI 318, "Building Code Requirements for Structural Concrete."
3. ACI 347, "Recommended Practice for Concrete Formwork."
4. ACI 362.1R-97, “Guide for the Design of Durable Parking Structures.”
5. ACI 423.3R, "Recommendations for Concrete Members Prestressed with Unbonded Tendons."
6. ACI 423.7, “Specification for Unbonded Single-Strand Tendon Materials and Commentary.”

C. American Society for Testing and Materials (ASTM):

1. ASTM A416, "Specification for Uncoated Seven-Wire Strand for Prestressed Concrete."
2. ASTM A421, “Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete.”

3. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures."

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP-2, "Manual of Standard Practice."

E. Post-Tensioning Institute (PTI):

1. PTI, "Guide Specifications for Post-Tensioning Materials."
2. PTI, "Performance Specification for Corrosion Preventive Coating."
3. PTI, "Specification for Unbonded Single Strand Tendons."
4. PTI, "Field Procedures Manual for Unbonded Single Strand Tendons."
5. PTI, “Guide for evaluation and Repair of Unbonded Post-Tensioned Concrete Structures.”

F. International Code Conference (ICC):

1. ICC, "International Existing Building Code."
2. ICC, "International Existing Building Code Standards."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the tendon and anchor locations with Work of other Sections, including “Cast-in-Place Concrete Restoration.” Immediately inform Engineer/Architect of any potential interference.

B. Sequencing:

1. Deviations in the construction and stressing sequence shown on the Drawings are not permitted without written acceptance from Engineer/Architect.

C. Make submittals in accordance with requirements provided by WSU.

D. Submittals and Resubmittals:

1. Engineer will review each submittal the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made.
2. Circle resubmittal changes/revisions/corrections. Engineer will review only circled items and will not be responsible for non-circled changes, revisions, corrections or additions.
3. Should additional resubmittals be required, reimburse Owner for all costs incurred, including the cost of Engineer’s services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.

E. Requests for Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. Do not use RFI process to request substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.

1.5 ACTION SUBMITTALS

A. Product Data: For each product as indicated.

1. Corrosion Inhibiting Coating: Type and chemical analysis.
2. Sheathing: Type, material, density and thickness.
3. Anchorage Device: Type, material and size.
4. Coupler Device: Type, material and size.
5. Intermediate Stressing Coupler Device: Type, material, and size.
6. Pocket Former: Type, material and size.
7. Sheathing Repair Tape: Type, material and width.
8. Encapsulation System: Type and materials.

B. Shop Drawings: Include the following prepared by or under the supervision of a qualified professional engineer, if requested by Engineer:

1. Number, arrangement and designation of tendons.
2. Tendon profile and method of tendon support. Show tendon profiles at sufficient scale to clearly indicate tendon high and low points.
3. Tendon anchorage details including bundled tendon flaring.

C. Samples: For the following products:

1. Encapsulation system.

D. Delegated-Design: For post-tensioning system.

1. Signed and sealed calculations prepared by a qualified structural engineer indicating method of elongation. Include values used for friction coefficients, anchorage seating loss, elastic shortening, creep, relaxation, wobble and shrinkage.

E. Stressing Records: Same day as stressing operation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Supplier and Installer using the forms at the end of this section.

B. Mill Test Reports: Certified mill test reports for each coil or pack of strand used on Project, indicating that strand is low relaxation and including the following information:

1. Heat number and identification.
2. Minimum breaking strength.
3. Yield strength at 1 percent extension under load.
4. Elongation at failure.
5. Modulus of elasticity.
6. Diameter and net area of strand.

C. Test and Evaluation Reports: Indicating compliance with the following requirements:

1. Tests required by ACI 301, Section “Post-Tensioned Concrete.”
2. Relaxation loss tests required by ACI 423.7 for low relaxation prestressing steel.

D. Field Quality-Control Reports: Within 72 hours of inspection.

E. Stressing Jack Calibration: Calibration certificates for jacks and gages to be used on Project. Calibrate each jack-and-gage set as a pair.

F. Warranty: Proposed warranty prior to the start of construction.

1.7 QUALITY ASSURANCE

A. Supplier Qualifications:

1. Use a fabricating plant certified by PTI.
2. Successfully provided all materials for at least 5 post-tensioning repair projects in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.

B. Installer Qualifications:

1. Certified by PTI.
2. Successfully performed at least 5 post-tensioning repair projects in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.
3. Use a full-time Project superintendent that has supervised at least 5 projects of similar magnitude.
4. Use PTI Certified Field Installers to install and stress post-tensioning system.

C. Engineer/Architect will accept, tentatively accept, or reject Supplier or Installer based on compliance with criteria referenced in this section. Following a qualifications check, tentatively accepted Suppliers will be notified of acceptance or rejection by Owner.

D. Suppliers who do not meet the qualification requirements above shall be rejected.

E. Comply with requirements in ACI 301, Section “Post-Tensioned Concrete.”

F. Perform all post-tensioning Work under the supervision of a PTI-certified Project Superintendent who is present during all operations including installation, concrete placement, stressing and finishing.

1.8 DELIVERY, STORAGE AND HANDLING

A. Assign all tendons in same member the same heat number and identify accordingly.

B. Package each tendon bundle at source to prevent physical damage to tendon during transportation and storage, and to protect strand from moisture. Use heavy padding; cardboard is not permitted. Do not use wire binding or other materials that could cut the sheathing or tendon.

C. Deliver, store, and handle post-tensioning materials according to ACI 423.7.

D. Immediately remove damaged components from Project site and replace at no cost to Owner.

E. Do not remove sheathing on stressing end until the day of stressing.

F. Materials Stored on Slabs:

1. Prior to final stressing of beams and slabs, do not store any materials on slab.
2. After final stressing of beams and slabs but before concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds 50 percent of the design live load.
3. After final stressing and after concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds the design live load.
4. Provide and maintain temporary shoring as needed to support construction loads (incidental).

1.9 WARRANTY

A. The Contractor shall guarantee against any and all defects in workmanship and materials for newly installed tendon strands, splices, anchorages, and anchoring hardware for a period of 5 years.

B. The Manufacturer shall guarantee against any and all defects in materials for newly installed tendon strands, splices, anchorages, and anchoring hardware for a period of 5 years.

C. Written warranty, signed by Contractor/Manufacturer, including:

1. Repair or replacement of post-tensioning tendon repairs installed by Contractor:

a. That do not comply with requirements.
b. With corroded or fractured prestressing steel or corroded post-tensioning accessories in repair area.
c. With corroded or fractured prestressing steel or corroded post-tensioning accessories in areas away from repair, which are directly due to post-tensioning repairs installed by Contractor.

2. Removal and patching of concrete necessary to remedy distress of post-tensioning repairs covered by warranty.
3. Repair or replacement, to satisfaction of Owner, of other work or items which may have been displaced or damaged as consequence of defective work.
4. Make immediate emergency repairs within 24 hours of notice of defective post-tensioning repairs.
5. Owner will reimburse Contractor for reasonable costs if post-tensioning distress is not due to Work performed by Contractor.
6. Warranty Period: 5 years after Substantial Completion date.

PART 2 - PRODUCTS

2.1 POST-TENSIONING SYSTEM CRITERIA

A. Post-tensioning repair anchorage and hardware described in this Section intended to satisfactorily perform in ACI 362.1R-97 zone III environment without long-term corrosion or other distress.

1. PT repairs are to be based on the following: Do not exceed the maximum tensile stress in the tendon during the stressing operation. The maximum tensile stress is 74 percent of the specified tensile strength of the tendon.

2. Do not exceed 64 percent of the specified tensile strength after the anchors are seated.

2.2 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A416, Grade 270, uncoated, seven-wire, low-relaxation strand with minimum ultimate strength of 270 ksi.

1. Manufactured by a single source.

2. Strands manufactured outside United States subject to Engineer/Architect's approval based on evidence of satisfactory performance in the United States during the previous 5 years.
3. Use of high stress bar system instead of strand system is not permitted unless accepted in writing by the Engineer.
4. Conform to ACI 423.7 for relaxation loss requirements.

B. Tendon Sheathing: Seamless and extruded high-density polypropylene or seamless and extruded high-density polyethylene with a specific gravity greater than 0.95 conforming to ACI 423.7.

1. Sufficient strength to withstand damage during fabrication, transport, installation, concrete placement and stressing.
2. Minimum thickness of 50 mils (–0 mils +15 mils)
3. Minimum inside diameter 0.03 inches greater than maximum strand diameter.
4. Chemically stable without becoming brittle or softening over anticipated temperature range and service life of structure.
5. Non-reactive with concrete, steel and corrosion inhibiting coating.
6. Contrasting color of corrosion inhibiting coating to enhance visibility of damage. Black/dark colored sheathing is not acceptable.
7. Annular space between sheathing and strand completely filled with corrosion inhibiting coating.
8. Watertight including all connections and components over entire length.

C. Tendon Anchor: Non-porous casting free of sand, blow holes, voids and other defects meeting the testing and material requirements of ACI 423.7.

1. Plastic coated bearing plates sized in accordance with ACI 423.7, unless certified test reports substantiate comparable or superior performance, for transfer at minimum stressing concrete strength.
2. Capable of complying with PTI Guide Specification requirements for aggressive environments.
3. Capable of developing at least 95% of the actual ultimate strength of tendon.
4. Minimum wedge cavity opening of at least 0.19 inches larger than tendon diameter. Reaming of anchor wedge cavity is not permitted.
5. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.
6. Provisions for a plastic cap which fits tightly and seals barrel end on stressing side of anchor.
7. Provisions for a plastic sleeve which prevents moisture infiltration into anchor casting or tendon sheathing on bearing side of anchor.

D. Coupler Assembly: Assembly of strands and wedges meeting the testing and material requirements of ACI 301.

1. Capable of complying with PTI Guide Specification requirements for aggressive environments.
2. Capable of developing at least 95 percent of the ultimate strength of tendon.
3. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.

E. Encapsulation System for New Prestressing Steel: Watertight encapsulation along the entire length of new tendon, including new anchorages and new couplers, when subjected to hydrostatic testing required in ACI 423.7 for aggressive environments.

1. Sleeve: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. Minimum 10 inches long and 4 inches overlap with sheathing, completely filled with corrosion inhibiting coating.
2. Anchor Cap: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. At intermediate anchorages, open to allow passage of strand.
3. Subject to the requirements provide one of the following systems:

a. “Zero Void,” General Technologies, Inc.
b. “Hayes Posi-Lock Plus,” Hayes Industries, Ltd.
c. Accepted equivalent.

2.3 ACCESSORIES

A. Pocket Formers: Capable of completely sealing wedge cavity from intrusion of concrete or cement slurry; sized to provide at least a 2-inch recess and allow access for cutting strand tail.

1. If Zero Void encapsulation system in used, the “Zero Void Nail-Less Pocket Former” is required.

B. Anchorage Fasteners: Stainless-steel ring nails. Subject to the requirements use one of the following:

1. Clendenin Brothers, Baltimore, MD.
2. Swan Secure Products, Baltimore, MD.
3. R.J. Leahy Co., San Francisco, CA.
4. Accepted equivalent.

C. Sheathing for Repair at Existing Prestressing Steel:

1. Watertight, chemically stable, and non-reactive with prestressing steel, corrosion inhibiting PT coating, and reinforcing steel.
2. Color shall contrast with PT coating so that sheathing tears will be readily visible.
3. Polypropylene or polyethylene tubing:

a. Minimum thickness of 0.050 inches.
b. Inside diameter at least 0.030 inches greater than prestressing steel diameter.
c. Slit tubing longitudinally for sheathing repairs at continuous prestressing steel.

D. Sheathing at New Intermediate Anchorage and Couplers:

1. Heat-shrink tubing to encapsulate couplers and splicing hardware at intermediate stressing locations.
2. Heat shrink tubing shall be: watertight, chemically stable, and non-reactive with prestressing steel, corrosion-inhibiting PT coating, and reinforcing steel.
3. Use one of following or approved equal:

E. Protection at New End and Intermediate Anchorages:

1. Epoxy coating field-applied to all surfaces of wires, plates, anchor washers, etc. at locations of end and intermediate anchorages and center stressing splices.

F. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with a minimum width of 2 inches in contrasting color to tendon sheathing, and that is non-reactive with sheathing, corrosion inhibiting coating, or tendon. Subject to the requirements use one of the following:

1. “3M Tape No. 226,” 3M, St. Paul, MN.
2. “Polyken 826,” Berry Plastics Corp, Evansville, IN
3. “Tyco Adhesives No. 398,” Tyco Adhesives, Franklin, MA

G. Sheathing Repair Material: For nicks and cuts less than 0.25 inches use one of the following:

1. “Scotch-Weld DP-8005,” by 3M.

