

SECTION 020010 - WORK ITEMS

PART 1 - GENERAL

RELATED DOCUMENTS

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

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

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:
 - WI 1.1 – Project Mobilization
 - WI 1.5 – Temporary Signage & Barriers

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 #2, #3, and #5.
- B. Materials
 - 1. None

C. Execution

1. At execution of agreement by all parties, payment of not more than 25% of Mobilization lump sum amount.
2. When amount earned is greater than 10% but less than 25% of original Contract amount, an additional amount will be paid to bring total payment for Mobilization to 50% of Mobilization lump sum amount.
3. When amount earned is equal to or greater than 25% but less than 50% of original Contract amount, an additional amount will be paid to bring total payment for Mobilization to 75% of Mobilization lump sum amount.
4. When amount earned is equal to or greater than 50% of original Contract amount, an additional amount will be paid to bring total payment for Mobilization to 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. Overhead protection required at Parking Structures #3 and #5 shall be incidental to this Work.
3. Sidewalk/lane closures and/or re-routing of pedestrian or vehicle traffic, if needed, shall be performed only during off-hours (nights/weekends) when parking structures are normally closed. Contractor shall obtain all required permits and comply with all City of Detroit requirements. Submit plan to Owner for approval prior to implementing sidewalk and/or lane closures.
4. This Work Item applies to Parking Structures #2, #3, and #5.

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.
- 3. Overhead Protection:
 - a. Contractor shall provide, erect, maintain, and remove following completion of project, overhead protection for vehicles and pedestrians, necessary to protect and control the project site for the duration of the project.

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.
- 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.
- 6. Overhead Protection shall be sufficient to ensure public safety while performing work on exterior facades. Nearby roads, sidewalks, entry/exits, etc. shall remain open during work and shall be protected at all times. Overhead protection shall be capable of handling all construction loads and provide protection from falling materials. Under no circumstances shall exterior façade work be performed without overhead protection in place to safeguard public.
- 7. Dust control measures shall ensure that all construction-generated dust & debris maintains confined within the work 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.
- 8. Submit plan to Engineer for review prior to start of work.

WI 3.0 CONCRETE FLOOR REPAIR

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities, and install patching material to restore floor slab to original condition and appearance. Refer to Detail Series 3.0 for specific requirements.
2. This Work applies to Parking Structure #2.

B. Materials

1. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and/or Section "Cast-in-Place Repair Mortar".
2. Steel reinforcement shall be as specified in Section "Cast-in-Place Concrete".

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".
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 3.1 FLOOR REPAIR - PARTIAL DEPTH

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

- B. The majority of this Work occurs in the Epoxy/Sand (W.I. 16.9) repair areas, shown shaded on levels 2-5. Intent is to repair all concrete floor deterioration in these areas prior to performing W.I. 16.9. Locate in field with Engineer.
- C. Payment for this Work Item shall be per square foot of repair performed.
- D. This Work Item applies to Parking Structure #2.

WI 3.2 FLOOR REPAIR – SLAB-ON-GRADE

- A. Refer to Work Item "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1 for similar requirements.
- B. Payment for this Work Item shall be per square foot of repair performed.
- C. This Work Item applies to Parking Structure #2.

WI 3.3 FLOOR REPAIR - FULL DEPTH

- 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 3.3 for specific requirements.
 - 2. Installation of supplemental reinforcement required on Detail 3.3 shall be incidental to this Work and NOT payable under other Work Items.
 - 3. This Work Item applies to Parking Structure #2.
- B. Materials
 - 1. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and/or Section "Cast-in-Place Repair Mortar".
 - 2. Steel reinforcement shall be as specified in Section "Cast-in-Place Concrete".
 - 3. Epoxy adhesive shall be Hilti HIT RE-500.
- 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.
 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".
 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 3.9 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 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. All reinforcement required on Repair Details and identified as incidental to other Work Items is NOT applicable for payment under this Work Item.
3. This Work Item applies to Parking Structure #2.

B. Materials

1. Conventional, epoxy-coated steel reinforcement shall be as specified in Section "Cast-in-Place Concrete".

C. Execution

1. Engineer shall inspect 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 damaged and defective reinforcement as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas".

3. Supplemental reinforcement shall be of equal to or greater diameter than the original diameter of the reinforcement being replaced. Verify in field with Engineer.

WI 3.10 REINFORCING EPOXY 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 minimum embedment depth as stated in Article "Execution" below.
2. Unit price for this work shall include providing, installing, and epoxy-anchoring 4-ft. long #4 bars as stated above. Doweled supplemental reinforcement shall be paid for under this work item only, and not double-billed for under W.I. 3.9 also.
3. All reinforcement dowels required on Repair Details and identified as incidental to other Work Items is NOT applicable for payment under this Work Item.
4. This Work Item applies to Parking Structure #2.

B. Materials

1. Epoxy-coated steel reinforcement shall be as specified in Section "Cast-in-Place Concrete".
2. Epoxy reinforcement adhesive shall be Hilti HIT RE-500.

C. Execution

1. Engineer shall inspect 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 damaged and defective reinforcement as specified in Section "Surface Preparation for Patching", Article "Reinforcement and Embedded Materials in Repair Areas" as directed by Engineer.
3. 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".
4. Verify the need for supplemental dowels with Engineer prior to concrete placement.

WI 4.9 REMOVE LOOSE CONCRETE – EXTERIOR COLUMNS

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.

2. Payment for this Work Item shall be lump sum to remove all sections of loose overhead concrete on exterior concrete columns and coat resulting cavities around the entire perimeter of the structure, on all levels.
3. Contractor shall verify overhead removal heights and general scope of removal requirements prior to submitting bid. This Work requires working around existing metal façade (incidental, do not damage).
4. This Work Item applies only to Parking Structure #3.

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.
2. Manlift or other means of access necessary to perform this Work shall be incidental. Any damage to existing items shall be repaired by Contractor at no cost to Owner.

C. Materials

1. Sika Armatex 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 exterior concrete columns throughout structure. Engineer will perform punchlist review at end of Project to verify loose concrete removals have been performed sufficiently.
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 entire removal area with specified epoxy-coating material (incidental).

WI 5.0 CONCRETE BEAM 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, install supplemental reinforcement, and install patching materials to restore concrete beams to original condition and appearance. Refer to Detail Series 5.0 for specific requirements.

2. Installation of supplemental reinforcement required on Detail Series 5.0 shall be incidental to this Work and NOT payable under Work Items 3.9 or 3.10.
3. This Work applies to Parking Structure #2.

B. Materials

1. Repair materials shall be as specified in Sections "Cast-in-Place Concrete", "Cast-in-Place 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".
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".
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 "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 (2 levels below) both stems of affected double tee prior to start of concrete removals (incidental).

- C. This Work Item applies to Parking Structure #2. 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 "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 #2. Payment for this Work Item shall be per square foot of repair performed.

WI 5.3 BEAM REPAIR - PARTIAL DEPTH (UNDERSIDE)

- A. Refer to Work Item "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 #2. Payment for this Work Item shall be per square foot of repair performed.

WI 5.4 BEAM REPAIR – SUPPLEMENTAL SUPPORT

- A. Refer to Work Item "Concrete Beam Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 5.4 for specific requirements.
- B. Install 25-kip minimum capacity shoring beneath both stems of affected double tee prior to start of concrete removals. Provide spreader pads on slab-on-grade consisting of two layers of 4"x4" timbers for shores to bear on (incidental). Verify requirements in field with Engineer.
- C. 6"x6"x1/2" angle and 1/2" stiffeners shall be ASTM A36, hot-dipped galvanized after fabrication/welding of stiffeners (1 stiffener may be field-welded to allow for installation, touchup with cold-galvanizing product).
- D. All connection hardware shall be stainless steel.
- E. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be lump sum to perform work as described and detailed.

WI 6.1 COLUMN REPAIR – PARTIAL DEPTH

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities, and install patching 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 Structure #2. Payment for this Work Item shall be per square foot of repair performed.

B. Materials

1. Repair materials shall be as specified in Sections "Cast-in-Place Concrete", "Cast-in-Place 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".
2. Review repair area with Engineer prior to start of removals to determine if temporary shoring is required (W.I. 18.1).
3. Procedure for delaminated 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 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 as specified in Section "Cast-in-Place Concrete".
6. Contractor shall prepare cavities for patch placement as specified in 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 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 necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities, and place patching materials to restore concrete walls to original condition and appearance. Refer to Detail Series 7.0 for specific requirements.

B. Materials

1. Repair materials shall be as specified in Sections "Cast-in-Place Concrete", "Cast-in-Place Repair Mortar", 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".
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".
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.
7. 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 "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 Structure #2. Payment for this Work Item shall be per square foot of repair performed.

WI 7.2 WALL REPAIR – BUMPER WALL CONNECTION

- A. Refer to Work Item "Concrete Wall Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 7.2 for specific requirements.
- B. Contractor shall clean and epoxy coat all exposed reinforcement prior to placing repair materials (incidental).
- C. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be 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 #2.
- B. Materials/Equipment
 - 1. Repair materials shall be as specified in Sections "Cast-in-Place Concrete", "Cast-in-Place 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". 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".
 - 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 "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 #2. Payment for this Work Item shall be per lineal foot of repair performed.

WI 8.3 TEE STEM REPAIR - 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. Refer to Detail Series 8.3 for specific requirements.
 2. This Work Item applies to Parking Structure #2. 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" and/or "Cast-in-Place Repair Mortar".
 2. Steel reinforcing shall be as specified in Section "Cast-in-Place Concrete".
 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: adjustable-type, rated for 6,000 lbs at required extension.
- 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. Both stems of double tee being repaired shall be shored as required on Detail Series 8.3 and in accordance with Section "Cast-in-Place Concrete".
 - 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 prestressing 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 prestressing strand and other reinforcement.
8. Install mild steel reinforcing in accordance with Section "Cast-in-Place Concrete" 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 11.1 ROUTE/SEAL 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 in concrete floor and/or topping. Refer to Detail 11.1 for specific requirements.
2. This Work occurs mainly at Epoxy/Sand (W.I. 16.9) repair areas. Intent is to seal all floor cracks prior to performing epoxy/sand repairs. Locate in field with Engineer.
3. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per lineal foot of repair performed.

B. Materials

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

C. Execution

1. Contractor shall thoroughly clean and inspect concrete slabs and/or topping for cracks. Those identified as either greater than 0.03 in. wide or showing evidence of water and/or salt staining on ceiling below shall be sealed. All cracks identified for repair shall be marked with chalk to aid in precision routing. Obtain depths to embedded reinforcement in area of repair by use of a pachometer. 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 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. Hand-held 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 associated reference specifications are listed in Article "Materials" above. Sealant installation procedures shall be in accordance with referenced specifications for selected material.
5. Traffic topping manufacturer shall specify joint sealant type compatible with traffic topping, as applicable.

WI 11.2 REPAIR CRACK/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 11.2 for specific requirements.
2. This Work occurs mainly at Epoxy/Sand (W.I. 16.9) repair areas. Intent is to replace all tee-to-tee joint sealant in epoxy/sand repair areas.
3. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per lineal foot of repair performed.

B. Materials

1. Approved materials for use in this Work are specified in 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 as required by 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. Install sealants in accordance with sealant manufacturer's instructions and Section "Concrete Joint Sealants".
6. Traffic topping manufacturer shall specify joint sealant type compatible with traffic topping, as applicable.

WI 11.3 REPLACE ISOLATION JOINT SEALANT

- A. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing sealant system, and provide and install backer rod and sealant at transition joints from slab-on-grade to supported at locations shown on Drawings. Refer to Work Item 11.2 for similar scope of work, materials, and procedures. Refer to Detail 11.3 for remaining requirements.
- B. Payment for this Work shall be per lineal foot of sealant replaced.
- C. This Work Item applies to Parking Structure #2.

WI 11.7 COVE SEALANT

- A. Scope of Work
 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing cove sealant, 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 occurs mainly at Epoxy/Sand (W.I. 16.9) repair areas. Intent is to replace all existing cove sealant in epoxy/sand repair areas.
 3. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per lineal foot of repair performed.
- B. Materials
 1. Joint sealant materials shall be as specified in Section "Concrete Joint Sealants".
- C. Execution
 1. Wall-floor 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.
7. Apply coating on horizontal and vertical surfaces where shown on Drawings in even layers in strict accordance with manufacturer's recommendations. Sealant material and associated reference specifications are listed in Article "Materials" above.

