

TABLE OF CONTENTS & LIST OF DRAWINGS

TECHNICAL SPECIFICATIONS

DIVISION 02 – EXISTING CONDITIONS

020010	Work Items
024110	Selective Structure Demolition
025130	General Concrete Surface Preparation
025140	Surface Preparation for Patching
025160	Hydro-Demolition Surface Preparation

DIVISION 03 – CONCRETE

033000	Cast-in-Place Concrete
033713	Shotcrete
033760	Pre-packaged Repair Mortar

DIVISION 07 – THERMAL & MOISTURE PROTECTION

071800	Traffic Coatings
079233	Concrete Joint Sealants
079500	Expansion Joint Assemblies

DIVISION 09 – FINISHES

099113	Exterior Painting
099121	Pavement Marking – Restoration

DIVISION 13 – SIGNAGE / WAYFINDING

101400	Signage
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LIST OF DRAWINGS

<u>SHT. #</u>	<u>DESCRIPTION</u>
R-001	General Notes, Iso, Legend, and W.I. List
R-002	Temporary Shoring (WI 18.1)
R-003	Traffic Control, Phasing, & Schedule
R-101	Level 2 Plan View
R-102	Level 3 Plan View
R-103	Level 4 Plan View
R-104	Level 5 Plan View
R-105	Level 6 Plan View
R-301	Existing Reinforcement (For Reference)
R-501	Repair Details
R-502	Repair Details
R-503	Repair Details
AG-101	Level 1 Signage Plan
AG-102	Level 2 Signage Plan
AG-103	Typical Level Signage Plan
AG-104	Top Level Signage Plan
AG-201	Sign Details and Schedule

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

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

WI 1.0 GENERAL REQUIREMENTS

- A. Scope of Work
 - 1. Work consists of performing all tasks, specifically required and incidental, which are not identified under separate Work Item designation, but necessary to perform the work identified in this project. This work includes, but is not limited to:
 - WI 1.1 – Project Mobilization
 - WI 1.5 – Temporary Signage
 - WI 1.6 – Temporary 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 all 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 for obtaining all permits required to perform work as specified, per all authorities having jurisdiction, including for access and use of

water through fire hydrants and disposal of wastewater per minimum City of Detroit requirements.

B. Materials (Not Applicable)

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

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, and supervision necessary to provide, install, maintain, and remove following completion of Project, all Temporary Signage as required for traffic control and user safety and information during construction and public safety/warning type signage, and as required by Owner/Engineer.
2. Temporary Signage shall be installed prior to start of any other Work.
3. Refer to Phasing Requirements on Drawings for further requirements.
4. Payment for this Work Item shall be lump sum to provide all required Temporary Signage to perform Base Bid and Alternate Work (if accepted). No extras will be allowed for providing or maintaining additional Temporary Signage to complete Alternate Work Items. Adjust Temporary Signage as needed throughout the project based on progress of construction and as directed by Owner/Engineer (incidental).

B. Materials

1. Temporary signage shall meet following minimum requirements:
 - a. Minimum size: 2' by 3'.
 - 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.

C. Execution

1. Mounting Height: 5-ft. to bottom of sign. Provide mounting brackets and/or bases as required (incidental).
2. Minimum Temporary Signage provided shall be sufficient to inform public of ongoing construction Project, and direct pedestrians and vehicles around closed Work areas and throughout structure. General requirements include, but are not limited to:
 - a. Signage at all pedestrian entrances to the structure informing public of ongoing construction Project, maintained for the duration of the Project.
 - b. Signage at all vehicle entry/exits. At closed vehicle entry/exits, provide minimum signage and barricades as indicated on Phasing Drawings. At open vehicle entry/exits, signage shall notify public of ongoing construction Project and closed work areas, stair towers, elevators, etc.
 - c. Signage in all stair and elevator towers on all levels, indicating which levels/areas are closed and which remain open.
 - d. Signage at all work area perimeters on all levels where hydro-demolition is to be performed, clearly defining work area limits and explicitly prohibiting vehicle and pedestrian access, maintained for the duration of the repairs.
 - e. Signage as necessary to maintain normal traffic flow throughout structure and around closed work areas, including access to all areas of the structure remaining open for public use during project. Provide signs indicating route to follow for additional areas of parking, and route to follow to exit structure, at all levels in bays adjacent to work areas.
 - f. Other signage as required by Owner/Engineer, and as needed throughout the Project.
 - g. In addition to signage requirements listed above, provide specific signage indicated on Phasing Drawings.
3. **Contractor shall submit shop drawings detailing sign layout and locations, size, colors, and mounting schemes for approval prior to fabricating signs and mounting brackets. Obtain Owner/Engineer approval of proposed signage prior to start of Work.**
4. Required Signage shall be in place prior to closing any work areas, no exceptions.
5. 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.

WI 1.6 TEMPORARY BARRIERS

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to install temporary dust, debris, water, and work area perimeter barriers, maintain them throughout Project and during demolition, and

other dust-, water-, and debris-related operations, and remove upon completion of Project. Barriers shall be required whenever demolition or other dust, water, or flying-debris producing activities occur.

2. A critical component of this Work is providing protection around the hydro-demolition work areas to contain all dust/debris/water within these work areas and not affect the adjacent areas that will remain open for normal use. **Contractor shall submit their proposed barriers/protection plan to be reviewed by Owner/Engineer prior to start of Work.** As a minimum, barriers/protection shall comply with performance requirements in this Work Item.
 - a. Contractor shall be responsible to continuously monitor hydro-demolition work and other concrete removals and surface preparation work for effectiveness of perimeter protection.
 - b. Contain all debris/dust/water/slurry within work areas.
3. Temporary Barriers shall be installed prior to start of any Work.
4. See Drawings for further requirements.
5. Payment for this Work Item shall be lump sum to provide all required Temporary Barriers to perform Base Bid and Alternate Work (if accepted).

B. Materials

1. Barrier wall frame around perimeter of hydro-demolition work areas (and on lower levels below hydro-demolition work areas) shall be made from 2" x 4" material (wood), unless Contractor submits alternate in writing that is approved by Owner.
2. As a minimum, barrier membrane shall be 6-mil. reinforced polyethylene or canvas "tarp" material.
3. On levels 1-5, as a minimum, full-height floor-to-ceiling ½" plywood barriers shall be installed around entire perimeter where hydro-demolition is occurring (and all levels below), and as required to protect the public.
4. Perimeter barriers shall be maintained until after concrete placement has been completed.
5. Utilize additional protective shroud(s) around hydro-demolition equipment.
6. Provide additional movable barriers as needed during hydro-demolition and high-pressure water blasting.

C. Execution

1. Contractor shall erect barriers full height, floor to ceiling, to completely separate all work areas from areas that will remain open to public use, prior to start of concrete removals. Barriers shall maintain their integrity as long as protection is required.
2. Plywood barriers shall be provided along the perimeter of the entire hydro-demolition work areas (W.I. 3.7), including all levels below (see work area limits indicated on plans). Plywood barriers shall also be provided at the stair/elevator towers adjacent to the required hydro-demolition work to prevent pedestrian access to the work areas (all levels). See Drawings for specific requirements.
3. Barriers and protection shall be sufficient to protect all areas adjacent to work areas at all times throughout the entire project (particularly during hydro-

demolition and conventional chipping, surface preparation, and high-pressure water blasting). All dust/debris/airborne particles/water shall be contained within the work areas at all times. **Contractor to submit proposed barriers/ protection plan for Owner approval outlining the following:**

- a. Entire proposed hydro-demolition procedure including: removal, cleanup, surface preparation, and concrete placement process explaining method/types of protection to be utilized during each step of the repair process.
 - b. Types of materials to be used (solid barriers/netting/machine enclosures/movable barriers/etc.).
 - c. Proposed size/height/type of construction of perimeter protection for hydro-demolition work areas.
 - d. Proposed size/height/type of construction of perimeter protection for other concrete removal work by conventional chipping at localized areas (ceilings/columns/etc.).
 - e. Proposed method of installing/anchoring perimeter protection to structure.
 - f. Any types of movable elements intended to be used to protect against airborne debris/particles (particularly during hydro-demolition removals and high-pressure water-blasting surface preparation).
 - g. Any other relevant information regarding contractor's proposed barriers/protection plan.
4. Contractor shall remove all temporary barriers upon completion of Project and repair all damage caused by their installation.
 5. Contractor shall remain responsible for prohibiting pedestrian and vehicle access to all closed work areas throughout duration of Project (incidental to this work).
 6. Contractor shall be responsible for containing run-off water and debris from hydro-demolition work within work area boundaries (incidental to this work). Any run-off water or debris affecting locations outside of designated work areas shall be corrected immediately by Contractor (incidental).
 7. Contractor shall be responsible for preventing hydro-demolition run-off water and debris/slurry from entering the existing drainage system. As a minimum, filters shall be provided at all floor drains in and near the designated work areas prior to start of concrete removals (incidental).
 8. Contractor shall be responsible for providing protection to prevent hydro-demolition run-off water and debris/slurry/dust from entering the elevator towers. All cleaning and/or repairs required to restore elevators to clean/functional condition shall be Contractor's responsibility.
 9. Contractor shall also clean/repair existing drains and piping as needed at end of Project to ensure drainage system is in proper working condition at no extra cost to Owner.
 10. Barriers (plywood/plastic sheeting) shall also be provided around localized repair areas while performing work outside of hydro-demolition work areas.

WI 1.7 GENERAL CONSTRUCTION ALLOWANCE

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to perform miscellaneous electrical, mechanical, and/or utility work; concrete repairs; and other work as directed by the Owner or Engineer.

B. Equipment (Not Applicable)

C. Execution

1. Special conditions, hidden conditions, and similar situations shall be brought to the attention of the Owner and Engineer.
2. Where above conditions warrant, or if Owner elects to add or delete work, contract modifications will be made in accordance Division 01 Sections. Contractor shall not bill, charge, invoice or in any other manner request payment against this work item unless specifically directed to do so by Owner/Engineer as indicated above.
3. Contractor shall provide detailed proposal for any Work that is to occur under this Allowance item for Owner approval. Contractor's proposal shall include detailed breakdown of pricing/materials/schedule/etc. for proposed work, and any other information as requested by Owner/Engineer.
4. Contractor shall not perform any Work that is to be billed under this Allowance item without prior written approval from Owner.
5. Any unused Allowance amount will be credited back to Owner at end of project.

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.

B. Materials

1. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and on Drawings.
2. Epoxy-coated 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 sand-blasting 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. This Work includes floor repairs at localized delaminated/spalled areas on supported levels (outside of overlay strip repair areas) as located in field with Engineer.
- C. Payment for this Work Item shall be per square foot of work actually performed, located and measured in field with Owner/Engineer.

WI 3.4 FLOOR REPAIR – FULL DEPTH AT EXPANSION JOINT

- 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 repair material to restore floor to original integrity and appearance. Refer to Detail 3.4 for specific requirements.
 2. Removal of existing metal-edged expansion joint system is incidental (including embedded studs). Concrete removals for this Work shall be by hydro-demolition or chipping hammers (or both) as required at overlay repair areas.
 3. Perform this Work in conjunction with W.I.'s 3.7 and 10.3.
 4. Payment for this Work Item shall be per square foot of work actually performed per requirements of Detail 3.4, measured in field with Owner/Engineer. Forming and placing expansion joint blockouts (per expansion joint manufacturer's requirements) is incidental to this Work.

B. Materials

1. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete" and on Drawings.
2. Epoxy-coated 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 boundaries prior to saw-cutting and preparation of patch edges. 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 sawcut or ground to depth of 0.5-in. Patches shall be as square- or rectangular-shaped as practical.
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 hydro-demolition or sand-blasting 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 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. Install supplemental reinforcement as shown on Detail 3.4 (incidental). Verify requirements in field with Engineer prior to placing concrete.
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.

WI 3.5 FLOOR REPAIR – CURBS

- A. Refer to Work Item 3.0 "Concrete Floor Repair" for scope of work, materials, and procedure associated with this Work Item. Refer to Detail 3.5 for specific requirements. Locations for this work shall be verified in field with Engineer.
- B. All curb spalls/delaminations occurring adjacent to the overlay strip repairs shall be repaired. See Detail 3.12 for adjacent slab edge repairs.
- C. Payment for this Work Item shall be per square foot of work actually performed, measured in field with Owner/Engineer.

WI 3.7 FLOOR REPAIR – OVERLAY STRIP PATCHING

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to sound floors to locate and mark work boundaries, remove concrete partial depth by hydro-demolition, remove debris and prepare surfaces to receive overlay, install concrete overlay to grades and/or profiles required to provide positive drainage, provide tooled control joints, and install cove sealant and control joint sealants (incidental) as required. Concrete removals, concrete placement, terminations, joints, etc. shall be performed per the requirements of Work Item and Detail Series 3.7. Work Item 3.7 involves localized floor repair patches (or strips) mainly around columns and along grid lines where there is a higher concentration of top reinforcing steel. General repair locations are shown on plans, verify actual locations in field with Engineer. See typical layout shown on Drawings R-103/R-104. See Detail Series 3.7 for additional specific requirements.
2. Refer to Section "Hydro-demolition Surface Preparation" for water pressure metering requirements at the City hydrants and other specific requirements.
3. Protection of existing permanent shores and perimeter vehicle barrier system shall be incidental to this work. Removals shall be performed around base plates to not undermine vehicle barrier or permanent shore bases. Perform adjacent removals with conventional chipping hammers as required (incidental). Refer to Detail 3.7.4 for similar requirement.
4. This Work Item occurs on levels 5 & 4 in bays 5 & 6 as shown on Drawings R-103/R-104. Payment for this Work Item shall be per square foot of repairs actually performed, as identified and located in field with Engineer.

B. Materials/Equipment

1. Concrete removals shall be performed by hydro-demolition (except for areas with limited access, such as around columns, walls, permanent shores, and vehicle barriers, which shall be performed using conventional chipping hammers, incidental) per Section "Hydro-demolition Surface Preparation". Concrete "shadows" underneath the reinforcement left behind after the hydro-demolition shall be removed with conventional chipping hammers (incidental).
2. Concrete repair materials shall be as specified in Section "Cast-in-Place Concrete".
3. Epoxy-coated steel reinforcement and related materials shall be as specified in Section "Cast-in-Place Concrete".
4. Sealant material shall be as specified in Section "Concrete Joint Sealants".

C. Execution

1. Locate all work areas to receive overlay strip patching as shown on Drawings by sounding floor slabs and marking deteriorated areas in field with Engineer. Refer to Drawings for further phasing requirements. Do not start removals until Engineer has confirmed repair locations.

2. Install Temporary Shoring (2 levels) beneath the floor slabs prior to start of concrete removals per Drawings and W.I. 18.1. Phase/coordinate work accordingly.
3. Temporary shoring at the cantilevered edges shall bear on existing foundations at grade level. Verify in field with Engineer.
4. **Temporary Shoring per W.I. 18.1 shall be installed beneath the entire floor area of the bays where strip patching (W.I. 3.7) occurs, not just at the localized areas where the strip patching is performed.**
5. Signage and Temporary Barriers and perimeter protection per requirements of W.I.'s 1.5 and 1.6 shall be in place prior to start of removals.
7. Remove concrete to depth required per Detail Series 3.7 and Section "Hydro-demolition Surface Preparation". Note: Floor reinforcing steel is closely spaced along column lines and may only have approximately 1-in. of clearance between bars. See Detail 5/R-301. Performance requirement is to remove concrete minimum $\frac{3}{4}$ " below the top mat of reinforcing steel. No extra payment for removals beyond this requirement. See W.I. 3.11 if deeper removals than that shown on the details are required to achieve $\frac{3}{4}$ " clearance below the reinforcement.
8. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching", Article "Inspection of Repair Preparation". All steel exposed within cavities shall be cleaned to bare metal by hydro-demolition 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".
9. Remove all hydro-demolition concrete debris through use of a vacuum truck suitable for this type of work (see Alternate W.I. 3.1A for alternative methods).
10. Removals and cleanup shall be performed to minimize damage to existing reinforcement. Remove only defective existing reinforcement that is no longer embedded in concrete. All other reinforcement shall be saved/protected. Do not cut any existing reinforcement without Engineer approval.
11. Prepare final concrete removal surfaces by water-blasting per Section "Hydro-demolition Surface Preparation". Remove debris and laitance soon enough after hydro-demolition to prevent re-settling or re-adhesion to sound concrete, which will interfere with bond of new concrete.
12. Receive Engineer approval of surface preparation one day prior to scheduled concrete pours, no exceptions.
13. Install supplemental epoxy-coated reinforcing as directed by Engineer per W.I. 3.9 to supplement/replace defective existing reinforcement. Do not cut or remove any reinforcement embedded in existing concrete unless specifically approved by Engineer on a case-by-case basis. Removal of defective reinforcement as required shall be incidental.
14. Place concrete overlay per Section "Cast-in-Place Concrete". Vibratory screed requirement may be eliminated if Contractor provides dedicated workers to vibrate and consolidate concrete with "stinger" type vibrators during placement.
15. Contractor shall be responsible to match existing grades around perimeter of strip patches, and to provide positive drainage within and around repair patches. Provide minimum 1% to maximum of 2% slope on repair surfaces to nearest drains and to match elevations at repair perimeters. Notify Engineer of any discrepancies prior to concrete placement. Ponding water is not acceptable, and shall be

- repaired by Contractor to Owner/Engineer's satisfaction at no additional cost to Owner.
16. Maintain existing height of top mat of reinforcement and maintain existing thickness of slab and existing concrete cover over reinforcement. Notify Engineer of any discrepancies and any proposed change(s) to slab thickness needed to achieve proper drainage prior to placing concrete.
 17. Contractor shall completely protect existing light fixtures, exit lights, pull alarms, signs, conduit, security cameras, elevators, vehicle barriers and permanent shores, user vehicles, and all other existing features and property within the structure from spray and damage from hydro-demolition and all other construction operations. Cleaning or repair/replacement of Contractor-caused damage to any existing features or property shall be performed by Contractor at no additional cost to Owner. With prior approval from Engineer, some existing features may be removed and re-installed (at Contractor's option). Submit plan for approval prior to start of Work or removing any existing fixtures.
 18. Protect existing conduit runs that occur on underside of repair areas. Contractor shall verify extent of protection requirements prior to submitting Bid. Refer to W.I. 25.1.
 19. Contractor shall verify and record condition of existing security system prior to start of Work (i.e. whether all elements of the security system are operational, and which, if any, are not functioning properly). Coordinate with Owner to document functional and non-functional features of the existing security system (throughout the entire structure) to verify Contractor's responsibility for any damage caused during construction operations. Any non-functional light fixtures shall also be documented during this review. Perform similar review of all elevators prior to start of Work.

WI 3.7A CONCRETE REMOVAL METHOD (ALTERNATE)

- A. On the Alternate Work Item Schedule in the Bid Form Section, state the **deduct** or **add** price if all concrete debris generated from hydro-demolition (W.I. 3.7) is allowed to be removed by a method other than the required vacuum method. Concrete demolition for the overlay strip patching repairs (W.I. 3.7) must still be performed by hydro-demolition. This Work Item only pertains to the removal method of debris after hydro-demolition is completed. Method of removal shall not damage existing reinforcing steel.

WI 3.8 FLOOR REPAIR – FULL DEPTH – ADDITIONAL REMOVALS

- A. Refer to Work Item 3.4 "Floor Repair – Full Depth at Expansion Joint" for similar scope of work, materials, and procedure. Refer to Detail 3.8 for specific requirements.
- B. This Work Item applies only to locations within the overlay strip repair areas (W.I. 3.7) that require full depth replacement due to slab deterioration. Payment for this Work Item is in addition to W.I. 3.7 as applicable at these full depth areas.
- C. Additional concrete removals by chipping hammers may be required after hydro-demolition is performed, as directed by Engineer (incidental to this Work Item).

- D. Payment for this Work Item shall be per square foot of work actually performed, measured in field with Owner/Engineer.
- E. Upon removal of formwork, Contractor shall repair bugholes, honeycombing, and all other noticeable imperfections to satisfaction of Owner/Engineer (incidental).

WI 3.9 SUPPLEMENTAL EPOXY-COATED STEEL

A. Scope of Work

- 1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to provide and install supplemental epoxy-coated reinforcing bars to replace/supplement defective existing reinforcing bars in concrete repair areas as directed by Engineer. Contractor shall verify condition of existing reinforcement with Engineer prior to placing repair material at all concrete repair areas.
- 2. This Work Item is applicable to all concrete repair items, and shall be used as needed and directed by Engineer. Contractor shall have 10% of bid quantity of reinforcement in the form of #6 bars (and #4 bars as needed), stockpiled on site prior to completion of slab demolition work. Lengths of stockpiled bars shall be no less than 20-ft. Contractor shall adjust quantities supplied to Project to meet demands of the Project as work progresses. Verify with Engineer prior to ordering materials.
- 3. Supplemental reinforcement indicated as incidental to other Work Items shall NOT be applicable for payment under this Work Item.
- 4. Payment for this Work Item shall be per pound of supplemental reinforcement actually installed, verified in field with Owner/Engineer. Contractor shall submit actual material invoices upon request of Owner.