H. Corrosion inhibiting coating: Capable of meeting the requirements of ACI 423.7. Subject to the requirements use one of the following

1. "Greasrex K-218," ExxonMobil Oil Corp., Irving, TX.
2. “Red-i PT Coating Grease,” Lubricating Specialties Co., Pico Rivera, CA
3. “Renolit PTG,” Fuch’s Lubricant Co., Harvey, IL
4. “Royal PT-1 and PT-2 Corrosion Inhibiting Grease,” Troco Oil Co., Tulsa, OK
5. “Strand Shield,” Martin Specialty Lubricants, North Kansas City, MO

I. Tendon supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons in place. Use tendon supports capable of meeting the requirements in CRSI’s “Manual of Standard Practice” and as follows:

1. Clearly marked to differentiate by height.
2. Capable of resisting overturning during construction operations.
3. Minimal contact with forms where concrete is exposed to view.
4. Do not cause voids or damage to surrounding concrete.
5. All-plastic supports conforming to CRSI Class 1 protection requirements and with a compressive strength higher than concrete.
6. Acceptable manufacturers:

    a. Aztec Concrete Accessories, Inc.
    b. General Technologies, Inc.
    c. Accepted equivalent.

2.4 GROUT MATERIALS

A. Premixed, nonmetallic, noncorrosive, non-staining grout product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Non-reactive with prestressing strand, anchorage materials, or concrete and without chlorides or other chemicals known to be deleterious to prestressing strand.

C. Subject to compliance with requirements, provide one of the following:

1. Sure Grip Grout, Dayton Superior.
2. Euco N.S., Euclid Chemical Co.
3. Masterflow 928, BASF.

2.5 EQUIPMENT

A. Stressing Equipment: Hydraulic jacks with calibrated pressure gauges, capable of gripping prestressing steel and stressing prestressing steel to specified level. Maintain equipment in safe, working condition.

1. Provide certified pressure gauges with means to cross check accuracy constantly. Second gauges are recommended for larger projects.
2. Provide at Site current, not to exceed 6 months, calibration chart for each jack relating gauge pressure to jacking force.
3. Exercise care in handling of stressing equipment.

B. Necessary equipment to detension, cut, and splice prestressing strands.

C. Calibration of hydraulic equipment and gauges.

D. The Contractor shall provide the equipment, and use appropriate methods to expose the embedded post-tensioning sheathing. The demolition to expose embedded post-tensioning sheathing shall not compromise the structural integrity of the slab and shall minimize damage to the tendon sheathing. The following equipment, or an approved equal, may be used on this project.

1. Chipping hammers of nominal 15-lb. class or less for removal of concrete to expose tendon sheathing.
2. Compressed air equipment capable of removing dust and dirt from concrete repair areas.

E. All equipment is to be operated and maintained according to the manufacturer's recommendations or the approved testing procedures.

F. Operation of stressing equipment shall be performed by tradesman experienced in this work with a PTI level 1 Unbonded – Field Installation certification.

PART 3 - EXECUTION

3.1 PRECAUTIONS

A. Prestressing steel under stress has significant stored energy. Exercise care in detensioning and stressing.

1. Erect and maintain work platforms in safe condition, in conformance with Government regulations.
2. Protect areas around, adjacent to, and below work area, including vehicular traffic, from damage.
3. Protect construction personnel and passersby from injury.

a. Do not allow anyone to stand in front of, behind, over or beneath hydraulic jack, or anywhere along the tendon during stressing or prestressing steel to be detensioned.
b. After stressing, when releasing jack pressure to transfer force to wedges, laborers' fingers shall be kept clear of assembly. .

B. Close off area around, adjacent to, and below work area or use canopies and barriers as necessary to protect public.

C. Detensioning shall be performed by cutting, preferably while tendon is still embedded in concrete, by use of specialty detensioning equipment, or by other approved means.

3.2 PREPARATION

A. Prior to concrete removal, locate prestressing steel using non-destructive testing (NDT) methods at locations along the length of each tendon in each bay, or by other approved means.

B. Identify and clearly mark fractured, corroded, or otherwise damaged sections of prestressing steel. Create exploratory openings in concrete as necessary to locate fractured or corroded sections. Engineer will inspect tendon and determine appropriate repair method before replacement. Tendons with fractured or severely corroded wires shall be replaced for its entire length or repaired by splicing in sections of new tendons similar in kind and size and restressing of tendons.

C. Where significant concrete removal is required or a significant number of tendons require spliced repair and restressing, install shoring and/or sequence repairs as directed by Engineer. This shoring must be designed by an Engineer competent in shoring design.

D. Remove unsound concrete as specified in Division 03, Section "Cast-in-Place Concrete," and as approved by Engineer. Exercise care to avoid damaging

prestressing steel, sheathings, anchorages, and remaining sound concrete. Do not remove concrete at post-tensioning anchorages unless directed to do so by Engineer.

E. Maintain tendon profile. Use grout or other means as necessary to securely maintain tendon position during Work.

F. Identify damaged sheathing and document locations.

3.3 SHEATHING REPAIR

A. At locations of damaged sheathing, remove concrete to expose sheathing at least 4 inches beyond damaged portion and to create space between the sheathing and the concrete. Exercise care to avoid further damage to sheathing. Concrete removal beneath a stressed tendon shall be minimized where the profile of the tendon may be affected.

B. At small localized areas of sheathing damage, as determined by Engineer(Note: Items 1 through 4 below are the repair procedure for isolated punctures, holes and slits where sheathing is mostly intact with minimal damage):

1. Remove rough portions of existing sheathing at damaged area.
2. Fill sheathing with corrosion-inhibiting PT coating.
3. Clean and prepare surface of existing sheathing per tape manufacturer's recommendations. Outer surface of sheathing shall be dry and free of corrosion-inhibiting PT coating.
4. Tape damaged area of sheathing. Wrap tape spirally around sheathing to provide at least layers of tape at all locations. Extend tape at least 2 inches beyond damaged area.

C. Remove damaged portion of sheathing.

D. Lightly sandblast exposed prestressing steel to remove rust. Protect existing sheathing from damage (at least a minimum of 4 in. of existing sheathing should be protected at each end of the exposed portion of the sheathing within a repair opening).

E. Coat exposed prestressing steel or pressure-inject with corrosion-inhibiting PT coating. PT coating must extend to, but not cover, 4 in. of intact existing sheathing at ends of the exposed portion of sheathing.

F. Clean and prepare the existing sheathing per tape manufacturer's recommendations. At a minimum, the surface of the sheathing shall be dry, clean, and free of corrosion-inhibiting PT coating.

G. Install new slit tube sheathing (For sheathing repairs where slit tube sheathing does not completely cover the stand, use waterproof tape in place of split sheathing).

1. Place slit tubing around prestressing strand. Position slit on side of prestressing steel, with shingle overlap (i.e., with upper portion overlapping lower portion).
2. Extend new sheathing at least 2 inches over existing sheathing.

3. Tape new sheathing. Wrap tape spirally around sheathing to provide at least 2 layers of tape. Extend tape at least 2 inches onto existing sheathing.

H. Install new wrapped sheathing (for sheathing repairs where slit tube sheathing of sufficient width to be placed around the entire circumference of the prestressing strand/wires is not available).

1. Wrap polyethylene sheeting around prestressing strand/wires, continuing around the prestressing steel at least three times to provide 3 layers of sheeting at all locations.
2. Position edge of sheeting on side of prestressing steel, with shingle overlap (i.e., with upper portion overlapping lower portion).
3. Extend new sheeting at least 2 inches over existing sheathing.
4. Wrap specialty sheathing tape spirally around sheathing to provide at least 2 layers of tape at all locations. Extend tape at least 2 inches onto existing sheathing.

I. Sheathing at couplers, central stressing splices (for 7-wire strand tendons), shall consist of heat shrink tubing. Place heat-shrink tubing over coupler, central stressing splice, or tendon during assembly of spliced tendon repair. Do not heat shrink tubing into final position until stressing is completed. Shrink tubing using a heat gun as approved by the Engineer, open flames shall not be permitted. Provide 2 in. minimum overlap with sheathing for adjacent section of tendon.

J. Protection of Anchorages (and Center Stressing Splices)

1. All new end anchor castings shall be supplied fully encased in 1 protective plastic cover, with plastic trumpet and plastic-covered encapsulation cap, to provide for full encapsulation of the new anchor.

K. Sheathing repairs shall be watertight.

3.4 SPLICING PRESTRESSING STEEL

A. Scope:

1. Repair tendons with broken or severely corroded wires at the locations determined by the Engineer by splicing in sections of new strands/tendons similar in kind, tensile strength, and size.
2. Restress the spliced tendons to obtain their design long-term effective post-tensioning force, 0.64 Pu (or other force determined by the Engineer after seating losses. Typically, to obtain 64% of specified tensile strength in tendon after the anchors are seated, the jacking force should not exceed 74% of the specified tensile strength of the strand.)

B. Detension prestressing steel as necessary by cutting, preferably while still embedded in concrete, or by the use of specialty detensioning equipment or by other approved means. Where detensioning of only a portion of the tendon length is desired, install lock-off anchor at location determined by Engineer.

C. Remove concrete as required to expose sufficient length of prestressing steel that is not deteriorated, on both sides of deteriorated strand section, and to permit installation of splice hardware allowing adequate room for movement of the splice during elongation of the prestressing steel. Exercise care to avoid damaging remaining sound concrete and sheathing.

D. If prestressing steel drapes into or across the area of concrete removal, discuss method of removing prestressing steel with Engineer. Maintain the design tendon profile.

E. Remove deteriorated section of prestressing steel.

F. Discuss splicing procedure with Engineer to ensure that remaining concrete is not overstressed during stressing. (It is very important to ensure that the prestressing force gets into the concrete. As a result, it is generally desirable to limit the size of the tendon repair openings so that a significant portion of the member cross-section remains available to resist the prestressing force as it is restored to the structure. This is particularly critical at anchorage zones of repaired end anchors, but extent of concrete removal should be considered at all cross-sections along a member being repaired.)

G. Form as necessary and cast concrete repairs that are necessary for stressing prestressing steel. (This will include the anchorage zone in front of new tendon end anchors, and may include other locations along the tendon length as appropriate for restoring the member cross-section prior to stressing. Note that prestressing steel will elongate, so repair openings must not be recast prior to stressing in a manner that would inhibit movement of the tendon and its couplers and central stressing splices. A common technique is to leave “boxouts” of sufficient size around couplers and central stressing splices to allow them to move during stressing.) Do not stress prestressing steel until repair concrete has achieved at least 3,000 psi. Concrete repair areas shall be prepared per Section 02 51 40, the exposed prestressing steel addressed per Paragraph I below, and the repair opening formed and cast per Division 03, Section “Cast-In-Place Concrete.”

H. Install splice materials.

1. Pull ends of existing prestressing steel (strand/wires/tendon) taut.
2. Install couplers, new end anchors, and central stressing 1 splices with new section of prestressing strand.
3. New sheathing may need to be placed on the tendon during splicing operations.

I. Prepare existing prestressing steel.

1. Coat exposed existing prestressing steel with corrosion-inhibiting PT coating.
2. Install slit-tube sheathing (or wrapped sheathing for button-head wire tendons) over existing prestressing steel, and wrap with specialty waterproof tape as described above in Section 3.3.

J. At locations of couplers (and center stressing splices for 7-wire strand tendons) (and sections of new tendon wires for button-head wire tendons), use heat shrink tubing to make sheathing continuous across repair opening. Install per Paragraph above.

K. Stress PT tendon per following.

L. When stressing operation has been completed and following tendon force verification, prepare repair openings, and form and cast repair openings with concrete.

1. Inspect anchors for correct installation.
2. Inspect sheathing for damage and for continuous seal between sheathing and anchor.

    a. Repair sheathing damage to watertight condition and correct anchor deficiencies.
    b. Do not leave tendons and repair area exposed to weather without protection prior to concrete placement. The Contractor shall propose to the Engineer the plan to guarantee a full protection of the PT system to weather aggression.

3. Apply PT coating to exposed prestressing tendons/strands/wires, including strand tails at anchorages, and restore sheathing per Paragraph 3.3.
4. Shrink heat-reactive tubing into position to encapsulate prestressing steel. Seal ends of new sheathing with specialty moisture-proof sheathing tape.
5. Sandblast clean exposed concrete and steel surfaces. Protect tendons from damage.
6. Coat other exposed steel, epoxy, galvanized coating, or approved method.
7. Install dowels into sides of full-depth repair openings as required, anchoring with epoxy.
8. Add supplemental reinforcing as directed by Engineer.
9. Install encapsulation caps over strand tails and secure. Fill stressing anchorage pockets with grout. When grout will be visible, trowel smooth and rub to match adjoining surface.

3.5 EXTRACTION AND THREADING OF NEW POST-TENSIONING STRAND/WIRES

A. Provide access to tendon to be removed at appropriate locations. (Excavate access openings at high and low points and/or and end anchors: Remove external cover; etc.)

B. Detension post-tensioning strand/wires as necessary by sawcutting, preferably while still embedded in concrete, or specialty detensioning equipment. Provide protection at the end anchorages to prevent anchorage, wedges, or tendon from rebounding during detensioning and causing damage to property or passerby.

C. Extract existing strand and thread new strand through existing sheathing. If existing strand is wet when exposed, dry sheathing. At the Engineer discretion, clean sheathing with clean rags until two clean passes are achieved. Rags may be saturated with an approved cleaning solvent prior to use. Fill sheathing with new corrosion inhibiting grease. Thread new strand through existing sheathing.

D. Install new end anchorages and repair concrete. Provide new wedges and hardware compatible with new end anchor.

E. Stress new strand per Paragraph 3.6.

F. Restore access openings at the completion of re-stressing.

3.6 STRESSING PRESTRESSING STEEL

A. Stressing operations shall be performed by personnel experienced in this Work with a minimum of PTI level 1, or under direct supervision of stressing equipment supplier's representative with a minimum of PTI level 1. Exercise care in handling stressing equipment to maintain accuracy of calibration.