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

B. Materials

1. TrafficGuard EP35 with DynaGrip Aggregate #8, by BASF.
2. PolyCarb Mark 171 with Washington Stone, Dow Chemical Company.
3. Neogard Epoxy/sand system with #16 aluminum oxide.
4. For any selected product:
 - a. Sand shall be 12-20 size minimum (or equivalent) unless noted otherwise. Submit various sized samples for Owner/Engineer approval.
 - b. Provide non-sag additive as required to prevent epoxy/sand from sagging. Seed stone until rejection.
 - c. For the topcoat, provide 5-10 mil epoxy lock coat to lock in top sand layer.

C. Execution

1. Contractor shall locate scaled surface repair areas and verify with Engineer prior to start of Work. See Drawings R-201, R-202, and R-203.
2. All loose/delaminated existing concrete shall be removed by scarifying to ½" amplitude.
3. 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 10-ft.x10-ft. trial section of epoxy/sand system for Owner/Engineer approval, utilizing scarification, sand-blasting, water-blasting, and other surface preparation as required. Do not proceed with further topping application until trial sections accepted in writing by Owner. Remove and replace rejected trial sections until approval is obtained (incidental).
5. Install the epoxy/sand overlay per manufacturer's recommendations to minimum depth shown on Detail.
6. Manufacturer's technical representative shall be onsite during surface preparation and epoxy/sand installation.
7. Provide 5-year warranty for labor and material for any material and adhesion/bonding failures.

WI 16.9A SCALED SURFACE REPAIR (EPOXY/SAND) (ALTERNATE)

- A. Refer to W.I. 16.9 for scope of work, materials, and procedure associated with this Work. Refer to Detail 16.9 for specific requirements.
- B. This Alternate Work Item, if accepted, occurs at shaded areas on plans indicated as Alternate. Payment for this Work Item shall be per square foot of repair performed.
- C. This Work applies to Parking Structure #2.

WI 18.1 TEMPORARY SHORING

- A. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide, install, and maintain 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 approve of 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 Structure #2.

WI 25.1 MECHANICAL / ELECTRICAL – ALLOWANCE

A. Scope of Work

1. Mechanical and 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 Structure #2.

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.

WI 25.2 MECHANICAL – FLOOR DRAIN REPLACEMENT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove concrete, remove existing floor drain, install supplemental reinforcement, install replacement floor drain, place concrete, and install sealant as required on Drawings. Work Item 25.3 "Mechanical - Pipe and Hangers" is directly related to this Work Item. Refer to Detail 25.2 for specific requirements.]
2. This Work Item applies to Parking Structure #2.

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. Contractor shall locate and mark all areas where existing floor drains are to be replaced.
2. Contractor shall verify low points on slab by ponding or elevation survey prior to locating drains.
3. Openings in floor slabs shall be performed by conventional chipping hammers in a manner to not damage existing reinforcement or embedded items; coring shall be prohibited. Do not cut or damage any existing embedded items.
4. Concrete preparation shall be as shown on Detail 25.2.
5. Drains shall be installed as shown on Detail 25.2.

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 connect replacement floor drains per W.I. 25.2 to existing floor drain system and replace existing deteriorated sections of piping by installing pipe and hangers. Work Item "Floor Drain Replacement" is directly related to this Work Item. Refer to Detail 25.3 for specific requirements.
2. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per lineal foot of repair performed.

B. Materials

1. Approved materials for this Work are as shown on Detail 25.3.

C. Execution

1. Contractor shall locate and mark all areas where floor drain piping is to be installed or replaced.
2. Removal of existing sections as needed shall be incidental.
3. Pipes and hangers shall be installed as shown on Detail 25.3 and per all applicable codes and ordinances.

WI 40.1 SUPPLEMENTAL CONNECTIONS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals including manlift/swingstage as necessary to access repair area, fabricate materials as required, and install repair materials. Refer to Detail 40.1 for specific requirements.
2. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per each connection installed as detailed, at locations shown on plans.

B. Materials

1. Materials shall be as specified on Detail 40.1.

C. Execution

1. Contractor shall locate and mark all Work areas as shown on Drawings. Contractor shall coordinate review of repair areas with Engineer.
2. Drilling for thru-connections shall be performed with caution to not damage embedded reinforcement and to minimize concrete spalling. All spalls shall be patched with approved repair material prior to proceeding with repair.
3. See Detail 40.1 for remaining requirements.

WI 40.2 ADDITIONAL SHIMS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide and install shims at existing shear transfer connections. Refer to Detail 40.2 for specific requirements.
2. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per each additional shim installed. Locate with Engineer in field.

B. Materials

1. Materials shall be as specified on Detail 40.2.

C. Execution

1. Contractor shall locate and mark all Work areas as shown on Drawings. Contractor shall coordinate review of repair areas with Engineer.
2. Required thickness of shims varies, Contractor to verify in field prior to submitting Bid.
3. Install shims of varying thickness for tight fit between ceiling and existing connection.
4. Install fasteners as shown on Detail to prevent future movement of shims.

WI 41.5 LANDING REPAIR – ELEVATOR LOBBY

- A. Refer to Work Item "Concrete Floor Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 3.1 for similar requirements.
- B. This Work occurs in the southwest and east elevator towers. Contractor shall only close 1 elevator at any one time to perform repairs. Coordinate with Owner.
- C. This Work Item applies to Parking Structure #2. Payment for this Work Item shall be per square foot of repair performed.

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 to perform traffic marking installation as described below.
3. This Work Item applies to Parking Structure #2.
4. 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.
5. This Work includes all traffic markings in all areas of the structure where markings are affected by the project including, but not limited to:
 - a. Epoxy/sand (W.I. 16.9) repair areas.
 - b. Floor repair areas.
 - c. Areas where dust/debris have accumulated.
 - d. Contractor staging/storage/parking areas.
 - e. Traffic markings affected by debris removal, cleanup procedures, equipment/material storage, construction traffic, deliveries, etc.
6. 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.
7. New traffic markings shall be installed in all work areas prior to re-opening for normal use.
8. Remove existing stripes in those locations where they conflict with new striping layout.
9. Any traffic markings required due to Alternate Work, if accepted, shall be incidental and included in the unit price of the Alternate Work Items (including at all Alternate Epoxy/sand areas per W.I. 16.9A). No extras allowed.

B. Materials

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

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".
5. Engineer shall inspect all layout and surface preparation for conditions in accordance with Section "Pavement Marking."
6. All procedures shall be in accordance with Section "Pavement Marking".

WI 45.3A PAINT – SOUTHEAST ELEVATOR TOWER EXTERIOR (BASE BID)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, clean/prepare, and paint exterior masonry walls as indicated on Drawings.
2. Payment for this Work shall be lump sum to clean, prepare, and paint all exterior masonry surfaces on all 4 sides of southeast elevator tower, all levels.
3. This Work Item applies to Parking Structure #5.

B. Materials

1. Refer to Section "Exterior Painting".

C. Execution

1. Contractor shall locate and layout Work areas as indicated on Drawings.
2. Contractor shall clean existing painted masonry surfaces using minimum of detergent and brush-scrubbing, and pressure-washing.
3. Contractor shall prepare surface to be painted in accordance with Section "Exterior Painting" and manufacturer's recommendations.
4. Protect adjacent non-painted surfaces from being painted. Mask off adjacent features not receiving paint.
5. Contractor shall apply paint in accordance with referenced specification section listed in Article "Materials" above, and manufacturer's recommendations.

WI 45.3B PAINT – NORTHEAST STAIR TOWER EXTERIOR (ALTERNATE)

- A. Refer to Work Item 45.3A for similar scope of work, materials, and procedure.
- B. Payment for this Alternate Work Item, if accepted, shall be lump sum to clean, prepare, and paint all exterior masonry surfaces on all 4 sides of northeast stair tower, all levels.
- C. This Work Item applies to Parking Structure #5.

WI 45.3C PAINT – SOUTHWEST STAIR TOWER EXTERIOR (ALTERNATE)

- A. Refer to Work Item 45.3A for similar scope of work, materials, and procedure.
- B. Payment for this Alternate Work Item, if accepted, shall be lump sum to clean, prepare, and paint all exterior masonry surfaces on all 4 sides of southwest stair tower, all levels.
- C. This Work Item applies to Parking Structure #5.

WI 45.3D PAINT - METAL DOORS AND FRAMES (ALL 3 STAIR/ELEVATOR TOWERS) (ALTERNATE)

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, clean, prepare, and paint all metal doors and frames on all 3 stair/elevator towers.
 - 2. Payment for this Alternate Work Item, if accepted, shall be lump sum to clean, prepare, and paint all metal doors and frames on all 3 stair/elevator towers, all levels.
 - 3. This Work Item applies to Parking Structure #5.
- B. Materials
 - 1. Refer to Section "Exterior Painting".
- C. Execution
 - 1. Contractor shall locate and layout Work areas. Verify in field with Engineer.
 - 2. Contractor shall clean existing painted metal surfaces per requirements of SSPC-SP3.
 - 3. Contractor shall prepare surface to be painted in accordance with Section "Exterior Painting" and manufacturer's recommendations.
 - 4. Contractor shall air blast and remove all debris from Work area prior to application of primer or paint.

5. Contractor shall apply primer to all cleaned and prepared metal surfaces on same day (within 8 hrs) as cleaning/preparation operations. Apply primer according to Section "Exterior Painting" and in strict accordance with manufacturer's recommendations.
6. Protect adjacent non-painted surfaces from being painted. Mask off adjacent features not receiving paint.
7. Contractor shall apply paint in accordance with referenced specification section listed in Article "Materials" above, and manufacturer's recommendations.

WI 50.1 ROOF LEVEL FLASHING (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, layout, and install flashing on roof level to provide water-tight condition. Refer to Drawing R-204 for locations and specific requirements.
2. This Work Item applies to Parking Structure #2. Payment for this Alternate Work Item, if accepted, shall be lump sum to perform work as described in this Section and required on Drawing R-204.

B. Materials

1. Flashing material shall be EPDM, 60-mil.
2. Termination Bar and fasteners shall be stainless steel.
3. Lumber and plywood shall be pressure-treated/exterior-rated.
4. Sealant shall be as specified in Section "Concrete Joint Sealants".
5. S.S. anchors for lumber shall be Hilti Kwik-Con II, 1/4" diameter, spaced at 12" on center maximum, with 1" minimum embedment into sound concrete.

C. Execution

1. Contractor shall locate and layout Work areas as indicated on Drawings. Verify in field with Engineer prior to start of Work.
2. Install trial section of flashing at location determined by Engineer for Owner/Engineer approval. Do not proceed with work until approval of trial section is obtained.
3. The top and sides of all column/beam joints on levels 5 and 6 along column lines "B" and "C" shall be sealed per Detail 50.1.5 (incidental to this Work).
4. See Drawing R-204 for further requirements.

WI 60.1 PATCH & COAT EXTERIOR CONCRETE BEAM (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to prepare existing exterior concrete beam surfaces,

install corrosion inhibitor, install vertical repair material, and install coating at location shown on Drawings.

2. Payment for this Work shall be lump sum to patch and coat exterior concrete beam at location shown on R-205. All existing cavities and areas of delaminated concrete shall be repaired on exterior surface of beam. All exposed embedded reinforcement shall be coated with corrosion inhibitor. After patch material has cured, exterior coating shall be applied on complete exterior vertical surface of beam, on top horizontal surface of beam, and wrapped down 2" onto interior vertical surface of beam.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Corrosion inhibitor:
 - a. Sika Armatec, or Engineer-approved equivalent.
2. Vertical repair material:
 - a. Sika MonoTop 623, or Engineer-approved equivalent.
3. Exterior Coating:
 - a. SikaGard 550W system (including primer as recommended by manufacturer).
4. Surface Preparation: Sand-blasting shall be performed at repair areas prior to patching. Contractor shall sand-blast entire exterior concrete beam surface to be coated.

C. Execution

1. Surface preparation shall be performed by coating system applicator or under its direct supervision.
2. Contractor shall locate and layout Work areas as indicated on Drawings.
3. Coat all exposed embedded reinforcement with corrosion inhibitor after sand-blasting, prior to patching.
4. Contractor shall clean concrete surfaces.
5. Contractor shall prepare surface to be coated in accordance with manufacturer's recommendations.
6. Protect adjacent surfaces during repairs. Mask off adjacent features not receiving coating. Contractor caused damage to adjacent elements shall be cleaned and/or repaired to satisfaction of the Owner and at no additional cost to Owner.
7. Submit color samples for Owner selection from manufacturer's full range.
8. Install mock up installation area, and receive Owner approval of application results, color, texture and finished appearance prior to proceeding with additional application.
9. Contractor shall apply primer and/or coating in accordance with manufacturer's recommendations.