B. Materials

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

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

WI 3.10 SUPPLEMENTAL REINFORCING DOWELS

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to dowel and epoxy-anchor supplemental epoxy-coated reinforcing bars as directed by Engineer. Unit price shall be based on 4-ft. long #4 bars, (with 6" hook as needed) with minimum embedment depth as stated in Article "Execution" below.
2. This Work Item is payable per each supplemental dowel installed. Locate and confirm requirements in the field with Engineer
3. Supplemental dowels or reinforcement indicated as required or incidental on Details, and noted as required or incidental to any other Work Items shall **not** be applicable for payment under this Work Item.
4. Unit price for this Work shall include providing, installing, and epoxy-anchoring each 4-ft. long #4 bar dowel (with or without hook) as stated above. All doweled supplemental reinforcement shall be paid for under this Work Item only, and not double-billed under W.I. 3.9 also. Quantity shall be verified in field with Engineer.

B. Materials

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

C. Execution

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

WI 3.11 FLOOR REPAIR – ADDITIONAL DEPTH

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove concrete to depths beyond the deepest removal limits set in W.I. 3.7, and to replace this additional depth of concrete removal with overlay concrete placed monolithic with overlay concrete specified in W.I. 3.7. See Detail Series 3.7 for additional information.
2. Unit price shall be per square foot of additional removals performed for each extra 1-in. depth of removal.
3. This Work Item applies to areas where existing reinforcing steel is significantly lower than expected, requiring deeper depths of removal to achieve $\frac{3}{4}$ " clearance around bottom layer of top mat of reinforcing steel.
4. This Work Item does NOT apply to removals beyond $\frac{3}{4}$ " below the bottom layer of the top mat of reinforcing steel, or the deepest removal limits established on Detail Series 3.7. Contractor is responsible for adjusting removal equipment to prevent excess removals beyond the established removal limits.
5. To be eligible for payment under this Work Item, the Contractor shall be responsible for providing acceptable documentation to Owner/Engineer of all areas of additional depth removals a minimum of 1-week prior to concrete placement. Perform and document elevation surveys (before and after concrete removals as required) and submit to Owner/Engineer as documentation of removal depths.
 - a. Contractor must provide elevation survey results taken both before and after concrete removals (at same locations) for this Work Item to be considered.
6. **Removal areas less than the deepest required removal depths may be used by Owner to offset this Work Item by an equivalent quantity.**

B. Materials

1. Refer to W.I. 3.7 for requirements.

C. Execution

1. Refer to W.I. 3.7 for requirements.

WI 3.12 FLOOR REPAIR – SLAB EDGE

- #### **A.**
- Refer to W.I.'s 4.1 and 6.1 for similar overhead and vertical surface concrete repair requirements. Refer to Detail 3.12 for specific requirements. Payment for this Work Item shall be per square foot of concrete removal/replacement on both overhead and vertical surfaces as shown on Detail 3.12. Verify repair areas in field with Engineer. See W.I. 3.5 for adjacent curb repairs.

WI 4.1 CEILING 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 supplemental reinforcement and patching material to restore ceilings to original condition and appearance. Refer to Detail 4.1 for specific requirements.
2. This work occurs at localized areas throughout the structure as needed. Verify repair areas in field with Engineer prior to start of Work.
3. Payment for this Work Item shall be per square foot of repairs performed. Provide localized signage and barriers around work areas per W.I.'s 1.5 & 1.6. Install localized temporary shoring (as needed) per W.I. 18.2; verify in field with Engineer.

B. Materials

1. Refer to Section "Cast-in-Place Repair Mortar" and/or Section "Shotcrete" for approved repair materials and procedures.
2. Trowel-applied repair material not allowed.

C. Execution

1. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching", Article "Inspection".
2. All live loads shall be removed from floor slab above and below repairs prior to start of work. Verify in field with Engineer.
3. Install temporary shoring per W.I. 18.2 at all ceiling repair locations exceeding 50 S.F. in size, and as needed based on field conditions. Verify in field with Engineer.
4. Procedure for delaminated, spalled, and unsound concrete removal shall be as specified in Section "Surface Preparation for Patching", Article "Preparation".
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 sand-blasting 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 coating as specified in Section "Cast-in-Place Concrete".
7. Contractor shall prepare cavities for patch placement in accordance with Section "Surface Preparation for Patching", Article "Preparation of Cavity for Patch Placement".
8. Install supplemental reinforcement as shown on Detail and secure to existing reinforcement.
9. 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.

10. 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 4.2 CEILING REPAIR – PARTIAL DEPTH AT DROP PANEL

- A. Refer to W.I. 4.1 for similar overhead concrete repair requirements. Refer to Detail 4.2 for specific requirements. Payment for this Work Item shall be per square foot of concrete repairs performed. Verify repair areas in field with Engineer.
- B. This work occurs as needed at the unreinforced drop panels at the columns. Install supplemental reinforcement and dowels as shown on Detail 4.2 (incidental). Verify requirements in field with Engineer prior to placing repair materials.

WI 6.0 CONCRETE COLUMN 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 install patching materials to restore concrete columns to original condition and appearance. Refer to Detail Series 6.0 for specific requirements.
- 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. Pressure applied concrete repair materials shall be as specified in Section "Shotcrete".
 3. Trowel applied repair material not allowed.
- C. Execution
 1. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching", Article "Inspection".
 2. All live loads shall be removed from floor slab above and below repairs. Verify in field with Engineer.
 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 6.1 COLUMN REPAIR – PARTIAL DEPTH

- A. Refer to Work Item "Concrete Column Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 6.1 for specific requirements.
- B. Payment for this Work Item shall be per square foot of repairs performed. Provide localized signage and barriers around work areas per W.I.'s 1.5 & 1.6. Install localized temporary shoring (as needed) per W.I. 18.2; verify in field with Engineer prior to removals.

WI 6.2 COLUMN REPAIR – PARTIAL DEPTH AT EXPANSION JOINT

- A. Refer to Work Item "Concrete Column Repair" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 6.2 for specific requirements.
- B. Payment for this Work Item shall be per square foot of repairs performed. Provide localized signage and barriers around work areas per W.I.'s 1.5 & 1.6. Install localized temporary shoring (as needed) per W.I. 18.2; verify in field with Engineer prior to removals.

WI 7.2 EXTERIOR BUMPER WALL REPAIRS (ALTERNATE)

- A. Scope of Work
 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals (including means of access and overhead protection) necessary to locate existing spalls, locate and remove delaminated and unsound concrete, prepare cavities and install concrete and reinforcing (as required) materials to restore exterior concrete walls to original condition and appearance. Refer to Detail 7.2 for specific requirements.
 2. This Alternate Work, if accepted, occurs as needed on the exterior concrete bumper walls on the south, east, and north elevations. Manlifts or other means of access shall be incidental. Submit access plan for Owner/Engineer approval. Overhead protection shall be provided and maintained at all times to protect

public/pedestrians/vehicles and sidewalks/roadways/landscaped areas (incidental).

B. Materials

1. Pressure-applied concrete repair materials shall be as specified in Division 03 Section "Shotcrete."
2. Cast-in-place concrete repair materials shall be as specified in Division 03 Section "Cast-in-Place Concrete" or "Prepackaged Repair Mortar".
3. Trowel applied patching material not allowed.

C. Execution

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

WI 10.3 EXPANSION JOINT – ELASTOMERIC CONCRETE EDGED

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove existing expansion joint systems, prepare concrete surfaces, and furnish and install new expansion joint system. Refer to Detail 10.3 for specific requirements.
2. Payment for this Work shall be lump sum to replace expansion joints on levels 4 & 5 in bays 5 & 6 as shown on Drawings.
3. Joints shall be extended into curbs at ends and turned up to promote positive drainage (incidental).

B. Materials

1. Expansion joint system materials shall be as specified in Section "Expansion Joint Assemblies", installed in strict accordance with manufacturer's recommendations.
2. Contractor shall coordinate with expansion joint manufacturer to size the blockouts and joints based on temperature at time of concrete placement and joint installation and expected thermal movement shown on Detail.

C. Execution

1. Contractor shall remove existing expansion materials in manner that minimizes damage to adjacent concrete. Expansion joint blackout forming and placement required for installation of new expansion joint system shall be performed in accordance with Work Item and Detail Series 3.7 and Work Item 3.4, as applicable.
2. Joint materials and associated reference specifications are listed in Article "Materials" above. Joint installation procedures shall be in accordance with referenced specifications and manufacturer's recommendations.
3. In-place testing: Prior to opening to traffic, test joint seal for leaks. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped.

WI 10.6 REPLACE STAIR TOWER ISOLATION JOINTS

- A. Refer to Work Item 10.0 "Expansion Joint Repair and Replacement" for scope of Work, materials and procedure associated with this Work Item. Refer to Detail 10.6 for specific requirements.
- B. This Work Item occurs on the roof level at all stair and elevator towers.
- C. Payment for this Work shall be lump sum to install new isolation joints between the parking deck and stair/elevator towers at all 6 stair/elevator towers on the roof level. Included in this work is removing existing premold joints (patching of blockouts/cavities paid under W.I. 3.1). Contractor also required to provide and install aluminum non-slip cover plates at all stair and elevator doorways on roof level, incidental to this work (9 total). Submit shop drawings for approval prior to ordering/fabricating cover plates.
- D. New aluminum non-slip cover plates shall be 3/16", Grade 2, with center crown and beveled edges from SlipNOT, or Engineer-approved equivalent. Length and width shall be customized to span joint and fit within existing door openings. Contractor required to verify dimensions in field. Secure to stair/elevator tower side of joint with countersunk stainless steel anchors. Installation shall be ADA-compliant.
- E. Submit shop drawings of new aluminum non-slip cover plates for Engineer approval prior to ordering/fabricating.
- F. Repair blackout as needed per other work items to provide suitable blackout per expansion joint manufacturer's requirements.
- G. Expansion joint installation shall comply with all written requirements of expansion joint manufacturer.

WI 11.1 SEAL FLOOR CRACKS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, prepare, and seal random cracks in concrete floors. Refer to Detail 11.1 for specific requirements.
2. Payment for this Work Item shall be per lineal foot of work actually performed, measured in field with Owner/Engineer.

B. Materials

1. Approved sealant materials shall be as specified in Section "Concrete Joint Sealants".
2. Joint sealant material shall be compatible with traffic topping materials specified in Section "Traffic Coatings".

C. Execution

1. Contractor shall thoroughly clean and inspect concrete slabs for cracks. Those identified as either greater than 0.03-inch wide or showing evidence of water and/or salt staining on ceiling below shall be sealed. All cracks and joints identified for repair shall be marked with chalk to aid in precision routing. Obtain depths to top reinforcing bars in area of repair by use of a pachometer. Determine depth of electrical conduit (if applicable). Do not exceed these depths 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 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 per this Work Item.
3. Cavities shall be thoroughly cleaned by grinding and sand-blasting 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. Sealant type shall be compatible with traffic coating specified in Section "Traffic Coatings".

WI 11.2 REPLACE JOINT SEALANTS

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.

B. Materials

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

C. Execution

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

WI 11.4 TOOL AND SEAL JOINTS (FOR REFERENCE ONLY)

A. Scope of Work

1. Work consists of providing all labor, materials, equipment, supervision, and incidentals necessary to provide tooled and sealed control joints in concrete repairs to maintain existing joint layout. Refer to Detail 11.4 for specific requirements.
2. This work is incidental to all concrete repair work items.

B. Materials

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

C. Execution

1. Contractor shall locate and provide control joints in all concrete floor repairs as needed to maintain existing floor joint layout.
2. Control joints shall be tooled and formed in plastic concrete. Saw-cutting joints after concrete sets will not be allowed.
3. Tooled joints shall be of proper dimension in plastic concrete.
4. Sealant materials and installation procedures shall be in accordance with referenced specifications for selected material.

WI 11.7 COVE SEALANT (INCIDENTAL)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to prepare concrete surfaces and install cove sealant between floor and vertical surfaces as shown on Drawings. Refer to Detail 11.7 for specific requirements.
2. This Work occurs at all applicable walls, curbs, and columns within the entire bays where W.I. 3.7 is being performed. This Work is incidental to W.I. 3.7 and is NOT a separate pay item. Contractor is required to install new cove sealant along all walls, curbs, and columns within the designated work areas after concrete has properly cured.

B. Materials

1. Joint sealant materials shall be as specified in Section "Concrete Joint Sealants".
2. Joint sealant material shall be compatible with traffic coating materials specified in Section "Traffic Coatings".

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 16.0 TRAFFIC TOPPING

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare existing floor surface and install traffic topping as

shown on Detail 16.1 and Drawings. Coating of all vertical surfaces within Work area (as required on Detail) shall be incidental to installation of traffic topping.

B. Materials

1. Approved materials for use in this Work are as specified in Section "Traffic Coatings".
2. Contractor shall submit samples of coating and obtain Owner/Engineer approval prior to start of Work. Approved sample shall be basis for acceptance criteria including, but not limited to: surface texture, color, amount of aggregate used, slip-resistance. Refer to Section "Traffic Coatings" for specific requirements.

C. Execution

1. Floor surface preparation shall be performed by coating system applicator or under its direct supervision. Shotblast surface preparation is required for floors.
2. Traffic topping shall be installed by licensed applicators in strict accordance with manufacturer's recommendations and referenced specification section listed in Article "Materials" above.
3. Coating system shall be thoroughly cured prior to Work areas being returned to service.

WI 16.1 TRAFFIC TOPPING – NEW SYSTEM

- A. Refer to Work Item "Traffic Topping" for scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 16.1 for specific requirements.
- B. Traffic topping shall be installed on all horizontal curb surfaces within required work areas (incidental).
- C. Payment for this Work shall be per square foot to install traffic topping in Bays 5 & 6 on levels 4 & 5 as shown on Drawings.

WI 16.3 TRAFFIC TOPPING – REPAIR (INCIDENTAL)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare surface previously traffic topped areas, and install traffic topping on prepared concrete and existing traffic topping. Refer to Detail 16.3 for specific requirements.
2. This work is incidental to W.I.'s 16.4 and 16.5 and is not a separate pay item.

B. Materials

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

C. Execution

1. All loose/debonded/damaged existing coating shall be removed and exposed existing concrete surfaces prepared in accordance with manufacturer's recommendations and referenced specifications.
2. Prepare existing surfaces to receive new coating material by shotblasting. Ensure existing coating to remain is adequately bonded to existing concrete slab.
3. Install primer, base coat, and intermediate coat(s) as needed to build up new coating system to match thickness of adjacent existing coating, incidental to this work. Areas shall then be recoated per W.I. 16.4/16.5 as applicable.

WI 16.4 TRAFFIC TOPPING – RECOAT

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to prepare and recoat the existing traffic topping as shown on Drawings. Refer to Detail 16.4 for specific requirements.
2. This work is intended to occur below and adjacent to hydro-demolition work areas as needed after construction operations are completed. Contractor and Engineer to review and document condition of existing coatings prior to start of Work, as well as Contractor's proposed methods and paths for debris removal, concrete placements, material deliveries, etc. Final scope of this recoating work will then be determined prior to start of concrete removals, and Contractor is required to perform construction operations in manner to minimize damage to existing coating.
3. Repair of existing coating as needed due to existing conditions or contractor-caused damage shall be repaired according to W.I. 16.3 (incidental to W.I. 16.4). Contractor to verify requirements in field.

B. Materials

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

C. Execution

1. Removal of loose/failed existing coating, preparation of exposed concrete surfaces and existing traffic topping membrane shall be in strict accordance with

manufacturer's recommendations and referenced specification section. Floor surface preparation shall be performed by coating system licensed applicator or under its direct supervision.

2. Shotblast surface preparation is required for floors.
3. Coating system shall be installed by licensed applicators in strict accordance with manufacturer's recommendations and referenced specification section.
4. Crack preparation, including installation of sealant material where required, shall be performed per W.I. Series 11.0.
5. Prior to recoating the area, any patches and/or bare concrete areas shall be coated with a base coat and an appropriate number of intermediate coats to bring the new membrane up to the level of the existing membrane per W.I. 16.3 (incidental). After this has been completed, the entire area shall be recoated per this Work Item.
6. W.I. 16.4: Existing prepared traffic topping membrane shall be recoated with a minimum of one intermediate coat with aggregate and one top coat.
7. Coating system shall be thoroughly cured and traffic marking completed prior to returning work areas to service.

WI 16.5 TRAFFIC TOPPING – RECOAT STAIRS

- A. Refer to Work Item 16.4 for similar scope of Work, materials, and procedure associated with this Work Item. Refer to Detail 16.4 for specific requirements.
- B. This work occurs in all 6 stair towers, and is payable per each stair tower. Traffic topping shall be installed on all horizontal and vertical tread/riser/landing surfaces within the stair towers (incidental).
- C. This work also includes painting of contrasting delineation strips on all tread nosings throughout stair tower (1-1/2" by width of treads). Confirm color with Owner.
- D. Repair of existing coating as needed due to existing conditions or contractor-caused damage shall be repaired according to W.I. 16.3 (incidental to W.I. 16.5). Contractor to verify requirements in field.

WI 18.1 TEMPORARY SHORING/RESHORING (FOR W.I. 3.7)

- A. Scope of Work
 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to install temporary floor slab shoring and to maintain shores in place until restoration work requiring shores is completed and associated concrete has properly cured and achieved minimum compressive strength requirements. This Work Item is associated with Work Item 3.7. **Submit shop drawings for approval prior to start of Work detailing all pertinent information related to this Work including: materials, layout, installation, anchoring, etc.**
 2. Payment for this Work shall be lump sum to install, maintain, and remove upon completion of Work, Temporary Shoring as required per this Work Item and on

Drawing R-002, minimum (2) levels below all hydro-demolition Work areas. Refer to Drawing R-002 for specific requirements.

3. Temporary Shoring per W.I. 18.1 shall be installed beneath the entire floor area of the bays where strip patching (W.I. 3.7) occurs, not just at the localized areas where the strip patching is performed.
4. Refer to Detail 3/R-002 for locations where temporary shoring is required.

B. Materials

1. Shores shall be steel, rated at 6,000-lbs at extension height required.

C. Execution

1. For purposes of calculations, minimum construction load = 25 psf (may be more based on project conditions). Dead load = slab weight (based on concrete unit weight of 150 lbs per cubic foot). See Drawings for further information and requirements.
2. Shoring shall be provided to bear at supported levels and slab-on-grade.
3. If during construction, modifications are necessary to accommodate other trades, revise and submit erection plan to Engineer for review.
4. Review of erection plan by Engineer does not relieve Contractor of responsibility for stability and safety of structure during construction.
5. Contractor shall be responsible for protecting shores from vehicle impact. Barricade/fence shored areas to prevent pedestrian and vehicle traffic through work areas.
6. Temporary Shoring requirements specified on Drawings to perform W.I. 3.7 are a minimum. Contractor shall be responsible for providing shoring for materials, equipment, or other construction loads in addition to the minimum shoring requirements to ensure structural stability for the duration of the project.

WI 18.2 TEMPORARY SHORING (FOR FLOOR/COLUMN/CEILING REPAIRS NOT ASSOCIATED WITH W.I. 3.7)

- A. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to install, maintain for duration of Project, and remove upon completion of Work, temporary shoring as needed at localized floor, ceiling, and/or column repair areas.
 1. Shores shall be steel, rated at 6,000-lbs at extension height required.
- B. Payment for this Work Item shall be for each shore post installed at localized concrete repairs (not including W.I. 3.7). Duplicate payment for shores already in place per W.I. 18.1 are NOT eligible for payment under this Work Item.
- C. 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.

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

WI 25.1 MECHANICAL / ELECTRICAL ALLOWANCE

- A. Mechanical / Electrical Allowance shall be related utility work (drain lines, sprinkler lines, electrical conduit, junction boxes, etc.) associated with interruptions of these utilities to repair existing structural areas.
- B. All utilities removed during Work shall be re-installed in accordance with latest edition of electrical and mechanical codes. Work **ineligible** for this Allowance includes Work covered by or incidental to other Work Items within this Specification or for Work required through Contractor's negligence.
- C. Repair, protection, or removal/reinstallation of utilities in overlay strip repair areas (W.I. 3.7) on level where hydro-demolition is being performed is incidental to those work items and is NOT eligible for payment under this Allowance.
- D. This Allowance is only applicable for damage due to unexpected or unavoidable full-depth repairs in the overlay areas (W.I. 3.7) on the underside of the level where hydro-demolition is being performed.
- E. Method of Payment:
1. Mechanical/Electrical Work, as approved in writing by Owner/Engineer 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/Electrical Allowance and actual payment receipts (including markup) will be reflected in an adjustment of Allowance amount.
 2. Contractor shall not perform any work to be billed under this Allowance without prior written approval from Owner.
 3. Contractor shall submit proposal for Owner approval for all work to be performed under this Allowance. Provide detailed breakdown of proposed work and costs for Owner approval.
 4. Any unused allowance amount will be credited back to Owner at end of project.