B. Before stressing, verify that prestressing steel is free-moving along its length. Orient anchorage wedges in the cavity perpendicular to the jack position during stressing.

C. Stress tendon to provide a final tensile force after seating loss of 0.64 P_u.

1. Calculate elongation for specified tensile stress for each tendon.
2. Sequence stressing as necessary.
3. Monitor hydraulic pressure and convert to jacking force with jack calibration curve.
4. Measure prestressing steel elongation and compare with calculated elongation. If difference is more than 7 percent notify the Engineer for direction. When specified tensile stress has been attained, anchor prestressing steel with wedges).
5. If required, perform lift-off test in presence of Engineer after stressing and seating of wedges (for 7-wire strand tendons). As an example, Liftoff testing may be required if the elongations do not meet the 7% as shown above.
6. Maintain stressing records during stressing operations.

D. If turnbuckle-type cable splice is used, stress tendon per the manufacturer's recommendations.

1. Calculate elongation for specified tensile stress for each tendon.
2. Restress tendon using calibrated torque wrench. Stress to designated tensile force using calculated correlation between applied torque and tensile force.
3. Measure prestressing steel elongation at various levels of stressing force and compare with calculated elongation.
4. If measured and calculated elongations differ by more than 7 percent, cease stressing operations until cause of deviation is found and corrected.
5. Record applied torque, determine calculated tensile force, and submit to Engineer for review and approval.

E. After Engineer has accepted stressing records, prepare repair openings for concrete placement per Paragraph 3.4.L above.

1. Cut off tails of prestressing strand.
2. Clean prestressing steel, anchorages, and concrete pockets of corrosion-inhibiting grease. Use non-corrosive solvent.

3. Cut end of prestressing steel within pocket, providing for at 1 least 3/4 inches of concrete cover at remaining steel.

    a. Do not damage prestressing steel, anchorage, or concrete. Leave prestressing steel end clean and free of burrs.
    b. Do not cut strands less than ½ inch from wedges.

4. Install protective cap on cut ends where possible to prevent moisture infiltration.
5. Prestressing steel ends shall be accessible for inspection prior to and during cutting, and prior to placement of protective caps and grout.

3.7 FIELD QUALITY CONTROL

A. Stressing records shall be filled out during retensioning operations, and then be submitted to the Engineer for review and verification, per PTI M-10. The following data shall be recorded as a minimum:

1. Name of the project
2. Tendon number correlated to a plan view identifying tendon locations
3. Gauge pressure to achieve required force as per supplied calibration chart
4. Calculated elongation, and allowable range of elongations, at design tensile force.
5. Actual elongation achieved
6. Actual gauge pressure at end of stressing
7. Date of stressing operation
8. Name and signature of the stressing operator or inspector
9. Serial or identification number of jacking equipment
10. Date of approved shop drawings used for installation and stressing

B. Maintain drying records documenting changes in moisture content during drying operations, and submit to Engineer.

C. Contractor shall inspect tendons after installation. Reject, repair or replace nonconforming work.

D. Inspect sheathing for unrepaired damage, for watertight seal between sheathing and anchor, and for correct installation of anchors, before concrete is placed around tendons.

E. Engineer or testing agency retained by Owner will inspect installed Work prior to concrete placement:

END OF SECTION 03 38 18

POST-TENSIONING SUPPLIER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Supplier:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #2	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING SUPPLIER QUALIFICATION FORM

SAMPLE PROJECT #3	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #4	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING SUPPLIER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Quality plan for manufacture, delivery, and detailing of post-tensioning system.
	Verification letter stating that the post-tensioning system will be manufactured in a plant with a current PTI certification and that all materials conform with ACI 301, ACI 318, and are approved by the International Code Council (International Building Code.)

POST-TENSIONING INSTALLER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Installer:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Contract:
City and State:	
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #2	Date Completed:
Project Name:	$ Value of PT Contract:
City and State:	
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #3	Date Completed:
Project Name:	$ Value of PT Contract:
City and State:	
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #4	Date Completed:
Project Name:	$ Value of PT Contract:
City and State:	
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Contract:
City and State:	
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Resume of Project Superintendent indicating required experience.
	Letter from post-tensioning Supplier accepting Installer.
	Verification letter stating that the Installer has a current PTI certification and that PTI Certified Field Installers will be used to install and stress post-tensioning system.

SECTION 03 63 00 - EPOXY INJECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the provision of all labor, materials, equipment, supervision and incidentals necessary to prepare cracks in structural concrete members and inject them with a 2-component, moisture-insensitive, 100 percent solids, low-viscosity epoxy resin system.

B. Related Sections: Following Sections contain requirements that relate to this Section:

1. Division 02 Section "Work Items."
2. Division 02 Section "General Concrete Surface Preparation."
3. Division 02 Section "Surface Preparation for Patching."

1.3 QUALITY ASSURANCE

A. Testing Agency will be independent testing laboratory employed by Owner and approved by Engineer/Architect.

B. Testing Agency is responsible for conducting, monitoring and reporting to Owner results of all field tests of epoxy injection and installation required under this Section with copy of all reports to Engineer and Contractor.

C. Submit following information for Field Testing of Epoxy Injection Installation unless modified in writing by Engineer/Architect:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address and phone number.
4. Epoxy material supplier.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.
8. Epoxy material data:

    a. Epoxy type.
    b. Gel type.

c. Width of cracks injected (if applicable).
d. Crack conditions (dry or wet).
e. Injection port spacing.
f. Initial and (if different) constant injection pressures.
g. Use rate of epoxy.

9. Weather data:

a. Air temperatures.
b. Weather.
c. Wind speed.

10. Field test data:

a. Date, time and place of test.
b. Thickness of epoxy in crack or void.

D. Qualifications:

1. Contractor Qualifications: Contractor shall be qualified in the field of concrete repair and protection with a minimum of 5 years experience in application of similar systems and products on projects of similar size and scope.

a. Successful completion of a minimum of 3 projects of similar size and complexity to specified Work.
b. Contractor shall maintain qualified personnel who have received product training by a manufacturer's representative.
c. Install materials in accordance with all safety and weather conditions required by the manufacturer, or as modified by applicable rules and regulations of local, state, and federal authorities having jurisdiction.

2. Manufacturer Qualifications: The manufacturer of the specified product shall be ISO 9001:2000 Certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis. The manufacturer shall have a minimum 15 years of experience in manufacturing of surface hardener.

E. Pre-Construction Meetings: Conduct Pre-Construction meeting at Project site to comply with requirements of Division 01 and as specified in this Section.

1. Schedule and convene meeting a minimum of 1 week prior to commencing Work of this Section.
2. Review requirements for application, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details, installation procedures, testing and inspection procedures, protection, and repair.
3. Discuss procedures for protecting adjacent finished Work.

1.4 REFERENCES

A. "Standard Specifications for Structural Concrete," (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.

B. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:

1. "Building Code Requirements for Reinforced Concrete," (ACI 318), American Concrete Institute, herein referred to as ACI 318.
2. "Causes, Evaluation, and Repair of Cracks in Concrete Structures" (ACI 224.112), American Concrete Institute.
3. "State-of-the-Art Report on Parking Structures" (ACI 362), American Concrete Institute.
4. ”Specification for Crack Repair by Epoxy Injection” (ACI 503.7), American Concrete Institute.
5. “Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes”, (ACI 503.6), American Concrete Institute.
6. "Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive" (ACI 503.1), American Concrete Institute.
7. "Guide for Repair of Concrete Bridge Superstructures" Reported by ACI Committee 546 (ACI 546.1).

C. Contractor shall have following ACI/ICRI publications at Project construction site at all times:

1. ”Specification for Crack Repair by Epoxy Injection” (ACI 503.7), American Concrete Institute.” Structural Crack Repair by Epoxy Injection”, ACI RAP Bulletin 1, American Concrete Institute.
2. "Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive" (ACI 503.1), American Concrete Institute.

1.5 SUBMITTALS

A. Make submittals in accordance with requirements of Division 01 and as specified in this Section.

B. Contractor: Submit manufacturer's product data sheets, technical sheets, recommended application procedures and information on epoxy injection equipment.

C. Testing Agency: Promptly report all test results to Engineer/Architect and Contractor. Include following information:

1. See Article "Quality Assurance," paragraph "Submit following information for Field Testing...."
2. Visual examination of epoxy resin penetration.

D. See requirements of Division 01 Sections for submittal procedures and RFI's.

1.6 WARRANTY

A. System manufacturer and Contractor shall furnish Owner written single source performance guarantee that epoxy resin injection system will be free of defects related to design, workmanship or material deficiency for 3-year period from date of acceptance of Work required under this Section against leakage or bond failure:

1. Any adhesive or cohesive failure.
2. Crazing or other weathering deficiency.
3. Normal abrasion or tear failure.

B. Any repair under this guarantee shall be done at no cost to Owner. Guarantee shall be provided by Contractor and manufacturer of system.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Injection epoxy shall be one of following:

1. "MasterInject 1380" or "MasterInject 1500" as manufactured by BASF Construction Chemicals., Shakopee, MN.
2. "Sikadur 35 Hi-Mod LV" or "Sikadur 52" as manufactured by Sika Chemical Corporation, Lyndhurst, NJ.
3. "Epoxy HP-LV" as manufactured by Hunt Process Corp-Southern, Ridgeland, MS.
4. "Pro-Poxy 50 Super LV" as manufactured by Unitex, Kansas City, MO.
5. "Eucopoxy" or "Duralcrete LV" as manufactured by The Euclid Chemical Company, Cleveland OH.
6. "Sure Inject J56 SLV" as manufactured by Dayton Superior Corp., Miamisburg OH.
7. "KonTek 11 LV" as manufactured by Contech Group, Inc. Seattle, WA.
8. "Kemko 038" as manufactured by ChemCo Systems, Inc., Redwood City, CA.

B. Epoxy gel shall be as specified by the selected injection epoxy manufacturer.

C. Equipment:

1. Epoxy injection unit shall be portable and equipped with positive displacement-type pumps with interlock to provide positive ration control of epoxy injection resin components. Pumps shall be air or electric powered and shall provide in-line mixing and metering system and shall be equipped with drain-back plugs.
2. Equipment used to inject epoxy shall be capable of following:

    a. Automatic proportioning of materials within mix ratio tolerances set by epoxy resin manufacturer.

b. Delivery of components, resin and hardeners, from separate reservoirs to mixing type discharge head.
c. Complete and uniform mixing of components at discharge head.
d. Injection of resin system at constant pressures not to exceed 150 psi.

PART 3 - EXECUTION

3.1 PREPARATION

A. Crack Identification:

1. All cracks 0.03 in. wide or greater that are designated by Engineer/Architect, and not coincident with principal delamination, shall be injected. Cracks that occur coincident with principal delaminations shall not be injected.
2. Cracks requiring repair shall be located by Contractor at time of construction and marked with chalk.

B. Crack Preparation for Injection:

1. Surface of concrete adjacent to crack must be free of all laitance, efflorescence, dirt or foreign particles.
2. Cracks may be damp or dry as per injection material manufacturer's recommended installation procedures.
3. All cracks shall be properly sealed along their exposed length with an approved epoxy gel.
4. Epoxy injection ports shall be uniformly spaced along crack and shall be installed as recommended by system manufacturer. If concrete member being injected is exposed on both sides, provide injection ports on opposite sides at staggered intervals.
5. Apply epoxy gel around injection port to provide an adequate seal to prevent escape of injection resin from perimeter of port while under pressure.
6. Apply epoxy gel for sealing in manner that will result in minimal defacing or disorganization of concrete substrate.

3.2 INSTALLATION

A. Epoxy Injection:

1. Dispense epoxy injection resin under constant pressure in accordance with manufacturer's recommended procedures or as required to achieve maximum filling and penetration of crack without inclusion of air voids in epoxy resin material.
2. Injection shall begin at lowest port and progress incrementally higher.
3. Appearance of epoxy resin at next higher port shall be considered evidence of successful crack filling.
4. If penetration of epoxy resin into cracks is not possible, notify Engineer/Architect prior to discontinuing injection procedures. If alternate injection procedures are possible, submit procedure in writing to Engineer/Architect for review.

5. Contractor shall adhere to all limitations and cautions for epoxy resin injection material as per manufacturer's current printed literature.

B. Cleaning:

1. When cracks are completely filled, allow adhesive to cure for sufficient time to allow the removal of the surface seal without any draining or runback of epoxy material from the cracks.
2. Remove the surface seal material, ports, and injection adhesive runs or spills from concrete surfaces.
3. Finish the face of the crack flush to the adjacent concrete, removing any indentations or protrusions caused by the placement of entry ports.
4. Match work area to adjacent surface including any surface treatments.

3.3 FIELD QUALITY CONTROL BY TESTING AGENCY

A. Core Testing:

1. Testing Agency shall obtain 3- 2 in. minimum diameter core samples in first 100 ft of repaired cracks and 1 core for each 100 ft thereafter. Cores shall be taken after injection resin has cured for period of 7 days. Core sample shall be for full crack depth. Core locations and sizes shall be submitted to Engineer/Architect for review prior to taking core samples. Care should be taken not to damage or cut existing reinforcement (ESPECIALLY POST-TENSIONING TENDONS).
2. Core samples shall be visually examined to determine degree of epoxy penetration. Minimum of 90% of crack shall be full of epoxy adhesive.