10. Repair materials shall be thoroughly cured prior to installation of coating. Verify with repair material and coating manufacturers.
11. Coating system shall be thoroughly cured prior to Work areas being returned to service.

WI 70.1 REPLACE MARBLE FAÇADE SEALANT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate existing joints, remove existing joint sealant material and filler/backing materials, prepare substrate, including removal of any debris/material within the full depth of the joint, and install new backer rod and flexible joint sealant material. Refer to Detail 70.1 for specific requirements.
2. Payment for this Work Item shall be lump sum to replace and seal all marble joint sealant on the entire exterior façade of the parking structure, all levels (including stair tower exteriors). The width of the joints varies throughout the exterior façade; Contractor is responsible to verify requirements in field prior to submitting Bid.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Backer rods and sealant shall be as specified in Section "Concrete Joint Sealants".

C. Execution

1. Contractor shall locate and mark all joints requiring placement as required on Drawings.
2. Repair sequence:
 - a. Remove existing joint sealants only at general locations where test inspections per W.I. 70.2 are to be performed for Engineer to review and determine exact locations for W.I. 70.2.
 - b. Do not proceed with further joint sealant removal/replacement until W.I. 70.2 is completed and Engineer has performed review of test inspections.
 - c. Contractor may proceed with remaining joint sealant work only with Engineer's direction.
3. Contractor shall remove existing joint sealant and filler/backing material. Care shall be taken not to damage adjacent masonry or architectural features.
4. Removal of existing sealant system shall be performed in manner to not damage existing connections. Repairs necessary due to connections damaged by Contractor shall be performed as directed by Engineer at no additional cost to Owner.

5. Removal of existing sealant system shall be performed to maintain existing shims in joints. Contractor shall be responsible to replace existing shims as necessary prior to installing new backer rod and sealant (incidental).
6. Any debris/material within the full depth of the joints shall be removed.
7. Joint shall be thoroughly cleaned by grinding to remove all mortar, residual joint filler material, joint sealant material, and unsound mortar. Joint shall be air blasted to remove remaining debris.
8. Damage to surrounding marble shall be repaired by Contractor at no cost to Owner.
9. Contractor shall install new backer rod and joint sealant in accordance with Details and manufacturer's recommendations.
10. Adjoining marble surfaces on both sides of joint shall be protected/masked prior to sealing joint. Remove protection/masking material upon completion of sealing joint.
11. Sealed joints shall be neat in appearance. Poorly sealed or improperly sealed joints shall be removed and replaced at Contractor's expense.

WI 70.2 TEST INSPECTIONS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, remove, and reset marble panels at locations determined by Engineer. Refer to W.I. 70.7 for similar marble removal/resetting requirements.
2. Payment for this Work Item shall be per each location. Contractor is required to remove existing marble panel, store/protect until Engineer has performed review of inspection area, and reset and re-anchor marble panel. Unit price for this Work shall include removal of (1) marble panel, and (8) new anchors at each Test Inspection location, not billable under W.I. 70.3. Refer to W.I. 70.3 for anchor requirements.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Anchors shall be as specified in W.I. 70.3.

C. Execution

1. Contractor shall remove existing joint sealants at general locations shown on Drawings for this Work to determine location of existing angles/bearing support. Engineer shall observe and determine exact marble panel to be removed per this Work.
2. Care shall be taken not to damage adjacent masonry or architectural features during removal of panels.
3. Upon Engineer's review of inspection area, re-install marble panel per similar requirements of W.I. 70.7.

4. Install new anchors per requirements of W.I. 70.3, incidental to this Work. (4) anchors required on marble panel being reset (1 near each corner). Include (4) additional anchors in unit price to be installed in adjacent panels as needed and directed by Engineer.

WI 70.3 SUPPLEMENTAL ANCHORS – MARBLE PANELS

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install supplemental repair anchors at marble façade panels at locations as determined by Engineer. Refer to Detail series 70.3 for specific requirements.
2. This Work occurs as needed throughout the entire exterior façade at locations where existing marble panel connections are damaged/missing. Upon removal of existing sealants per W.I. 70.1, Contractor shall allow Engineer to observe condition of existing panels and connections to locate required supplemental anchors prior to continuing with sealant replacement work.
3. This Work may occur at either conditions of solid concrete or hollow CMU backup material. See Article “Materials” below and Details 70.3 and 70.3.1 for anchor requirements.
4. Payment for this Work Item shall be per each anchor installed at locations directed by Engineer. Anchors indicated as incidental to other Work Items are NOT eligible for payment under this Work Item.
5. This Work Item applies to Parking Structure #3.

B. Materials

1. Anchors at hollow CMU backup: As specified on Detail 70.3.
2. Anchors at solid concrete backup: As specified on Detail 70.3.1.

C. Execution

1. Contractor shall locate and mark all work areas as shown on Drawings.
2. Upon removal of existing sealants per W.I. 70.1, Contractor shall provide access for Engineer (incidental) to review condition of existing connections to locate required supplemental anchors for this Work.
3. Contractor shall install anchors at locations directed by Engineer.
4. Prepare and install per manufacturer requirements, and as noted in Contract Documents.
5. Thoroughly clean drilled holes of all dust and debris prior to adhesive/chemical anchor installation. Prepare inside surfaces of hole per adhesive/chemical anchor manufacturer’s recommendations.

6. Contractor shall drill through marble panels with care to prevent damage and minimize spalling. Contractor shall repair any damage at no additional cost to Owner. Do not over-tighten.
7. Contractor shall take care not to damage masonry/façade elements adjacent to areas of anchor installation. All masonry/façade element damage resulting from anchor installation shall be replaced at no cost to Owner by the contractor to Owner's satisfaction.

WI 70.4 PATCH MARBLE PANEL

A. Scope of Work

1. This work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate and repair localized area of damaged marble panel. This Work occurs on the east elevation of the southeast stair tower at ground level.
2. Payment for this Work Item shall be lump sum to patch damaged/missing corner of marble panel at location indicated on Drawings. Contractor shall be responsible to verify requirements in field prior to submitting Bid.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Repair Material: Cathedral Stone Products, Inc.; Jahn M120 Marble Repair Mortar, or Engineer-approved equivalent.
2. Fasteners or and dowels shall be type 304 stainless steel threaded rod, or approved equivalent pinning material.
3. Submit samples of material, and demonstrate repair techniques for mock up approval prior to attempting repairs.

C. Execution

1. Contractor shall locate and mark repair area for Engineer's review prior to proceeding with repair.
2. Clean area to receive patch thoroughly. Do not damage surrounding area.
3. Install pins or anchoring materials to connect patch material to existing marble panel and backing material.
4. Install approved patch material to completely fill stone defect, and form repair surface to match original design surface.

WI 70.5 TUCKPOINT – CAPSTONE BED JOINTS

- A. Refer to Work Item 71.1 "Tuckpointing" for similar scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 70.5 for specific requirements.

- B. Payment for this Work Item shall be lump sum to tuckpoint entire capstone bed joint around perimeter of roof level at locations indicated on Drawings.
- C. This Work Item applies to Parking Structure #3.

WI 70.6 REPLACE CAPSTONE JOINT SEALANT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate existing capstone joints, remove existing joint sealant material and backer rod, prepare substrate and install flexible joint sealant material (including backer rod). Refer to Detail 70.6 for specific requirements.
2. Payment for this Work Item shall be lump sum to replace all existing capstone joint sealants along the perimeter of the roof level as indicated on Drawings.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Backer rod and sealant shall be as specified in Section "Concrete Joint Sealants".

C. Execution

1. Contractor shall locate and mark all joints requiring replacement as detailed on Drawings.
2. Contractor shall remove existing joint sealant and backer rod. Care shall be taken not to damage adjacent masonry or architectural features.
3. Joint shall be thoroughly cleaned by grinding to remove all mortar, residual joint filler material, joint sealant material, and unsound capstone material for depth of new joint sealant. Joint shall be airblasted to remove remaining debris.
4. Unnecessary damage to surrounding wall assembly shall be repaired by Contractor at no cost to Owner.
5. Contractor shall install new joint sealant in accordance with Details and Section "Concrete Joint Sealants".
6. Adjoining marble surfaces on both sides of joint shall be covered with tape prior to sealing joint. Remove tape upon completion of sealing control joint.
7. Sealed joints shall be neat in appearance. Poorly sealed or improperly sealed control joints shall be removed and replaced at Contractor's expense.

WI 70.7 REMOVE/RESET LOOSE PANEL

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing marble units from the building façade, and reinstall and reanchor the stones to their original building location in a square and plumb "like original" condition. See Detail 70.7 for existing condition and further requirements.
2. Payment for this Work Item shall be per each marble panel removed/reset at locations shown on Drawings. This Work includes removing existing steel panel anchors, cleaning/preparing void space, and installing new anchors for stones removed and reset on the building, as well as replacing stone anchors for adjacent stone units remaining on the building that are damaged during stone removal operations (include total of 6 new anchors at each location in unit price for this Work, not billable under W.I. 70.3). Contractor is responsible for maintaining stability of panels remaining in place on the building while existing anchors are removed and replaced with stainless steel anchors.
3. Contractor shall install mortar/grout as necessary on backside of marble panels to maintain existing void space and reset panels flush with adjacent panels (incidental).
4. This Work Item applies to Parking Structure #3.

B. Materials/Equipment

1. Anchors shall be same as specified for W.I. 70.3.
2. Sealant shall be as specified in Section 079233.

C. Execution

1. Contractor shall locate and verify with Engineer all panels for removal.
2. All stones and building elements shall be adequately secured and stabilized during construction operations.
3. Contractor shall provide pedestrian and vehicular protection in areas where stones are being actively hoisted overhead.
4. Stone removal and resetting shall be completed in conjunction with other building restoration work.
5. Contractor shall remove existing premold sealant, and install silicone sealant between marble panel and concrete bumper wall upon completion of resetting marble panel.

WI 70.8 REPLACE MARBLE STONES (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide properly cut, fabricated and prepared replacement stone unit for installation to the building façade. This work item is for providing stone, removal of existing stone (as applicable), installing replacement stone, all new stone anchors and associated work.
2. Payment for this Alternate Work Item, if accepted, shall be per each replacement stone installed. Provide and install replacement stone units at locations indicated on Drawings and/or directed by Owner/Engineer. Contractor shall be required to verify location, sizes, and general requirements in field prior to submitting Bid. Include installation of (8) anchors per requirements of W.I. 70.3 in unit price for this Work, not billable under W.I. 70.3.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Stone: Provide natural marble stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with similar physical properties. Size and shape shall match existing stone being replaced.
 - a. Provide sample for Owner selection that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes. Provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

C. Execution

1. Contractor shall locate and verify with Engineer all existing stone units for replacement. See Drawings for locations of replacement stones.
2. Submit stone sample to Owner for approval prior to ordering materials.
3. Removal of existing stone, preparing of building façade location to accept stone, and installation of new stone, including all new stone anchors shall be incidental to this Work. Refer to requirements of W.I. 70.3 for new anchors.

WI 70.9 REPLACE CAPSTONES (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide properly cut, fabricated and prepared replacement capstone unit for installation to the building façade. This work item is for providing capstone, removal of existing capstone, installing replacement capstone, all new capstone anchors, installing sealant at capstone joints and associated work.

2. Payment for this Alternate Work Item, if accepted, shall be per each replacement capstone installed. Provide and install replacement capstone units at locations directed by Owner. Contractor shall be required to verify location, sizes, and general requirements in field prior to submitting Bid. Include installation of (2) pin anchors at each replacement capstone in unit price for this Work.
3. This Work Item applies to Parking Structure #3.

B. Materials

1. Stone: Provide natural marble capstone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with similar physical properties. Size and shape shall match existing stone being replaced.
 - a. Provide sample for Owner selection that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes. Provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

C. Execution

1. Contractor shall locate and verify with Owner all existing capstone units for replacement.
2. Submit sample to Owner for approval prior to ordering materials.
3. Removal of existing capstone, preparing of substrate at location to accept capstone, installation of setting mortar and installation of new stone, including pin anchors shall be incidental to this Work.

WI 70.10 REPLACE SHELF ANGLE ANCHORS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to install new anchor to replace or supplement existing shelf angle attachment points. This work item applies when existing angle attachment point is determined to be defective. Removal/resetting of marble panel to provide access shall be performed under W.I. 70.2.
2. Payment for this Alternate Work Item, if accepted, shall be per each new shelf angle anchor installed. Removal of existing anchors, if needed, shall be incidental.
3. This Work applies to Parking Structure #3.