WI 25.2 MECHANICAL – REPLACEMENT FLOOR DRAIN

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to remove concrete full-depth, disconnect and remove existing floor drain, install supplemental dowels, install new drain, place concrete, and install sealant around perimeter of drain. Refer to Detail 25.2 for specific requirements. Work Item 25.3 is directly related to this Work Item.
2. This Work occurs as needed in overlay strip repair areas (W.I. 3.7). Verify specific requirements in field prior to hydro-demolition.
3. Payment for this Work Item shall be per each replacement drain installed as required, including all associated work required in this Section and on Detail 25.2.

B. Materials

1. Approved materials for this Work are 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 drains are to be removed and replacement floor drains are to be installed.
2. Concrete removals and replacement shall be as shown on Detail 25.2, payable under other Work Items.
3. Install and epoxy-anchor supplemental reinforcement as shown on Detail 25.2.
4. Concrete removals required to install replacement drains and reinforcement shall be performed with conventional chipping hammers. Saw-cutting or coring through slab NOT allowed. Do not cut existing reinforcement.
5. Drains shall be installed as shown on Detail 25.2.
6. Contractor shall set and verify all final drain elevations to ensure proper drainage and provide minimum 1% slope to maximum of 2% slope on floor surfaces. Notify Engineer of any discrepancies prior to placing concrete. No ponding allowed.

WI 25.3 MECHANICAL – PIPE & HANGERS

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to connect new floor drains installed per W.I. 25.2 to existing drainage system. Refer to Detail 25.3 for specific requirements.
2. Payment for this Work Item shall be per lineal foot of piping installed as required, including all associated incidental work required on Detail 25.3.
3. This work occurs only as needed to connect new drains installed per W.I. 25.2. Any dis-connecting or replacement of piping due to debris

collection/filtering/removal per W.I. 3.7 shall be incidental and not eligible for payment under this Work Item.

B. Materials

1. Approved materials for this Work are as shown on Detail 25.3.
2. Match existing pipe sizes (verify in field prior to submitting Bid).

C. Execution

1. Contractor shall locate and mark all areas where floor drain piping and hangers are to be installed.
2. Pipes and hangers shall be installed as shown on Detail 25.3 and in accordance with all applicable codes and ordinances.

WI 30.1 PATCH GROUT AT PERMANENT SHORES

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals to remove unsound/deteriorated grout, and replace with new grout. See Detail 30.1 for general requirements.
2. Payment shall be per each location.

B. Materials

1. Grout Material:
 - a. Five Star Grout (High Performance Precision Non-Shrink/Non-Sag Grout)
Five Star Products Inc.
750 Commerce Dr.
Fairfield, CT 06825
 - b. Engineer-approved equivalent 5,000 psi Non-shrink, Non-sag grout.

C. Execution

1. This work occurs as needed throughout the structure at the existing permanent shores. See Detail 30.1 for typical condition. Locate repairs in field with Engineer.
2. Remove all live loads from tributary areas above, and install temporary shoring as directed by Engineer per W.I. 18.2.
3. Remove deteriorated grout and replace with new grout material to restore to original condition.

WI 37.1 REPLACE ROOF LEVEL DOORS AND FRAMES

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to remove existing metal doors and frames and install new doors and frames to match original condition. Door and frame shall be installed level and plumb, and all surrounding joints sealed and finished. Door shall be provided in galvanized finish, painted to match existing colors, including level number indicators on both sides (incidental).
2. Payment shall be per each location of door/frame replacement on the roof level (9 total locations).

B. Materials

1. Approved materials for this Work:
 - a. Metallic-Coated Steel Sheets: ASTM A 653, Commercial Steel, Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
 - b. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1) Level 3 and Physical Performance Level A (Extra Heavy Duty), Model.
 - c. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
 - d. Frames of 0.053-inch thick steel.
 - e. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.
 - f. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.
 - g. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.
 - h. Provide lever-type door hardware per ADA requirements.
 - i. Steel Doors and Frames – Acceptable Manufacturers:
 - 1) Amweld Building Products, Inc.
 - 2) Benchmark Commercial Doors; a division of General Products Co., Inc.
 - 3) Ceco Door Products; a United Dominion Company.
 - 4) Copco Door Co.
 - 5) Curries Company.
 - 6) Deansteel Manufacturing, Inc.
 - 7) Kewanee Corporation (The).

- 8) Mesker Door, Inc.
- 9) Pioneer Industries Inc.
- 10) Republic Builders Products.
- 11) Steelcraft; a division of Ingersoll-Rand.

j. Submit shop drawings for approval prior to ordering/fabricating materials.

- 4. Contractor responsible to verify existing door and frame dimensions in field prior to ordering/fabrication.

C. Execution

- 1. Contractor shall coordinate door and door frame replacement work with Owner.
- 2. Contractor is responsible for securing stair tower work areas during work. Do not allow public access to work area, but keep remainder of stair tower open during work. See requirements of W.I.'s 1.5 and 1.6, and phasing requirements shown on Drawings.
- 3. Contractor shall install and finish door completely, including final painting. Door shall be installed plumb and level, and shall be permanently fixed in door opening with appropriate anchors, shims and necessary hardware.
- 4. Submit shop drawings and samples for Owner/Engineer approval of all materials, hardware, anchors, colors, etc. prior to ordering or fabricating.

WI 41.1 STAIR REPAIR – LANDINGS

- A. Refer to Work Item "Concrete Floor Repair" for similar scope of Work, materials, and procedures. See Detail 41.1 for further requirements.
- B. Locate repairs in field with Engineer.
- C. Contractor may close (1) stair tower at a time to complete landing repairs. Elevators shall remain open for normal use at all times.

WI 41.2 STAIR REPAIR – TREAD NOSINGS

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate existing spalled or delaminated stair nosing, removal of embedded metal nosing, removal of deteriorated and unsound concrete, prepare cavities, install reinforcement and install patching material. Refer to Detail 41.2 for specific requirements.
 - 2. Contractor may close (1) stair tower at a time to complete repairs. Elevators shall remain open for normal use at all times.

B. Materials

1. Repair materials shall be as specified in Section "Cast-in-Place Concrete" or "Pre-Packaged Repair Mortar".

C. Execution

1. Locate treads to be repaired in field with Engineer. Removal of embedded metal nosings is incidental.
2. Contractor shall locate and mark all Work areas as specified in Section "Surface Preparation for Patching and Overlay" Article "Inspection."
3. Procedure for delaminated, spalled and unsound concrete removal shall be as specified in Section "Surface Preparation for Patching and Overlay" Article "Preparation." Remove all unsound concrete within marked boundary prior to saw-cutting and preparation of patch edges.
4. Engineer shall inspect all cavities for condition according to Section "Surface Preparation for Patching and Overlay" 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 and Overlay" Article "Cleaning of Reinforcement within Delamination and Spall Cavities," and damaged and defective reinforcement replaced as specified in Section "Surface Preparation for Patching and Overlay" Article "Reinforcement and Embedded Materials in Repair Areas." Exposed steel shall be coated with an approved corrosion inhibitor coating in Work Item "Concrete Reinforcement."
6. Contractor shall prepare cavities for patch placement as specified in Section "Surface Preparation for Patching and Overlay" Article "Preparation of Cavity for Patch Placement."
7. Patch materials and associated reference specifications are listed in Work Item "Concrete Floor Repair," Article "Materials," above. Patch installation procedures shall be in accordance with referenced specifications for selected material.
8. Repaired tread surfaces shall have surface slope of up to 1%. Confirm in field with Engineer prior to placing concrete.

WI 42.1 REMOVE PERIMETER METAL GRILLE @ GROUND LEVEL (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, remove, and dispose of existing perimeter metal grille system around the ground level of the structure. See Detail 42.1 for further requirements. See Drawing R-001 for key plan of typical locations for this Work.
2. Contractor shall close localized adjacent parking stalls on the interior of the structure as needed to complete work, as well as sidewalk on exterior of structure. Coordinate all localized closures with Owner prior to start of Work.
3. This Work includes removal of all existing anchors and cutting flush and coating to prevent corrosion (incidental).

4. This work also includes tuckpointing interior and exterior sides of the mortar bed joints as shown on Detail for entire length of work, and replacing sealant at all capstone butt joints.
5. Perform this work in conjunction with W.I. 42.1A as applicable. It is the intent of the Owner to minimize capstone replacement work. Every reasonable effort shall be made by the contractor to preserve existing capstones that are in salvageable condition.

B. Materials

1. Corrosion Inhibitor: Sika Armatec, or Engineer-approved equivalent.
2. Tuckpointing Mortar: See W.I. 76.3.
3. Capstone Sealant: See Section "Concrete Joint Sealants".

C. Execution

1. Locate repairs in field with Engineer. Perform removal of metal grille system to not damage existing construction to remain.
2. Remove all existing anchors and cut flush. Install corrosion inhibitor on exposed metal surfaces.
3. Replace existing damaged capstones as needed per Alt. W.I. 42.1A.
4. Tuckpoint full length of masonry bed joints beneath capstones (interior and exterior sides) as shown on Detail (incidental). Refer to W.I. 76.3 for tuckpointing requirements.
5. Replace and install sealant at all new and existing capstone butt joints (incidental). Refer to W.I. 76.1 for similar sealant requirements.

WI 42.1A REPLACE CAPSTONES

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install properly cut, fabricated and prepared replacement capstone unit to its original building location in a square and plumb "like original" condition.
2. Pay unit = each replacement capstone (4'-0" in length, with profile/thickness to match existing). Field-cut new capstones to provide length as needed (incidental).
3. See Detail 42.1A for existing capstone dimensions/conditions (provided for reference only, Contractor responsible to verify in field).
4. Work includes removing existing stone anchors and installing new stainless steel stone anchors for replacement capstones.

B. Materials

1. Match existing size, shape, thickness, color, texture, etc. of existing capstones. Provide samples for Owner approval prior to proceeding.

C. Execution

1. Contractor shall locate and verify with Engineer/Architect all existing capstone units for replacement.
2. Submit stone sample to Owner for approval prior to ordering materials.
3. Contractor shall provide pedestrian and vehicular protection as needed.
4. Set new capstones in full bed of mortar.

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. Traffic markings shall match all existing markings and be provided at same locations. Contractor shall be responsible for verifying and recording existing traffic marking layout prior to start of Work.
4. Work includes all traffic markings in bays 5 & 6 on levels 1-5, and all other areas in the structure where markings are affected by the project including, but not limited to:
 - a. Areas on level 1 used for contractor staging/storage/parking/access/etc.
 - b. Contractor path of access in and out of structure and to/from work areas (all affected levels and bays).
 - c. Areas where dust/debris have accumulated.
 - d. Areas of new traffic topping and areas of traffic topping repair and recoating.
 - e. All locations where existing Traffic markings are affected by project due to debris removal, cleanup procedures, equipment/material storage, construction traffic, deliveries, etc.
5. Perform this work to comply with parking space closure requirements as specified on Drawings. New traffic markings shall be installed in all work areas prior to re-opening for normal use.
6. Remove existing stripes in those locations where they conflict with new striping layout.

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 striping 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 45.2 PAINT COLUMNS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, layout, prepare and paint all surfaces of all existing concrete columns on all levels of the parking structure.
2. Included in this work is providing localized protection around work areas to contain dust/debris/water/overspray within work areas. Comply with phasing and parking space closure requirements shown on Drawings. Submit proposed phasing plan to Owner for approval.
3. See Section 099113 and Detail 45.2 for further requirements.
4. Contractor shall not damage the surrounding patron's vehicles or WSU property with airborne, excess, and/or spilled paint, or debris/water from surface preparation. Any property damage shall be restored to its original condition and appearance at no cost to the Owner.
5. Protect all existing adjacent architectural elements including, but not limited to: light fixtures, exit lights, pull alarms, signs, conduit, security cameras, elevators, vehicle barriers and permanent shores, user vehicles, and all other existing features and property within the structure. Cleaning or repair/replacement of Contractor-caused damage to any existing features or property shall be performed by Contractor at no additional cost to Owner.

B. Materials/Execution

1. See Section 099113.

WI 45.3 PAINT – EXTERIOR BUMPER WALLS (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, layout, prepare and paint surfaces of exterior concrete bumper walls on all supported levels of the south, east, and north elevations of parking structure.
2. Payment for this Alternate Work Item, if accepted, shall be lump sum to paint the exterior vertical surfaces of all perimeter concrete bumper walls on the south, east, and north elevations, all levels.
3. Included in this work is providing localized protection around work areas to contain dust/debris/water/overspray within work areas. Comply with phasing and parking space closure requirements shown on Drawings. Submit proposed phasing plan to Owner for approval.
4. Also included in this work is manlifts or other means of access, and providing and maintaining overhead protection above sidewalks, roadways, vehicle entry/exits, pedestrian entrance, etc.
5. See Section 099113 for further requirements.
6. Contractor shall not damage the surrounding patron's vehicles or WSU property with airborne, excess, and/or spilled paint, or debris/water from surface preparation. Any property damage shall be restored to its original condition and appearance at no cost to the Owner.
7. Protect all existing adjacent architectural elements including, but not limited to: light fixtures, exit lights, pull alarms, signs, conduit, security cameras, elevators, vehicle barriers and permanent shores, user vehicles, and all other existing features and property within the structure. Cleaning or repair/replacement of Contractor-caused damage to any existing features or property shall be performed by Contractor at no additional cost to Owner.

B. Materials/Execution

1. See Section 099113.

WI 45.4 PAINT – PERMANENT SHORES (ALTERNATE)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to locate, layout, prepare and paint surfaces of previously-painted steel permanent shores. Pay unit = each permanent shore. Locate in field with Engineer. This work only applies to previously-painted permanent shores; hot-dipped galvanized shores are not to be painted.

2. Included in this work is providing localized protection around work areas to contain dust/debris/water/overspray within work areas. Comply with phasing and parking space closure requirements shown on Drawings. Submit proposed phasing plan to Owner for approval.
3. See Section 099113 and Detail 45.4 for further requirements.
4. Contractor shall not damage the surrounding patron's vehicles or WSU property with airborne, excess, and/or spilled paint, or debris/water from surface preparation. Any property damage shall be restored to its original condition and appearance at no cost to the Owner.
5. Protect all existing adjacent architectural elements including, but not limited to: light fixtures, exit lights, pull alarms, signs, conduit, security cameras, elevators, vehicle barriers and permanent shores, user vehicles, and all other existing features and property within the structure. Cleaning or repair/replacement of Contractor-caused damage to any existing features or property shall be performed by Contractor at no additional cost to Owner.

B. Materials/Execution

1. See Section 099113.

WI 50.1 SIGNAGE

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout, and provide/install signage as shown on AG Drawings. Payment shall be lump sum to provide and install new signs at all locations shown on Drawings, and remove existing signage as noted below. This work includes:
 - a. Providing and installing the following aluminum signs:
 - 1) "Exit Stairway" signs, S1, Detail 1/AG-201.
 - 2) "Elevator Lobby" signs, S2, Detail 2/AG-201.
 - 3) Stair level designation signs, S3, Detail 3/AG-201.
 - 4) Level/bay designation signs, S5, Detail 5/AG-201.
 - 5) Level designation signs with braille and raised characters, S6, Detail 6/AG-201.
 - 6) "Exit" signs, S7, Detail 8/AG-201.
 - b. Removing all existing bay/level designations that are painted on concrete columns. Contractor to verify existing layout and quantity in field. Perform paint removals in manner to not damage concrete surface. Perform 1 trial location for Owner approval prior to proceeding.

- c. Removing and disposing of existing conflicting or outdated aluminum signs.
 - 1) Amount and location of existing signs to be removed shall be confirmed in field with Owner/Engineer. For bidding purposes, assume a total of 200 existing signs require removal/disposal. Typical condition of existing signs to be removed is aluminum signs mounted to concrete columns, similar to the new signs being provided by this Work Item.
- B. Contractor to submit shop drawings for approval of all signs prior to fabrication. Submit 1 sample of all signs for Owner/Engineer approval prior to fabricating remaining signs.
- C. See AG Drawings and Section 101400 for further requirements.

WI 50.1A SIGNAGE – PAINT COLUMN BANDS (ALTERNATE)

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout, and paint color-coded bands on concrete columns as shown on AG Drawings. Payment for this Alternate Work Item, if accepted, shall be lump sum to paint color-coded bands at all locations shown on AG Drawings. See Detail 5/AG-201.
- B. Paint shall be exterior-grade, low-gloss, two-part acrylic polyurethane, by Carboline, Tnemec, PPG, or Sherwin Williams.
- C. Submit paint samples for Owner approval, and install 1 mockup for each different color. Obtain Owner approval prior to proceeding.
- D. If this Alternate Work Item is accepted, painting of column bands shall be completed before installation of Base Bid "S5" aluminum signs.
- E. See AG Drawings and Section 101400 for further requirements.

WI 50.1B SIGNAGE – EXIT SIGNS (F5) (ALTERNATE)

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install new exit signs at locations indicated on AG Drawings and as directed by Engineer. Removal and disposal of existing signs is incidental to this work. Payment for this Alternate Work Item, if accepted, shall be per each exit sign. See light fixture schedule on Drawing AG-201 (sign mark S7).

- B. Exit Signs: Exit signs shall be provided as shown on Drawings and listed in Exit Light Fixture Schedule on Drawing AG-201. All exit signs shall be vandal resistant, tamper resistant, self contained units, and UL approved for wet locations.
- C. Remove and dispose of all existing exit signs if this Alternate work is accepted (incidental).
- D. Any conduit/wiring repair or replacement required to disconnect existing exit signs and connect new exit signs is incidental. Contractor to verify requirements in field.
- E. Comply with manufacturer's written requirements and all applicable laws, codes, and ordinances. PVC conduit shall be schedule 80.

WI 50.1C SIGNAGE – EXIT SIGNS (F5A) (ALTERNATE)

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide and install new exit signs at locations indicated on AG Drawings and as directed by Engineer. Removal and disposal of existing signs is incidental to this work. Payment for this Alternate Work Item, if accepted, shall be per each exit sign. See light fixture schedule on Drawing AG-201 (sign mark S8).
- B. Exit Signs: Exit signs shall be provided as shown on Drawings and listed in light fixture schedule. All exit signs shall be vandal resistant, tamper resistant, self contained units, and UL approved for wet locations.
- C. Remove and dispose of all existing tritium exit signs if this Alternate work is accepted (incidental). Disposal shall comply with all USNRC regulatory requirements, including properly transferring the signs to a "specific licensee", such as an approved manufacturer, distributor, licensed radioactive waste broker, or licensed low-level radioactive waste disposal facility. Contractor required to coordinate removal and disposal with "specific licensee" before removing any tritium signs.
 - 1. Within 14 days of disposal, provide written report of all disposal procedures to WSU for submission to the NRC.
- D. Comply with manufacturer's written requirements and all applicable laws, codes, and ordinances.

WI 50.1D SIGNAGE – LEVEL INDICATION AT STAIRS (ALTERNATE)

- A. Scope of Work
 - 1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate, layout, and provide/install signage as shown on

AG Drawings. Payment for this Alternate Work Item, if accepted, shall be per each sign.

- a. Sign mark S4, Detail 4/AG-201.
- B. Contractor to submit shop drawings for approval of all signs prior to fabrication. Submit 1 sample of all signs for Owner/Engineer approval prior to fabricating remaining signs.
- C. Confirm mounting height and location in field with Owner/Engineer.
- D. See AG Drawings and Section 101400 for further requirements.

WI 76.1 MASONRY – REPLACE FAÇADE SEALANTS (WEST ELEVATION)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to locate existing sealants, remove existing joint sealant material and compressible filler/backing materials, prepare substrate, including removal of any debris/material within the joints, and install new backer rod, bond breaker and flexible joint sealant material. Refer to Detail 76.1 for specific requirements.
2. Manlifts of other means of access to work areas is incidental to this work. Submit proposed method for Owner/Engineer approval. Repair surrounding areas (sidewalks, lawn, landscaping, etc.) to existing condition, incidental to this work.

B. Materials

1. Single-Component Neutral-Curing Silicone Sealant:
 - a. Available Products:
 - 1) Dow Corning Corporation; 790.
 - 2) GE Silicones; SilPruf LM SCS2700.
 - 3) Tremco; Spectrem 1 (Basic).
 - b. Type and Grade: S (single component) and NS (nonsag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (non-traffic).
 - e. Uses Related to Joint Substrates: M, G, and, as applicable to joint substrates, O.
2. Backer rods, sealants, compressible closed cell foam filler, and bond breaker tape shall be as specified in Division 07 Section "Concrete Joint Sealants" and manufacturer's recommendations.
3. Color shall match surrounding masonry to satisfaction of Owner. Install mockup(s) for Owner approval prior to proceeding.

C. Execution

1. Contractor shall locate and mark all joints requiring sealant replacement as shown on Drawings. Confirm in field with Engineer.
2. Contractor shall remove existing joint sealant and filler/backing material. Care shall be taken not to damage adjacent masonry or architectural features.
3. Any debris/material within the joint shall be removed.
4. Joint shall be thoroughly cleaned by grinding to remove all mortar, residual joint filler material, joint sealant material, and unsound brick and/or masonry. Joint shall be air blasted to remove remaining debris.
5. Damage to surrounding brick shall be repaired by Contractor at no cost to Owner.
6. Contractor shall install new compressible filler backer rod and joint sealant in accordance with Details and manufacturer's recommendations.
7. Adjoining masonry surfaces on both sides of joint shall be protected/masked prior to sealing joint. Remove protection/masking material upon completion of sealing joint.
8. Sealed joints shall be neat in appearance. Poorly sealed or improperly sealed joints shall be removed and replaced at Contractor's expense.