B. Evaluation and Acceptance of Epoxy Injection:

1. Results of visual examination will be reviewed by Engineer/Architect for compliance with Article "Field Quality Control by Testing Agency," paragraph "Core Testing."
2. If results of initial cores fail by lack of penetration, work shall not proceed further until area represented by cores has been re-injected and re-tested for acceptance.
3. After cracks have been re-injected, additional cores shall be taken as directed by Engineer/Architect. Cores shall be tested for compliance with Article "Field Quality Control by Testing Agency," paragraph "Core Testing" by Owner's Testing Agency at Contractor's expense.
4. Core holes shall be filled with non-shrink grout material. Grout shall be applied with hard trowel, and be thoroughly rodded and tamped in place. Finish, texture and color to match existing surface. Materials and procedures for filling testing core holes shall be submitted to Engineer/Architect for review prior to starting work.

C. Acceptance of Structure:

1. Acceptance of completed concrete injection work will be according to requirements of Article "Field Quality Control by Testing Agency," paragraph "Core Testing."
2. Grouted core holes shall be sounded by Engineer/Architect and Contractor with hammer or rod after curing for 48 hours.

END OF SECTION 03 63 00

SECTION 07 18 00 – TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete waterproofing system including all products specified in Division 07 Sections.

B. This Section includes Traffic Coating: Fluid-applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface.

C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Distribute reviewed submittals to all others whose Work is related.

B. Pre-installation Conference: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful coating performance. Require every party concerned with coating Work, or required to coordinate with it or protect it thereafter, to attend. Include manufacturer's technical representative and warranty officer.

C. Make submittals in accordance with requirements of Division 01 Sections.

D. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including cost of Engineer’s services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

E. Requests for Information

1. Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems frivolous and/or deems already answered in the Contract Documents.
2. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in Contract Documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated, submit the following at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation and aggregate loading required within each coat.

B. Samples:

1. One 4 in. by 4 in. stepped sample showing each component for each system indicated.

C. Mockups:

1. Minimum 10-ft by 10-ft in size.
2. Obtain Owner/Engineer approval prior to start of full-scale work.
3. Approved mockups shall demonstrate final coating product texture/color and shall be used as acceptance criteria for all coating on project.
4. Remove rejected mockups and install new mockups until approval is obtained at no additional cost.

D. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Certification that products and installation comply with applicable federal, State of Michigan, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.
3. Certification from Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic coating.

4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
5. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic coating application specified on project. Containers shall bear UL labels.
6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.

B. Manufacturer's Instructions: For each system indicated.

1. Crack treatment and surface preparation method and acceptance criteria.
2. Method of application of each coat.
3. Maximum and minimum allowable times between coats.
4. Final cure time before resumption of parking and/or paint striping.
5. Any other special instructions required to ensure proper installation.

C. Field Quality Control:

1. Quality Control Plan as defined in Part 3.
2. Two copies each of manufacturer's technical representative's log for each visit.
3. Testing agency field reports.

D. Qualification Statements:

1. Manufacturer's qualifications as defined in "Quality Assurance" article.
2. Installer's qualifications as defined in "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Five copies of snow removal guidelines for areas covered by Warranty.

C. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

   a. Name and location of project.
   b. Type of system applied.

c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer’s Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer’s superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Traffic coating shall satisfy current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state this project is being constructed.
3. Licensing/certification agreement shall include following information:

a. Applicator’s financial responsibility for warranty burden under agreement terms.
b. Manufacturer’s financial responsibility for warranty burden under agreement terms.
c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
d. Authorized signatures for both Applicator Company and Manufacturer.
e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. At no time shall weight of stored material being placed on slab areas exceed total design loads (contractor to confirm).

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. System Manufacturer (New Application and Complete System Recoating): Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). Warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Spalling surfaces.
3. Weathering.
4. Surface crazing (does not apply to traffic coating protection course).
5. Abrasion or tear failure resulting from normal traffic use.
6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic coating installation on double tees only.

B. System Manufacturer (Partial System Recoating): Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). Warranty shall provide that system will be free of defects, chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Spalling surfaces.
3. Weathering.
4. Surface crazing (does not apply to traffic coating protection course).
5. Abrasion or tear failure resulting from normal traffic use.

C. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

D. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

E. Perform any repair under this warranty at no cost to Owner.

F. Address following in terms of Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty,

responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

G. Snowplows, vandalism, studded snow tires and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. Advanced Polymer Technology (APT), Harmony, PA
2. BASF Building Systems (BASF), Shakopee, MN
3. Deneef Construction Chemicals (Deneef), Houston, TX.
4. Lymtal International Inc. (Lymtal), Lake Orion, MI.
5. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX.
6. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
7. Poly-Carb Inc. (Poly-Carb), Twinsburg, OH.
8. Polycoat Products Division of Amer. Polymers (Polycoat), Santa Fe Springs, CA.
9. Pecora Corporation (Pecora), Harleysville, PA
10. Sika Corporation (Sika), Lyndhurst, NJ.
11. Technical Barrier Systems, Inc. (TBS), Oakville, Ontario.
12. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC COATING

A. Acceptable coatings are listed below. Contractor/manufacturer to confirm coatings are compatible with all other materials in this Section, all existing substrates/coatings, and all related work.

1. Heavy Duty:

a. Autogard HD-48, Autogard E, Neogard.
b. Elasto-Deck 5000-HT, Pacific Polymers.
c. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
d. MasterSeal Traffic 1500, BASF.
e. Qualideck Heavy Vehicular (152/252/372/512), APT
f. Sikalastic 710/715, Sika.
g. Vulkem 350/950NF/951NF Deck Coating System, Tremco.
h. Pecora-Deck 800 Series.
i. Kelmar TE Exposure 3, TBS.
j. Flexodeck Mark 170.2 Solvent Free Heavy Duty, Poly-Carb.
k. Poly-I-Gard 246HD, Polycoat.

B. Recoating: Provide all wearing course components specified for new heavy-duty applications.

C. Provide ultraviolet screening for all traffic coating placed on this project.

D. Finish top coat shall be colored grey.

E. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:

1. Denedeck Crack Sealer, Deneef.
2. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.
3. MasterSeal 630, BASF.
4. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
5. SikaPronto 19TF, Sika.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:

1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to Engineer/Architect.
2. Concrete surfaces have completed proper curing period for system selected.
3. Joint Sealants are compatible with traffic coatings.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Remove all laitance and surface contaminants, including oil, grease and dirt as specified by manufacturer's written recommendations.

D. Remove all debonded traffic coatings. Remove all laitance and surface contaminants, including oil, grease and dirt, by shotblasting and appropriate degreasers, or as specified by manufacturer's written recommendations to provide warranty.

E. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.

F. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.

G. All random cracks on concrete surface less than 0.03 in. wide and showing no evidence of water and/or salt water staining on ceiling below shall receive detail coat unless more complete treatment required in accordance with manufacturer's recommendations. Rout and seal random cracks, construction joints and control joints prior to installation of primer or base coat.

H. Mask off adjoining surfaces not to receive traffic coating and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic coating.

3.3 INSTALLATION/APPLICATION

A. Installation should include all the following steps:

1. Surface Preparation: Prepare concrete for system application.
2. Crack/Construction/Control/Cove Joint Sealing: Detail for crack bridging.
3. Primer Coat: Insure proper adhesion of membrane to substrate.
4. Base Coat: Provide crack spanning in conjunction with Crack Detail noted above.
5. Aggregate Coat – to hold aggregate in system, providing skid and wear close up resistance.
6. Aggregate: Correct size, shape, hardness and amount necessary to insure proper skid and wear resistance.
7. Top Coat: Lock aggregate into place, provide a maintainable surface and provide resistance to ponding water, UV degradation, color loss and chemical intrusion.

B. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.

C. A primer coat is required for all systems. No exception.

D. Do not apply traffic coating material until concrete has been air dried at temperatures at or above 40 deg F for at least 30 days after curing period specified.

1. Alternatively, contractor may perform moisture content testing at own expense. Submit results and provide written approval of acceptable moisture testing results from coating manufacturer.

E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.

F. All adjacent vertical surfaces shall be coated with traffic coating minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.

G. Complete all Work under this Section before painting line stripes.

H. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.

C. Install 1 trial section of coating system for each duty grade and/or recoat system specified. Do not proceed with further coating application until trial sections accepted in writing by Owner/Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:

1. Wet mil thickness application.
2. Adhesion to concrete substrate and/or existing coating(s).
3. Overall dry mil thickness.

D. Use trial sections to determine adequacy of pre-application surface cleaning. Obtain Owner, Engineer/Architect and manufacturer acceptance of:

1. Cleaning before proceeding with traffic coating application.
2. Visual appearance of finished coating application.
3. Conformance to ADA static coefficient of friction.
4. Elcometer or equivalent pull test to quantify traffic coating adhesion to concrete and existing traffic coating.

E. Determine overall coating system mil thickness:

1. Contractor shall provide 6 in. by 6 in. bond breaker (coating coupon) on concrete surface for each 25,000 sq. ft, or fraction thereof, of coating to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
2. Contractor shall assist Testing Agency in removing coating coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per coating manufacturer's instructions.
3. Testing Agency shall determine dry mil thickness of completed Traffic Coating System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at 2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall coating system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.

END OF SECTION 07 18 00

SECTION 07 18 10 - EPOXY BROADCAST OVERLAY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This work consists of furnishing and placing an overlay system comprised of a two-component epoxy resin system with broadcast aggregate for the purpose of improving skid resistance and sealing the concrete surface. The surface of the concrete shall be prepared and two applications of the epoxy-aggregate system shall be made in accordance with these specifications. The Contractor shall install an aggregate wearing course that is provided through a single manufacturer.

B. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

1.3 QUALITY ASSURANCE

A. Submit following information for field testing of epoxy broadcast overlay installation unless modified in writing by Engineer.

1. Project name and location.
2. Contractor's name.
3. Epoxy material supplier.
4. Date of report.
5. Placement location within structure.
6. Epoxy material data:

    a. Epoxy type.
    b. Application rate (gals/sf)
    c. Aggregate rate (lbs/sf)
    d. Area applied (sf)

7. Weather data:

    a. Air temperatures.
    b. Weather.
    c. Wind speed.

8. Written acceptance of surface preparation from manufacturer representative.

9. Written acceptance of installation/application of epoxy from manufacturer representative.

1.4 REFERENCES

A. "Standard Specifications for Structural Concrete," (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.

B. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:

1. "Building Code Requirements for Reinforced Concrete," (ACI 318), American Concrete Institute, herein referred to as ACI 318.
2. "Causes, Evaluation, and Repair of Cracks in Concrete Structures" (ACI 224.112), American Concrete Institute.
3. "State-of-the-Art Report on Parking Structures" (ACI 326), American Concrete Institute.
4. "Use of Epoxy Compounds with Concrete" (ACI 503), American Concrete Institute.
5. "Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive" (ACI 503.1), American Concrete Institute.
6. “Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate” (ACI 503.3), American Concrete Institute
7. "Guide for Repair of Concrete Bridge Superstructures" Reported by ACI Committee 546 (ACI 546.1).

C. Contractor shall have following ACI publications at Project construction site at all times:

1. "Use of Epoxy Compounds with Concrete" (ACI 503), American Concrete Institute.
2. "Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive" (ACI 503.1), American Concrete Institute.
3. “Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate” (ACI 503.3), American Concrete Institute.

1.5 SUBMITTALS

A. Make submittals in accordance with requirements of the contract and as specified in this Section.

B. Contractor: Submit manufacturer's product data sheets, technical sheets, surface preparation procedures and equipment, recommended application procedures and information on epoxy broadcast system.

C. The Contractor shall submit documentation that confirms his having a minimum of five years of experience in the use and application of similar specified materials or the

Contractor shall retain the services of a manufacturer's representative with said experience.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Five copies of snow removal guidelines for areas covered by Warranty.

C. Final executed Warranty.

1.7 WARRANTY

A. System manufacturer and Contractor shall furnish Owner a written single source performance warranty that the epoxy overlay system will be free of defects related to design, workmanship or material deficiency for 5-year period from date of acceptance of Work required under this Section against leakage, bond failure and excessive aggregate loss:

B. Any repair under this warranty shall be done at no cost to Owner. Warranty shall be provided by Contractor and manufacturer of system.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 10 or more projects completed with submitted system, to include:

    a. Name and location of project.
    b. Type of system applied.
    c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any installer.

1. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 2 verifiable years of installations similar to those involved in this Contract, and minimum 5 projects with submitted system.
2. Listing of 3 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Michigan.
2. Licensing/certification agreement shall include following information:

a. Applicator's financial responsibility for warranty burden under agreement terms.
b. Manufacturer's financial responsibility for warranty burden under agreement terms.
c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
d. Authorized signatures for both Applicator Company and Manufacturer.
e. Commencement date of agreement and expiration date (if applicable).

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of manufacture.
4. Lot or batch number.
5. Manufacturer's instructions for mixing.
6. Warning for handling and toxicity.
7. Expiration date.