B. Materials

1. Anchor types shall be same as those specified under W.I. 70.3, for either solid concrete or hollow CMU backup based on field conditions.
2. Anchor diameters per this Work Item shall be increased to 3/4".

C. Execution

1. Drill hole for new anchor at suitable location for new/supplemental anchor installation as directed by Engineer. Drilling through existing angle as needed shall be incidental. Do not locate new anchor at corners/ends or adjacent to discontinuities that will undermine the capacity or attachment capability of the new anchor.
2. Touch up existing shelf angle paint/coating at location of new hole to match surrounding conditions with approved paint/coating.

WI 71.1 TUCKPOINTING

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to tuckpoint defective, cracked, broken or eroded joints in existing masonry work. Refer to detail 71.1 for specific requirements.
2. Payment for this Work Item shall be per lineal foot of tuckpointing performed. This Work occurs on the stair/elevator tower exteriors prior to painting, all levels. Means of access to perform this Work shall be incidental, no extras allowed. Located work areas in field with Engineer.
3. This Work Item applies to Parking Structure #5.

B. Materials

1. Mortar: ASTM C 270, Proportion Specification.
2. Masonry Cement: Do not use masonry cement.
3. Do not use calcium chloride in mortar.
4. Portland Cement: ASTM C 150, Type I or II.
5. Aggregate for Mortar: ASTM C 144, except for joints less than 0.25-in., use aggregate graded with 100% passing the No. 16 sieve.
6. Water: Potable.
7. Mortar shall match existing color. Install mockup for Owner approval prior to continuing with Work.

C. Execution

1. Contractor shall locate and mark all Work areas. Engineer shall verify locations prior to start of Work.
2. All defective joints which are cracked, broken, or eroded to depth of 0.5 in. or more shall be tuckpointed.
3. Joints to be tuckpointed shall be cut back to depth of 3/4 inch, or to full depth of deterioration. Use mechanically operated blades only to perform cutting. Joint at back of cut shall have square shoulder. Remove all mortar from upper and lower surfaces and sides of mortar joint being prepared.
4. Contractor shall flush all mortar joints thoroughly with clean water under pressure prior to tuckpointing to remove all dust, dirt, and laitance. Masonry

shall be damp and free of excess water before tuckpointing commences. Take all necessary precautions to prevent water from entering cavity space during cleaning operations.

5. Tuckpointing shall be performed using Type N mortar. Match existing mortar color. Mortar shall be dry and mixed thoroughly prior to adding sand. Add one-half required mixing water and allow to stand $\frac{1}{2}$ - 1 hour depending on field conditions, then add balance of mixing water.
6. Press mortar into prepared joint using pointing tool 0.125 in. smaller than width of joint until joint is packed full. Finish point joint with pointing tool at least 0.125 in. wider than prepared joint.
7. Prior to initial set of mortar, tool joints to match existing.
8. Allow 3 to 7 days for mortar to harden prior to cleaning of brick wall.
9. Dispose of all accumulated material and leave premises in clean condition.
10. Masonry surfaces that become dirty or smeared during joint cutting and repointing of joint surfaces shall be cleaned with bristle brushes and plain water.
11. Unnecessary damage to surrounding masonry shall be repaired by Contractor at no cost to Owner.

WI 71.2 REMOVE & REPLACE MASONRY UNITS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary for local masonry unit removal and replacement due to fractures, cracks, broken or unsound brick. Refer to Detail 71.2 for specific requirements.
2. This Work occurs as needed on the stair/elevator towers prior to painting. Locate in field with Engineer. Means of access to perform this Work shall be incidental.
3. Payment for this Work shall be per square foot of Work performed.
4. This Work Item applies to Parking Structure #5.

B. Materials

1. Concrete Masonry Units: ASTM C 90; Weight Classification, Normal Weight; Type I, moisture-controlled units. Size of units to match existing (incidental).
2. Mortar shall be as specified in W.I. 71.1.

C. Execution

1. Contractor shall locate and mark all masonry units to be replaced. Engineer shall verify replacement locations prior to start of Work.
2. Contractor shall remove all existing fractured, cracked, spalled, broken or structurally unsound masonry and all masonry damaged during removal and toothing work.

3. Internal structural steel exposed during removal process shall be sandblasted to bare metal and coated with approved corrosion inhibitor.
4. Entire cavity of removal area shall be thoroughly cleaned of all mortar from top, bottom, and both sides of all brick that abut new brick work. Do not allow mortar droppings to accumulate in cavity space, in weep holes, or on flashing. Engineer 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 masonry replacement. Take all necessary precautions to prevent water from entering cavity space during cleaning operations. Allow excess water to run off. New masonry shall be laid in full bed of mortar while wall is still damp. All masonry repair work shall be flush with existing.
6. Prior to initial set of mortar, tool joints to match existing.
7. Adequate weather protection shall be installed over all areas left open at completion of each day's work.
8. Allow 3 to 7 days for mortar to harden prior to cleaning of brick wall.
9. Dispose of all accumulated material and leave premises in clean condition.
10. Masonry surfaces that become dirty or smeared during joint cutting and repointing of joint surfaces shall be cleaned with bristle brushes and plain water.
11. Unnecessary damage to surrounding masonry shall be repaired by Contractor at no cost to Owner.

WI 71.4 ROUTE/SEAL FACADE 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 in masonry façade. Refer to Detail 71.4 for specific requirements.
2. Payment for this Work Item shall be lump sum to route and seal cracks in stair/elevator exterior masonry facades prior to painting. For Bidding purposes, include 200 L.F. of this work in lump sum price.
3. This Work occurs on stair/elevator tower exterior masonry facades, all levels. Means of access to perform this Work shall be incidental.
4. This Work Item applies to Parking Structure #5.

B. Materials

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

C. Execution

1. Contractor shall thoroughly clean and inspect façade assembly elements for cracks. Those identified as either greater than 0.03 in. wide or showing evidence of water infiltration shall be sealed. All cracks and joints identified for

- repair shall be marked with chalk to aid in precision routing. Obtain depths to any embedded reinforcing in area of repair by use of a pachometer. 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 shall be ground or saw cut 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.
 3. Cavities shall be thoroughly cleaned by either sandblasting or grinding to remove all laitance, unsound façade material and any compounds which may interfere with adhesion. Groove shall be air blasted to remove remaining debris.
 4. Sealant installation procedures shall be in accordance with referenced specifications for selected material and sealant manufacturer's instructions.

WI 81.1 VEHICLE ENTRY/EXIT EQUIPMENT REPLACEMENT (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing equipment, remove concrete curbs/islands/sidewalk/slab-on-grade full-depth, prepare and compact soil, provide and layout conduit and pull wiring, install reinforcement, place concrete slab-on-grade and curbs/islands, and paint curb/island edges according to layout shown on Detail 81.1.
2. Payment for this Alternate Work Item, if accepted, shall be lump sum to perform all concrete work, and provide and install all conduits and power at west vehicle entry/exit as shown on Drawings and described in this Section.
3. This Work Item applies to Parking Structure #2.

B. Materials

1. New sidewalks shall be 6" thick, fiber-reinforced (increased to 8" thick where crossing driveways, with rebar installed per note below).
2. At driveways, and where sidewalk crosses driveway, slab thickness shall be 8", reinforced with (1) layer of #4's at 18" O.C. both ways.
3. Provide and install #4 dowels at 18" O.C. into existing concrete along entire repair area perimeter. All reinforcement shall be incidental to this Work.
4. New concrete curbs/island shall match height of existing (reinforced with fibers same as sidewalks). Paint vertical edge and 6" of horizontal surface along all curbs/island.
5. Conduit shall be Schedule 80 PVC, installed per layout shown on Drawings.

C. Execution

1. Verify removal requirements and boundaries in field with Engineer prior to start of Work.

2. Dimensions shown on Drawings are approximate. Verify in field prior to start of Work.
3. All conduit shall be provided to enter devices from underground. All conduits shall enter the booth from underground.
4. See Detail 81.1 for specific requirements.

END OF SECTION 020010

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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 deg of perpendicular of finished surface.
- C. **SPALLS:** Potholes, cavities, or voids in floor slabs, beams, columns, and walls. 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. Concrete scaling is caused by freeze-thaw action. If concrete is frozen in saturated state, excess water freezing in concrete causes high internal stresses.
- F. **SHOTBLASTING:** Scarification of concrete surfaces using an abraded metal shot-rebound. See Corps of Engineer's Manual EM 1110-2-2002 and the National Cooperative Highway Research Program's Report #99 for a more detailed definition.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 025130

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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, preparation of cavities created by removal to receive patching material, and preparation of existing surface spalls and potholes to receive patching material.

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. "Guide for Repair of Concrete Bridge Superstructures" (ACI 546.1), American Concrete Institute.

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 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 in repair area and mark these locations for reference during concrete removal. Do **NOT** nick or cut any embeds.

3.2 PREPARATION

- A. **Temporary shoring may be required at concrete floor repair areas exceeding 5 sq ft and at any beam, joist, or column repair. Contractor: Review all marked removal and preparation areas and request clarification by Engineer 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, chipping hammers less than 15 lb shall be used to minimize damage to sound concrete. 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 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 directs.
- E. Sawcut to depth of 0.75 in. into floor slab, unless otherwise noted. 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 delamination 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-approved methods at no additional cost to Owner.

3.3 INSPECTION OF REPAIR PREPARATION

- A. After removals are complete, but prior to final cleaning, cavity and exposed reinforcement shall be inspected by Contractor and verified by Engineer for compliance with requirements of this Section. Where Engineer finds unsatisfactory cavity preparation, Engineer shall direct Contractor to perform additional removals. Engineer 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 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.

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, electrical conduit, corrosion protection systems and snow/ice melting equipment **shall be protected by Contractor** during 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 Section "Cast-in-Place Concrete". 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 patch 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 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.
- 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 patch placement to insure that base metal is not exposed to elements and further rusting for extended periods of time. Engineer may require entire bar diameter be cleaned.
- B. After all sand-blasting operations and cleanup are completed, paint all exposed steel with an approved epoxy. Protect prepared surfaces from damage prior to and during patch placement.

3.6 PREPARATION OF CAVITY FOR PATCH PLACEMENT

- A. Cavities will be examined prior to commencement of patching operations. Sounding surface shall be part of examination. Any delamination noted during sounding shall be removed as specified in this Section.
- B. Cavities shall be sandblasted. Air-blasting is required as final step to remove sand. All debris shall be removed from site prior to commencement of patching.

END OF SECTION 025140

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SECTION 033000 – CAST-IN-PLACE CONCRETE

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 specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture proportions, placement procedures, finishes, and other miscellaneous items related to cast-in-place concrete.
- B. Cast-in-place concrete includes project requirements specified herein and on the drawings:
 - 1. Water/cementitious materials ratio: See General Notes on Drawings.
 - 2. Entrained air: See General Notes on Drawings.
 - 3. Water Reducing Admixtures: See Part 2 Article "Admixtures".

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.
- B. Self-Consolidating Concrete (SCC): Highly-flowable, non-segregating concrete that can spread into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation.

1.4 SUBMITTALS

- A. 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 will in turn reimburse Engineer.

B. Requests For Information

1. Engineer reserves the right to reject, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, 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.

C. Submit Product data for concrete component materials and other concrete related items including, but not limited to:

1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
 - a. Cementitious materials and aggregates.
 - b. Admixtures.
 - c. Form materials and form-release agents.
 - d. Steel reinforcement and accessories.
 - e. Epoxy coating.
 - f. Fiber reinforcement.
 - g. Curing materials.
 - h. Floor and slab treatments.
 - i. Bonding agents.
 - j. Repair materials.
2. Submit certification that curing compound or evaporation reducer, if used, is compatible with products specified in Division 07 Sections.

D. Submit materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

E. Submit evidence of licensure in Michigan for professional engineer providing professional services as required for Contractor in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures.

1. Contractor's responsibilities include formwork, shoring and re-shoring procedures, and other work described in Article "Contractors Professional Design Services", Article "Formwork", and Article "Shores and Re-shores".
2. Performance and design criteria are shown on the Drawings and in Article "Contractor's Professional Services - Performance and Design Criteria".
3. Contractor's Professional Engineer shall furnish Owner a Certificate of Professional Liability Insurance in minimum amount of \$1,000,000 per claim.
4. Submit signed and sealed drawings, calculations, specifications, or other submittals to indicate compliance with the applicable performance and design criteria provided.