WI 76.2 MASONRY – ROUTE/SEAL FAÇADE CRACK

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 façade assembly. Refer to Detail 76.2 for specific requirements. Locate repairs in field with Engineer. This work typically occurs on the exterior of the stair tower walls that face the interior of the parking structure.

B. Materials

1. Single-Component Neutral-Curing Silicone Sealant:
 - a. Available Products:
 - 1) Dow Corning Corporation; 790.
 - 2) GE Silicones; SilPruf LM SCS2700.
 - 3) Tremco; Spectrem 1 (Basic).
 - b. Type and Grade: S (single component) and NS (nonsag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (non-traffic).
 - e. Uses Related to Joint Substrates: M, G, and, as applicable to joint substrates, O.
2. Backer rods, sealants, compressible closed cell foam filler, and bond breaker tape shall be as specified in Division 07 Section "Concrete Joint Sealants" and manufacturer's recommendations.

3. Color shall match surrounding masonry to satisfaction of Owner. Install mockup(s) for Owner approval prior to proceeding.

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 (rebar locator). Determine depth of electrical conduit (metal or plastic). Do not exceed this depth of routing where the crack to be repaired crosses the embedded items. Damage to embedded items will require repair or replacement at no cost to the Owner.
2. Cracks 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 76.3 MASONRY – 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 brick work. Refer to detail 76.3 for specific requirements. Locate repairs in field with Engineer. This work typically occurs on the exterior of the stair tower walls that face the interior of the parking structure.

A. Materials

1. Portland Cement: ASTM C 150, Type I or II.
2. Quicklime: ASTM C5; pulverized lime.
3. Hydrated Lime: ASTM C 207, Type N.
4. Aggregate for Mortar: ASTM C 144; except for joints less than 0.25 in., use aggregate graded with 100% passing the No. 16 sieve.
5. Water: Potable
6. Mortar shall match existing color. Install mockup(s) for Owner approval prior to proceeding.

B. Execution

1. Contractor shall locate and mark all Work areas. Engineer/Architect shall verify locations prior to start of Work.
2. Joints to be tuckpointed shall be cut back to depth of 0.75 in., 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.
3. Contractor shall flush all mortar joints thoroughly with clean water under pressure prior to tuckpointing to remove all dust, dirt, and laitance. Brick 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.
 4. Tuckpointing shall be performed using Type N mortar in accordance with ASTM C270 using specified materials.
 5. Match existing mortar color. Mortar shall be dry and mixed thoroughly prior to adding water. Add one-half required mixing water and allow to stand 1 hour, 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 brick shall be repaired by Contractor at no cost to Owner.

WI 80.1 REMOVE/REPLACE FACE BRICK

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary for local brick removal and replacement due to fractures, cracks, broken or unsound brick. Refer to Detail 80.1 for specific requirements. Locate repairs in field with Engineer. This work typically occurs on the exterior of the stair tower walls that face the interior of the parking structure.

B. Materials

1. Match existing size, shape, color, texture, etc. of existing brick. Provide samples for Owner approval prior to proceeding.

C. Execution

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

- Engineer/Architect shall inspect all cavities for condition prior to commencement of new construction.
5. New brick veneer shall be anchored to backing with flexible metal ties embedded in masonry joints and attached to existing structure. Space veneer anchors at 16 in. o.c. vertically. Horizontal anchor spacing shall not exceed 24 in. o.c. Existing veneer anchors not damaged during brick removal may be reused at Contractor's option. Clean existing anchors prior to replacing brick veneer.
 6. Flush cavity thoroughly with water to remove all dust and laitance prior to brick replacement. Take all necessary precautions to prevent water from entering cavity space during cleaning operations. Allow excess water to run off. New brick or existing brick removed from building shall be laid in full bed of mortar while wall is still damp. All brick repair work shall be flush with existing.
 7. New brick work is to be toothed into existing brick work.
 8. All bed and head joints shall be fully filled with mortar. Collar joints shall remain clear of mortar in single wythe veneer construction. For multi-wythe brick construction, fill collar joints.
 9. Prior to initial set of mortar, tool joints to match existing.
 10. Adequate weather protection shall be installed over all areas left open at completion of each day's work.
 11. Allow 3 to 7 days for mortar to harden prior to cleaning of brick wall.
 12. Dispose of all accumulated material and leave premises in clean condition.
 13. Masonry surfaces that become dirty or smeared during joint cutting and repointing of joint surfaces shall be cleaned with bristle brushes and plain water.
 14. Unnecessary damage to surrounding brick shall be repaired by Contractor at no cost to Owner.

END OF SECTION 020010

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SECTION 024110 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of the structure or site elements. Refer to Drawings and Sections 025130, 025140, and 020010 for specific requirements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B. Owner retains right of refusal for all existing items/elements on site that are to be removed (specifically mentioned on Drawings or not) prior to disposal. When in doubt, Contractor shall verify requirements with Owner prior to removal/disposal.

1.5 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers and owners, and other information specified.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Contractor shall provide schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 01 Sections.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site prior to start of Work, with all parties involved in demolition work and cleanup present. Coordinate pre-

demolition conference with other scheduled meetings/site visits. Review methods and procedures related to selective demolition including, but not limited to:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations. Refer to phasing and work schedule requirements on drawings.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practical.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate ADA-compliant routes around closed or obstructed traffic ways if required by governing regulations.
 2. Erect temporary protection, such as walks, fences, railings, canopies, covered passageways and vehicular barriers, where required by authorities having jurisdiction. Temporary barriers and controls shall meet the occupancy requirements of each side of the barrier.
 3. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect equipment and other features that have not been removed.
- C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
- D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- E. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to

remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain. **Do not cut existing embedded reinforcement.**
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Torches (if applicable): Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
 9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with WSU's requirements for using and protecting elevators, stairs, walkways, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished. Neatly trim openings to dimensions indicated.
- G. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

- B. Patching: Comply with applicable Division 02 and Division 03 Sections.
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Refer to Drawings and Specifications for specific work requirements, and corresponding phasing and schedule requirements.

END OF SECTION 024110

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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° of perpendicular of finished surface.
- C. **SPALLS:** Potholes, cavities or voids in concrete. Usually result of delamination migrating to face of concrete member. When fracture finally reaches surface, concrete encompassed by delamination breaks away, resulting in spall.
- D. **UNSOUND CONCRETE:** Concrete exhibiting one or more of:
 - 1. Incipient fractures present beneath existing delaminated or spalled surfaces.
 - 2. Honeycombing.
 - 3. Friable or punky areas.
 - 4. Deterioration from freeze-thaw action.
- E. **SCALING:** Deterioration which attacks mortar fraction (paste) of concrete mix. First appears as minor flaking and disintegration of concrete surface. Scaling eventually progresses deeper into concrete, exposing aggregate which breaks away.
- F. **SHOTBLASTING:** Scarification of concrete surfaces using an abraded metal shot-rebound. See ICRI Guideline 03732 "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays."

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 025130

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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 delaminated and unsound concrete, existing failed patches, surface spalls and potholes, and preparation of cavities created by removal to receive concrete 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. "Concrete Repair Guide" (ACI 546R-04)

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 INSPECTION

- A. Floor Slabs:
 - 1. Floor slab delaminations: locate by sounding surface with hammer, rod, or chain drag.
 - 2. When delaminated area is struck, distinct hollow sound is heard.
 - 3. Contractor: sound all designated floors for delaminations.
 - 4. Certain structural systems that contain thin slab thicknesses with Welded Wire Reinforcement or other small diameter reinforcing, such as waffle slab or precast tees, may have significant deterioration without evidence of delaminations. These

structural systems require qualified personnel to provide additional inspections, primarily visual in nature, to define the extent of deterioration.

5. Contractor: Visually inspect thin slab thicknesses with small diameter reinforcing for deterioration.

B. Vertical and Overhead Surfaces:

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

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

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

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

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

- G. Contractor: Locate and determine depth of all embedded REINFORCEMENT and ELECTRICAL CONDUIT in repair area and mark these locations for reference during concrete removal. Do **NOT** nick, cut, or damage any embeds.

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

3.2 PREPARATION

- A. **Temporary shoring may be required at concrete floor repair areas and at any beam, joist, or column repair. Contractor: Review all marked removal and preparation areas and request clarification by Engineer/Architect of shoring requirements in questionable areas. Shores shall be in place prior to concrete removal and cavity preparation in any area requiring shores.**

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

chipping shall continue until all unsound and delaminated concrete has been removed from cavity.

1. All work shall comply with OSHA Crystalline Silica Requirements.
- 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/Architect directs.
- E. Sawcut patch boundaries to depth of 0.75 in. into floor slab, unless otherwise noted. No saw-cutting required at boundaries abutting existing vertical surface (wall, beam, curb, etc.). For vertical and overhead surfaces, marked boundary may be sawcut, ground or chipped to depth of 0.5 in. to 0.625 in. into existing concrete, measured from original surface. All edges shall be straight and patch areas square or rectangular-shaped. Diamond blade saw or grinder with abrasive disk suitable for cutting concrete is acceptable for performing work. Edge cut at boundary shall be dressed perpendicular to member face. It shall also be of uniform depth, for entire length of cut. Exercise extra caution during saw-cutting to avoid damaging existing reinforcement and electrical conduit and any other embedded items near surface of concrete. Any damage to existing embedded reinforcement or conduit during removals shall be repaired by Contractor with Engineer/Architect-approved methods at no additional cost to Owner.
- F. All sound surfaces (surfaces not requiring spall or delamination repair as previously discussed in this section) to receive repair material shall be heavy abrasive blasted or heavy shot-blasted prior to placement of repair material, to produce a final concrete surface profile matching ICRI CSP 8 or above.

3.3 INSPECTION OF REPAIR PREPARATION

- A. After removals are complete, but prior to final cleaning, exposed concrete surfaces and exposed reinforcement shall be inspected by Contractor and verified by Engineer/Architect for compliance with requirements of this Section. Where Engineer/Architect finds unsatisfactory surface or cavity preparation, Engineer/Architect shall direct Contractor to perform additional removals. Engineer/Architect shall verify areas after additional removals.
- B. Contractor shall inspect embedded reinforcement and conduits exposed within cavity for defects due to corrosion or damage resulting from removal operations. Contractor shall notify Engineer/Architect of all defective and damaged reinforcement or conduits. Replacement of damaged or defective reinforcement or conduits shall be performed according to this Section and as directed by Engineer/Architect.

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

3.4 REINFORCEMENT AND EMBEDDED MATERIALS IN REPAIR AREAS

- A. All embedded reinforcement exposed during surface preparation that has lost more than 15% (10% if 2 or more consecutive parallel bars and/or tendons are affected) of original cross-section due to corrosion shall be considered DEFECTIVE. All non-defective exposed reinforcement that has lost section to extent specified above as direct result of Contractor's removal operations shall be considered DAMAGED.
- B. **Embedded materials** including, but not limited to, 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 Division 03 specification Sections.
- D. Loose and supplemental reinforcement exposed during surface preparation shall be securely anchored prior to concrete placement. Loose reinforcement shall be adequately secured by wire ties to bonded reinforcement or shall have drilled-in anchors installed to original concrete substrate. Drilled-in anchors shall be Powers "Tie-Wire Lok-Bolt" anchors, ITW Ramset/Red Head "TW-1400" anchor, or approved equivalent. Supplemental reinforcing needed to be held off substrate shall be adequately secured by drilled-in anchors installed to original concrete substrate with Powers "Tie-Wire Spike", ITW Ramset/Red Head Redi-Drive "TD4-112" anchors, or approved equivalent. Engineer/Architect will determine adequacy of wire ties and approve other anchoring devices prior to their use. Securing loose and supplemental reinforcement is incidental to surface preparation and no extras will be allowed for this Work.
- E. Concrete shall be removed to provide minimum of 3/4 in. clearance on all sides of 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 concrete placement to insure that base metal is not exposed to elements and further rusting for extended periods of time. Clean entire bar diameter be cleaned.
- B. After all sandblasting operations and cleanup are completed, paint all exposed steel with an approved epoxy. Protect prepared surfaces from damage prior to and during concrete placement.

3.6 PREPARATION OF CAVITY FOR PATCH PLACEMENT

- A. Floor slab and cavity surfaces will be examined prior to commencement of concrete placement operations. Sounding surface shall be part of examination. Any delamination noted during sounding shall be removed as specified in this Section.
- B. Cavities prepared by chipping or other impact methods shall be sandblasted to remove material that may impair concrete bonding. Sound concrete surfaces shall be prepared by shotblasting as previously specified in this section. Airblasting is required as final step to remove all debris including sand and dust. All debris shall be removed from site prior to commencement of concrete placement, bonding agent preparation, etc. as specified in Division 03 Sections.

END OF SECTION 025140

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SECTION 025160 – HYDRO DEMOLITION SURFACE PREPARATION

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 and supervision necessary to remove existing concrete surface (partial depth) as shown on Drawings, using hydrodemolition, and preparation of exposed surfaces created by removal to receive overlay or strip patches.

1.3 SUBMITTALS

- A. Submit proof of manufacturer's certification for hydro-demolition operator(s), or provide information regarding operator(s) qualifications for Owner/Engineer approval.
- B. Submit layout details for installation of temporary water supply piping and piping for containment, filtering, and transportation of hydro-demolition waste water from work area to treatment facility to disposal site.
- C. Submit layout for treatment facility for hydro-demolition waste water. Include all containment tank locations and sizes; filtering devices, sizes, and locations; pump size, location, and electrical requirements; valve locations, piping sizes, and layout.
- D. Submit hydro-demolition equipment. Include robot size specification, supply water volume and pressure requirements, water consumption, exhaust location, and layout for high pressure pumps, high pressure supply hose specifications.

1.4 CALIBRATION AND TESTING OF HYDRODEMOLITION EQUIPMENT

- A. Trial area will be designated by Engineer/Architect to demonstrate that equipment, personnel and methods of operation are capable of producing results satisfactory to Engineer/Architect. Trial area shall consist of 2 sections, approximately 100 sq. ft. each.
- B. Adjust equipment as needed to remove concrete to depth shown on drawings. Multiple passes may be required.
- C. After completion of above test section, if sufficient result is obtained, parameters shall be used for production removal.

1.5 QUALITY CONTROL

- A. Work shall be performed under the immediate control of a person experienced in this type of Work. The person identified with immediate control of the Work shall have supervised verifiable projects of similar magnitude and type acceptable to Owner/Engineer.
- B. Person identified with immediate control of hydro-demolition Work shall be present on site during all operations.
- C. The hydro-demolition system shall be operated by a competent, trained individual, having experience with the machinery used for the performance of the hydro-demolition acceptable to Owner/Engineer.
- D. The Contractor shall perform and pay for testing of hydro-demolition waste water to ensure compliance with the City of Detroit water quality standards prior to depositing any waste water into the sanitary/storm system. **No waste water shall be deposited into sanitary/storm system that was not tested, or that does not comply with City of Detroit water quality standards.** Contractor shall be responsible to verify water quality standards with the City of Detroit prior to start of Work.
 - 1. Submit waste water testing results to Owner upon request.
- E. The Owner, as part of its quality assurance efforts, reserves the right to perform and will pay for independent testing of hydro-demolition waste water to ensure compliance with the City of Detroit water quality standards. This additional testing may be performed at any time during the construction process. The Owner will notify the Contractor immediately prior to taking any water samples so the Contractor may witness the procedure. If testing performed by the Owner reveals that the water quality is not within the acceptable standards, the Contractor shall bear the cost of this additional water quality testing.
- F. If any of the waste water quality test results are in non-compliance with specified water quality standards, the Contractor shall immediately cease the depositing of waste water into the sanitary/storm sewer system. Resumption of waste water removal through the use of the sanitary/storm sewer system will not be allowed to resume until the treatment system is modified to bring the waste water into compliance with the City of Detroit water quality standards. The Contractor shall bear the cost of any system modifications and additional testing required to verify that the water quality has achieved acceptable standards.
- G. Testing of the waste water for compliance with the City of Detroit water quality standards during hydro-demolition is the responsibility of the Contractor and shall be performed as required by the City of Detroit. The cost for this testing is incidental and shall be included as part of the Work.

1.6 PRE-APPROVED HYDRO-DEMOLITION CONTRACTORS

- A. American Hydro: Baltimore, MD. Phone: 410.574.8470.
- B. Rampart Hydro Services: Coraopolis, PA. Phone: 412.262.4511.
- C. Prepcon: Baltimore, MD. Phone: 410.265.6722.
- D. Great Lakes Hydro-demolition Services, Inc.: Bad Axe, MI. Phone: 989.213.3404
- E. 2X Hydro-Demolition, LLC: Strawberry Plains, TN. Phone: 502.645.7553.
- F. The Kilian Corporation: Mascoutah, IL. Phone: 636.343.9990.
- G. All other Hydro-demolition Contractors/Subcontractors: Submit qualifications along with Bid for Owner/Engineer review/approval.

1.7 PAYMENT

- A. See Proposal Form. Contractor shall not be compensated for any un-authorized excess concrete removed below the removal depth shown on the Drawings. See Drawings and Section "Work Items" for provisions for additional depth removals.
- B. Unit price payment shall be full compensation for all Work, equipment, materials, and incidentals required to complete concrete removals and surface preparation, including furnishing and appropriate handling of water, conventional chipping work as required in areas inaccessible by hydro-demolition equipment or to remove "shadows" beneath rebar, and required cleanup and surface preparation work, all as required to complete Work Items.

PART 2 - PRODUCTS

2.1 HYDRODEMOLITION EQUIPMENT

- A. Concrete removals shall be performed with approved water jet system utilizing high pressure water stream. Equipment shall be capable of removing concrete to depth specified on Drawings and shall be capable of removing all rust and laitance from exposed reinforcement designated to remain in place.
- B. Concrete removals shall be performed using Engineer/Architect-accepted hydrodemolition equipment.
- C. Hydrodemolition contractor: supply necessary equipment and manpower to maintain pre-established production rate and assure adherence to construction schedule shown on Drawings.
- D. Equipment shall be capable of performing bulk concrete removals as shown on Drawings.

- E. Hydro-demolition unit weight shall not exceed 8,000 lbs. See temporary shoring requirements for additional restrictions.
- F. At specified rebar location, hydrodemolition equipment shall be capable of removing 0.75 in. of concrete directly below reinforcement without removing excessive concrete volume between reinforcement.
- G. Hydro-demolition equipment and noise-producing operations shall only be performed within specified hours. Contractor shall be responsible to verify and comply with City of Detroit requirements, and to maintain compliance throughout entire Project. Contractor shall not be compensated for any additional work and/or extra provisions required to maintain noise level and working-hours compliance.
 - 1. Demolition/Construction Activities: 7:00am thru 7:00pm, 7 days a week.
 - 2. Cleanup Only (no demolition/construction activities): 7:00pm thru 9:00pm, 7 days a week.
 - a. Cleanup (non-noise activities) from 7:00pm thru 9:00pm, allowed only with Owner review/approval of sound levels to adjacent residences remaining within acceptable limits.
 - 3. No Work of any kind allowed from 9:00pm thru 7:00am, 7 days a week.

PART 3 - EXECUTION

3.1 LOCATION IDENTIFICATION AND MARKING OF WORK AREAS

- A. Boundaries of overlay or strip patch areas shown on Drawings shall be verified and marked by Contractor and Engineer. General repair locations are shown on plans.
- B. Floor Slabs:
 - a. Delaminations: locate by sounding surface with hammer, rod, or chain drag.
 - b. When delaminated area is struck, distinct hollow sound is heard.
 - c. Contractor: sound all designated floors for delaminations.
- C. Delaminated areas, once located by Contractor, shall be further sounded to define limits. Mark limits with chalk or paint.
- D. Contractor: locate spalls by visual inspection and mark boundaries with chalk or paint after sounding surface.
- E. Engineer/Architect will define and direct the Contractor to mark additional unsound concrete areas for removal, if required.
- F. Areas to be removed shall be bounded by straight edges and rectangular in shape as practical to encompass repair and provide neat patch. Sawcutting and vertical chipping may be required.

3.2 PRE-REMOVAL SHORING

- A. Temporary shoring is required at all concrete floor repair areas per W.I. 18.1 and Drawings and Specifications. Contractor: Review all marked removal and preparation areas and request clarification by Engineer of shoring requirements in questionable areas. Shores shall be in place and properly secured prior to concrete removal. Contractor: Provide positive means of adjustment of shores. See Drawings and Sections "Work Items" and "Cast-in-Place Concrete" for shoring requirements.