B. Store materials under cover and protect from weather at temperatures between 40-100 deg F. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. At no time shall weight of stored material being placed on slab area exceed total design load (contractor to confirm).

1.10 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

B. Dispose of unused materials in accordance with MSDS.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Epoxy Resin System. The epoxy resin system shall be a two-component, 100% solids (Zero VOC), low-modulus, flexible, high-elongation, moisture-insensitive and fuels resistant system. It shall be in accordance with the following requirements:

1. Properties of the mixed epoxy resin:

   a. Pot Life, 1 qt., (AASHTO T-237): 15-35 minutes at 73°F

2. Properties of the cured epoxy resin shall meet material requirements of ASTM C881, Type III, and as follows:

   a. Compressive Properties (ASTM D-695):

      1) Compressive Strength at 7 days: 4,000-7,000 psi

   b. Compressive Properties (ASTM C-109):

      1) Compressive Strength at 4 hours: 1,400 psi
      2) Compressive Strength at 7 days: 7,000 psi

   c. Tensile Properties (ASTM D-638) at 7 days:

      1) Tensile Strength: 2,200 psi
      2) Elongation at Break: 30 percent minimum

   d. Water Absorption, 24 hr. %, (ASTM D570) : <0.5
   e. Thermal Compatibility, (ASTM C-884): Passing
   f. Effective Shrinkage, (ASTM C-883): Passing
   g. Adhesion to Concrete, (ACI Method 503R-30): Concrete Failure

B. Fine Aggregate: An aggregate wearing surface shall be broadcast into a liquid binder according to the manufacturer's specifications. The fine coarse aggregates shall be those typically used for high performance surfaces. Aggregates shall consist of clean, hard, durable, non-staining and non-corroding fragments such as flint, chert, emery, or basaltic sand that are primarily angular or sub-angular in shape and have been crushed. Particle material, size, shape and surface texture shall be optimized for the binder. Aggregates shall have a proven record of durability in this type of application. The aggregate's origin shall not be from ocean or saltwater sources unless it has been washed and certified as chloride-free. All aggregate shall be stored in a dry, moisture-free atmosphere. The aggregate shall be fully protected from any contaminants on the job site and shall be stored so as not to be exposed to rain or other moisture sources. Alternate aggregates may be used as approved by the Engineer. The aggregate used shall contain at least 10 percent aluminum oxide and conforming to Table 1.

TABLE 1

FINE AGGREGATE GRADATION

	Bridge Deck	Parking Deck or Pedestrian Walkway
Sieve Size	**Percent Passing**	
#4	100	100
#8	30~75	51-75
#16	5(max)	14-50
#30	1	0-25
#200	0.2	0-2

C. The aggregate shall conform to the properties listed in Table 2 below:

TABLE 2

FINE AGGREGATE PROPERTIES

TESTS	Method	Limit
Los Angeles Abrasion (after 500 revolutions)	AASHTO T 96	40% max
MOHS Scale of Hardness	MOHS	7 min
Moisture Content ASTM C566	By Weight	<= 0.2%

D. Equipment: All equipment for cleaning the existing concrete surface and mixing and applying the epoxy-aggregate system shall be in accordance with the epoxy manufacturer's recommendations as approved by the Engineer prior to commencement of any work.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from the following manufacturers.

1. Unitex Chemical Co., a division of Dayton Superior
2. Sika Corporation
3. BASF Construction Chemicals - Building Systems
4. LymTal International, Inc.
5. ChemCo Systems
6. The Euclid Chemical Company
7. IPA Systems, Inc.

B. Acceptable epoxy broadcast overlay systems are listed below. Epoxy broadcast system shall meet the above requirements and specifications. Provide compatible polyurethane topcoat to lock aggregate (incidental).

1. Unitex Total Overlay System – Dayton Superior, Miamisburg, OH.
2. Sikadur Epoxy Broadcast Overlay System – Sika Corp, Lyndhurst, NJ
3. MasterSeal 350 – BASF Construction Chemicals – Building Systems, Shakopee, MN.
4. Iso-Flex 200 Epoxy Overlay System - LymTal International, Lake Orion, MI
5. Kemko 128 FlexDek Binder - ChemCo Systems, Inc., Redwood City, CA
6. Flexolith – The Euclid Chemical Company, Cleveland, OH
7. Ipanol E-Flex – IPA Systems, Inc.

C. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

A. Weather and Substrate Conditions for Epoxy: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:

1. Ambient temperature is less than 50 deg F.
2. Substrate surfaces have cured for less than 1 month.
3. Rain or temperatures below 50 deg F predicted for a period of 24 hours.
4. Earlier than 24 hours after surfaces became wet.
5. Substrate is frozen or surface temperature is less than 50 deg F.

B. Weather and Substrate Conditions for Other Materials: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

3.2 PREPARATION

A. The overlay system shall be applied in accordance with these specifications at the locations indicated on the plans. The quantities and rates shown are for typical situations only. Exact quantities and rates shall be as recommended by the manufacturer and approved by the engineer, based on the existing scaling surface conditions. See Detail 16.9 for typical thickness requirements of the epoxy overlay system.

1. Trial Application. Prior to constructing the overlay, one or more trial overlays shall be placed to determine the initial set time and to demonstrate the effectiveness of the mixing, placing, and finishing equipment proposed. Each overlay shall be 4 ft wide, at least 6 feet long and the same thickness as the overlay to be constructed. Conditions during the construction of the trial overlays and equipment used shall be similar to the expected and those to be used for construction of the multilayer

epoxy-overlay. The location of the trial overlays shall be approved by the Engineer.

a. Tensile strength of the concrete surface shall average 250 psi minimum in accordance with ASTM C1583. At least 3 locations shall be tested. Tests shall be repeated if concrete failure represents less than 50% of the specimen's area.

2. Surface Preparation. The surface of the concrete deck shall be prepared for application of the overlay by first repairing the concrete deck and then scarification, shotblast, abrasive blasting, hydroblasting, and other cleaning required by the Epoxy Manufacturer and the Engineer so as to remove all unsound concrete, laitance, curing compounds, sealers, grease, oils, paint, dirt, or any other contaminants that could interfere with the proper adhesion of the epoxy overlay system in accordance with the following requirements:

a. The existing deck shall be rehabilitated prior to the epoxy overlay per other Work Items. Spalled and delaminated areas of the deck shall be chipped back to sound concrete and patched.

3. After concrete patching repairs, all remaining loose/delaminated existing concrete shall be removed by scarifying up to ½" amplitude.

4. Shotblast Cleaning: The preferred method of cleaning is shotblasting. This cleaning shall not commence until all work involving the repair of the concrete deck surface has been completed. Additionally, surface preparation shall not commence until all concrete repairs are sufficiently cured. Following completion of shotblast cleaning, any loose shot or other particles shall be removed from the deck prior to the application of the overlay. The shotblast cleaning or other approved method will not be measured and paid for separately, but shall be included in the work.

5. Sand-blasting and/or Water-blasting: After shot-blasting, sand-blasting and/or water-blasting shall then be performed to remove all dust/debris/laitance. Additional surface preparation and/or cleaning shall be performed as needed in strict accordance with manufacturer's recommendations.

6. Product manufacturer shall provide written approval of surface preparation prior to start of installation.

7. Surface preparation methods will not be measured and paid for separately, but shall be included in the work.

3.3 INSPECTION

A. Inspect surfaces to receive Work and report immediately in writing to Engineer any deficiencies in surface which render it unsuitable for proper execution of Work.

3.4 INSTALLATION

A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, thicknesses, texture and curing.

B. Manufacturer's technical representative, acceptable to Engineer, shall be on site during surface preparation and installation.

1. Application of Epoxy-Aggregate Overlay. Application of the overlay will not be allowed unless the ambient temperature is a minimum of 50 deg F and rising, and the concrete deck temperature is at least 50 deg F. At cooler temperatures, the material should be conditioned at 75 deg F at least 24 hours prior to use. Additionally, application shall not begin until the concrete deck is completely surface dry. Values shown in this specification are typical of general installations. Actual values and application rates shall be per Manufacturer's recommendations.
2. Mixing of Epoxy Components: Components A and B shall each be thoroughly stirred in its own container prior to mixing in order to disperse any settlement which may have occurred. Components A and B shall be proportioned in strict accordance with the instructions of the manufacturer and then thoroughly blended together with a mechanical mixing device for at least 2 minutes. Hand mixing is not acceptable. No diluent, thinner, or other foreign material shall be added to either the individual components or the mixed epoxy.
3. Applying the Overlay: Application of the mixed epoxy to the concrete surface shall be squeegee, roller, or spray, or combinations thereof as approved by the Engineer following the trial application. The application method used shall apply the material smoothly, uniformly, and continuously. The epoxy shall not be allowed to puddle or accumulate in holes or depressions in the deck. The Contractor shall provide suitable coverings, such as heavy-duty drop cloths and the like, to protect all exposed areas not to be overlayed with epoxy, such as curbs, sidewalks, railings, parapets, joints, etc. All damage or defacement resulting from this application shall be cleaned or repaired at the Contractor's expense, to the satisfaction of the Engineer.

    a. First Coat: The epoxy shall be applied to the concrete deck at the rate of **35-40 square feet per gallon**, unless otherwise recommended by the manufacturer, and dependent on profile of existing surface. While the epoxy is still wet broadcast the aggregate until no wet spots are visible. In broadcasting, the aggregate shall be sprinkled or dropped vertically in such a manner so as not to violently disturb the wet epoxy film. When this first coat has cured sufficiently to sustain working traffic, any excess aggregate remaining shall be removed by sweeping or vacuum.
    b. Second Coat: The second coat shall be applied in a manner identical to the application of the first coat, except that the coverage of the epoxy shall be **20-25 square feet per gallon** and the aggregate shall be broadcast until no wet spots are visible. When the second coat has cured sufficiently to sustain working traffic, all excess aggregate remaining shall be removed by sweeping or vacuum.

C. Curing. The Contractor shall allow the epoxy overlay to cure sufficiently before subjecting it to loads or traffic of any nature that may damage the overlay. Cure time depends upon the ambient and deck temperatures. The field cure, if approved by the Engineer, can be determined as follows:

1. The overlay shall be considered cured to a firm, hard state when no movement of the overlay can be detected when pressure is applied. Actual degree of cure and suitability for traffic shall be determined by the manufacturer, acceptable to the Engineer, on the actual epoxy concrete overlay.

3.5 FIELD QUALITY CONTROL

A. Develop a quality control plan for assured specified uniform overlay thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.

3.6 ACCEPTANCE

A. Repair of Surface Defects. The repair method for surface defects in the overlay shall be identical to that used for the application of the overlay. All surface defects shall be repaired to the satisfaction of the Engineer before acceptance of the work is made.

B. An additional cleaning of the overlay area is required prior to opening area to traffic to remove all loose or excess aggregate by sweeping or vacuum.

C. The manufacturer shall furnish certification to the Engineer that the material supplied is in accordance with all requirements specified and stating that the material supplied is the same system and is identically formulated to the material tested for manufacturer and brand name approval.

END OF SECTION 07 18 10

SECTION 07 19 00 – WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete waterproofing system including all products specified in Division 07 Sections.

B. This Section includes penetrating concrete sealer on the following applicable surfaces:

1. Supported concrete floor and concrete roof surfaces including curbs, walks, islands and pour strips.
2. Concrete stair treads and landings.

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM D6489, “Standard Test Method for Determining the Water Absorption of Hardened Concrete Treated with a Water Repellent Coating.”

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.

B. Make submittals in accordance with requirements of Division 01 Sections.

C. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of

Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

D. Requests for Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications, and limitations.
2. Areas and application rates of materials to be applied.
3. Proposed alternate application methods, if any.

1.6 INFORMATION SUBMITTALS

A. Certificates:

1. Certification that products and installation comply with applicable federal, state of Michigan, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

B. Field Quality Control:

1. ASTM D6489 Test Results
2. Two copies of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

    a. Name and location of project.
    b. Type of system applied.
    c. On-Site contact with phone number.

B. Installer's Qualifications: Owner retains right to reject any installer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

C. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

D. Certifications

1. Sealer shall satisfy the current national and local Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
2. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Michigan.
3. Licensing/certification agreement must provide following information:

    a. Applicator's financial responsibility for warranty burden under agreement terms.
    b. Manufacturer's financial responsibility for warranty burden under agreement terms.
    c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
    d. Officers' signatures for both Applicator Company and Manufacturer.
    e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.

2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. At no time shall weight of stored material being placed on slab area exceed total design load of slab area (contractor to confirm).

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:

1. Ambient temperature is less than 40 deg F.
2. Substrate surfaces have cured for less than 1 month.
3. Rain or temperatures below 40 deg F predicted for a period of 24 hours.
4. Less than 24 hours after surfaces became wet.
5. Substrate is frozen or surface temperature is less than 40 deg F.
6. Wind velocities higher than manufacturer's specified limit to prevent solvent flash-off.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:

1. Advanced Chemical Technologies Inc. (ACT), Oklahoma City, OK.
2. BASF Building Systems (BASF), Shakopee, MN.
3. GCP Applied Technologies (GCP), Cambridge, MA.
4. Evonik Corporation (Evonik), Parsippany, NJ.
5. Euclid Chemical Company (Euclid), Cleveland, OH.
6. Lymtal International Inc. (Lymtal), Lake Orion, MI.
7. Prosoco, Inc. (Prosoco), Lawrence, KS
8. Sika Corporation (Sika), Lyndhurst, NJ.