- F. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
 2. Proportion mixtures as defined in ACI 301 Section 4 header "Proportioning". Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
 3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading "Concrete Mixtures" header "Shrinkage" for drying shrinkage limit.
 4. Use mixture proportions submission form at end of this Section for each concrete mixture, which identifies the following:
 - a. Mixture Proportions Identification and use.
 - b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 – *Field test data* or *Trial mixtures*).
 - c. Gradation of fine and coarse aggregates.
 - d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
 - e. Water/cementitious materials ratio.
 - f. Slump, ASTM C143.
 - g. Certification of the chloride content of admixtures.
 - h. Air Content:
 - 1) Of freshly mixed concrete by pressure method, ASTM C231, or volumetric method, ASTM C173.
 - 2) Of hardened concrete by microscopical determination (as applicable), including parameters of air-void system, ASTM C457.
 - i. Freeze-thaw resistance, ASTM C457 and C666. If super-plasticized concrete cannot meet hardened air content requirements of Part 2, ASTM C666 laboratory test result of specimens with concrete mixture proportions similar to proposed mixture for project shall be submitted for review by Engineer. Report air void parameters (spacing and specific surface area in accordance with ASTM C457) (at point of placement) of specimens tested. Test specimens shall contain specified air system (within plus or minus 1.5 percent) and high-range water-reducer (superplasticizer) used in concrete for project. Report relative durability factor of concrete for specimens tested in accordance with Procedure A of ASTM C666. Acceptable concrete durability factor greater than 90 percent (> 90%) at 300 test cycles. Relative durability factor of concrete containing superplasticizer greater than or equal to 80 percent (\geq 80%) compared with reference.
 - j. Density (Unit weight) of concrete, ASTM C138.
 - k. Strength at 4, 7, and 28 days, ASTM C39.
 - l. Water soluble chloride ion content of concrete: ASTM C 1218.
 - m. Mill test report of silica fume: Provide report for each 400 cu. yd. or fraction thereof, of concrete placed on project. Provide to Owner from independent

- testing lab showing chemical analysis in percent by weight of silica fume solids supplied and used.
- n. Silica fume concrete admixture: Comply with ASTM C1240 and following additional requirements:
 - 1) Silicon dioxide content: 90 percent (minimum).
 - 2) Loss on ignition (LOI): 6 percent (maximum).
 - 3) Surface area (nitrogen absorption): 15,000 m²/kg.
 - 4) Crystallinity: Non-crystalline within limits of detection less than or equal to 0.5 percent [$\leq 0.5\%$] depending upon x-ray machine used] by x-ray diffraction.
 - 5) Oversize foreign materials (in fume): 5% maximum on 45 micron sieve (wet).
 - o. Certificate of analysis of coal fly ash or processed ultra fine fly ash: Comply with ASTM C618, Class F only. Class C Fly Ash Prohibited.
- G. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:
- 1. See Article "Quality Assurance."
 - 2. Density (unit weight) of concrete, ASTM C 138.
 - 3. Slump, ASTM C 143.
 - 4. Air content of freshly mixed concrete by pressure method, ASTM C 231 or volumetric method, ASTM C 173.
 - 5. Air content and parameters of air-void system by microscopical determination, ASTM C 457 (as applicable).
 - 6. Concrete temperature at placement time: ASTM C 1064.
 - 7. Air temperature at placement time.
 - 8. Strength determined in accordance with ASTM C 39.
 - 9. Calcium Nitrite presence in plastic concrete: See Part 3 heading, "Quality Control."
- H. Submit current certification of welders.
- I. Submit shop drawings for steel reinforcement:
- 1. Prepare placing drawings that detail fabrication, bending, and placement of concrete reinforcement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Comply with ACI SP-66, "ACI Detailing Manual." Include special reinforcement required for openings through concrete structures, elevations of all walls and columns with locations of all splices and couplers.
- J. Submit samples of materials as requested by Engineer, including names, sources, and descriptions.
- K. Submit laboratory test reports for concrete materials and mixtures.
- L. Submit Minutes of concrete pre-installation conference.

1.5 CONTRACTOR'S PROFESSIONAL SERVICES - PERFORMANCE AND DESIGN CRITERIA

- A. Provide professional services for temporary conditions during construction and portions of the Work required to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Specific requirements and criteria include, but are not limited to the following:
 - 1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 and ACI 347 to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. The contractor is responsible for layout and design, reviews, approvals, and inspections.
 - 2. Design formwork, shoring, bracing, and other conditions for structural requirements and stability during construction and until final structure is completed and accepted.
 - a. Comply with ACI 347.2 for design, installation, and removal of shoring and reshoring.
 - b. Superimposed loads to the concrete structure, slab-on-grade, and soil shall be less than the design loads as shown on Drawings.
 - c. Check early-age strength of concrete members against anticipated construction loads. Reduce the load on concrete members at the critical concrete age or change the concrete mixture for accelerated strength gain to avoid distress of concrete members.
 - d. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads such that no floor or member would be excessively loaded or would induce tensile stresses in concrete members.
 - e. Plan sequence of removal of shores and reshores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excess stress or deflection.

1.6 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 Qualification:** An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.
- C. **Codes and Standards:** Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301, "Specifications for Structural Concrete."

2. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 3. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Michigan and who is experienced in providing professional engineering services of the kind indicated. See Article "Contractor's Professional Services Performance and Design Criteria".
- E. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- F. In advance of scheduled start of concrete construction, contractor shall conduct meeting to review proposed mixture proportions and methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 20 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but not limited to, the following:
1. Contractor's superintendent.
 2. Agency (laboratory) responsible for concrete mixture proportions.
 3. Agency (laboratory) responsible for field quality control.
 4. Ready-mixed concrete producer.
 5. Concrete subcontractor.
 6. Primary admixture manufacturers.
 7. Engineer or Owner's representative.
 8. At the pre-concrete meeting the contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.
- G. Welders and welding procedures shall conform to requirements of AWS D1.4. Welding of reinforcing steel is prohibited.
- H. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.
- I. Epoxy coated reinforcement, ASTM A775 and A884:
1. Coating applicator shall have quality control program to assure that coated reinforcement comply with requirements of Specifications.
 2. Submit proof of current certification for rebar coating plant from Concrete Reinforcing Steel Institute.
- J. 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.

2. Testing laboratory shall submit documented proof of ability to perform required tests.
 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4, according to ACI CP-1 or an equivalent certification program.
- K. 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 General Contractor's authorized on-site representative and to Owner's authorized on-site representative.
- L. Proportioning, production and finishing of silica fume and processed ultra fine fly ash concrete shall be reviewed by and have approval of silica fume and processed ultra fine fly ash manufacturers.
- M. 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 data (quantity and type):
 - a. Cement.
 - b. Fine aggregates.
 - c. Coarse aggregates.
 - d. Water.
 - e. Air entraining admixtures.
 - f. High-range water-reducing admixture.
 - g. Other admixtures, including supplementary cementitious materials.
 12. Weather data:
 - a. Air temperatures.
 - b. Weather.
 - c. Wind speed.
 13. Field test data:
 - a. Date, time and place of test.
 - b. Slump.
 - c. Concrete Temperature.

- d. Air content.
 - e. Density (Unit weight).
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).
- N. Provide certification that curing compound conforms to requirements of ASTM C 1315.
- O. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-construction Conference and obtain Engineer's written acceptance.
- P. Silica fume supplier shall make available qualified individual, experienced in placement of silica fume concrete, to aid Contractor. Qualification of supplier's representative shall be acceptable to Owner Representative, shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.
- Q. Coal fly ash and processed ultra fine fly ash supplier shall make available qualified individual, experienced in placement of fly ash concrete, to aid Contractor. Qualification of supplier's representative shall be acceptable to Owner. Representative shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.
- R. At all times during high-evaporation conditions, maintain adequate supply of evaporation reducer at site. Do not use evaporation reducer as finishing aid. See Part 3.
- S. Testing Agency: Identify those trucks of concrete supplier's which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.7 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
- 1. AASHTO, "Standard Specifications for Highway Bridges."
 - 2. AASHTO T 318, "Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying."

B. 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."
12. ACI 362.1, "Guide for the Design of Durable Parking Structures."
13. ACI SP15, "Field Reference Manual."

C. American Iron and Steel Institute (AISI):

1. AISI, "Specification for the Design of Cold-Formed Steel Structural Members."

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

1. ASTM A 36, "Standard Specification for Carbon Structural Steel."
2. ASTM A 185, "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement."
3. ASTM A 497, "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement."
4. ASTM A 615, "Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement."
5. ASTM A 706, "Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement."
6. ASTM A 775, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars."
7. ASTM A 884, "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement for Reinforcement."
8. ASTM A 934/A 934M, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars."
9. ASTM B 633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel."
10. ASTM C 31, "Standard Practice of Making and Curing Concrete Test Specimens in the Field."
11. ASTM C 33, "Standard Specification for Concrete Aggregates."
12. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens."
13. ASTM C 94, "Standard Specification for Ready-Mixed Concrete."
14. ASTM C 109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)."
15. ASTM C 138, "Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete."
16. ASTM C 143, "Standard Test Method for Slump of Hydraulic Cement Concrete."

17. ASTM C 150, "Standard Specification for Portland Cement."
18. ASTM C 157, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete."
19. ASTM C 171, "Standard Specification for Sheet Materials for Curing Concrete."
20. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete."
21. ASTM C 173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
22. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
23. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete."
24. ASTM C 309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete."
25. ASTM C 311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete."
26. ASTM C 330, "Standard Specification for Lightweight Aggregates for Structural Concrete."
27. ASTM C 457, "Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete."
28. ASTM C 494, "Standard Specifications for Chemical Admixtures for Concrete."
29. ASTM C 567, "Standard Test Method for Determining the Density of Structural Lightweight Concrete."
30. ASTM C 595, "Standard Specification for Blended Hydraulic Cements."
31. ASTM C 618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete."
32. ASTM C 666, "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing."
33. ASTM C 672, "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals."
34. ASTM C 989, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
35. ASTM C 1064/C 1064M "Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete."
36. ASTM C 1077, "Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation."
37. ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete."
38. ASTM C 1202, "Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration."
39. ASTM C 1218, "Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete."
40. ASTM C 1240, "Standard Specification for Silica Fume Used in Cementitious Mixtures."
41. ASTM C 1260, "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)."
42. ASTM C 1293, "Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction."
43. ASTM C 1315, "Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete."

44. ASTM C 1567, "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerate Mortar Bar Method)."
 45. ASTM C 1602/C 1602M, "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete."
 46. ASTM C 1610/C 1610M, "Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique."
 47. ASTM C 1611/C 1611M, "Standard Test Method for Slump Flow of Self-Consolidating Concrete."
 48. ASTM C 1621/C 1621M, "Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring."
 49. ASTM D 448, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction."
 50. ASTM D 3963/D 3963M, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars."
 51. ASTM E 96/E 96M, "Standard Test Methods for Water Vapor Transmission of Materials."
 52. ASTM E 1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs."
 53. ASTM E 1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs."
 54. ASTM F1637 02, "Standard Practice for Safe Walking Surfaces."
- E. American Welding Society (AWS):
1. AWS D1.1, "Structural Welding Code-Steel."
 2. AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- F. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI MSP, "Manual of Standard Practice."
- G. US Army Corps of Engineers (CE):
1. CE CRD-C 513 "Specifications for Rubber Waterstops."
 2. CE CRD-C 572 "Specifications for Polyvinyl Chloride Waterstops."
 3. CE CRD-C 662 "Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar Bar Method)."
- H. Prestressed Concrete Institute (PCI):
1. PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products."
 2. PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
 3. PCI MNL 120, "Design Handbook Precast Prestressed Concrete."
 4. PCI MNL 122, "Architectural Precast Design Handbook."
 5. PCI MNL 129, "Parking Structures-Recommended Practice for Design and Construction."

6. PCI MNL 135, "Tolerances for Precast and Prestressed Concrete Construction."
 7. PCI "Code of Standard Practice for Precast Concrete."
- I. Contractor shall have following ACI publications at Project construction site:
1. ACI SP-15, "Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with selected ACI References."
 2. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
 3. ACI 305R, "Hot Weather Concreting."
 4. ACI 306.1, "Cold Weather Concreting."
- J. Accessibility Requirements:
1. "Americans with Disabilities - Act 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, <http://www.access-board.gov/adaag/ADAAG.pdf>
- K. International Conference on Building Officials (ICBO):
1. ICBO, "Uniform Building Code."
 2. ICBO, "Uniform Building Code Standards."
- L. International Code Council (ICC):
1. IBC, "International Building Code 2006".
 2. IPMC, "International Property Maintenance Code."
 3. IFC, "International Fire Code."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.
- B. Deliver reinforcement to Project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.
- D. Avoid damaging coatings on epoxy coated reinforcement:
1. Contact areas of handling and hoisting systems shall be padded or be made of nylon or other acceptable material.
 2. Use spreader bars to lift bundles of coated bars to prevent bar-to-bar abrasion.
 3. Pad bundling bands or fabricate of nylon or other acceptable material.
 4. Store coated bars on padded or wooden cribbing.
 5. Do not drag coated bars.