3.3 OPERATION OF HYDRODEMOLITION EQUIPMENT

- A. Once operating parameters of hydrodemolition equipment are defined and calibrated, they shall be maintained as machine progresses across parking deck, in order to prevent unnecessary removal of sound concrete below required minimum removal depth. Contractor shall exercise care to avoid removal of sound concrete below required depth, and make adjustments as needed.
- B. Operation of hydrodemolition equipment shall be performed by and supervised by qualified personnel, acceptable to Owner/Engineer.
- C. All water used for hydrodemolition shall be potable. Stream or lake water is prohibited. Contractor may **not** use available water supply within Parking Structure for hydro-demolition purposes. Contractor may obtain water supply from nearby City fire hydrants, in compliance with City requirements. Contractor shall be responsible for obtaining and paying for all City water connections including, but not limited to: metering, usage charges, and permits.
- D. Contractor is responsible for supplying all equipment and tools necessary to connect to and utilize the water source.
- E. Contractor shall install meters on hydrant(s) to monitor and record obtained water pressures (in addition to any metering requirements imposed by the City of Detroit). Water pressure readings at the hydrant(s) shall be taken and recorded regularly by the Contractor (minimum 3 times daily: 7-8am, 12-1pm, and 5-6pm) throughout the entire hydro-demolition process. If water pressure becomes too low for required production rates for typical industry standard hydro-demolition equipment, then Contractor shall record pressures at hourly intervals until adequate pressure has resumed, and submit to Owner immediately. Contractor must also notify Owner and Engineer immediately and continually during periods of low water pressure from the hydrants.
- F. Contractor is required to contact/notify City of Detroit immediately if service or repairs are required to maintain water supply in serviceable condition.
- G. Contractor shall provide and maintain booster pumps sized as needed to provide sufficient flow capacity to run hydro-demolition equipment at required production rates.
- H. Contractor shall provide for proper filtering and disposal of runoff water generated by hydrodemolition process. Contractor shall obtain all required permits and shall comply with applicable regulations concerning such water disposal. Contractor shall make

provision for control and safe handling of runoff water. All hydro-demolition waste water shall be treated and tested per the City of Detroit requirements prior to discharging into the sanitary/storm system.

- I. Unfiltered or untested water shall not be allowed to enter storm sewers, floor drains, or mix with other surface water.
- J. All water from the hydro-demolition and cleaning process must be contained within the construction barrier limits of the work areas. The remaining portion of the parking facility outside of the specified work areas will be operating under normal conditions. If any water escapes the designated work areas, hydro-demolition must be shut down immediately and water removed from occupied areas without delay. The construction barriers shall then be resealed to eliminate the leak prior to re-starting hydro-demolition operations.
- K. All waste water containment equipment required for the collection, clean up, filtering, treating, and transfer of waste water from the work area to the sanitary/storm sewer system shall be provided and maintained by the Contractor. Equipment includes, but is not limited to:
 - 1. Sediment tanks.
 - 2. Piping.
 - 3. Pumps.
 - 4. Hoses.
 - 5. Adjustment equipment for pH levels.
- L. Protect existing drains to prevent hydro-demolition run-off water from entering the parking structure's drainage system. Contractor is responsible for cleaning of drain lines, sumps, etc. as part of final cleanup.
- M. Contractor shall provide adequate lighting as required to perform removals.
- N. Contractor shall maintain, on job site, inventory of common wear parts and replacement accessories for equipment adequate to assure that routine maintenance tasks can be performed readily.
- O. Contractor shall adequately shield area of water-blasting to ensure concrete/debris projectiles resulting from water-blasting operation remain within work area barriers.
- P. Immediately after discharge of the last hydro-demolition waste water into the sanitary/storm sewer system, Contractor shall flush the sewer with potable water to verify the flow through the sewer pipe has remained unrestricted.

3.4 CONCRETE REMOVAL

- A. Install required barriers, perimeter protection, signage, and temporary shoring before beginning concrete removal work.

1. Hydro-demolition equipment shall be equipped with protective shroud(s) as needed to ensure all debris and flying projectiles are contained within the work areas.
- B. Prior to the start of hydro-demolition in each work area, Contractor shall perform a survey of the existing slab conditions to determine existing elevations and the existing low points of the slab for installation of temporary drains as needed for containment of hydro-demolition waste water within the Work areas.
- C. Contractor shall protect all features and surfaces from construction debris/slurry, and shall remove all debris/slurry on a regular basis. Any features or surfaces damaged during the hydro-demolition or cleaning process shall be repaired or replaced to the satisfaction of the Owner at no additional cost to the Owner.
- D. All concrete within marked boundaries shall be removed to minimum depth shown on Drawings using hydrodemolition techniques. Concrete shall be removed to depth of 0.75 in. below lowest top reinforcement. Removals shall be performed in manner that avoids excessive concrete removals between reinforcement.
- E. Provide vertical edge along perimeter of repair area and around perimeter of all columns. Care shall be exercised to avoid undermining columns at floor slab/column interfaces. Column cross section as minimum shall be same as above floor, throughout depth of slab.
- F. If floor delaminations exist beyond minimum removal depth, removals shall continue until all unsound and delaminated concrete has been removed from cavity.
- G. Any areas of prepared surface contaminated by oil or other materials detrimental to good bond as result of Contractor's operations shall require additional removals until clean surface is obtained, at no extra cost to Owner.
- H. At all locations where exposed reinforcement is designated to remain in place, exercise extra caution to avoid damaging it during removal of concrete. Any reinforcement damaged by Contractor's operations shall be repaired or replaced at no cost to Owner. Work Item 3.9 is included to supplement deteriorated reinforcement; replacement of reinforcement due to damage caused by Contractor is not applicable for payment.
- I. Remove concrete debris immediately after hydrodemolition process, to prevent debris from resettling or re-adhering to surface of remaining sound concrete. If debris build-up is observed, Contractor shall clean surface as directed by Engineer/Architect at no extra cost to Owner.
- J. Continuously remove from the site all concrete debris, sludge, slurry, and other materials generated by the Work, and legally dispose of all waste materials.
- K. Contractor: protect drains to prevent buildup of debris in drain lines. Install filters on floor drains and City storm/sanitary inlets as a minimum, and provide other means of protection as necessary to prevent hydro-demolition debris/slurry from entering existing drainage systems. Contractor: responsible for cleaning of drain lines, sumps, etc. as part of cleanup.

1. At Contractor's option and at no additional cost to Owner, Contractor may disconnect floor drains from existing piping system during repairs and reconnect prior to re-opening areas to parking. Verify with Engineer prior to start of Work.
- L. Removals in areas of deck that are not accessible for hydrodemolition operations shall be performed using conventional methods as specified in Section "Surface Preparation for Concrete Patching and Overlay." Inaccessible areas shall be brought to Engineer/Architect's attention before hydrodemolition begins.
- M. Contractor: Install protection as required to prevent hydro-demolition debris/slurry and water/dust from entering elevator systems. Contractor is responsible for any cleaning and/or repairs required to the elevator systems.
 1. If operation of elevators is affected by hydro-demolition work, Contractor shall pay for inspection of affected elevator by qualified personnel (WSU's approved elevator vendor), and any necessary repairs or cleaning required to restore elevator operation.

3.5 INSPECTION OF EXPOSED SURFACES AND REINFORCEMENT

- A. After removals are complete, but prior to final cleaning, all exposed concrete surfaces and all reinforcement designated to remain in place will be inspected by Engineer/Architect for compliance with requirements of Article "Reinforcement in Repair Areas." Where Engineer/Architect finds unsatisfactory surface preparation, Engineer/Architect will direct Contractor to perform additional removals. Engineer/Architect will re-inspect areas after additional removals.
- B. Obtain Engineer's approval of surface preparation minimum one day prior to concrete pours, no exceptions.**
- C. Engineer/Architect will inspect all reinforcement designated to remain in place within cavity for defects due to corrosion or damage resulting from Contractor's removal operations. Replacement of defective or damaged reinforcement shall be performed according to Article "Reinforcement in Repair Areas" and as directed by Engineer/Architect.
- D. After inspections are complete and all preparation accepted, Engineer/Architect and Contractor shall measure and document removal and replacement quantities for payment.

3.6 CLEANING OF REINFORCEMENT WITHIN REMOVAL AREAS

- A. All exposed reinforcement designated to remain in place shall be cleaned of rust and laitance to bare metal by hydrodemolition process. If for any reason hydrodemolition cannot clean reinforcement to bare metal, Contractor shall clean reinforcement by sandblasting. Contractor shall insure that base metal is not exposed to elements and further rusting before completion of repairs.

3.7 REINFORCEMENT IN REPAIR AREAS

- A. **Do not cut any existing embedded reinforcement without Engineer's approval on case-by-case (individual bar) basis.** All exposed reinforcement designated to remain in place that have lost more than 15% (10% if 2 or more consecutive parallel bars 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.
- 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 reinforcing bars shall be ASTM A615 Grade 60 steel installed in accordance with Division 03 Sections."
- D. Loose reinforcement designated to remain in place shall be securely anchored to original surface prior to overlay placement. Loose reinforcement shall be adequately secured by wire ties to bonded reinforcement or shall have drilled-in anchors installed to original deck at 4 ft. intervals maximum. Engineer/Architect shall determine adequacy of wire ties and approve other anchoring devices prior to their use. **Tying loose reinforcement to bonded reinforcement and securing loose reinforcement with drilled anchors is incidental to surface preparation; no extras will be allowed for this Work.**
- E. Concrete shall be removed to provide minimum of 0.75 in. clearance on all sides of exposed embedded reinforcement designated to be left in place. **Concrete "shadows" remaining underneath reinforcement shall be removed by conventional chipping hammers as needed (incidental).** Minimum of 1.5 in. concrete cover shall be provided over all new and existing floor 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.

3.8 FINAL PREPARATION OF SURFACES FOR OVERLAY OR STRIP PATCH PLACEMENT

- A. Prior to placement of new concrete, exposed concrete surface to be overlaid shall be waterblasted to remove **all** laitance, oil, grease, rust, debris, or other foreign material. Water jet pressure of waterblasting equipment shall have minimum operating pressure of 8000 psi with minimum flow rate of 18 gal/min working at 8 in. from concrete surface. Waterblasting shall be done sufficiently ahead of bonding grout placement to permit surface to become dry.
- B. Floor slab and cavity surfaces will be examined by Engineer/Architect prior to strip patch placement. Where Engineer/Architect finds unsatisfactory surface preparation,

Engineer/Architect will direct Contractor to perform additional work to obtain satisfactory surface preparation.

END OF SECTION 025160

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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 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, 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 Admixture: See Part 2 Article "Admixtures."
 - 4. High strength: See General Notes on Drawings.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Make submittals in accordance with requirements of Division 01 Sections
- 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 will in turn reimburse Engineer.

C. 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.

D. 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. Curing materials
 - g. Floor and slab treatments
 - h. Bonding agents
 - i. Vapor barriers/reducer
 - j. Repair materials
2. Submit certification that curing compound or evaporation reducer, if used, is compatible with products specified in Division 07 and Division 09 Sections.

E. 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.

F. 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 Services-Performance and Design Criteria", 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 calculations and dimensions for "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification "Expansion Joint Assemblies".
 5. Submit signed and sealed drawings, calculations, specifications, or other submittals to indicate compliance with the applicable performance and design criteria provided.
- G. 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 as soon as possible after award of contract, but 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, 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 7 and 28 days, ASTM C39.
 - l. Water soluble chloride ion content of concrete: ASTM C 1218.
 - m. Rapid Chloride Permeability test results per ASTM C 1202.
 - n. Certificate of analysis of coal fly ash or processed ultra-fine fly ash: Comply with ASTM C618, Class F.
- H. 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. Concrete temperature at placement time. ASTM C 1064.
 - 6. Air temperature at placement time.
 - 7. Strength determined in accordance with ASTM C 39.
 - 8. Calcium Nitrite presence in plastic concrete: See Part 3 heading, "Quality Control."
- I. Contractor: Submit grout temperature limitations with grout submittal.
- J. Submit current certification of welders.
- K. 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.
- L. Submit samples of materials as requested by Engineer, including names, sources, and descriptions.
- M. Submit laboratory test reports for concrete materials and mixtures.

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 and shoring, 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.
 - 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.
 - B. Design the "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification Section "Expansion Joint Assemblies".

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. At least 15 days prior to 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
 - 8. Owner's representative.
 - 9. The minutes shall include a statement by the Concrete Contractor indicating that the proposed mixture proportions and the placing/finishing/curing techniques can produce the concrete quality required by these specifications.
- G. Welders and welding procedures shall conform to requirements of AWS D1.4. Welding of reinforcing steel is prohibited unless accepted by Engineer in writing.
- 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. Inspection of steel reinforcement is required in accordance with **IBC Section 110**. Inspections shall be conducted by an inspection agency employed by Owner and approved by Engineer. Inspector shall provide report in approved format to Owner with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to shop drawings and Contract Documents shall be completed prior to concrete placement.

- K. Submit following information on Inspection of Reinforcement unless modified in writing by Engineer.
1. Project name and location.
 2. Contractor's name.
 3. Inspection Agency's name, address, and phone numbers (office and mobile).
 4. Date and time of inspection.
 5. Inspection Agency technician's name.
 6. Fabricator's name.
 7. Weather data:
 - a. Air Temperatures.
 - b. Weather.
 - c. Wind speed.
 8. Inspection location within structure.
 9. Reinforcement inspection data (including but not limited to):
 - a. Bar size, spacing, cover, and grade.
 - b. Splices, bends, anchorages, welding.
 - c. Epoxy coating or galvanizing as required.
 - d. Support methods and construction sequencing.
 10. Diary of general progress of Work.
- L. 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 1 according to ACI CP-1 or an equivalent certification program.
- M. 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.
- N. Proportioning, production and finishing of silica fume and metakaolin, and processed ultra-fine fly ash concrete shall be reviewed by and have approval of silica fume metakaolin, and processed ultra-fine fly ash manufacturers.
- O. 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. Water-reducing admixture and high-range water-reducing admixture.
 - g. Other admixtures.
 - h. 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).
- P. 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.
- Q. Mockups: Before casting concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances,

and standard of workmanship. Build mockups using materials indicated for the completed Work.

1. Stains, bug holes or other surface blemishes that deviate from the mockup will not be acceptable.
 2. Demonstrate curing, cleaning, and protecting of cast-in-place concrete finishes, and contraction joints, as applicable.
 3. In presence of Engineer, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Obtain Engineer's acceptance of mockups before casting concrete.
 5. Approved mockups may become part of the completed Work if approved.
- R. 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.
- S. 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.
- T. 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 for 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. "2010 ADA Standards for Accessible Design", 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 Code Council (ICC):

1. IBC, "International Building Code 2012."
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, high reactivity metakaolin 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.

1.9 WARRANTY

- A. Period of this warranty shall be in accordance with the General Conditions or a minimum of one year after substantial completion of the work. Should any defect (other than hairline cracks: defined as not more than 0.006 in. wide) be discovered after acceptance and occupancy of Project, which can be directly attributed to defect in material or workmanship not evident at time of initial occupancy, then contractor shall, upon written notice, correct defects without expense to Owner or Engineer/Architect. The Contractor's warranty excludes remedy for damage or defect caused from abuse, improper or insufficient maintenance, or normal wear and tear.

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

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. Dayton Superior Corp.
 - 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. "MasterEmaco P 124", BASF Construction Chemicals, LLC.
 - d. "Duralprep AC," The Euclid Chemical Company.
 - e. "Rebar Spray J62", Dayton Superior Corp.
- C. Epoxy Coating for Existing Exposed Non-prestressed Steel Reinforcement or Welded Wire Reinforcement:
1. Provide one of following epoxy coatings:
 - a. "Sikadur 32 Hi-Mod," Sika Chemical Corp.
 - b. "MasterEmaco ADH 326," BASF Construction Chemicals, LLC.

- c. "Scotchkote 413 PC," 3M Company.
 - d. "Dural 452 Series," The Euclid Chemical Company.
 - e. "Sure Bond J-58," Dayton Superior Corporation.
- D. For mechanical tension splices of reinforcement:
 - 1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:
 - a. Bar-Lock Rebar Coupler, by Dayton Superior.
 - b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
 - c. Extender HRC 500 Series Coupler, by Headed Reinforcement Corp.
 - d. Splice Sleeve, by NMB.
 - e. LENTON Splices, by Erico.
- E. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

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.
 - 2. Blended cement, ASTM C 595, Type IP only with prior written acceptance from Engineer.
- C. Coal Fly Ash:
 - 1. ASTM C 618, Class F.
 - 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, Class 5s.
 - b. No deleterious materials such as, but not limited to, chert or opaline.
 - c. Fine aggregate: Natural or manufactured sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 8.5.1.
 - 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. Sections less than 3 in. thick: Size number 7 or 67.
 - b. All other members: 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 water-reducing admixture, mid-range water-reducing admixture or 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) for concrete with water/cementitious ratio of less than or equal to 0.45.

- D. Use air-entraining admixture in exterior exposed concrete. 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. "Air-Mix," "Eucon Air-Series" or "AEA-92," Euclid Chemical Co.
 - b. "Daravair Series" or "Darex Series," GCP Applied Technologies.
 - c. "Micro-Air," or "MB-VR," or "MBAE-90," BASF Construction Chemicals.
 - d. "Sika AEA Series," or "Sika AIR Series," Sika Corporation.
 - e. "ConAir Series," Premiere Concrete Admixtures.
 - f. Polychem "VR" or "VRC" or "Polychem AE," General Resource Technology.
 - g. "RSA-10," Russ Tech Admixtures, Inc.
- I. Normal Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon Series," Euclid Chemical Co.
 - b. "WRDA Series," GCP Applied Technologies.
 - c. "Pozzolith Series," or "PolyHeed Series," BASF Construction Chemicals.
 - d. "Plastocrete Series", Sika Corporation.
 - e. "OptiFlo Series" or "EcoFlo Series," Premiere Concrete Admixtures.
 - f. "Polychem Series" or "KB Series," General Resource Technology.
 - g. "LC-400 Series" or "LC-500 Series," Russ Tech Admixtures, Inc.
- J. Mid Range Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Subject to compliance with requirements, provide one of following:
 - a. "Eucon MR" or "Eucon X-15 and X-20," Euclid Chemical Co.
 - b. "Daracem Series" or "MIRA Series," GCP Applied Technologies.
 - c. "PolyHeed Series," BASF Construction Chemicals.
 - d. "Sikaplast Series" or "Plastocrete Series", Sika Corporation.
 - e. "Polychem 1000" or "KB Series," General Resource Technology.
 - f. "Finishease-NC," Russ Tech Admixtures, Inc.
 - g. "OptiFlo Series" or "EcoFlo Series," Premiere Concrete Admixtures.

K. 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 "Plastol Series," Euclid Chemical Co.
 - b. "Daracem Series" or "ADVA Series," GCP Applied Technologies.
 - c. "Rheobuild 1000", "PS 1466" or "Glenium Series," BASF Construction Chemicals.
 - d. "Sikament Series" or "Sika ViscoCrete Series," Sika Corporation.
 - e. "Melchem Series," General Resource Technology.
 - f. "Superflo 443" or "Superflo 2000 Series," Russ Tech Admixtures, Inc.
 - g. "EcoFlo Series" or "UltraFlo Series," Premiere Concrete Admixtures.

L. High-Range Water-Reducing Admixture (Superplasticizer) for Self-Consolidating Concrete, ASTM C 494 Type F.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Plastol Series" or "Eucon SPJ," Euclid Chemical Co.
 - b. "ADVA Series," GCP Applied Technologies.
 - c. "Glenium Series" or "PS1466," BASF Construction Chemicals.
 - d. "Sika ViscoCrete Series" or "Sikament Series", Sika Corporation.
 - e. "Superflo 2000 Series," Russ Tech Admixtures, Inc.
 - f. "UltraFlo Series," Premiere Concrete Admixtures.

M. 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," GCP Applied Technologies.
 - c. "Sikament Series," Sika Corporation
 - d. "Melchem," General Resource Technology.

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

1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon AcN-Series," "Accelguard 80," "Accelguard NCA," or "Accelguard 90," Euclid Chemical Co.
 - b. "DCI," "PolaraSet," "Lubricon NCA," "Daraset," or "Gilco," GCP Applied Technologies.
 - c. "Pozzutec 20+" or "Pozzolith NC 534," BASF Construction Chemicals.
 - d. "Sika Set NC," "Plastocrete 161FL", or "Sika Rapid-1," Sika Corporation.
 - e. "Polychem NCA" or "Polychem Super Set," General Resource Technology.
 - f. "LCNC-166," Russ Tech Admixtures, Inc.
 - g. "NitroCast Series," Premiere Concrete Admixtures.

O. Water-Reducing or retarding Admixture: ASTM C 494, Type D or B.

1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon Retarder-75", "Eucon DS" or "Eucon W.O." Euclid Chemical Co.
 - b. "Daratard-17" or "Recover," GCP Applied Technologies.
 - c. "Pozzolith Series" or "Delvo Series," BASF Construction Chemicals.
 - d. "Sikatard Series," or "Plastiment Series" or "Plastocrete Series," Sika Corporation.
 - e. "Polychem R," General Resource Technology.
 - f. "LC-400 Series" or "LC-500 Series," Russ Tech Admixtures, Inc.
 - g. "OptiFlo Series," Premiere Concrete Admixtures.