2.2 MATERIALS, CONCRETE SEALER

A. Silane (90% or greater solids, 400 g/L or less VOC):

1. MasterProtect H 1000, 200 sf/g, BASF.
2. Iso-Flex 618-100 CRS, 200 sf/g, Lymtal.
3. Protectosil BHN, 200 sf/g, Evonik Corp.

4. Sikagard 705L ,200 sf/g, Sika.
5. Sil-Act ATS-100 LV, 200 sf/g, ACT.

B. Proposed substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:

1. SikaPronto 19TF, Sika.
2. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
3. MasterSeal 630, BASF.
4. DeNeef Denepox I-40,GCP.
5. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:

1. Concrete surface finishes are acceptable for system to be installed.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Control joint and expansion joint Work is complete and has been accepted by Engineer/Architect.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Repair or replace all sealant materials damaged by surface preparation operations.

D. Shot blast clean all surfaces to be sealed as acceptable to sealer manufacturer before sealer application. Shot blasting is not recommended or required for new slabs that are water cured per ACI 308, Paragraph 2.2. Cleaning method and materials shall be sufficient to allow absorption criteria stated in Field Quality Control article to be met. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

E. Equipment used during floor slab cleaning shall not exceed height limitation of facility and shall not exceed 3,000 lb. axle load or vehicle gross weight of 6,000 lb.

F. Mask off adjoining surfaces not to receive sealer and mask off drains to prevent spillage and migration of liquid materials outside sealer area. Provide neat/straight lines at termination of sealer.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverage, mil thickness and texture, and as shown on Drawings.

B. Clean all surfaces affected by sealer material overspray and repair all damage caused by sealer material overspray to adjacent construction or property at no cost to Owner.

C. Clean off excess material as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Install 3 trial sections of sealer to verify treated surface is not glazing as result of sealer application. If application of sealer causes glazing at trial section, contact sealer manufacturer to obtain written recommendations for solving problem. Do not proceed with sealer application following trial section applications until directed to do so in writing by Engineer/Architect.

B. Testing Agency shall take a) 1 core from each trial section and b) 3 additional cores as directed by Engineer/Architect after sealer application to test for sealer effectiveness in accordance with ASTM D6489. Concrete core samples shall be taken 14 days after application of sealer. Report water absorption through top and bottom surfaces of core. Sealer shall reduce water absorption by at least 85 percent when compared with the unsealed bottom surface.

3.5 NON-CONFORMING WORK

A. Unsatisfactory Field Quality Control test results shall be grounds for rejection of sealer or sealer application rate. Perform sealer reapplication at no additional cost to Owner.

END OF SECTION 07 19 00

SECTION 07 92 33 –CONCRETE JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete waterproofing system including all products specified in Division 07 Sections.

B. This Section includes the following:

1. Exterior joints in the following horizontal traffic bearing surfaces:

    a. Construction joints in cast-in-place concrete.
    b. Control joints in slab-on-grade, pour strips, slabs and topping slabs.
    c. Joints between precast concrete units.
    d. Perimeter of floor drains.
    e. Other joints as indicated on the Drawings.

2. Exterior joints in the following vertical and horizontal non-traffic surfaces:

    a. Construction joints in cast-in-place concrete.
    b. Joints between precast concrete units.
    c. Cove joints at intersection of horizontal and vertical concrete.
    d. Other joints as indicated on the Drawings.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.
3. Coordinate layout of joint system and approve methods for providing joints with precast concrete and concrete contractors.
4. Inspect site and precast plant before precast production to insure proper joint configuration.

B. Make submittals in accordance with requirements of Division 01 Sections.

C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

D. Requests for Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 14 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate

B. Samples:

1. One for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:

1. Two copies each of manufacturer's technical representative's log for each visit.
2. Testing agency field and test reports.

C. Qualification Statements:

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted sealant, to include:

   a. Name and location of project.
   b. Type of sealant applied.
   c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any installer or subcontractor.

1. Installer shall be legally licensed to perform work in the state of Michigan. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted sealant.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Licensing/certification document from system manufacturer that confirms sealant installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Michigan.

2. Licensing/certification agreement shall include following information:

    a. Applicator's financial responsibility for warranty burden under agreement terms.
    b. Manufacturer's financial responsibility for warranty burden under agreement terms.
    c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
    d. Authorized signatures for both Applicator Company and Manufacturer.
    e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. At no time shall weight of stored material being placed on slab area exceed total design load (contractor to confirm).

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that sealant will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Weathering.
3. Abrasion or tear failure resulting from normal traffic use.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Snowplows, vandalism, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN.
2. Dow Corning Corp. (Dow Corning), Midland, MI.
3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
4. Pecora Corporation (Pecora), Harleysville, PA.
5. Sika Corporation (Sika), Lyndhurst, NJ.
6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.

B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.

C. Color of sealants shall match adjacent surfaces.

D. Closed cell or reticulated backer rods: Acceptable products:

1. “Sof Rod,” Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
2. “ITP Soft Type Backer Rod,” Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
3. “MasterSeal 921 Backer Rod,” BASF.

E. Bond breakers and fillers: as recommended by system manufacturer.

F. Primers required for all sealants, no exceptions.

G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.

H. Acceptable polyurethane control joint sealants (traffic bearing):

1. MasterSeal SL-2 or MasterSeal SL-2 SG, BASF.
2. Iso-flex 880 GB or Iso-flex 881, Lymtal.
3. Dynatrol II-SG or Urexpan NR 200, Pecora.
4. Sikaflex-2c SL or Sikaflex-2c NS TG, Sika.
5. THC-901, Vulkem 45SSL, Dymeric 240 FC or Dymonic 100, Tremco.

I. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):

1. Sikaflex-2c NS EZ, Sika.
2. MasterSeal NP-2, BASF.
3. Dymeric 240FC, Dymonic 100 or THC 901 (cove only), Tremco.
4. Dynatred, Pecora.
5. Iso-flex 881, Lymtal.

J. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning installation

1. Concrete surfaces are finished as acceptable for system to be installed.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Correct unsatisfactory conditions before installing sealant system.

C. Acid etching is prohibited.

D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

E. Final preparation of joints shall be a sandblast with medium that removes dust and ground material from surfaces to receive sealant.

F. Check preparation of substrate for adhesion of sealant.

G. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.

B. Completely fill joint without sagging or smearing onto adjacent surfaces.

C. Self-Leveling Sealants: Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.

D. Non-Sag Sealants: Tool joints concave: Wet-tooling not permitted.

E. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

F. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.

3.4 FIELD QUALITY CONTROL

A. Contractor and Engineer/Architect will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:

1. Contractor, at Engineer/Architect's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.

2. Contractor, at Engineer/Architect's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer/Architect, for Engineer/Architect and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.

B. Repair all random joint sealant "cut out" sections at no cost to Owner.

C. Flood test joints where shown on Drawings.

D. Testing Agency:

1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.
2. If flood test of joints required by this Section, report results to Engineer/Architect.

END OF SECTION 07 92 33

SECTION 079500 – EXPANSION JOINT ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete waterproofing system including all products specified in Division 07 Sections.

1.3 DEFINITIONS

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestressing, cyclic thermal movements, and seismic movements.

D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.

E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.

F. Service Load Level: Defined level of load under which joint assembly remains elastic and fully functional.

G. Fatigue Load Level: Defined level of load under which joint assembly remains elastic and fully functional, including all noise mitigation components, for the stated number of cycles.

H. Collapse Load Level: Defined level of load under which joint assembly remains capable of bridging the gap, although plates may yield and components may break.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General:

a. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
b. Coordinate requirements for transitions, tolerances, levelness, and plumbness to ensure the installed expansion joint system can perform with expected movement capabilities.
c. Coordinate and assign responsibility for preparation of concrete surfaces adjacent to expansion joints.
d. Expansion joint surface areas each side of joint gap shall have a vertical differential less than ¼" and meet requirements of expansion joint manufacturer.
e. Minor surface defects shall be repaired according to manufacturer's recommendations. Repair materials shall be compatible with intended system materials and shall be approved by the Engineer prior to surface preparation and installation.
f. Submit for approval repair products and procedures for all major defects. Repair description shall indicate materials, manufacturer's requirements, expected service life, and maintenance requirements. Take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.
g. Coordinate layout of joint system and approval of methods for providing joints.

2. Joint Opening Width:

a. Use temperature adjustment table to properly size joint gap at time of concrete pour and show that proposed joint system is capable of equal individual and combined movements in each direction when installed at designated temperature shown on drawings.
b. Where installation temperature is other than specified temperature, perform calculations showing joint is capable of movement within design temperature range (Criteria on Drawings) for "other" temperature, and that design and installation follow manufacturer's recommendations.
c. Expansion joint movement capability and the actual joint gap movement may not coincide. Construct actual joint gap in accordance with expansion design criteria.

3. Blockouts:

    a. Float expansion joint blockouts to remove all air pockets, voids and spalls caused by form work.
    b. Blockouts shall be plumb with maximum tolerance per Manufacturer or not more than 0.125 inches deviation in 12 inches. Noncompliant blockouts shall be considered major defects.
    c. Blockouts shall be straight and true with maximum tolerance per Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts shall be considered major defects.

B. Preinstallation Meetings: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include Engineer of Record and manufacturer's technical representative and warranty officer.

C. Make submittals in accordance with requirements of Division 01 Sections.

D. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer’s services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

E. Requests for Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated:

1. Construction details, material descriptions, dimensions, and finishes.
2. Proposed method of preparation of concrete surface to receive expansion joint systems.
3. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive expansion joint systems.

4. Horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.
5. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10 deg F increments and a calculation showing joint system is capable of movement within the design temperature range.

B. Shop Drawings: For each type of product indicated:

1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, and terminations. Provide isometric or clearly detailed drawings depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.
2. Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

    a. Manufacturer and model number for each joint system.
    b. Joint system location cross-referenced to Drawings.
    c. Form width.
    d. Nominal joint width.
    e. Movement capability.
    f. Minimum and maximum joint width.
    g. Classification as thermal or seismic.
    h. Materials, colors, and finishes.
    i. Product options.
    j. Fire-resistance ratings.

3. Components and systems required to be designed by a professional engineer, shall bear such professional's written approval when submitted.

C. Samples:Samples for each type of joint system indicated.

    a. Submit 2 samples for each type. Full width by 6 inches (150 mm) long, for each system required.
    b. Field samples of premolded joint sealant. Width, thickness and durometer hardness of sealant shall be checked by Testing Agency. Upward buckling caused by joint gap closure shall be limited to a maximum of ¼ inch per ADA Guidelines.

2. Develop mockups of concrete surface preparation for review and to establish a control for the application.

D. Delegated Design Submittals:

1. Analysis indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of design criteria used in design.

E. Test and Evaluation Reports:For premolded joints, Testing Agency shall check Shore A hardness of materials in accordance with ASTM D2240 and insure limited upward buckling of ¼ inch or less.
   2. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates

   1. Certification that products and installation comply with applicable federal, state of Michigan, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
   2. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.

      a. Submit test reports from accredited laboratory attesting to joint systems' movement capability and ADA compliance.
      b. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).

   3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
   4. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.

B. Field Quality Control

   1. Two copies each of manufacturer's technical representative's log for each visit.

C. Qualification Statements

   1. Manufacturer's qualifications as defined in the "Quality Assurance" article within 60 days of project award.
   2. Installer's qualifications as defined in the "Quality Assurance" article.
   3. Evidence of manufacturer's certification of installer/applicator. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

1. Maintenance Manual: 3 copies of System Maintenance Manual.
2. Five copies of snow removal guidelines for areas covered by warranty.

B. Warranty Documentation: 2 executed copies of Labor and Material Warranty including all terms, conditions and maintenance requirements.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Experience Record and Qualifications paragraph below.
2. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
3. Copy of sample warranty that meets the requirements of the “Warranty” article in Section 1.
4. Evidence of financial stability acceptable to Owner or Engineer/Architect.
5. Evidence of compliance with "Single Installer" requirement.

B. Experience Record and Qualifications: Verification of systems shall be established by either System Validation or Design Validation.

1. System Validation: Submitted system for similar applications with minimum five (5) years’ experience and five (5) verified projects completed. Validation submittal shall include:

   a. Sealed design calculations by an engineer licensed in Michigan, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.
   b. Field history as defined below.
   c. Results of seismic load tests defined below for projects with a Seismic Design Category of C or higher.

2. Design Validation: Submitted system for similar application with less than five (5) years’ experience shall include a design validation submittal. Validation submittal shall include:

   a. Sealed design calculations by an engineer licensed in Michigan, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.
   b. Results of cyclic and seismic load tests defined below.

3. Acceptable field history consists of successful performance of five (5) installations in place over the previous five (5) years under similar project loads, traffic frequency, footprints, and joint sizes. Include sketches, photos, and references for each installation. Installations shall have experienced at least moderate levels of traffic.