6. After placement, restrict traffic on coated bars to prevent damage.
 7. Repair damaged epoxy coatings according to ASTM D 3963.
- E. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. **For concrete with silica fume or processed ultra fine fly ash, concrete shall be completely discharged within one hour after water has been added to cement or cement has been added to aggregates, in all weather conditions, hot or cold.** Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
- B. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, curing compound, stains or paints.
- C. Form Ties: Factory - fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.
1. Provide ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.
- D. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75 in. by 0.75 in. min. unless noted otherwise.

2.2 STEEL REINFORCEMENT

- A. Epoxy-Coated Fabricated Reinforcing Bars: ASTM A775, and as follows:
1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
 - 1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:
 - 1. In manner acceptable to Engineer solely, bar and welded wire reinforcement supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
 - 2. For slabs on ground, use all-plastic supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with ground so that they shall not allow clearance loss when reinforcement installed or concrete placed.
 - 3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
 - 4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
 - 5. For epoxy-coated reinforcement, use all-plastic bar supports.
 - 6. Acceptable manufacturers:
 - a. Aztec Concrete Accessories, Inc.
 - b. General Technologies, Inc.
 - c. Accepted equivalent.
 - 7. For welded wire reinforcement, provide continuous bar supports spaced at 2 feet o.c., maximum."
- B. Epoxy Coating Materials for Reinforcement: ASTM A 775 and A 884:
 - 1. Supplier shall be certified currently under CRSI Fusion Bonded Epoxy Coating Applicator Plant Certification Program.
 - 2. Provide one of following epoxy coatings for reinforcement and steel accessories as noted on Drawings:
 - a. "Scotchkote 413," 3M Company.
 - b. "Nap-Gard 7-2709," DuPont Powder Coatings, USA, Inc.
 - c. "Epoxiplate R346 or R349," Armstrong Products Company.

3. Use patching material recommended by epoxy powder manufacturer, compatible with epoxy coating and inert in concrete. Acceptable:
 - a. "Scotchkote 413 PC," 3M Company.
 - b. "Armatec 110," Sika Corporation.
 - c. "EMACO P22," BASF Construction Chemicals, LLC.
 - d. "Corr Bond, or Duralprep AC," The Euclid Chemical Company.
- 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. "Concressive Liquid LPL," BASF Construction Chemicals, LLC.
 - c. "Scotchkote 413 PC," 3M Company.
 - d. "Euco 452," The Euclid Chemical Company.
 - e. "Resi-Bond (J-58)," Dayton Superior Corporation.

2.4 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 (ACI 301, Section 4 header "Cementitious Materials"):
 1. Portland cement, Type I, ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
- C. Coal Fly Ash:
 1. ASTM C 618, Class F only. Class C Fly Ash Prohibited.
 2. Testing: ASTM C311.
 3. Percentage of fly ash in Mixture Proportion shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.
 4. Prohibited: Fly ash in same mix with Type IP blended cement.
 5. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
 6. Submit all fly ash concrete Mixture Proportions per ACI 301.
- D. Slag – (Ground Granulated Blast-Furnace Slag – GG-BFS):
 1. ASTM C 989, Grade 100 or higher.

2. Percentage of GGBF slag in Mixture Proportion shall be by weight, not by volume. Water-cement ratio shall be calculated as water-cementitious (total portland cement + GGBF slag) ratio.
 3. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
 4. Submit all GGBF slag concrete mixture proportions per ACI 301.
- E. Normal Weight Aggregates (ACI 301, Section 4 header "Aggregates"):
1. Normal weight concrete aggregates:
 - a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
 - 1) All other concrete: Class 5S.
 - b. No deleterious materials such as, but not limited to, chert or opaline.
 - c. Fine aggregate: Natural sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
 - d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.
 2. Combined 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 than No. 50.
 3. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:
 - a. Repairs less than 3 in. thick: Size number 67.
 - b. Repairs greater than 3 in. thick: Size number 57.
 4. Chloride Ion Level: ASTM C 1218. Chloride ion content of cement, aggregates and all other ingredients: tested by laboratory making trial mixes.
- F. Water: Comply with ASTM C 1602.
- G. Storage of Materials (ACI 301, Section 4 header "Materials Storage and Handling").

2.5 ADMIXTURES

- A. Use high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.
- B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F as required for schedule.

- C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45.
- D. Use air-entraining admixture in exterior exposed concrete as indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1.5 percent within limits shown on Drawings.
- E. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.
- F. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer's recommendations.
- G. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.
- H. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Catexol AE 260," Axim Concrete Technologies.
 - b. "Air-Mix," "Eucon Air-Series" or "AEA-92," Euclid Chemical Co.
 - c. "Daravair Series" or "Darex Series," W.R. Grace & Co.
 - d. "Micro-Air," or "MB-VR," or "MBAE-90," BASF Construction Chemicals.
 - e. "Sika AEA Series," or "Sika AIR Series" Sika Corporation.
 - f. "Polychem "VR" or "VRC" or "Polychem AE," General Resource Technology.
 - g. "RSA-10," Russ Tech Admixtures, Inc.
- I. 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. "Rheobuild 1000", "PS 1466" or "Glenium Series," BASF Construction Chemicals.
 - d. "Sikament Series" or "Sika ViscoCrete Series," Sika Corporation.
 - e. "Catexol 1000 SP-MN," Axim Concrete Technologies.
 - f. "Melchem Series," General Resource Technology.
 - g. "Superflo 443" or "Superflo 2000 Series," Russ Tech Admixtures, Inc.

- J. High Range water reducing retarding (superplasticizer), ASTM C 494 Type G:
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 537 or RD2," Euclid Chemical Co.
 - b. "Daracem 100," W.R. Grace & Co.
 - c. "Melchem," General Resource Technology.
- K. Corrosion Inhibiting Admixture 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. "Rheocrete CNI," BASF Construction Chemicals.
 - d. "Sika CNI," Sika Corporation.
 - e. "Catexol 1000 CN-Cl," 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.
- L. Silica Fume ASTM C 1240:
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon MSA," Euclid Chemical Co.
 - b. "Force 10,000 D" by W.R. Grace & Co.
 - c. "Rheomac SF 100," BASF Construction Chemicals.
 - d. "Sikacrete 950 DP," Sika Corporation.
 - e. "Polychem CI," General Resource Technology.
 - f. "EMS 970DA (Elkem Materials) Dry Compacted Silica Fume," General Resource Technology.
 - g. "Russ Tech CSF," Russ Tech Admixtures, Inc.

2.6 CURING MATERIALS

- A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Evaporation Retarder:
 - a. Cimfilm; Axim Concrete Technologies.
 - b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
 - c. Eucobar; Euclid Chemical Co.

- d. E-Con; L&M Construction Chemicals, Inc.
 - e. Confilm; BASF Construction Chemicals, LLC.
 - f. SikaFilm; Sika Corporation.
 - g. Sure-Film (J-74); Dayton Superior Corporation.
 - h. "EVRT", Russ Tech Admixtures, Inc.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Curing Compound: Prohibited for concrete with water/cementitious materials ratio less than 0.45.

2.7 RELATED MATERIALS

- A. Bonding Grout: Bonding grout shall consist of sand and cement in proportions similar to mortar in concrete with sufficient water to form stiff slurry to achieve consistency of "pancake batter". Apply with brush to surface of existing concrete in repair areas. Surface of existing concrete shall be SSD.

2.8 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. Supplementary cementitious materials: Maximum weight of fly ash, natural pozzolans, silica fume, processed ultra fine fly ash or slag included in concrete shall not exceed

percentages of total weight (see footnotes for ACI 301 Part 4 Table "Requirements for Concrete Exposed to Deicing Chemicals") of cementitious materials as follows:

1. Fly Ash or other pozzolans conforming to ASTM C 618: 25 percent.
2. Slag conforming to ASTM C 989: 50 percent.
3. Silica fume conforming to ASTM C 1240: 10 percent.
4. Processed ultra fine fly ash conforming to ASTM C 618: 15 percent.
5. Total of fly ash or other pozzolans, slag and silica fume: 50 percent. Within the total, Fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
6. Total of fly ash or other pozzolans and silica fume: 35 percent. Within the total, Fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Total of fly ash or other pozzolans and processed ultra fine fly ash: 35 percent. Within the total, Fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

F. 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.
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 in² 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. Refer to Part 1 Article "Submittals."

G. 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") Test 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 nitrate used to offset chloride ions is in addition to calcium nitrate used as a corrosion inhibitor. Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

H. Alkali-Aggregate Reactivity Resistance:

1. Total equivalent alkali content of mixture less than 5 lb/cu. yd.

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

1. Consider using high-range water-reducing admixture (Superplasticizers) as required for placement, workability, and finishing.
2. Consider using retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high range water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio of 0.45 or less.
4. Use corrosion-inhibiting admixture in concrete mixes as indicated.

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 superplasticized 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 superplasticized 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. 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.

L. 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.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Truck mixing prohibited. Mix at plant.
- 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.

2.11 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: Prohibited.
 - a. Joints shall be tooled in plastic concrete.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads and in accordance with Article 1.5 "Contractor's Professional Services – Performance and Design Criteria".
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, except as modified below:
 - 1. Columns, Walls, Beams, and Slabs:
 - a. Variation in cross-sectional dimensions of beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.

- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Kerf wood inserts for easy removal.
 - 3. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, stems, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. 28-day design compressive strength.

- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.3 SHORES AND RESHORES

- A. Comply with ACI 347.2, ACI 318 and ACI 301, for design, installation, and removal of shoring and reshoring and in accordance with Article 1.5 "Contractor's Professional Services – Performance and Design Criteria".
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain specified concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2 ft o.c., maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:
 - 1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
 - 2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
1. Rest epoxy coated steel member supported from formwork on coated wire bar supports, or on bar supports made of dielectric material or other suitable material.
 2. Coat wire bar supports with dielectric material for minimum distance of 2 in. from point of contact with coated steel member.
 3. Fasten epoxy-coated steel members with nylon-, epoxy-, or plastic-coated tie wire, or other suitable material acceptable to Engineer.
 4. Repair all damage to epoxy coating to bars, welded wire reinforcement and all other epoxy coated items. Use a mirror to view undersides of all items for possible damage so it can be repaired.
 5. Do not cut epoxy-coated steel unless permitted by Engineer. When cut, coat ends with material used for repair of coating damage.
- G. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

3.5 JOINTS

- A. Joints in Concrete (ACI 301, Section 5):
1. Construction, control and isolation joints are located and detailed on Drawings:
 - a. Tool joints at time of finishing. Tool: Part 2 Article "Tools."
 - b. Saw Cut Joints: Prohibited.
 - 1) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.
- B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Verify location of construction joints in field with Engineer prior to concrete placement.
- C. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.
- D. Joint sealant material is specified in Division 7 Sections.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer.
- C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- D. Check air content after any site addition of admixtures to increase slump.
- E. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- F. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use plastic or rubber-tipped vibrators when concrete reinforcement is epoxy-coated.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically (in thin slabs vibrator may be inserted at angle or horizontally to keep vibrator head completely immersed) inserted at uniformly spaced locations no farther than 1.5 times action radius so area visibly affected by vibrator overlaps adjacent previously vibrated area by 3-4 inches. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration (usually 5 to 15 seconds) of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- G. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge or motor driven vibrating screed and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- H. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.
- I. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Finishes: As-cast concrete texture imparted by form-facing material in accordance with ACI 301 and as specified below in accordance with Class of Finish:
 - 1. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Provide Class A finish as described in ACI 347. Class A permits gradual or abrupt irregularities of 1/8 inch.
- 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.