P. 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. Calcium Nitrite based Corrosion Inhibitor shall have a concentration of 30 percent, plus or minus 2 percent of solids content. Dosage rate shall be 3 gal/cu. yd. of concrete which will inhibit corrosion to 9.9 lbs of chloride per cu. yd. of concrete.
 - 1) "Eucon CIA" or "Eucon BCN," Euclid Chemical Company.
 - 2) "DCI" or "DCI-S," GCP Applied Technologies.
 - 3) "Rheocrete CNI," BASF Construction Chemicals.
 - 4) "Sika CNI," Sika Corporation.
 - 5) "Polychem CI," General Resource Technology.
 - 6) "Russ Tech RCI," Russ Tech Admixtures, Inc.
 - 7) "Impede CNI," Premiere Concrete Admixtures.
 - b. Amine Carboxylate based corrosion inhibitor (concentrated liquid or powder formulation).
 - 1) "MCI-2005," Cortec Corporation, dosage rate 1.0 pt/cu. yd.
 - 2) "MCI-2005 NS," Cortec Corporation, dosage rate 1.5 pt/cu. yd.
 - 3) "MCI-2006 NS," Cortec Corporation, dosage rate 1 lb/cu. yd.

Q. Alkali-Silica Reaction Inhibiting Admixture.

1. Products:
 - a. "ASRx 30LN," BASF Construction Chemicals.
 - b. "Eucon Integral ARC," Euclid Chemical Co.
 - c. "Sika Control ASR," Sika Corporation.
 - d. "Rasir," GCP Applied Technologies.
 - e. "Impede LN," Premiere Concrete Admixtures.

2. Include water content in admixture when calculating water-to-cement ratio.

3. Provide satisfactory results with lithium admixture as defined in "Resistance to Alkali-Silica Reaction" paragraph below.

R. Shrinkage Reducing Admixture:

1. Design requires using materials with combined drying shrinkage characteristic of 0.04 percent maximum at 28 days. Proposed concrete Mixture(s), using actual aggregates, admixtures and cement of the proposed mix for Project as detailed herein and in Drawings, shall meet criteria. Submit ASTM C 157 (may be modified by curing period duration) results for at least 3 specimens. Test takes 28 days minimum. Begin tests as soon as possible so final test results available for submittal to Engineer.
2. Products: Subject to compliance with requirements, provide one of following:
 - a. If calcium nitrite is present in the original concrete mixture:
 - 1) "Eclipse 4500," GCP Applied Technologies.
 - 2) "Eucon SRA +" or "Conex," Euclid Chemical Company.
 - 3) "Sika Control 40", Sika Corporation.
 - b. If calcium nitrite is not present in the original concrete mixture:
 - 1) "Eucon SRA," "Eucon SRA+," or "Conex" Euclid Chemical Company.
 - 2) "Eclipse 4500," GCP Applied Technologies.
 - 3) "Tetraguard AS 20," BASF Construction Chemicals.
 - 4) "Sika Control 40," Sika Corporation.
 - 5) "SRA-157," Russ Tech Admixtures, Inc.
 - 6) "PCA-SRA," Premiere Concrete Admixtures.

2.6 CURING MATERIALS

- A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Evaporation Retarder:
 - a. Eucobar; Euclid Chemical Co.
 - b. E-Con; L&M Construction Chemicals, Inc.
 - c. MasterKure ER 50; BASF Construction Chemicals.
 - d. SikaFilm; Sika Corporation.
 - e. AquaFilm Concentrate J74; Dayton Superior Corporation.
 - f. "EVRT", Russ Tech Admixtures, Inc.
 - g. "Barrier," Premiere Concrete Solutions.
- 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.

2.7 RELATED MATERIALS

- A. Bonding Additive: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- E. Post Installed mechanical and adhesive anchors shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, Simpson Anchor Systems, Columbus, OH, Powers Fasteners, Brewster, NY, or accepted equivalent. Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fiber.
 - 1. Strength of anchors shall comply with ACI 318-11 Appendix D, and ACI 355.2 and ICC-ES-AC193 for mechanical anchors and ACI 355.4 and ICC-ES-AC308 for adhesive anchors.
 - 2. Stainless steel anchors shall be manufactured from ASTM A304, or A663 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
 - 3. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications. Adhesive anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For adhesive anchors, consult with manufacturer's engineer.
 - 4. Safety Factors: Static loads 4:1 minimum. Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Adhesive anchors are not permitted for critical loads and where resistance to direct sustained tension is required.

- a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.
 5. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors, except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.
 6. Anchor installation shall be as required by manufacturers printed installation instructions.
- F. Joint Filler:
1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:
 - a. "Flexcell," Knight-Celotex Corp.
 - b. "Fibre Expansion Joint," W.R. Meadows, Inc.
 2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
 3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:

2.8 REPAIR MATERIALS

- A. See Section "Pre-packaged Repair Materials".

2.9 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.
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.
 5. 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.
 6. 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 nitrite used to offset chloride ions is in addition to calcium nitrite used as a corrosion inhibitor. Maximum of 1.5 lb. of chloride ion per cubic yard may be offset in this manner.
- H. Resistance to Alkali-Silica Reaction – Unless otherwise specified, or unless members are assigned to Exposure class C0, use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction:
1. For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 shall not exceed 0.04 percent at 1 year.
 2. For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 shall not exceed 0.10 percent at an age of 16 days.
 3. Alkali content in concrete (LBA) shall not exceed 4 lb/yd³ for moderately reactive aggregate or 3 lb/yd³ for highly reactive aggregate. Reactivity shall be determined by testing in accordance with ASTM C1293 and categorized in accordance with the ASTM C1778. Alkali content shall be calculated as follows:
 - a. $LBA = (\text{cement content lb/yd}^3) \times (\text{equivalent alkali content of portland cement in percent} / 100 \text{ percent})$.
- I. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Consider using water-reducing admixture or high-range water-reducing admixture (Superplasticizers), OR admixtures that achieve self-consolidating concrete, as required, for placement, workability, finishing and when required, increased flowability.
 2. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use high range water-reducing admixture for concrete with a water-cementitious materials ratio of 0.45 or less.
 4. Use corrosion-inhibiting admixture in concrete mixes where 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.
3. Average length change after 28 days shall be limited to 0.04%, unless otherwise accepted by Engineer. Values exceeding 0.04% shall be rejected.
- 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.

2.10 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.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.

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:
 - a. Prohibited.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork and shoring, 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.
 - b. Variation in elevation from specified elevation for columns and walls: Plus or minus 0.5 in.
 2. Anchor bolts: concrete contractor shall place anchor bolts within tolerances stated under heading "Anchor Bolts and Bearing Plates" of PCI "Code of Standard Practice for Precast Concrete."
- 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, sink ages, 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 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install Reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 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, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 75 percent of 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores per requirements of W.I. 18.1.

- 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 Architect.

3.4 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.

3.5 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. Fasten epoxy-coated steel members with nylon-, epoxy-, or plastic-coated tie wire, or other suitable material acceptable to Engineer.
2. Mechanical connections, when required, shall be installed in accordance with splice device manufacturer's recommendations. Repair any damage to coating.
3. All parts of mechanical connections on epoxy-coated steel, including steel splice sleeves, bolts, and nuts shall be coated with same material used for repair of coating damage.
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. When cut, coat ends of epoxy-coated steel 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.
2. For mechanical tension splices of reinforcement:
 - a. Column bar lengths shall not exceed 30 ft. between splices. In any bar, no splices shall occur at any floor level.
 - b. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
 - c. For all mechanical splices, perform splicing in strict accordance with manufacturer's requirements and instructions.
 - d. Stagger splices in adjacent bars.
 - e. Welding of reinforcement prohibited without prior written authorization by Engineer.
3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
4. Welded wire reinforcement shall not extend through contraction joints.

3.6 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.
 - c. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
 - d. Coordinate configuration of tooled joints with control joint sealants.

B. Provide keyways at least 1-1/2 in. deep in construction joints in walls and slabs. Accepted bulkheads designed for this purpose may be used for slabs.

- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.
- D. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.
- E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
 - 1. Joint filler and sealant materials are specified in Division 7 Sections of these Specifications.

3.7 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/Architect.
- 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.

3.8 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.
- C. Mock-Up: Provide a mock-up for all finishes exposed to view as described in article "Quality Assurance".

3.9 FINISHING FLOORS AND SLABS

- A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish":
 1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:
 - a. Use minimal passes so as to not overwork the concrete.
 - b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.
 2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
 3. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.8.6: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
 4. Before installation of flatwork and after submittal, review, and approval of concrete mixture proportions, Contractor shall fabricate two acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer, in which case Contractor shall repeat

procedure on rejected panel(s) until Engineer acceptance is obtained. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.

5. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.
- B. Flatwork in Stairtowers and enclosed, Finished Areas (Float Finish, ACI 301, Paragraph 5.3.4.2.b):
1. Give slab floated finish. Texture shall be as accepted by Engineer from sample panels.
 2. Finishing tolerance ACI 301, Section 5 header "Measuring Tolerances for Slabs" and ACI 117, paragraph 4.8.6: 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 3/8 in. from elevation noted on Drawings anywhere on floor surface.
- C. 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 1/4 inch in height may be without edge treatment as shown in ADA Figure 303.2.
 - 2) Changes in Level between 1/4 inch and 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 1/2 inch in height are not permitted unless they can be transitioned by means of a ramp with minimum ADA guidelines.
 - 4) Openings in floor or ground surfaces shall not allow passage of a sphere more than 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) Static coefficient of friction for walking surfaces shall be measured on a dry surface by the NBS – Brungraber machine using a silastic sensor

shoe and shall be 0.6 or larger for a level surface and 0.8 or larger for ramps.

3.10 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.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still workable and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.11 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 colored tint disappears.
- C. Formed Surfaces: Cure formed concrete surfaces of columns, walls, and upturned beams, including the underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Tepid (within 20 deg F of concrete temperature) water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Tepid (within 20 deg F of concrete temperature) water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer/Architect. Remove and replace concrete that cannot be repaired and patched to Engineer/Architect's approval.
- B. Patching Mortar: See Section "Pre-packaged Repair Mortar".
- C. 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 ½ 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 mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified bonding agent.
 2. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer/Architect.

3. 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 07 Sections. Receive Engineer's written acceptance of methods and materials selected prior to application.
- D. 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 receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of ¼ inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing. Remove defective areas with clean, square cuts and expose steel reinforcement with at least ¾ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. 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.
 8. 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 07 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.

3.13 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 under provisions of Division 1 Section "Quality Control."
2. Repair all epoxy coating damage due to fabrication and handling, using a mirror to find any damage on undersides.
3. Repair all damaged areas using manufacturer's recommended patching material and method.
4. No damaged area shall be left uncorrected.

D. Temperature:

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

E. Slump Test:

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

F. Air Content:

1. General Contractor: Coordinate all parties involved to produce conforming concrete.
2. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172 and **conduct one air content test** in accordance with ASTM C 231 or ASTM C 173 **for each truck of ready-mix, air entrained concrete** delivered to Project.
3. Sample fresh concrete immediately following placement and screeding and conduct air content tests in accordance with ASTM C 231 or ASTM C 173 at rate of one for every 10 truckloads of ready-mix, air-entrained concrete delivered to Project. For small or half-loads, obtain Engineer's acceptance of procedure 2 weeks before situation arises.

G. Concrete Compressive Strength:

1. Make test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 39 as follows:
 - a. Take minimum of three sets of cylinders for each 100 cu yds. or fraction thereof, of each Mixture of concrete placed in any one day.
 - b. A set of cylinders shall be comprised of two 6 inch by 12 inch cylinders or three 4 inch by 8 inch cylinders.
 - c. At Contractor's option and cost, cylinders may be taken to verify concrete strength prior to form removal.
 - d. Testing Agency: Provide and maintain site cure box for cylinders.

2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated. Sample concrete for test cylinders to be used to verify concrete compressive strength for post-tensioning as near as possible to actual tendon anchorages.
3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
4. Cure test cylinders per ASTM C 31 as follows:
 - a. To verify compressive strength prior to form removal or for additional test cylinders required due to cold weather concreting conditions:
 - 1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
 - 2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.
 - b. To verify 28-day compressive strength:
 - 1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
 - 2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.
5. Compression test:
 - a. Test one set of cylinders at 7 days.
 - b. Test one set of cylinders at 28 days.
 - c. Hold one set of cylinders in reserve for 56 days for use as Engineer/Architect directs.
 - d. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.
- H. Testing for the presence of the Calcium Nitrite admixture in the concrete shall conform to APPENDIX at end of this section for plastic concrete testing.
- I. Testing for the presence of MCI admixture in the concrete shall be per manufacturer's recommendations.
- J. 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.
- K. 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.

3.14 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.

3.15 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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APPENDIX: Test method for Calcium Nitrite presence in plastic concrete.

A. Scope

This Method of Test is used to determine the presence of calcium nitrite in the plastic concrete state. A freshly mixed concrete sample shall be tested. Quantofix test strips, for high range nitrite, manufactured by Macherey-Nagel Inc. of Bethlehem, PA or equivalent, shall be used.

For each day's operation, unless directed otherwise, a minimum of one test shall be performed.

B. Apparatus

Quantofix Test Strips for high range nitrite #91322
Macherey-Nagel Inc. (888) 321-6224

10cc disposable syringes with Leur-Lok tip #309604
Becton-Dickinson & Co (201) 847-6800

Disposable Filters 25mm/.45 micron # SLHA02510
Millipore (800) 645-5476

Wide-mouth Container

Clean Measuring Cup

C. Procedure

1. Determine the amount of concrete to be tested based on the design amount of Calcium Nitrite and the table below. Add concrete to pre-measured 0.5 gallons of water in a wide mouth container. Use the water in the container to rinse out the measuring cup.
2. Shake the container for 2 to 5 minutes until contents are well mixed.
3. Using the syringe, uptake approximately 10 milliliters of extraction water from the container. Attach a disposable filter to the end of the syringe.
4. Filter the extraction water into a clean cup.
5. Dip the test strip into the clear, filtered extraction water and compare the color to the chart on the side of the test strip container.
6. Using the table below determine if the reading on the test strips corresponds with the expected reading for the design amount of Calcium Nitrite.

<u>Design Amount of Calcium Nitrite, gal/CY</u>	<u>Volume of Concrete to be Added, oz.</u>	<u>Expected Reading on Test Strip</u>
2.0	8	0.3
2.5	6	0.3
3.0	5	0.3
3.5	4	0.3
4.0	8	0.6
4.5	7	0.6
5.0	6	0.6

Notes:

1. Column 1 indicates the amount of calcium nitrite, in gallons, that has been added to a cubic yard of concrete.
2. Column 2 indicates the amount of concrete that should remain in the container after shaking.
3. Column 3 is the test strip reading that will correspond to the indicated quantity of calcium nitrite.

D. Verification Requirements for Calcium Nitrite Dispensing Systems:

1. Independent Testing agency shall perform the following:
 - a. Prior to and after each pour take volume readings of corrosion inhibitor tank, correlate to size of pour, and report results to Engineer, corrosion inhibitor manufacturer/supplier, and concrete producer. Volume used should be within plus or minus 10 percent of specified amount.

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:	Type	Product-Manufacturer (Source)
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

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

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

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

V. <u>RATIOS</u>		VI. SPECIFIC GRAVITIES	
Water ⁽¹⁾	lb.	Fine Aggregate:	
=	=		
Cementitious Material ⁽²⁾	lb.	Coarse Aggregate:	
=	=		
Fine Agg.	lb.		
=	=		
Total Agg.	lb.		
<p>NOTES:</p> <p>⁽¹⁾Includes ALL water, including added water and free water contained on aggregates.</p> <p>⁽²⁾Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra-Fine Fly Ash or other pozzolan.</p>			

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>		<u>Yes</u>	<u>N/A</u>
(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			
<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>(Less than 3000) $f'_{cr} = f'_c + 1000$ or (3000 to 5000) $f'_{cr} = f'_c + 1200$ or (Over 5000) $f'_{cr} = 1.1f'_c + 700$</p> <p>For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.</p>			
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. <u>OTHER REQUIRED TESTS</u>		
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. <u>Remarks:</u>

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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 C 1567 or Test report for each aggregate

ASECTION 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. Samples: Approximately 24 by 24 by 2 inches (600 by 600 by 50 mm), to illustrate quality of finishes, colors, and textures of exposed surfaces of shotcrete.
- D. Design Mixes: For each shotcrete mix.
- E. Material Test Reports: For shotcrete materials.
- F. Material Certificates: For each material item, signed by manufacturers.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** Shotcrete contractor shall have a minimum of three (3) years experience in the application performed. All Nozzlemen to perform work shall have a current ACI / ASA Nozzlemen Certification. A qualified installer employing nozzle operators who attain mean core grades not exceeding 2.5, according to ACI 506.2, on preconstruction tests.
- B. **Testing Agency Qualifications:** Independent and qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548, and acceptable to authorities having jurisdiction.
- C. **Comply with provisions of the following, unless more stringent requirements are indicated:**
 - 1. ACI 301, "Specification for Structural Concrete."
 - 2. ACI 506.2, "Specification for Shotcrete."
 - 3. CRSI's "Manual of Standard Practice."
- D. **Preconstruction Testing Service:** Owner will engage a qualified independent testing agency to perform preconstruction testing and inspections indicated below:
 - 1. Produce test panels before shotcrete placement according to requirements in ACI 506.2 and ASTM C 1140 for each design mix, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 3-1/2 inches (90 mm). From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced. Agency will perform the following:
 - a. Test each set of unreinforced specimens for compressive strength according to ASTM C 42.
 - b. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.
- E. **Mockups:** Before installing shotcrete, construct mockups for each finish required and for each design mix, shooting orientation, and nozzle operator to demonstrate aesthetic effects and set quality standard for installation.
- F. **Pre-installation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

- A. Cold-Weather Shotcreting: Protect shotcrete work from physical damage or reduced strength caused by frost, freezing, or low temperatures according to ACI 306.1 and as follows:
1. Discontinue shotcreting when ambient temperature is 40 deg F (4.4 deg C) and falling. Uniformly heat water and aggregates before mixing to obtain a shotcrete shooting temperature of not less than 50 deg F (10 deg C) and not more than 90 deg F (32 deg C).
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
 4. Do not use calcium chloride, salt, and other materials containing antifreeze agents.
- B. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 305R when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:
1. Cool ingredients before mixing to maintain shotcrete temperature at time of placement below 100 deg F (38 deg C) for dry mix or 90 deg F (32 deg C) for wet mix.
 2. Decrease temperature of reinforcing steel and receiving surfaces below 100 deg F (38 deg C) before shotcreting.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

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

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel-Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel-Welded Wire Reinforcement: ASTM A 497, flat sheet.
- E. Supports: Bolsters, chairs, spacers, ties, and other devices for spacing, supporting, and fastening reinforcing steel in place according to CRSI's "Manual of Standard Practice" and as follows:
1. Use all-plastic bar supports.

- F. Reinforcing Anchors: ASTM A 36/A 36M, unheaded rods or ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), hex-head bolts; carbon steel; and carbon-steel nuts.
1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

2.3 SHOTCRETE MATERIALS

- A. Shotcrete Cement and Blended Cements:
1. Portland Cement: ASTM C 150, Type I, I/II, III. Use only one brand and type of cement for Project. Select supplementary cementing materials from subparagraphs below, if permitted. Blending of fly ash, slag, silica fume with Portland cement is done at ready-mix plant.
 2. Fly Ash: ASTM C 618, Class F.
 3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 4. Silica Fume: ASTM C 1240, amorphous silica.
- B. Acceptable Blended Shotcrete Cement
1. Gun-Rite Cement: JE Tones, Blue Island, IL
- C. Normal-Weight Aggregates: ASTM C 33, from a single source, and as follows:
1. Aggregate Gradation: ACI 506R, Gradation No. 2 with 100 percent passing 1/2-inch (13-mm) sieve.
 2. Coarse-Aggregate Class: 3S.
- D. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored, water-reducing admixtures, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.
1. Color: Match existing adjacent surfaces to satisfaction of Owner.
- E. Water: Potable, complying with ASTM C 94, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.
- F. Carbon-Steel Fiber: ASTM C 1116, Type 1, carbon-steel fiber and ASTM A 820, Type 1, cold-drawn wire not less than 1 inch (25 mm) long.
- G. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in shotcrete, complying with ASTM C 1116, Type III, not less than 1/2 inch (12 mm) long.
- H. Ground Wire: High-strength steel wire, 0.8 to 1 mm in diameter.

2.4 CHEMICAL ADMIXTURES

- A. General: ASTM C 1141, Class A or B, but limited to the following admixture materials. Provide admixtures for dry mix or wet mix shotcrete that contains not more than 0.1

percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.