4. Vertical and horizontal cyclic load tests shall be performed at an independent laboratory, and witnessed by a professional engineer who shall issue a sealed final report of the test results. Tests shall consist of cyclic load testing using the design criteria in Part 2 and project joint sizes. Tests shall meet the following criteria:

    a. Vertical load cycle counts shall be a minimum of 2, 1000, and 1,000,000 cycles for the collapse, service, and fatigue level loads respectively.
    b. Horizontal load cycle counts shall be a minimum of 1,000 and 25,000 cycles for the service and fatigue level loads respectively. No horizontal load test is required for the collapse level loads.
    c. The vertical service and fatigue load test shall consist of a rolling tire at specified load in order to gauge joint wear. Test specimen shall show no signs of yielding of load carrying elements.
    d. Observation and testing results of performance for noise mitigation elements shall be reported.
    e. Different specimens may be used for the tests if they are of the same size and design. Conditions adjacent to the joint, e.g. the blockout region, shall be in keeping with the system design. Test joints shall be not less than 4 feet per tire in length, and shall replicate typical field installed geometry.

5. Seismic load tests shall be performed by an independent laboratory and witnessed by a professional engineer who shall issue a sealed final report of the test results. Tests shall consist of harmonic cycle testing at seismic velocities and displacements.

    a. Test displacements shall not be less than 85% of the joint's design range, at a frequency not less than 0.5Hz, for not less than 10 cycles.
    b. Longitudinal displacements (parallel to the joint) shall be 10% of the transverse displacement (perpendicular to the joint), but not less than 1", for joints where only unidirectional movement is expected, and 50%, but not less than 1", for joints in which bidirectional movement is anticipated. Longitudinal and transverse displacements shall be applied simultaneously with a vertical offset of ½" between opposite sides of the joint.
    c. Seismic testing is not required for small movement joints with seismic design displacements of less than 2" (+/-2", 4" total).

C. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Provide reports to Owner detailing maintenance activities have been performed in accordance with written maintenance agreement for expansion joints.
2. Materials shall be compatible with materials or related Work with which they come into contact and the related materials sections.
3. Manufacturer/Applicator: Review and approve all details before construction. Confirm in writing to Owner.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.10 WARRANTY

A. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

B. Installation Requirements: Include a written plan of construction and coordination requirements, to allow joint system installation to proceed with specified warranty, that specifically addresses the following:

1. Block out acceptance criteria.
2. Surface preparation acceptance criteria.
3. Crack, surface defect, and detailing recommendations.
4. Method of protection of surrounding surfaces.
5. Method of expansion joint system installation description.
6. Primer type and application rate.
7. Method of preparation of all glands and reinforced membranes.
8. Temperature, humidity and other weather constraints. Specify substrate moisture testing criteria, if any.
9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
10. Any other special instructions required to ensure proper installation.

C. Quality Service Requirements: Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:

1. Installer’s financial responsibility for warranty burden under agreement terms.
2. Manufacturer’s financial responsibility for warranty burden under agreement terms.
3. Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
4. Authorized signatures for both Installer Company and Manufacturer.
5. Commencement date of agreement and expiration date (if applicable).
6. Provide copy of contractor’s field application quality control procedures.

D. Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that expansion joints will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of: Warranty shall provide that system shall be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any water leakage through expansion joint system or leaking conditions of reinforced membrane, other waterproofing components, or glands.
2. Any adhesive or cohesive failures of the system.
3. Shifting of plates out of alignment due to system failure.
4. Loose plates, anchor blocks, bolts.
5. Metal to metal vibration causing noises during use.
6. Metal to non-metal vibration causing noises during use.
7. Tears, weathering, or degradation in gland from normal use.
8. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of ½ inch below the floor surface.

E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. A single Installer shall be responsible for providing complete expansion joint system. Obtain all joint systems through one source from a single manufacturer.

B. Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated.

C. Do not modify intended aesthetic effects, as judged solely by Engineer, except with Engineer's approval. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.

2.2 PERFORMANCE REQUIREMENTS

A. Intent of this section is to insure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and minimize water leakage.

B. Provide design of expansion joint for preparation of final details for fabrication and construction of all concrete openings, expansion joint elements and required accessories. An integral part of this project is engineering for the following:

1. Include calculations for the size and forming of concrete openings to provide nominal joint width as indicated on drawings. Provide a summary of the design criteria used in the design.
2. Include calculations for the appropriate size of expansion joint elements in accordance with the expansion joint assembly performance criteria. Include installation requirements of expansion joint assembly for specific project conditions and scheduling. Provide a summary of design criteria used in design.

C. Expansion joint design shall meet or exceed all expected movements shown on drawings.

D. Installation temperature range and estimated volume change movements are shown on drawings. Nominal form width shown on the drawings shall be adjusted for the ambient temperature at time of concrete placement and designer shall verify that width of joint at installation shall meet minimum installation requirements.

E. Expansion joint systems shall be capable of resisting a differential vertical movement of ½ inch.

F. Materials shall be supplied in lengths to minimize or eliminate the need to splice waterproofing components.

1. Waterproofing materials directly exposed to vehicular traffic shall be supplied with no joints in vehicle drive aisles.
2. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.
3. All Santoprene butt to butt splices shall be heat welded.
4. Butt to butt splices with other materials shall be per manufacturer's recommendations.

G. Design system for passenger vehicles traveling at speeds normally expected within a parking structure.

H. Design system for passenger vehicles traveling at speeds higher than those expected in a parking structure.

I. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:

1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
2. Shall be designed to comply with "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1. Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S.

Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1–800-872-2253.

3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:

    a. Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2.
    b. Changes in Level between ¼ inch and ½ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3.
    c. Changes in level greater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp per minimum ADA guidelines.
    d. Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3.

2.3 MANUFACTURERS

A. Subject to compliance with requirements, provide products from one of following manufacturers (listed in alphabetical order), only where specifically named in product categories:

1. Balco Inc., Wichita, KS (Balco).
2. Construction Specialties, Inc., Muncy, PA (C/S).
3. Dow Corning Corp., Midland, MI (Dow Corning).
4. Emseal Joint Systems, Westborough, MA (Emseal).
5. Erie Metal Specialties, Inc., Akron, NY (EMS).
6. Inpro Jointmaster, Muskego, WI (Jointmaster)
7. Lymtal International Inc. Lake Orion, MI (Lymtal).
8. MM Systems Corporation, Atlanta, GA (MM).
9. TechStar, Inc., Findlay, OH (TechStar).
10. Tremco, Cleveland, OH (Tremco).
11. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.4 PRODUCTS, STANDARD EXPANSION JOINT SYSTEMS

A. Elastomeric concrete edged, extruded rubber expansion joint system.

1. CR Series System, Jointmaster.
2. DuraFlex Chambered Wing Seal CS and DCS Series, Balco.
3. Iso-Flex Winged Joint System J Series, LymTal.
4. Lokcrete Membrane System (LMS) Series, MM.
5. Polycrete/Membrane System, Type CR Series, EMS.
6. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.
7. Vulkem WF series Vehicular Expansion Joint System, Tremco.
8. Wabo®Crete Membrane System ME Series, WBA.

B. Expanding foam sealants:

1. 1200 Series Foam Seal, Jointmaster.
2. ColorJoint Silicone Sealing System, ESS Series, MM.
3. Seismic Colorseal, Emseal.
4. Iso-Flex Precom “C”, LymTal.
5. Wabo Seismic WeatherSeal, WBA.

C. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.

B. Check elevations on each side of expansion joint gap to ensure flush slab-to-slab transition.

C. Check anticipated or actual minimum and maximum joint openings. Compare to manufacturer’s movement specifications and make joint sizing recommendations.

D. Coordinate and verify that related Work meets following requirements:

1. Check adhesion to substrates and recommend appropriate preparatory measures.
2. Curing compounds used on concrete surfaces are compatible with Work to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Coordinate expansion joint system with other related Work before installation of expansion joint.
5. Verify expansion joints are compatible with Joint Sealants and traffic toppings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids or spalls. Repair with approved material prior to installation of expansion joint.

G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations

B. Surface Preparation:

1. Acid etching: Prohibited.
2. Prepare substrates according to joint system manufacturer's written instructions.
3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.

B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.

D. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.

E. Seal all openings to occupied spaces to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

F. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Prior to opening to traffic, test joint seal for leaks by maintaining continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hours.

B. Manufacturer Services: Provide qualified manufacturer’s technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation and waterproofing system installation.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of Work.

END OF SECTION 07 95 00

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

- **W.I. 45.2 "Paint – Standpipes" (PS#4 & PS#5 Alternate, PS#8 Base Bid)**
- **W.I. 45.3 "Paint – Stair Tower Interiors" (PS#5 & PS#8 Alternate)**
- **W.I. 45.4 "Paint – Roof Level Panels" (PS#8 Alternate)**
- **W.I. 45.5 "Paint – Concrete Walls and Beams" (PS#4 Alternate)**
- **W.I. 45.6 "Paint – Steel Connections" (PS#4 & PS#5 Alternate)**
- **W.I. 45.7 "Clean/Paint Shear Transfer Angles" (PS#5 Base Bid)**

1.3 DEFINITIONS

A. MPI Gloss Level 1 (Matte Finish): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3 ('Egg-Shell-Like' Finish): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 4 ('Satin-Like' Finish): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.
5. Provide additional samples at Owner request until Owner approval is obtained (incidental).

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. Sample Warranty: For each system indicated.

F. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims, including:

a. Applicator’s financial responsibility for warranty burden under agreement terms.
b. Manufacturer’s financial responsibility for warranty burden under agreement terms.

1.5 EXTRA MATERIALS

A. Furnish extra materials that are described below from the same product run (batch mix) as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 gallons of each material and color applied.

1.6 QUALITY ASSURANCE

A. Standards:

1. Preparation and Workmanship: Comply with manufacturer's written instructions and recommendations in "MPI Maintenance Repainting Manual" applicable to substrates and paint systems indicated.
2. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Owner/Engineer at no added cost to Owner.

B. Pre-construction Testing:

1. No testing has been performed on any of the existing coatings. There are no existing records for paint type and/or lead/hazardous material content. The age of the existing paint systems is unknown.
2. Contractor is responsible for pre-construction testing required to comply with all Federal, State, and Local requirements regarding painting preparation and application work. See section “Scope of Work” under “Part 3 – Execution” in this Section for additional information.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment, and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.9 WARRANTY

A. Paint Materials: Furnish Owner with written **5-year** warranty that paint products will not experience the following due to material defects:

1. Check, crack, blister, or delaminate from the substrate.
2. Fade or change color.
3. Weather or exhibit loss of gloss.
4. Chalking.

B. Paint System (Includes Preparation & Installation Procedures): Furnish Owner with written **5-year** Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements. Warranty shall state that Paint system will be free of any defects listed under note 1.9A above related to material deficiency as well as any deficiencies related to preparation or installation procedures for a period of 5 years from date of Substantial Completion.

C. Perform any repair under this warranty at no cost to Owner.

D. Address and state following in terms of Warranty:

1. Length of warranty.
2. Change in value of warranty – if any – based on length of remaining warranty period.
3. Transferability of warranty.
4. Responsibilities of each party.
5. Notification procedures.
6. Dispute resolution procedures.
7. Limitations of liability for direct and consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products listed in the Exterior Painting Schedule at the end of this Section.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Contractor responsible to verify compatibility of existing coatings with new paint products.

B. Colors: In general, match color of existing adjacent surfaces to Owner’s satisfaction. Provide samples/mockups for Owner selection and approval of colors.

C. See Section 3 “Execution” for schedule of paint systems to be used on this project.

PART 3 - EXECUTION

3.1 GENERAL INFORMATION

A. Preparation and painting is required as described in this Section and noted on the Drawings and in Section 020010.

B. Minor items that are not specifically listed may also require preparation and painting as part of base bid work scope, and are incidental to the project scope of work.

C. Mockups

1. Provide Mockups for each type of paint and substrate combination. Obtain Owner/Engineer approval of surface preparation and finished painting work product for all applicable combinations of substrate, surface preparation procedures, and paint products, colors, and finishes prior to proceeding with Work. Install additional mockups as needed to obtain approval (incidental).

D. Existing Paint Information

1. No testing of existing paint materials to establish type of existing paints has been completed or is available.

E. Metal / Hazardous Material Content Testing Results:

1. No testing of existing paint materials for hazardous materials content has been completed or is available.

3.2 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

C. Remove all debonded coatings. Remove all laitance and surface contaminants, including oil, grease, and dirt as specified by manufacturer’s written recommendations to provide warranty.

D. Proceed with coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor’s acceptance of substrate surfaces and conditions.

E. **Pre-construction Paint Testing:** Testing of existing paint materials for lead and other hazardous materials content has **not** been conducted. Testing of existing paint for lead content and other hazardous materials content is responsibility of Contractor and is incidental to this project.

F. **Preconstruction Adhesion Testing:** Adhesion testing of the generic paint systems specified has **not** been conducted. Coordination of the following preconstruction testing is responsibility of Contractor:

1. Using the specific paint product manufacturer and paint products to be used for painting work, Owner will engage an independent paint materials testing laboratory technician (acceptable to Owner/Engineer) to perform ASTM D4541 - 09e1 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers. Successful adhesion test results at representative areas (minimum 5 S.F. in area), on each substrate prepared and the new paint system applied according to this specification shall be tested prior to acceptance of a full-scale application of the paint products. Successful adhesion test results shall be demonstrated prior to proceeding with painting work. Test locations include, but are not limited to:

    a. All applicable combinations of substrates, locations, and paint products to be utilized.