3.8 FINISHING FLOORS AND SLABS

- A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom 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.
 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.
- B. Flatwork in Stairtowers and Parking Garage floor 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 "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
 - b. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - 1) Changes in level of less than $\frac{1}{4}$ inch in height may be without edge treatment as shown in ADA Figure 303.2.
 - 2) Changes in Level between $\frac{1}{4}$ inch and $\frac{1}{2}$ inch in 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ 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.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Comply with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Reducer: Apply evaporation reducer to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing. Do not finish immediately after evaporation reducer applied. Wait until after (green, if Confilm used – pink, if Eucobar used) film disappears.
- C. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - 1. Tepid (within 20 deg F of concrete temperature) water.
 - 2. Continuous water-fog spray.
 - 3. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
- D. 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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- E. Curing Compound: Prohibited for concrete with water/cementitious materials ratio less than 0.45.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than $\frac{1}{2}$ inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact with specified patching material. Fill form-tie voids with specified patching material.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching material will match surrounding color. Patch a test area on mockup, or if none, at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact patching material in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
 - 4. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping to produce a smooth, uniform, plane, and level surface.
 - 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or patching material as approved by the Engineer. Remove defective areas with clean, square cuts and expose steel reinforcement with at least $\frac{3}{4}$ inch clearance all around. Dampen

concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
 7. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
- D. Perform structural repairs of concrete, subject to Engineer/Architect's approval, using materials as approved by the Engineer.
- E. Repair materials and installation not specified above may be used, subject to Engineer/Architect's approval.

3.12 FIELD QUALITY CONTROL

- A. Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sample concrete in accordance with ASTM C 172.
- C. Epoxy Coated Material:
1. Perform field inspection of installed epoxy coated material.
 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 each truck of ready-mixed concrete delivered to Project.
 2. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.

F. 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, C 173, or C 231 as applicable. Conduct one air content test for every truck of ready-mix, air entrained concrete delivered to Project. Conduct additional air content tests as needed due to non-conforming results.

G. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:
 - a. Take minimum of eight cylinders for each 100 cu yd or fraction thereof, of each Mixture of concrete placed in any one day.
 - b. Additional cylinders shall be taken under conditions of cold weather concreting per Part 3 Heading "Concrete Curing and Protection."
 - c. Additional cylinders may be taken to verify concrete strength prior to form removal. Contractor responsible to coordinate with Testing Agency prior to date of scheduled pour.
 - d. Testing Agency: Provide and maintain site cure box for cylinders.
2. 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.
3. Cure test cylinders per ASTM C 31 as follows:
 - a. To verify compressive strength prior to 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.
4. Compression test for non-prestressed concrete:
 - a. Test 2 cylinders at 4 days.

- b. Test 2 cylinders at 7 days.
 - c. Test 2 cylinders at 28 days.
 - d. Hold 2 cylinders in reserve for 56 days for use as Engineer directs. Unless directed otherwise, cylinders may be discarded after 56 days.
- H. Report all nonconforming test results to Engineer and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.
- I. 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.

3.13 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.
- B. Core tests, when required, in accordance with ASTM C42 and ACI 301.
- C. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.14 ACCEPTANCE OF STRUCTURE

- A. Acceptance of completed concrete Work will be according to provisions of ACI 301.
- B. Concrete rejected due to entrained air content below specified limit will be accepted if any of following conditions are met:
 - 1. ASTM C 457: Three concrete specimens tested in accordance with ASTM C 457 meet air void parameters of Part 2.
 - 2. ASTM C 457: Three concrete specimens tested shall meet air void parameters of concrete reported and approved by Engineer in Part 1.
 - 3. ASTM C 666, Test Procedure A: Test three concrete specimens removed from structure Concrete specimens tested shall have durability characteristics similar to that reported in Part 1.

END OF SECTION 033000

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CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

¹ example: Footings, interior flatwork, floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA:		
Proportioning Based on (Check only one): Standard Deviation Analysis: _____ (see section VIII) or Trial Mix Test Data: _____ (see Section IX)		
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

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	<u>Type</u>	<u>Product-Manufacturer (Source)</u>
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. <u>MIX PROPORTIONS</u> ⁽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.		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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. <u>ADMIXTURES</u>				
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		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

VIII. <u>STANDARD DEVIATION ANALYSIS:</u>		<u>Yes</u>	<u>N/A</u>
(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".)			
<u>Number of Tests Evaluated:</u> (One test is average of two cylinder breaks)		<u>Standard Deviation:</u> (Single Group)	
<u>Attach copy of test data considered:</u>		<u>Standard Deviation:</u> (Two Groups)	
Required average compressive strength: $f'_{cr} = f'_c + \underline{\hspace{2cm}}$ psi			
<p>NOTE:</p> <p>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:</p> <p>(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)</p> <p>(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.)</p>			
MIXTURE CHARACTERISTICS (As shown on drawings)			
Slump = <u> </u> in.		Air Content = <u> </u> %	
Unit Wet Wt. = <u> </u> pcf		Unit Dry Wt. = <u> </u> pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = <u> </u> in.		Final Slump <u> </u> in.	
Unit Wet Wt.= <u> </u> pcf.		Unit Dry Wt. = <u> </u> pcf.	
Air Content = <u> </u> %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

IX. <u>TRIAL MIXTURE TEST DATA:</u>		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".)			
<u>Age</u> (days)	<u>Mix #1</u> (comp. str.)	<u>Mix #2</u> (comp. str.)	<u>Mix #3</u> (comp. str.)
<u>7</u>			
<u>7</u>			
<u>28</u>			
<u>28</u>			
<u>28</u>			
<u>28</u> 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 = _____ %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

X. OTHER REQUIRED TESTS		
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:

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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

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project 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 033713 - SHOTCRETE

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 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. Design Mixes: For each shotcrete mix.
- D. Material Test Reports: For shotcrete materials.
- E. 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. Pre-installation Conference: Conduct conference at Project site prior to start of Work. Coordinate with other scheduled meetings/site visits.

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 SHOTCRETE MATERIALS

- A. Shotcrete Cement and Blended Cements
 - 1. Portland Cement: ASTM C 150, Type I. 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 only. Class C Fly Ash Prohibited.
 - 3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - 4. Silica Fume: ASTM C 1240, amorphous silica.
- B. 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.
- C. 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.
- D. Water: Potable, complying with ASTM C 94, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.
- E. Ground Wire: High-strength steel wire, 0.8 to 1 mm in diameter.

2.3 CHEMICAL ADMIXTURES

- A. General: ASTM C 1141, Class A or B, but limited to the following admixture materials. Provide admixtures for 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.

2.4 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.

2.5 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. 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.

2.6 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): 5,000 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.

2.7 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.

2.8 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 hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.

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 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.

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

3.6 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.

3.7 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.

3.8 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.

3.9 FIELD QUALITY CONTROL

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

3.10 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.

3.11 CLEANING

- A. Remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

END OF SECTION 033713

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SECTION 033761 – CAST IN PLACE 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 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.
- 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 number.
 - b. Age of mortar when tested.
 - c. Date and time of cube 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. "Hot Weather Concreting" reported by ACI Committee 305.
 3. "Cold Weather Concreting" reported by ACI Committee 306.
 4. "Standard Specification for Curing Concrete" (ACI 308).
- 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. "Hot Weather Concreting" reported by ACI Committee 305.
 3. "Cold Weather Concreting" reported by ACI Committee 306.
- D. American Society for Testing and Materials (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".

1.5 SUBMITTALS

- A. Make submittals as specified in this Section and as required by Owner/Engineer. Provide (3) hard copies of submittals to Engineer. One copy with response/comments will be returned to Contractor, one copy forwarded to Owner, and one copy retained by Engineer for record purposes.
- B. Contractor: At pre-construction 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 MATERIALS

- A. Prior to submitting bid, Contractor shall be responsible to verify that materials intended to be used from lists below correspond to repair methods that will be utilized (i.e., form and pour, form and pump, horizontal application), per manufacturer's written data sheets. The following listed materials are not acceptable for all types of repair methods.
- B. Horizontal Repair Mortar: Shall be pre-packaged, silica-fume-modified, cementitious repair mortar containing integral corrosion inhibitor, capable of horizontal pour and screed, partial and full depth applications, achieving a minimum 5,000 psi compressive strength at 28 days per ASTM C39 extended with aggregate as certified by manufacturer.
 - 1. Acceptable materials with corrosion inhibitor for this Work are as follows:
 - a. Silica fume modified:
 - 1) "Emaco S66 CI" or Emaco R310 CI", by BASF Building Systems, Shakopee, MN.
 - 2) "Eucocrete", by The Euclid Chemical Company, Cleveland, OH.
 - 3) "Planitop 15" with "Planicrete AC" or "MAPECEM 202" by MAPEI Corporation, Deerfield Beach, FL.
 - 4) "SikaTop 122 Plus," by Sika Corporation, Lyndhurst, NJ.
- C. Form and Pour/Pump Repair Mortar: Flow-able, one-component, high strength silica-fume-modified repair mortar with 0.375 in. aggregate extendable, and containing an integral corrosion inhibitor. The product shall achieve minimum 3,000

psi compressive strength at 1 day and 8000 psi compressive strength at 28 days per ASTM C39 extended at a 9-inch slump.

1. Acceptable materials for this Work are as follows:

a. Polymer/Silica fume modified:

- 1) "Emaco S77 CI," by BASF Building Systems, Shakopee, MN.
- 2) "Eucocrete Supreme," or "Concrete Top Supreme" by The Euclid Chemical Company, Cleveland, OH.
- 3) "Planitop 18 ES" by MAPEI Corporation, Deerfield Beach, FL

2.2 MATERIAL ACCESSORIES

A. Bonding Grout (for horizontal, un-formed surfaces): Bonding grout shall consist of sand and cement in proportions similar to mortar in concrete with sufficient water to form stiff slurry to achieve consistency of "pancake batter". Apply with brush to surface of existing concrete in repair areas. Surface of existing concrete shall be SSD.

B. Extended Open Time Epoxy Bonding Agent (for formed overhead/vertical surfaces): 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. Emaco P24," by BASF Building Systems, Shakopee, MN.
- b. "Duralprep A.C.," by The Euclid Chemical Company, Cleveland, OH.
- c. "Planibond 3-C" or Mapefer 1K," by Mapei Corporation, Deerfield Beach, FL.
- d. "Sika Armatec 110 EpoCem", by Sika Corporation, Lyndhurst, NJ.

C. Epoxy Adhesive (for formed overhead/vertical surfaces): 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. "Concresive Liquid LPL", by BASF Building Systems, Shakopee, MN.
"Kemko 001 or 008", by ChemCo Systems, Inc., Redwood City, CA.
- b. "Euco #452 Epoxy," or "Duralcrete", by The Euclid Chemical Company, Cleveland, OH.
- c. "Planibond EBA" by Mapei Corporation, Deerfield Beach, FL.
- d. "Sikadur 32 Hi-Mod LPL", by Sika Corporation, Lyndhurst, NJ.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Preparation of surfaces to receive repair mortar shall be in accordance with Section "Surface Preparation for Patching" and manufacturer's written instructions. All unsound concrete, dust, debris, laitance, etc. shall be removed from repair cavities. Cavity surfaces shall be wet to saturated surface dry condition prior to placement of repair material.

3.2 INSTALLATION

- A. Mortar Placement: Properly proportioned and mixed mortar material shall be placed to consolidate mortar so that no voids exist within new material and continuous contact with base concrete is achieved.
- B. Form and Pour Repair Mortar Placement: Mix and apply in strict accordance with manufacturer's written instructions, to achieve a maximum 9" slump.

3.3 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. "Confilm", by BASF Building Systems, Shakopee, MN.
- 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. Immediately 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. Dissipating curing compounds complying with ASTM C309 may be used in accordance with recommendations of ACI 506.7, "Specification for Concrete". 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.
 - 4. During initial and final curing periods maintain concrete above 50 deg F.
 - 5. Prevent rapid drying at end of curing period.
- D. Horizontal concrete surfaces shall be cured with moisture curing or moisture-retaining cover only; curing compounds prohibited.
- E. Dissipating Curing Compound, for overhead or vertical surfaces only, (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 kg/m² when applied at 200 sq. ft./gal. Manufacturer's certification is required. Silicate based compounds are prohibited.
 - 1. Subject to project requirements provide one of the following products:
 - a. "Kurez DR VOX", "Kurez RC", or "Kurez RC Off", The Euclid Chemical Company.
 - b. "RxCure WB", "RxCure VOC", or "W.B. Cure VOC", Conspec Marketing & Manufacturing.
 - c. "Kure N Seal W" or "Kure N Seal WB", BASF Building Systems, LLC.
 - d. "MAPECURE DR", by MAPEI Corporation, Deerfield Beach, FL.
- F. 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. Curing Compound: For overhead and vertical surfaces only; prohibited on horizontal surfaces. Apply uniformly in continuous operation by power spray or

roller 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.

3.4 FIELD QUALITY CONTROL OF AGGREGATE EXTENDED MATERIAL

- 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.
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - 2. Determine strength at 3, 7, and 28 days. Each test shall consist of two 6-inch diameter cylinders or three 4-inch diameter cylinders. Testing shall be in accordance with ASTM C39.