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

B. Blended Admixture

1. Gun-Rite HP, JE Tomez, Blue Island, IL.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 SHOTCRETE MIXES, GENERAL

- A. Prepare design mixes for each type and strength of shotcrete.
 1. Limit use of fly ash ground granulated blast-furnace slag and silica fume to not exceed, in combination, 25 percent of portland cement by weight.
- B. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.
- C. Admixtures: When included in shotcrete design mixes, use admixtures and retarding admixtures according to manufacturer's written instructions.
- D. Carbon-Steel Fiber or Synthetic Fiber (if utilized): Uniformly disperse in shotcrete mix, according to manufacturer's written instructions.
- E. Design-Mix Adjustments: Subject to compliance with requirements, shotcrete design-mix adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.7 NORMAL-WEIGHT SHOTCRETE MIXES

- A. Proportion dry mixes by field test data methods and wet mixes according to ACI 211.1 and ACI 301, using materials to be used on Project, to provide normal-weight shotcrete with the following properties:
 - 1. Compressive Strength (28 Days): 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 7percent with a tolerance of plus or minus 1-1/2 percent.
- B. Acceptable pre-packaged fiber reinforced shotcrete mixes:
 - 1. "Eucoshot F", (Dry or Wet Method) by The Euclid Chemical Company, Cleveland, OH.
 - 2. "Gun-Rite 5000" (Wet Method), by JE Tomes & Associates, Blue Island, IL.
 - 3. "Gun-Rite HP", (Wet Method), by JE Tomes & Associates, Blue Island, IL.
 - 4. "Gun-Rite DS-1", (Dry Method) by JE Tomes & Associates, Blue Island, IL.
 - 5. "MS-D1 Shotcrete", (Dry Method), by King Packaged Materials Company, Burlington, ON.
 - 6. "MasterEmaco S 211 SP", (Dry or Wet Method), by BASF Construction Chemicals, Shakopee, MN.
 - 7. "Sikacem 103F", (Dry or Wet Method) by Sika Corporation, Lyndhurst, NJ.
 - 8. "Sikacem 133F", (Dry Method) by Sika Corporation, Lyndhurst, NJ.

2.8 SHOTCRETE EQUIPMENT

- A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.
- B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.
 - 1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
 - 2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.
- C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.9 BATCHING AND MIXING

- A. Dry-Mix Process: Measure mix proportions by weight batching according to ASTM C 94 or by volume batching complying with ASTM C 685 requirements.
 - 1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
 - 2. Pre-packaged shotcrete materials may be used at Contractor's option. Pre-dampen pre-packaged 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. Pre-packaged shotcrete materials may be used at Contractor's option.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Concrete or Masonry: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces before shotcreting.
 - 1. Abrasive blast or hydro-blast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.
- B. Steel: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.
 - 1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
 - 2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape

of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.

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

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.
- C. Securely embed reinforcing anchors into existing substrates, located as required.
- D. Accurately position, support, and rigidly secure reinforcement against displacement by formwork, construction, or shotcreting. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
- E. Place reinforcement to obtain minimum coverages for shotcrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during shotcreting. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.
- F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. Construction Joints: Locate and install construction joints tapered to a 1:1 slope where joint is not subject to compression loads and square where joint is perpendicular to main reinforcement. Continue reinforcement through construction joints, unless otherwise indicated.
- B. Contraction Joints: Construct contraction joints in shotcrete using saw cuts 1/8-inch- (3-mm-) wide-by-1/3 slab depth or pre-molded plastic, hardboard, or fiberboard strip inserts 1/4-inch- (6-mm-) wide-by-1/3 shotcrete depth, unless otherwise indicated.
 - 1. After shotcrete has cured, remove strip inserts and clean groove of loose debris.
 - 2. Confirm joint spacing in field with engineer.
 - 3. Tool edges round on each side of strip inserts if floated or troweled finishes are required.

3.5 ALIGNMENT CONTROL

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

3.6 EMBEDDED ITEMS

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

3.7 APPLICATION

- A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.
- B. Moisten wood forms immediately before placing shotcrete where form coatings are not used.
- C. Apply shotcrete according to ACI 506.2.
- D. Apply dry-mix shotcrete materials within 45 minutes after pre-dampening and wet-mix shotcrete materials within 90 minutes after batching.
- E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.
 - 1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
- F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray and prevent build-up against front face during shotcreting.
- G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.
- H. Do not permit shotcrete to sag, slough, or dislodge.
- I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.
- J. Do not disturb shotcrete surfaces before beginning finishing operations.
- K. Remove ground wires or other alignment control devices after shotcrete placement.

- L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.
- M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117R, increased by a factor of 2.

3.8 SURFACE FINISHES

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

3.9 CURING

- A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from shotcrete surface after placing and finishing.
- C. Curing Exposed Surfaces: Cure shotcrete by the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for at least seven days with water, continuous water-fog spray, water-saturated absorptive covers, or moisture-retaining covers. Lap and seal sides and ends of covers.
 - 2. Curing Compound: Apply curing compound uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Apply curing compound to natural- or gun-finished shotcrete at rate of 1 gal./100 sq. ft. (1 L/2.5 sq. m).
- D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.10 FORM REMOVAL

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

1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

3.11 FIELD QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to sample materials, visually grade cores, perform tests, and submit reports during shotcreting.
- B. Air Content: ASTM C 173, volumetric method or ASTM C 231, pressure method; 1 test for each compressive-strength test for each mix of air-entrained, wet-mix shotcrete measured before pumping.
- C. Shotcrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and 1 test for each set of compressive-strength specimens.
- D. Test Panels: Make a test panel, reinforced as in structure, for each shotcrete mix and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 4-1/2 inches (115 mm). From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced.
1. Test each set of unreinforced specimens for compressive strength according to ASTM C 1140 and construction testing requirements in ACI 506.2.
 2. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.
- E. In-Place Shotcrete: Take a set of 3 unreinforced cores for each mix and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C 42. Do not cut steel reinforcement.
- F. Strength of shotcrete will be considered satisfactory when mean compressive strength of each set of 3 unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
1. Mean compressive strength of each set of 3 unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

3.12 REPAIRS

- A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.
 - 1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces and apply new shotcrete.
- B. Repair core holes from in-place testing according to repair provisions in ACI 301 and match adjacent finish, texture, and color.

3.13 CLEANING

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

END OF SECTION 033713

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SECTION 033760 – PREPACKAGED REPAIR MORTAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 QUALITY ASSURANCE

- A. Work shall conform to requirements of ACI 301 as applicable except where more stringent requirements are shown on Drawings or specified in this Section.
- B. Testing Agency:
 - 1. Independent testing laboratory employed by Owner and acceptable to Engineer.
 - 2. Accredited by AASHTO under ASTM C1077. Testing laboratory shall submit documented proof of ability to perform required tests.
- C. Sampling and testing of mortar shall be performed by ACI certified Concrete Field Technicians Grade I. Certification shall be no more than three years old.
- D. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency has authority to reject mortar not meeting Specifications. Testing Agency does not have the authority to accept mortar that does not meet specifications.
- E. Testing Agency shall submit the following information for Field Testing of Concrete unless modified in writing by Engineer:
 - 1. Project name and location.
 - 2. Contractor's name.
 - 3. Testing Agency's name, address and phone number.
 - 4. Mortar manufacturer.
 - 5. Date of report.
 - 6. Testing Agency technician's name (sampling and testing).
 - 7. Placement location within structure.

8. Weather data:
 - a. Air temperatures.
 - b. Weather.
 - c. Wind speed.
9. Date, time, and place of test.
10. Compressive test data:
 - a. Cube or cylinder number.
 - b. Age of sample when tested.
 - c. Date and time of test.
 - d. Compressive strength.

1.4 REFERENCES

- A. "Standard Specification for Structural Concrete" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.
- B. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:
 1. "Building Code Requirements for Structural Concrete" (ACI 318), American Concrete Institute, herein referred to as ACI 318.
 2. "Hot Weather Concreting" reported by ACI Committee 305.
 3. "Cold Weather Concreting" reported by ACI Committee 306.
 4. "Standard Specification for Curing Concrete" (ACI 308.1)
- C. Contractor shall have following ACI publications at Project construction site at all times:
 1. "Standard Specifications for Structural Concrete (ACI 301) with Selected ACI and ASTM References," ACI Field Reference Manual, SP15.
 2. "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."
 3. ASTM C1583, "Standard Test Method for the Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)"

1.5 SUBMITTALS

- A. Make submittals in accordance with requirements of Division 01 and as specified in this Section.
- B. Contractor: At preconstruction meeting, submit procedures for demolition, surface preparation, material batching, placement, finishing, and curing of application. Provide procedure to protect fresh patches from severe weather conditions.
- C. Testing Agency: Promptly report all mortar test results to Engineer and Contractor. Include following information:
 - 1. See Article "Quality Assurance," paragraph "Testing Agency shall submit...."
 - 2. Strength determined in accordance with ASTM C109.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:
 - 1. BASF Building Systems (BASF), Shakopee, MN
 - 2. Euclid Chemical Corporation (Euclid), Cleveland, OH
 - 3. King Construction Products (King), Burlington, ON
 - 4. Mapei Corporation (MAPEI), Deerfield Beach, FL
 - 5. Sika Corporation (Sika), Lyndhurst, NJ.
 - 6. J.E. Tomes (Tomes), Blue Island, IL

2.2 MATERIALS

- A. The following listed materials are not acceptable for all types of repair methods and work items (i.e. form and pour, form and pump, horizontal application, overhead application, partial-depth, full-depth, etc.). Contractor to state proposed use for individual products on product submittals for Engineer approval prior to start of work.
- B. Horizontal Repair and Form and Pour Mortar: Shall be prepackaged cementitious repair mortar capable of horizontal and form and pour partial depth applications, achieving a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C39 as certified by manufacturer with maximum lineal shrinkage of 0.10% at 28 days. Extend per manufacturer's instructions as required for deeper placements.
 - 1. Acceptable cementitious repair materials for this Work are as follows:
 - a. "MasterEmaco S440," by BASF.
 - b. "Eucocrete," by Euclid.

- c. "FA-S10 Concrete," by King.
 - d. "Planitop 11," by MAPEI.
 - e. "Sikacrete 211," by Sika.
 - f. Other types may be used only with Engineer's approval in writing prior to bidding.
- 2. Acceptable polymer modified materials for this Work are as follows:
 - a. "MasterEmaco T310 CI" by BASF.
 - b. "Sika Repair 222 with Latex R" or "SikaTop 111 Plus", by
 - c. "Duraltop" by Euclid
 - d. Form-Flo P-38 by Tomes
 - e. Other types may be used only with Engineer/Architect's approval in writing prior to bidding.
- C. Rapid Strength Repair Mortar: Shall be pre-packaged, cementitious repair mortar. Repair mortar shall be capable of application achieving a minimum 3,500 psi compressive strength at 1 day and 5,000 psi compressive strength at 28 days per ASTM C39 as certified by manufacturer. Extend per manufacturer's instructions as required for deeper placements.
 - 1. Acceptable materials for this Work are as follows:
 - a. "MasterEmaco T430," by BASF.
 - b. "Speedcrete 2028," by Euclid.
 - c. "HP-S10 Concrete," by King.
 - d. "Planitop 18 ES" by MAPEI.
 - e. "Sikaquick 1000," by Sika.
 - f. "Aprisa P-80," by Tomes.
 - g. Other types may be used only with Engineer's approval in writing prior to bidding.
- D. Trowel Applied Repair Mortar (not allowed for structural repairs, only allowed for minor repairs of honey-combing, bugholes, etc.): Shall be prepackaged, cementitious repair mortar capable of vertical/overhead application by trowel achieving a minimum 3,000 psi compressive strength at 7 days and 4,500 psi compressive strength at 28 days per ASTM C 109 as certified by manufacturer.
 - 1. Acceptable materials for this Work are as follows:
 - a. "MasterEmaco N425," by BASF.
 - b. "Verticoat Supreme," by Euclid.
 - c. "Super-Top," by King.
 - d. "Planitop XS," by MAPEI
 - e. "Sikaquick VOH," by Sika.
 - f. "CT-40 Do All Mortar," by Tomes.
 - g. Other types may be used only with Engineer's approval in writing prior to bidding.

2. Acceptable polymer modified materials for this Work are as follows:
 - a. "MasterEmaco N 400 RS," "MasterEmaco N 400," "MasterEmaco N 426," or "MasterEmaco N 300 CI" by.
 - b. "Verticoat," "Speedcrete PM," or "Duraltop Gel" by The Euclid.
 - c. "SikaRepair 223 with Latex R", "SikaRepair SHB with Latex R", or "SikaRepair SHA with Latex R," by.
 - d. "Super-Top OV" by King
 - e. Other types may be used only with Engineer's approval in writing prior to bidding.

2.3 MATERIAL ACCESSORIES

- A. Bonding Grout: Bonding grout shall consist of prepackage repair material mixed with sufficient water to form stiff slurry to achieve consistency of "pancake batter."
- B. Extended Open Time Epoxy Bonding Agent: Three-component, water-based, epoxy modified portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer's open time in which to apply repair mortar.
 1. Acceptable materials for this Work are:
 - a. "MasterEmaco P124," by BASF.
 - b. "Duralprep A.C.," by Euclid.
 - c. "Planibond 3C," by MAPEI.
 - d. "Armatec 110 EpoCem", by Sika.
 - e. "B-1 Rebar Coating," by Tames.
- C. Clear, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
 1. Prohibited on surfaces to receive paints, stains, coatings, etc. Confirm with Engineer prior to use.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Epoxy Bonding Agent Extended Open Time:
 1. In strict accordance with manufacturer's recommendations, mix and apply epoxy bonding agent to all areas as indicated on Drawings.
 2. Allow epoxy bonding agent to dry a minimum 2 hours, but no more than the Manufacturer's recommended open time prior to placing repair mortar.

B. Bonding Grout:

1. Mix bonding grout and scrub into SSD repair substrate with a stiff broom to all areas as indicated on Drawings.
2. Place repair material prior to initial set of grout. If grout sets prior to placement of repair material, completely remove grout from surface and re-clean prior to proceeding with new grout placement and repair mortar.

C. Mortar Placement: Mortar materials shall be placed in strict accordance with manufacturer's instructions. Properly proportioned and mixed mortar material shall be placed using tools to consolidate mortar so that no voids exist within new material and continuous contact with base concrete is achieved.

D. Form and Pour Repair Mortar Placement: Mix and apply in strict accordance with manufacturer's written instructions, to achieve a maximum 9" slump. Consolidate mortar so that no voids exist and continuous contact with base concrete is achieved.

E. Vertical and Overhead Repairs: Mortar materials shall be placed in strict accordance with manufacturer's instructions. Properly proportioned and mixed mortar material shall be placed using tools to consolidate mortar so that no voids exist within new material and continuous contact with base concrete is achieved. Supplemental wire mesh shall be required for delamination and spall repairs greater than two inches in depth. Fresh bonding grout/bonding agent is required between successive lifts of patching material, if recommended by manufacturer.

F. Finishing:

1. Apply a non-slip broom finish to top of floor patches and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Provide a surface finish similar to adjacent surfaces for vertical and overhead partial depth repairs.
3. Finish formed surfaces similar to adjacent surfaces.

3.2 CONCRETE PROTECTION AND CURING

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

B. Immediate upon conclusion of finishing operation cure concrete in accordance with ACI 308.1 for duration of at least seven days by curing methods listed below. Provide additional curing immediately following initial curing and before concrete has dried.

1. During initial and final curing periods maintain concrete above 50 deg F.
2. Prevent rapid drying at end of curing period.

- C. Concrete surfaces to receive slab coatings or penetrating sealers shall be cured with moisture curing or moisture-retaining-cover curing.
- D. Curing Methods: Cure formed and non-formed concrete moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing compound: Apply curing compound in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency acceptable to the Engineer to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Perform tests according to ACI 301.
- B. Testing Frequency: Perform one set of strength testing and one bond test for each product used for each day's work. Prepare samples in accordance with ASTM C31.
- C. Compressive Strength Testing: Determine strength at 7, and 28 days. Each test shall consist of two 6-inch diameter cylinders or three 4-inch diameter cylinders. Testing shall be in accordance with ASTM C39. Bond Testing: Bond testing shall be performed at 7 days in accordance with ASTM C1583.

3.4 EVALUATION AND ACCEPTANCE OF WORK

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

3. If shrinkage cracks appear in repair area when initial curing period is completed, repair shall be considered defective, and it shall be removed and replaced by Contractor at no extra cost.
4. Patches shall be considered defective if average strength does not meet minimum strength at 28 days or if average bond strength does not meet minimum requirements of 150 psi.

END OF SECTION 033760

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SECTION 071800 – TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. A single installer shall be responsible for providing complete waterproofing system, including all products specified in Division 07 Sections.
- B. This Section includes traffic coating: Fluid applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface.
- C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Distribute reviewed submittals to all others whose Work is related.
- B. Pre-installation Conference: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful coating performance. Require every party concerned with coating Work, or required to coordinate with it or protect it thereafter, to attend. Include manufacturer's technical representative and warranty officer.
- C. Make submittals in accordance with requirements of Division 01 Sections.
- D. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

E. Requests For Information:

1. Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems frivolous and/or deems already answered in the Contract Documents.
2. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in Contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated, submit the following at least 60 days prior to application.

1. Product description, technical data, appropriate applications, and limitations.
2. Primer type and application rate.
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation, and aggregate loading required within each coat.

B. Samples:

1. Two 4-in. by 4-in. samples showing finished product of complete coating system to be used as acceptance criteria for coating installation and finished product for entire project. Acceptance criteria that will be considered includes, but is not limited to: surface texture, color, amount of aggregate used, slip-resistance. **Obtain Owner/Engineer's approval of finished product sample prior to start of Work.**
2. Install mockups for approval to match approved samples prior to start of full scale operations.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Certification that products and installation comply with applicable federal, state of Michigan, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
3. Certification from Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic coating.
4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).

5. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic coating application specified on project. Containers shall bear UL labels.
 6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.
- B. Manufacturer's Instructions: For each system indicated.
1. Crack treatment and surface preparation method and acceptance criteria.
 2. Method of application of each coat.
 3. Maximum and minimum allowable times between coats.
 4. Final cure time before resumption of parking and/or paint striping.
 5. Any other special instructions required to ensure proper installation.
- C. Field Quality Control:
1. Quality Control Plan as defined in Part 3.
 2. Two copies each of manufacturer's technical representative's log for each visit.
 3. Testing agency field reports.
- D. Qualification Statements
1. Manufacturer's qualifications as defined in "Quality Assurance" article.
 2. Installer's qualifications as defined in "Quality Assurance" article.
 3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Three copies of System Maintenance Manual.
- B. Five copies of snow removal guidelines for areas covered by Warranty.
- C. Final executed Warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.
1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 2. Evidence of financial stability acceptable to Engineer/Architect.
 3. Listing of 20 or more projects completed with submitted system, to include:
 - a. Name and location of project.
 - b. Type of system applied.
 - c. On-Site contact with phone number.

- B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.
- C. Installer's Qualifications: Owner retains right to reject any manufacturer.
 - 1. Evidence of compliance with Summary article paragraph "A single installer. . ."
 - 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
 - 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.
- E. Certifications:
 - 1. Traffic coating shall satisfy current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
 - 2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state this project is being constructed.
 - 3. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

- A. System Manufacturer (**New Application and Complete System Recoating**): Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). Warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
 - 1. Any adhesive or cohesive failures.
 - 2. Spalling surfaces.
 - 3. Weathering.
 - 4. Surface crazing (does not apply to traffic coating protection course).
 - 5. Abrasion or tear failure resulting from normal traffic use.
 - 6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic coating installation on double tees only.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to Owner.
- E. Address following in terms of Warranty: length of warranty, change in value of warranty, if any, based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.
- F. Snowplows, vandalism, studded snow tires and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
 - 1. Advanced Polymer Technology (APT), Harmony, PA

2. BASF Building Systems (BASF), Shakopee, MN
3. Deneef Construction Chemicals (Deneef), Houston, TX.
4. Lymtal International Inc. (Lymtal), Lake Orion, MI.
5. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX.
6. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
7. Poly-Carb Inc. (Poly-Carb), Twinsburg, OH.
8. Polycoat Products Division of Amer. Polymers (Polycoat), Santa Fe Springs, CA.
9. Pecora Corporation (Pecora), Harleysville, PA
10. Sika Corporation (Sika), Lyndhurst, NJ.
11. Technical Barrier Systems, Inc. (TBS), Oakville, Ontario.
12. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC COATING

- A. Acceptable coatings are listed below. Contractor to confirm that coatings are compatible with all other materials in this Section and other Division 07 Sections and related work.
1. Heavy Duty:
 - a. Autogard HD-48, Autogard E, Neogard.
 - b. Elasto-Deck 5000-HT, Pacific Polymers.
 - c. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
 - d. MasterSeal Traffic 1500, BASF.
 - e. Qualideck Heavy Vehicular (152/252/372/512), APT
 - f. Sikalastic 710/715, Sika.
 - g. Vulkem 350/345/346/346 Deck Coating System, Tremco.
 - h. Pecora-Deck 800 Series.
 - i. Kelmar TE Exposure 3, TBS.
 - j. Flexodeck Mark 170.2 Solvent Free Heavy Duty, Poly-Carb.
 - k. Poly-I-Gard 246HD, Polycoat.
- B. Recoating **Complete System**: Provide complete traffic coating system with all components specified for new, heavy-duty applications, including all waterproofing and wearing courses.
- C. Provide ultraviolet screening for all traffic coating placed on this project.
- D. Color of finish top coat shall be as selected by Owner from manufacturer's full range.
- E. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
1. Denedeck Crack Sealer, Deneef.