G. **Ongoing Adhesion Testing:** In addition to the pre-construction adhesion testing outlined above, the Owner reserves the right to perform adhesion testing throughout the project for verification as painting work progresses. Ongoing adhesion testing is to be performed after all specified preparation work is completed.

H. **Paint Thickness Testing:** Owner will engage an independent testing agency to document (time, location, and result) wet film thickness testing. Contractor in conjunction with paint manufacturer shall develop a project standard that correlates minimum wet film thickness readings required to achieve the required dry-film thicknesses (DFT).

1. Contractor shall also utilize wet film thickness testing at the beginning of work on any new substrate, in order to assist with developing the final application technique.

I. **Paint Manufacturer's Technical representative:** A technical representative of the paint manufacturer to be used for this project shall be present on site during representative and critical examination tasks, including pre-construction and ongoing adhesion testing operations.

3.3 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Provide mockups of surface preparation procedures for Owner/Engineer approval.

C. See section 3.2 “Examination” for additional tasks required prior to preparation and painting work, including testing to be performed and demonstrated prior to proceeding with paint preparation and painting.

D. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

E. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, bird droppings, failed existing coatings, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.

F. Perform surface preparation to all surfaces/substrates as outlined elsewhere in this specification document. Containment, collection, and disposal of all preparation debris shall be responsibility of Contractor. Submit plan to Owner/Engineer prior to start of Work. Minimum requirements include:

1. Provide containment and collection procedures to not affect nearby vehicles, patrons, or other operational areas.
2. Contain and/or collect preparation debris and dispose of in manner acceptable to Owner/Engineer. Preparation debris shall not be allowed into existing drainage system. Disconnect and/or protect existing drainage system.

G. Perform additional mechanical preparation to remove unsound coatings, corrosion, etc. down to bare metal as outlined elsewhere in this specification document.

H. Transitions between different layers of substrates/coatings shall be mechanically feathered together to provide a sound and tight transition for over-coating.

I. **All Painting Work Items**: All surfaces shall receive a 2,000-psi power wash with a paint manufacturer-approved and Owner-approved bio-degradable detergent to remove all “chalking”, dirt, grease, bird droppings, and material that could inhibit bond of new paint materials. Contractor to confirm power-washing procedure does not damage existing construction prior to proceeding with full-scale operation. After power-washing, all surfaces shall be thoroughly rinsed to remove all remaining detergent residue and contaminants.

1. Do not use high-pressured power washers that may cause damage. Confirm that 2,000 psi washing will not damage surfaces, and adjust accordingly as necessary.
2. Power washing shall not be used near elevator towers as it may damage operation of the elevator. Solvent cleaning and power tool cleaning/abrading shall be utilized

in lieu of power washing in these areas. Protect elevator towers from dust/debris and water entering into shaft.

J. **Steel Substrates:** Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer. All existing painted surfaces shall be cleaned and prepared according to SSPC-SP3 “Hand / Power Tool Cleaning” to provide a mechanically abraded / profiled surface to promote a mechanical bond.

1. Corroded and/or exposed steel shall be prepared by the following, prior to spot priming:
   a. SSPC-SP11 “Power Tool Cleaning to Bare Metal”.
2. Proper containment, collection, and disposal of preparation debris shall be the responsibility of the Contractor.

K. **All Painting Work Items**: After mechanically preparing all areas, **all** surfaces shall be thoroughly rinsed to remove all remaining laitance to provide suitable final substrate for painting. Comply with manufacturer’s written requirements.

L. Boundaries between different layers of existing coatings and between existing coatings and bare steel shall be feathered together prior to application of primer paint materials.

M. Provide barriers and containment as required by applicable regulations to contain all airborne debris.

N. **Paint Manufacturer’s Technical representative:** A technical representative of the paint manufacturer to be used for this project shall be present on site during representative and critical preparation tasks, and shall view and approve representative results of surface preparation work prior to paint application operations.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated. Application by roller, brush, or spray shall be pre-approved by manufacturer and Engineer.
2. Paint surfaces behind movable items same as similar exposed surfaces.

B. If undercoats or other conditions show through topcoats, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.5 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner may engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of paint materials with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.6 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 EXTERIOR PAINTING SCHEDULE

A. Minimum dry-film thicknesses (DFT) shall be verified with manufacturer's recommendations for each system.

B. Submit color samples to Owner for final approval of paint color and finish.

C. **W.I. 45.2 "PAINT - STANDPIPES" (PS#4 & PS#5 ALTERNATE, PS#8 BASE BID)**

1. Alkyd System MPI EXT 5.1D:

a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.

1) Benjamin Moore; Super Spec HP – Alkyd Metal Primer.

2) Sherwin-Williams; Protective & Marine - Kem Kromik Universal Primer.
3) Equivalent products by other manufacturers and approved by Architect/Engineer.

b. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) Benjamin Moore; Corotech - Alkyd Gloss Enamel.
2) Sherwin-Williams; Protective & Marine - Seaguard 1000 Marine.
3) Equivalent products by other manufacturers and approved by Architect/Engineer.

D. **W.I. 45.3 "PAINT – STAIR TOWER INTERIORS" (PS#5 & PS#8 ALTERNATE)**

1. Steel Substrates (except for new galvanized steel): One polyurethane top coat (3 mils DFT minimum), over one epoxy mastic intermediate coat (5 mils DFT minimum), over prepared existing sound paint or one coat of epoxy mastic spot primer (5 mils DFT minimum) where prepared bare metal or marginal existing paint occurs.

a. Tnemec:

1) Top Coat: EnduraShield 74 Polyurethane or UVX Series 750.
2) Intermediate Coat (over prepared existing sound paint or one coat of primer): 135 Chembuild.
3) Primer (over prepared bare metal): 135 Chembuild.
4) Sealer Primer: As recommended by Tnemec.

b. Carboline:

1) Topcoat: Carbothane 133 LH.
2) Intermediate Coat (over prepared existing sound paint or one coat of primer): Carbomastic 615.
3) Primer: Carbomastic 615.
4) Sealer Primer: Rustbond.

c. Sherwin-Williams:

1) Topcoat: Hi-Solids Polyurethane.
2) Intermediate Coat (over prepared existing sound paint or one coat of primer): Macropoxy 646.
3) Primer (over prepared bare metal): Macropoxy 646.
4) Sealer Primer: Macropoxy 920 pre-prime.

d. PPG:

1) Topcoat: Durethane 95-3300 Rust Inhibitive DTM Urethane Gloss
2) Intermediate Coat: As recommended by PPG
3) Primer: Amerlock 2 Surface Tolerant Epoxy
4) Sealer Primer: As recommended by PPG

e. Engineer-approved equivalent.

2. Galvanized steel substrates:

a. PPG

1) Finish: Durethane 95-3300 Rust Inhibitive DTM Urethane gloss (3 mils DFT minimum)
2) Primer: Amerlock 2 Surface Tolerant Epoxy (5 mils DFT minimum)
3) Engineer-approved equivalent.

3. Existing Painted CMU Masonry Surfaces: Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. Kelly-Moore Paint Company (Kelly-Moore).
c. PPG Industries, Inc. (Pittsburgh Paints).
d. Sherwin-Williams Co. (Sherwin-Williams).
e. United Coatings.
f. BASF Building Systems (BASF).
g. Carboline.
h. Tnemec.

1) BLOCK FILLERS

a) Interior/Exterior Latex Block Filler: MPI #4.
b) VOC Content: E Range of E3.

2) LATEX PAINTS

a) Latex (Semi-gloss): MPI #11 (Gloss Level 5).
b) VOC Content: E Range of E3.

3) ALKYD PAINTS

a) Exterior Alkyd Enamel (Semi-gloss): MPI #94 (Gloss Level 5).
b) VOC Content: E Range of E2.

E. **W.I. 45.4 "PAINT – ROOF LEVEL PANELS" (PS#8 ALTERNATE)**

1. Silicone Resin Exterior Paint: prepare surfaces and apply paint to minimum DFT as recommended by manufacturer.

a. Klaas:

1) Topcoat: Si-Rex03.
2) Midcoat: Same as topcoat.
3) Primer: Si-Prime.

b. Engineer-approved equivalent.

F. **W.I. 45.5 "PAINT – CONCRETE WALLS AND BEAMS" (PS#4)**

1. Paint shall be exterior-grade, low-gloss, two-part acrylic polyurethane, by Carboline, Tnemec, PPG, or Sherwin Williams. Color to be chosen by Owner. Install primer as needed/recommended by manufacturer. Apply minimum two topcoats.

G. **W.I. 45.6 "PAINT – STEEL CONNECTIONS" (PS#4 & PS#5 ALTERNATE)**

1. Carboline:

   a. Base Coat: Carboline 615.
   b. Topcoat (2 coats): Carbothane 133 LH.

2. PPG:

   a. Base Coat: Pittguard 97-145.
   b. Topcoat (2 coats): Pitthane 95-812.

3. Tnemec:

   a. Base Coat: Series 135 Chembuild.
   b. Series 73 EnduraShield.

4. Engineer-approved equivalent.

H. **W.I. 45.7 "CLEAN/PAINT SHEAR TRANSFER ANGLES" (PS#5)**

1. Same as W.I. 45.6.

END OF SECTION 09 91 13

SECTION 09 91 21 - PAVEMENT MARKING - RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of high build paint systems to replace existing for the items of types, patterns, sizes, and colors described in this article.

B. Provide the following systems as applicable to match the existing pavement markings throughout the structures:

1. Parking Stall Stripes.
2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.
3. International Symbol of Accessibility.

C. Provide painting of curbs and curb ramps as described in the following paragraphs:

1. Paint vertical surface and the first 6 in. of the abutting horizontal surface at the top of all curbs and islands (including PARCS equipment islands) within parking facility to match existing, unless otherwise noted on the Drawings.
2. Paint color for curbs and curb ramps shall be yellow.

D. Proportion International Symbol of Accessibility in accordance with ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.

E. Related Work:

1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Provide product data as follows:

1. Manufacturer’s certification that the material complies with standards referenced within this Section.
2. Intended paint use.

3. Pigment type and content.
4. Vehicle type and content.

C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

1.4 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

A. Provide written 1-year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement marking materials shall meet Federal, State and Local environmental standards.

B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.

C. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59.

D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 PAVEMENT MARKING PAINTS:

A. 100% acrylic waterborne - paint shall be used for white and yellow pavement markings and shall meet requirements of MPI #70.

1. Available Products: Subject to compliance with the requirements, products that may be incorporated into the Work include, but are not limited to the following:

    a. Hi-Build Latex “Liquid Thermoplastic” Traffic & Zone Marking Paint, 5430/5431, by RAE Products & Chemicals Corporation
    b. Setfast Acrylic Waterborne Marking Paint, TM 226/227 by Sherwin Williams Company

2. 100% acrylic waterborne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.

B. All products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.

2.3 COLOR OF PAINT

A. Color of paint shall match existing, unless directed otherwise by Owner/Engineer:

1. White: Match federal color chip 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
2. Yellow: Match federal color chip No. 33538. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
3. Blue: Match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Document the location of existing striping and traffic marking, and colors utilized prior to removal of traffic lines and markings for surface preparation.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

E. Striping shall not be placed until full cure of concrete repairs, sealers or coatings. Sealers (other than silane) generally require 14 days @ 70 deg F or higher. Silane sealers require 24 hrs. @ 70 deg F or higher. Bituminous surfaces generally require 30 days @ 45 deg F or higher. Coatings shall be fully cured.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Do not paint or finish any surface that is wet or damp.

C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, release agents, curing compounds, efflorescence, chalk, and incompatible paints and encapsulants.

D. Concrete Substrates: Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Lay out all striping on each tier, using existing layout, dimensions and details unless otherwise noted on Contract Drawings.

F. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.

G. Where existing painted pavement markings and/or stripes conflict with new striping layout or must be removed due to installation which does not conform to contract requirements, remove existing paint markings, using care to avoid scarring substrate surface.

1. Concrete and asphalt surfaces: Material shall be removed by methods acceptable to Owner/Engineer and cause as little damage as possible to surface texture of pavement. Methods that may provide acceptable results are grinding and air or shot blasting. Use of chemicals to remove pavement markings prohibited. Collect residue generated by removal of pavement markings and dispose of as required by all applicable laws and regulations. If grinding is used, lightly grind floor surface using wheel mounted floor grinder or similar equipment with positive elevation control of grinder head. For all removal techniques: On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.

2. Traffic Topping/Membrane surfaces: Remove existing pavement markings by solvent washing or high-pressure water washing. Submit letter from traffic topping/membrane manufacturer certifying that solvents and/or water pressures are acceptable for this use and will not damage material. On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
3. Contractor shall not use paint, bituminous bond coat or other methods of covering markings to obliterate existing pavement markings.
4. Material deposited on pavement as a result of removal shall be removed as work progresses. Accumulation of material, that might interfere with drainage or might constitute a hazard to traffic, prohibited.
5. Curing compounds on new concrete surfaces (less than 1 yr old) shall be removed per existing pavement marking removal requirements prior to installation of new pavement markings.

H. Work Areas:

1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

I. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

J. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

A. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40 deg F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.

1. Total wet mil thickness of 0.015 in (minimum).
2. Total dry film thickness of 0.008 in (minimum).

B. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

C. All lines shall be 4-inches wide unless otherwise noted.

END OF SECTION 09 91 21