3.5 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.

END OF SECTION 033761

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SECTION 042010 – UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submit samples for concrete masonry units and colored mortar.
- B. Comply with ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90; Weight Classification, Normal Weight; Type I, moisture-controlled units.
 - 1. Special shapes for lintels, corners, jambs, sash, control joints, and other special conditions shall match existing.

2.2 MORTAR

- A. Mortar: ASTM C 270, Proportion Specification.
 - 1. Masonry Cement: Do not use masonry cement.
 - 2. Do not use calcium chloride in mortar.
 - 3. Type N.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with motor-driven saws. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- D. Stopping and Resuming Work: In each course, rack back units; do not tooth.

- E. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- F. Tool exposed joints slightly concave when thumbprint hard, unless otherwise indicated.
- G. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.

3.2 FIELD QUALITY CONTROL

- A. Owner may engage a qualified independent testing agency to perform the following tests for each 5000 sq. ft. (460 sq. m) of wall area or portion thereof.
 - 1. Mortar Properties: ASTM C 270.
 - 2. Mortar Composition and Properties: ASTM C 780.

3.3 CLEANING

- A. Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, remove large mortar particles and scrub unit masonry.
 - 1. Wet wall surfaces with water, apply cleaner, then remove cleaner by rinsing thoroughly with clear water.

END OF SECTION 042010

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SECTION 079233 – 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. Concrete Sealants:
 - a. Exterior joints in horizontal traffic bearing surfaces.
 - b. Exterior joints in horizontal and vertical non-traffic surfaces.
 - 2. Exterior Façade Sealants:
 - a. Exterior horizontal and vertical joints between marble panels.
 - b. Cove joints at intersection of horizontal and vertical surfaces.

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.
- B. 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.

C. 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 60 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. 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 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 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. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer
 - 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 original design load of slab area.

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 and Contractor shall furnish Owner written single source performance guarantee that the joint sealant 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. 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 period 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:
 - 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.
- 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), North Canton, OH.
 6. Sonneborn, a Division of BASF Construction Chemicals (BASF).
 7. 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. "Sonneborn Soft Type Backer Rod," Sonneborn, Minneapolis, MN.
- E. Bond breakers and fillers: As recommended by system manufacturer.
- F. Primers: As recommended by sealant manufacturer.
- G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.

- H. Acceptable Concrete Sealants (at epoxy/sand repairs areas (W.I. 16.9 at PS#2), Contractor remains responsible to verify sealants used are compatible with epoxy/sand repair material. Provide written acceptance from manufacturers.):
1. Acceptable polyurethane control joint sealants (traffic bearing):
 - a. Sonolastic SL-2, BASF.
 - b. Iso-flex 880 GB, Lyntal.
 - c. Dynatrol II-SG or Urexpan NR 200, Pecora.
 - d. Sikaflex-2c SL, Sika.
 - e. THC-900/901, Vulkem 45SSL, or Vulkem 245, Tremco.
 2. Acceptable silicone control joint sealants (traffic bearing):
 - a. Spectrem 800/900SL, Tremco.
 - b. 310-SL, Pecora.
 - c. Dow Corning SL or FC Parking Structure Sealant, Dow Corning.
 3. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
 - a. Sikaflex-2c NS, Sika.
 - b. Sonolastic NP-2, BASF.
 - c. Dymeric 240/240FC or THC 901 (cove only), Tremco.
 - d. Dynatred, Pecora.
 - e. Iso-flex 881, Lyntal.
 4. Acceptable silicone vertical and cove joint sealants (non-traffic bearing):
 - a. Spectrem 1 or Spectrem 4-TS, Tremco.
 - b. 311-NS, Pecora.
 - c. Dow Corning NS Parking Structure Sealant, Dow Corning.
- I. Acceptable Facade Sealants – W.I. (Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates):
1. Dow Corning Corporation; 790.
 2. GE Silicones; SilPruf LM SCS2700.
 3. Tremco; Spectrem 1 (Basic).
 - a. Type and Grade: S (single component) and NS (nonsag).
 - b. Use Related to Exposure: NT (nontraffic).
 - c. Uses Related to Joint Substrates: M, G, and A, as applicable.
- J. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- K. 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.
- H. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form-release agents from concrete.
- I. Joint Priming: Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- J. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

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. Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.
- D. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.
- 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°F.
- F. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- G. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- H. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- I. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- J. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
- K. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.4 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079233

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SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

- 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 cleaning, surface preparation, and the application of paint systems on the following exterior substrates:
 - 1. Previously Painted Concrete Masonry Units (CMU).
 - 2. Previously Painted Metal Doors and Frames.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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 indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:

1.4 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 Engineer at no added cost to Owner.

B. Pre-construction Testing:

1. Contractor is responsible for pre-construction testing required to comply with all Federal, State, and Local requirements regarding painting preparation and application work and verifying compatibility of proposed paint system with all substrates and existing coatings.

1.5 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.

1.6 PROJECT 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Coronado Paint Company.
3. ICI Paint Stores (Delux Paint).

4. Kelly-Moore Paint Company (Kelly-Moore).
5. M.A.B. Paint.
6. PPG Industries, Inc. (Pittsburgh Paints).
7. Sherwin-Williams Co. (Sherwin-Williams).
8. United Coatings.
9. BASF Building Systems (BASF).
10. Porter Coatings.
11. Carboline.
12. Tnemec. Or, an Engineer approved alternate.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Owner from manufacturer's full range.
- C. See Section 3 – Execution schedule of paint systems to be used on this project.

2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 1. VOC Content: E Range of E3.

2.4 LATEX PAINTS

- A. Latex (Semi-gloss): MPI #11 (Gloss Level 5).
 1. VOC Content: E Range of E3.

2.5 ALKYD PAINTS

- A. Exterior Alkyd Enamel (Semi-gloss): MPI #94 (Gloss Level 5).
 1. VOC Content: E Range of E2.

PART 3 - EXECUTION

3.1 PAINTING SCOPE OF WORK

- A. **BASE BID - W.I. 45.3A Paint – Southeast Elevator Tower Exterior:** This work consists of cleaning, preparing, and painting all masonry surfaces on the exterior of the southeast elevator tower, all 4 sides, all levels. It is the general intent of the Owner to paint the entire exterior of the elevator tower. Submit color samples to Owner for selection prior to start of work.
- B. **ALTERNATE W.I. 45.3B Paint – Northeast Stair Tower Exterior:** This Alternate work, if accepted, consists of cleaning, preparing, and painting all masonry surfaces on the exterior of the northeast stair tower, all 4 sides, all levels. It is the general intent of the Owner to paint the entire exterior of the stair tower. Submit color samples to Owner for selection prior to start of Work.
- C. **ALTERNATE W.I. 45.3C Paint – Southwest Stair Tower Exterior:** This Alternate work, if accepted, consists of cleaning, preparing, and painting all masonry surfaces on the exterior of the southwest stair tower, all 4 sides, all levels. It is the intent of the Owner to paint the entire exterior of the stair tower. Submit color samples to Owner for selection prior to start of Work.
- D. **ALTERNATE W.I. 45.3D Paint – Metal Doors and Frames (All 3 stair/elevator towers):** This Alternate work, if accepted, consists of cleaning, preparing, and painting all metal doors and frames at all 3 of the stair/elevator towers. All exposed surfaces of the metal door and frame systems shall be painted, at all 3 stair/elevator towers, all levels. Verify scope of work in field with Engineer. Submit color samples for Owner selection prior to start of Work.
- E. **Incidental Paint Items:** Repainting any paint that is disturbed, damaged, discolored, etc. by work defined in this contract is considered incidental to the project and shall not be included as a pay item in any of the work items above.
- F. The owner reserves the right to choose any of the alternate work items listed above.
- G. Mockups
 - 1. Mockups for each type of paint and substrate combination are required prior to receiving final Owner approval of surface preparation and finished painting work product.

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 work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete/Masonry: 12 percent.
- 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. **Pre-construction Adhesion Testing:**
 - 1. No testing of existing coating materials has been performed. The contractor is required to perform pre-construction testing to ensure compatibility of the new paint with the existing systems.
 - 2. Refer to the coating manufacturer's recommendations for preconstruction testing requirements.
 - 3. Pre-construction testing is considered incidental to the painting Work.
 - 4. Submit results of pre-construction testing to Engineer. Submit manufacturer's written certification of compatibility between existing coating and new paint prior to start of Work.
- E. **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 paint 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 surface-applied protection for all surfaces not to be painted prior to start of surface preparation and painting.
 - 1. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 2. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

- C. Existing Painted Substrates: Remove all failed existing coatings, dirt, grease and material that could inhibit bond of new over-coat paint materials.
 - 1. Perform power washing preparation to all surfaces/substrates as outlined in this Section.
 - 2. At all areas where existing coating is not intact after power washing, perform additional mechanical preparation to remove unsound coatings, corrosion, etc. down to bare masonry/metal as outlined elsewhere in this specification document. Do not damage existing substrate.
 - 3. Transitions between different layers of substrates/coatings shall be mechanically feathered together to provide a sound and tight transition for over-coating.
- D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. General Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and re-prime.
 - a. Use water power washing methods as primary preparation method.
 - 1) Trial preparation area shall be performed to determine final water pressure and cleaning techniques. Equipment shall utilize a rotary nozzle and alkaline detergent designed for preparing existing paint coatings for over-coating. Resultant surfaces after cleaner application, dwell time, and pressure water cleaning at appropriate pressure and volume shall be: all surfaces free from loose coatings, dirt, grease, chalk/oxidation, and contaminants (including chlorides and salt contaminants). Cleaning/preparation shall be approved by Owner's Representative, and by representative of paint manufacturer.
 - 2) Solvent cleaning and power tool cleaning/abrading shall be utilized in lieu of power washing where power washing is not possible.
 - b. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - c. If abrasive blast-cleaning methods must be used, provide protection to prevent blast-cleaning material from leaving work area.
 - d. When abrasive blast-cleaning methods must be used, all residues from the preparation must be thoroughly removed.
 - e. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

- F. Ferrous Metal Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 - 1. Corroded and/or exposed steel shall be prepared by one of the following:
 - a. SSPC-SP11 "Power Tool Cleaning to Bare Metal".
 - b. SSPC-SP6 "Commercial Blast Cleaning".
 - c. Proper containment, collection and disposal of preparation debris shall be the responsibility of the contractor.
- G. 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.

3.4 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. If undercoats or other conditions show through topcoat, 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.
- D. Graphics, level numbering, color banding, etc. shall be provided to match existing. Submit plan to Owner and obtain written approval prior to start of Work. Install with sharp clean edges. Any color overruns, fuzziness, drips shall be fixed at no cost to the Owner.
- E. Graphics, level numbering, color banding, etc. shall be installed level and plumb. Deviations of more than $\frac{1}{4}$ " in 8' shall be repaired at no cost to the Owner.

3.5 FIELD QUALITY CONTROL

- A. Contractor is responsible to perform wet-mil tests during paint application (minimum 2 per each elevation). Submit results to Owner/Engineer for record.
- B. 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 will 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 noncomplying-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 PAINTING SCHEDULE

- A. Masonry (CMU) Substrates:
 1. Latex System: MPI EXT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Topcoat: Exterior latexflat.
- B. Steel Substrates:
 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Exterior alkyd enamel traditional gloss.

END OF SECTION 099113

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SECTION 099120 - PAVEMENT MARKING

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 pavement markings systems as required per Drawings and Section 020010.
- B. Proportion International Symbol of Accessibility in accordance with ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.
- C. Related Work:
 - 1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, coatings, and all other existing and new surface treatments.

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 degrees F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees 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 meet requirements of MPI #70.
 - 1. All products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.
 - 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.

2.3 COLOR OF PAINT

- A. Color of white paint shall 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.

- B. Color of yellow paint shall 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.
- C. Color of blue paint shall 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.
- D. Color of green paint shall match federal color chip No. 34108. 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.
- E. Color of red paint shall match federal color chip No. 31136. 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.
- F. Color of black paint shall match federal color chip No. 37038. Black paint shall also meet Federal Specification TT-P-110.

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. 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.
- D. Pavement markings shall not be placed until full cure of concrete slab and waterproofing materials.

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, and incompatible paints and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. 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 dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer 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.
- F. 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 Engineer/Architect and cause as little damage as possible to surface texture of pavement. Methods, that can 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 existing surfaces 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.

- G. 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.

H. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

I. 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 paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor's option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.
1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
- B. 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° F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.
- C. 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).

END OF SECTION 099120

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