2. Iso-Flex 609 Epoxy Crack Sealer, Lyntal.
3. MasterSeal 630, BASF.
4. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
5. SikaPronto 19TF, Sika.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
 1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to Engineer/Architect.
 2. Existing coatings, curing compounds, etc. on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.
 4. Joint Sealants are compatible with traffic coatings.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents, and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Acid etching is prohibited.
- C. Remove all laitance and surface contaminants, including oil, grease, and dirt as specified by manufacturer's written recommendations.
- D. Remove all debonded traffic coatings. Remove all laitance and surface contaminants, including oil, grease, and dirt, by shotblasting and appropriate degreasers, or as specified by manufacturer's written recommendations to provide warranty.
- E. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.
- F. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.
- G. All random cracks on concrete surface less than 0.03 in. wide and showing no evidence of water and/or salt water staining on ceiling below shall receive detail coat unless more

complete treatment required in accordance with manufacturer's recommendations. Rout and seal random cracks, construction joints and control joints prior to installation of primer or base coat. Crack preparation including installation of joint sealant material, where required, is incidental to traffic coating work.

- H. Mask off adjoining surfaces not to receive traffic coating and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic coating.

3.3 INSTALLATION/APPLICATION

- A. Installation should include all of the following steps:
 - 1. Surface Preparation: Prepare concrete for system application.
 - 2. Crack/Construction/Control/Cove Joint Sealing: Detail for crack bridging.
 - 3. Primer Coat: Insure proper adhesion of membrane to substrate.
 - 4. Base Coat: Provide crack spanning in conjunction with Crack Detail noted above.
 - 5. Aggregate Coat: To hold aggregate in system, providing skid and wear close up resistance.
 - 6. Aggregate: Correct size, shape, hardness and amount necessary to insure proper skid and wear resistance.
 - 7. Top Coat: Lock aggregate into place, provide a maintainable surface and provide resistance to ponding water, UV degradation, color loss and chemical intrusion.
- B. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.
- C. A primer coat is required for all systems. No exception.
- D. Do not apply traffic coating material until concrete has been air dried at temperatures at or above 40 deg F for at least 30 days after curing period specified.
- E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.
- F. All adjacent vertical surfaces shall be coated with traffic coating minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.
- G. Complete all Work under this Section before painting line stripes.
- H. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

- A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.
- B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.
- C. Install 1 trial section of coating system for each duty grade and/or recoat system specified. Do not proceed with further coating application until trial sections accepted in writing by Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:
 - 1. Wet mil thickness application.
 - 2. Adhesion to concrete substrate and/or existing coating(s).
 - 3. Overall dry mil thickness.
- D. Use trial sections to determine adequacy of pre-application surface cleaning. Obtain Owner, Engineer/Architect and manufacturer acceptance of:
 - 1. Cleaning before proceeding with traffic coating application.
 - 2. Visual appearance of finished coating application.
 - 3. Conformance to ADA static coefficient of friction guidelines.
 - 4. Elcometer or equivalent pull test to quantify traffic coating adhesion to concrete and existing traffic coating.
- E. Determine overall coating system mil thickness:
 - 1. Contractor shall provide 6 in. by 6 in. bond breaker (coating coupon) on concrete surface for each 25,000 sq. ft. or fraction thereof, of coating to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
 - 2. Contractor shall assist Testing Agency in removing coating coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per coating manufacturer's instructions.
 - 3. Testing Agency shall determine dry mil thickness of completed Traffic Coating System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at 2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall coating system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.

END OF SECTION 071800

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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. Exterior joints in the following horizontal traffic bearing surfaces:
 - a. Construction and control joints in cast-in-place concrete.
 - b. Perimeter of floor drains.
 - c. Other joints as indicated on the Drawings.
 - 2. Exterior joints in the following vertical and horizontal non-traffic surfaces:
 - a. Construction and control joints in cast-in-place concrete.
 - b. Cove joints at intersection of horizontal and vertical concrete.
 - c. Other joints as indicated on the Drawings.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
 - 2. Distribute reviewed submittals to all others whose Work is related.
- B. Make submittals in accordance with requirements of Division 01 Sections.
- C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's

services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

D. Requests For Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 14days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate

B. Samples:

1. One for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:

1. Two copies each of manufacturer's technical representative's log for each visit.
2. Testing agency field and test reports.

C. Qualification Statements:

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Final executed Warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.
 - 1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 - 2. Evidence of financial stability acceptable to Engineer/Architect.
 - 3. Listing of 20 or more projects completed with submitted sealant, to include:
 - a. Name and location of project.
 - b. Type of sealant applied.
 - c. On-Site contact with phone number.
- B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.
- C. Installer's Qualifications: Owner retains right to reject any installer or subcontractor.
 - 1. Installer shall be legally licensed to perform work in the state of Michigan. Evidence of compliance with Summary article paragraph "A single installer. . ."
 - 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted sealant.
 - 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- D. Testing Agency: Independent testing laboratory employed by Owner] and acceptable to Engineer/Architect.
- E. Certifications:
 - 1. Licensing/certification document from system manufacturer that confirms sealant installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Michigan.
 - 2. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.
- C. At no time shall weight of stored material being placed on slab area exceed total design load 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. Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that sealant will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
 - 1. Any adhesive or cohesive failures.
 - 2. Weathering.
 - 3. Abrasion or tear failure resulting from normal traffic use.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5-year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to Owner.
- E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty, if any, based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

- F. Snowplows, vandalism, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
 - 1. BASF Building Systems (BASF), Shakopee, MN.
 - 2. Dow Corning Corp. (Dow Corning), Midland, MI.
 - 3. Lyntal International Inc. (Lyntal), Lake Orion, MI.
 - 4. Pecora Corporation (Pecora), Harleysville, PA.
 - 5. Sika Corporation (Sika), North Canton, OH.
 - 6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

- A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.
- B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.
- C. Color of sealants shall match adjacent surfaces.
- D. Closed cell or reticulated backer rods: Acceptable products:
 - 1. "Sof Rod," Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
 - 2. "ITP Soft Type Backer Rod," Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
 - 3. "MasterSeal 921 Backer Rod," BASF.
- E. Bond breakers and fillers: As recommended by system manufacturer.
- F. Primers: 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 polyurethane control joint sealants (traffic bearing):
 - 1. MasterSeal SL-2 or MasterSeal SL-2 SG, BASF.
 - 2. Iso-flex 880 GB or Iso-flex 881, Lyntal.
 - 3. Dynatrol II-SG or Urexpan NR 200, Pecora.

4. Sikaflex-2c SL or Sikaflex-2c NS TG, Sika.
 5. THC-900, THC-901, Vulkem 45SSL, Dymeric 240, Dymeric 240 FC or Dymonic 100, Tremco.
- I. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
1. Sikaflex-2c NS, Sika.
 2. MasterSeal NP-2, BASF.
 3. Dymeric 240/240FC, Dymonic 100 or THC 901 (cove only), Tremco.
 4. Dynatred, Pecora.
 5. Iso-flex 881, Lymtal.
- J. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning installation
1. Concrete surfaces are finished as acceptable for system to be installed.
 2. Curing compounds on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Correct unsatisfactory conditions before installing sealant system.
- C. Acid etching is prohibited.
- D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

- E. Final preparation of joints shall be a sandblast with medium that removes dust and ground material from surfaces to receive sealant.
- F. Check preparation of substrate for adhesion of sealant.
- G. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.
- B. Completely fill joint without sagging or smearing onto adjacent surfaces.
- C. Self-Leveling Sealants: Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.
- D. Non-Sag Sealants: Tool joints concave: Wet tooling not permitted.
- E. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.
- F. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.

3.4 FIELD QUALITY CONTROL

- A. Contractor and Engineer/Architect will perform sealant testing to verify sealant profile:
 - 1. Contractor, at Engineer/Architect's direction, shall cut out sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
- B. Repair all random joint sealant "cut out" sections after review.
- C. Flood test joints prior to substantial completion. Repair sealants as needed until no leaks observed at no cost to Owner.
- D. Testing Agency:
 - 1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.
 - 2. If flood test of joints required by this Section, report results to Engineer/Architect.

END OF SECTION 079233

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SECTION 079500 – EXPANSION JOINT ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. A single installer shall be responsible for providing complete waterproofing system, including all products specified in Division 07 Sections.
- B. This Section includes the following: Standard expansion joint systems:
 - a. W.I. 10.3: Elastomeric concrete edged, extruded rubber joint system.
 - b. W.I. 10.6: Expanding foam sealants.

1.3 DEFINITIONS

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestressing, cyclic thermal movements, and seismic movements.
- D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.
- E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.
- F. Service Load Level: Defined level of load under which joint assembly remains elastic and fully functional.

- G. Fatigue Load Level: Defined level of load under which joint assembly remains elastic and fully functional, including all noise mitigation components, for the stated number of cycles.
- H. Collapse Load Level: Defined level of load under which joint assembly remains capable of bridging the gap, although plates may yield and components may break.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General:

- a. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- b. Coordinate requirements for transitions, tolerances, levelness, and plumbness to ensure the installed expansion joint system can perform with expected movement capabilities.
- c. Coordinate and assign responsibility for preparation of concrete surfaces adjacent to expansion joints.
- d. Expansion joint surface areas each side of joint gap shall have a vertical differential less than $\frac{1}{4}$ " and meet requirements of expansion joint manufacturer.
- e. Minor surface defects shall be repaired according to manufacturer's recommendations. Repair materials shall be compatible with intended system materials and shall be approved by the Engineer prior to surface preparation and installation.
- f. Submit for approval repair products and procedures for all major defects. Repair description shall indicate materials, manufacturer's requirements, expected service life, and maintenance requirements. Take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.
- g. Expansion joint manufacturer shall approve of all blockout surfaces prior to joint installation.
- h. Coordinate layout of joint system and approval of methods for providing joints.

2. Joint Opening Width:

- a. Use temperature adjustment table to properly size joint gap at time of concrete pour and show that proposed joint system is capable of equal individual and combined movements in each direction based on expected movements shown on drawings.

- b. Where installation temperature is other than specified temperature, perform calculations showing joint is capable of movement within design temperature range (Criteria on Drawings) for "other" temperature, and that design and installation follow manufacturer's recommendations.
 - c. Expansion joint movement capability and the actual joint gap movement may not coincide. Construct actual joint gap in accordance with expansion design criteria.
 - 3. Blockouts:
 - a. Float expansion joint blockouts to remove all air pockets, voids and spalls caused by form work.
 - b. Blockouts shall be plumb with maximum tolerance per Manufacturer or not more than 0.125 inches deviation in 12 inches. Noncompliant blockouts shall be considered major defects.
 - c. Blockouts shall be straight and true with maximum tolerance per Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts shall be considered major defects.
- B. Preinstallation Meetings: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include Engineer of Record and manufacturer's technical representative and warranty officer.
- C. Make submittals in accordance with requirements of Division 01 Sections.
- D. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- E. Requests For Information
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated:
1. Construction details, material descriptions, dimensions, and finishes.
 2. Proposed method of preparation of concrete surface to receive expansion joint systems.
 3. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive expansion joint systems.
 4. Horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.
 5. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10 deg F increments and a calculation showing joint system is capable of movement within the design temperature range.
- B. Shop Drawings: For each type of product indicated:
1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, and terminations. Provide isometric or clearly detailed drawings depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.
 2. Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - a. Manufacturer and model number for each joint system.
 - b. Joint system location cross-referenced to Drawings.
 - c. Form width.
 - d. Nominal joint width.
 - e. Movement capability.
 - f. Minimum and maximum joint width.
 - g. Classification as thermal or seismic.
 - h. Materials, colors, and finishes.
 - i. Product options.
 3. Components and systems required to be designed by a professional engineer, shall bear such professional's written approval when submitted.
- C. Samples: Samples for each type of joint system indicated.
- a. Submit 2 samples for each type. Full width by 6 inches (150 mm) long, for each system required.
 2. Develop mockups of concrete surface preparation for review and to establish a control for the application.
- D. Delegated Design Submittals:

1. Analysis indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of design criteria used in design.
- E. Test and Evaluation Reports:
1. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of Michigan, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
 - a. Submit test reports from accredited laboratory attesting to joint systems' movement capability and ADA compliance.
 - b. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).
3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
4. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.

B. Field Quality Control

1. Two copies each of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article within 60 days of project award.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Evidence of manufacturer's certification of installer/applicator. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Manual: 3 copies of System Maintenance Manual.

- B. Five copies of snow removal guidelines for areas covered by warranty.
- C. Warranty Documentation: 2 executed copies of Labor and Material Warranty including all terms, conditions and maintenance requirements.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Owner retains right to reject any manufacturer.
 - 1. Evidence of compliance with Experience Record and Qualifications paragraph below.
 - 2. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 - 3. Copy of sample warranty that meets the requirements of the "Warranty" article in Section 1.
 - 4. Evidence of financial stability acceptable to Owner or Engineer/Architect.
 - 5. Evidence of compliance with "Single Installer" requirement.
- B. Experience Record and Qualifications: Verification of systems shall be established by either System Validation or Design Validation.
 - 1. System Validation: Submitted system for similar applications with minimum five (5) years experience and five (5) verified projects completed. Validation submittal shall include:
 - a. Sealed design calculations by an engineer licensed in Michigan, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.
 - b. Field history as defined below.
 - c. Results of seismic load tests defined below for projects with a Seismic Design Category of C or higher.
 - 2. Design Validation: Submitted system for similar application with less than five (5) years experience shall include a design validation submittal. Validation submittal shall include:
 - a. Sealed design calculations by an engineer licensed in Michigan, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.
 - b. Results of cyclic and seismic load tests defined below.
 - 3. Acceptable field history consists of successful performance of five (5) installations in place over the previous five (5) years under similar project loads, traffic frequency, footprints, and joint sizes. Include sketches, photos, and references for each installation. Installations shall have experienced at least moderate levels of traffic.
 - 4. Vertical and horizontal cyclic load tests shall be performed at an independent laboratory, and witnessed by a professional engineer who shall issue a sealed final

report of the test results. Tests shall consist of cyclic load testing using the design criteria in Part 2 and project joint sizes. Tests shall meet the following criteria:

- a. Vertical load cycle counts shall be a minimum of 2, 1000, and 1,000,000 cycles for the collapse, service, and fatigue level loads respectively.
 - b. Horizontal load cycle counts shall be a minimum of 1,000 and 25,000 cycles for the service and fatigue level loads respectively. No horizontal load test is required for the collapse level loads.
 - c. The vertical service and fatigue load test shall consist of a rolling tire at specified load in order to gauge joint wear. Test specimen shall show no signs of yielding of load carrying elements.
 - d. Observation and testing results of performance for noise mitigation elements shall be reported.
 - e. Different specimens may be used for the tests if they are of the same size and design. Conditions adjacent to the joint, e.g. the blockout region, shall be in keeping with the system design. Test joints shall be not less than 4 feet per tire in length, and shall replicate typical field installed geometry.
5. Seismic load tests shall be performed by an independent laboratory and witnessed by a professional engineer who shall issue a sealed final report of the test results. Tests shall consist of harmonic cycle testing at seismic velocities and displacements.
- a. Test displacements shall not be less than 85% of the joint's design range, at a frequency not less than 0.5Hz, for not less than 10 cycles.
 - b. Longitudinal displacements (parallel to the joint) shall be 10% of the transverse displacement (perpendicular to the joint), but not less than 1", for joints where only unidirectional movement is expected, and 50%, but not less than 1", for joints in which bidirectional movement is anticipated. Longitudinal and transverse displacements shall be applied simultaneously with a vertical offset of 1/2" between opposite sides of the joint.
 - c. Seismic testing is not required for small movement joints with seismic design displacements of less than 2" (+/-2", 4" total).
- C. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.
- D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.
- E. Certifications
1. Provide reports to Owner detailing maintenance activities have been performed in accordance with written maintenance agreement for expansion joints.
 2. Materials shall be compatible with materials or related Work with which they come into contact and the related materials sections.
 3. Manufacturer/Applicator: Review and approve all details before construction. Confirm in writing to Owner.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.10 WARRANTY

- A. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.
- B. Installation Requirements: Include a written plan of construction and coordination requirements, to allow joint system installation to proceed with specified warranty, that specifically addresses the following:
 - 1. Block out acceptance criteria.
 - 2. Surface preparation acceptance criteria.
 - 3. Crack, surface defect, and detailing recommendations.
 - 4. Method of protection of surrounding surfaces.
 - 5. Method of expansion joint system installation description.
 - 6. Primer type and application rate.
 - 7. Method of preparation of all glands and reinforced membranes.
 - 8. Temperature, humidity and other weather constraints. Specify substrate moisture testing criteria, if any.
 - 9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
 - 10. Any other special instructions required to ensure proper installation.
- C. Quality Service Requirements: Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:
 - 1. Installer's financial responsibility for warranty burden under agreement terms.
 - 2. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - 3. Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
 - 4. Authorized signatures for both Installer Company and Manufacturer.
 - 5. Commencement date of agreement and expiration date (if applicable).
 - 6. Provide copy of contractor's field application quality control procedures.

- D. Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that expansion joints will be free of defects, water penetration, and chemical damage related to system design, workmanship or material deficiency, consisting of: Warranty shall provide that system shall be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
1. Any water leakage through expansion joint system or leaking conditions of reinforced membrane, other waterproofing components, or glands.
 2. Any adhesive or cohesive failures of the system.
 3. Shifting of plates out of alignment due to system failure.
 4. Loose plates, anchor blocks, bolts.
 5. Metal to metal vibration causing noises during use.
 6. Metal to non-metal vibration causing noises during use.
 7. Tears, weathering, or degradation in gland from normal use.
 8. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of ½ inch below the floor surface.
- E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. A single Installer shall be responsible for providing complete expansion joint system. Obtain all joint systems through one source from a single manufacturer.
- B. Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated.
- C. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Intent of this section is to ensure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and minimize water leakage.

- B. Provide design of expansion joint for preparation of final details for fabrication and construction of all concrete openings, expansion joint elements and required accessories. An integral part of this project is engineering for the following:
 - 1. Include calculations for the size and forming of concrete openings to provide nominal joint width as indicated on drawings. Provide a summary of the design criteria used in the design.
 - 2. Include calculations for the appropriate size of expansion joint elements in accordance with the expansion joint assembly performance criteria. Include installation requirements of expansion joint assembly for specific project conditions and scheduling. Provide a summary of design criteria used in design.
- C. Expansion joint design shall meet or exceed all expected movements shown on drawings.
- D. Nominal form width shall be adjusted for the ambient temperature at time of concrete placement and expansion joint designer shall verify that width of joint at installation shall meet minimum installation requirements.
- E. Expansion joint systems shall be capable of resisting a differential vertical movement of $\frac{1}{2}$ inch.
- F. Materials shall be supplied in lengths to minimize or eliminate the need to splice waterproofing components.
 - 1. Waterproofing materials directly exposed to vehicular traffic shall be supplied with no joints in vehicle drive aisles.
 - 2. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.
 - 3. All Santoprene butt-to-butt splices shall be heat welded.
 - 4. Butt-to-butt splices with other materials shall be per manufacturer's recommendations.
- G. Design system for passenger vehicles traveling at speeds normally expected within a parking structure.
- H. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
 - 1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
 - 2. Shall be designed to comply with “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)” and ICC A117.1. Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
 - 3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:

- a. Changes in level of less than $\frac{1}{4}$ inch in height may be without edge treatment as shown in ADA Figure 303.2.
- b. 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.
- c. Changes in level greater than $\frac{1}{2}$ inch in height are not permitted unless they can be transitioned by means of a ramp per ADA guidelines.
- d. 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.

2.3 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from one of following manufacturers (listed in alphabetical order), only where specifically named in product categories:
1. Balco Inc., Wichita, KS (Balco).
 2. Construction Specialties, Inc., Muncy, PA (C/S).
 3. Dow Corning Corp., Midland, MI (Dow Corning).
 4. Emseal Joint Systems, Westborough, MA (Emseal).
 5. Erie Metal Specialties, Inc., Akron, NY (EMS).
 6. Inpro Jointmaster, Muskego, WI (Jointmaster)
 7. Lymtal International Inc. Lake Orion, MI (Lymtal).
 8. MM Systems Corporation, Atlanta, GA (MM).
 9. TechStar, Inc., Findlay, OH (TechStar).
 10. Tremco, Cleveland, OH (Tremco).
 11. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.4 PRODUCTS, STANDARD EXPANSION JOINT SYSTEMS

- A. Elastomeric concrete edged, extruded rubber expansion joint system:
1. CR Series System, Jointmaster.
 2. DuraFlex Chambered Wing Seal CS and DCS Series, Balco.
 3. Iso-Flex Winged Joint System J Series, LymTal.
 4. Lokcrete Membrane System (LMS) Series, MM.
 5. Polycrete/Membrane System, Type CR Series, EMS.
 6. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.
 7. Vulkem WF series Vehicular Expansion Joint System, Tremco.
 8. Wabo®Crete Membrane System ME Series, WBA.
 9. ZB 200/400 Series, C/S.
- B. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

2.5 PRODUCTS, OTHER

- A. Expanding foam sealants:
 - 1. 1200 Series Foam Seal, Jointmaster.
 - 2. ColorJoint Silicone Sealing System, ESS Series, MM.
 - 3. DSM or Colorseal, Emseal.
 - 4. Iso-Flex Precom "C", LymTal.
 - 5. Wabo Seismic WeatherSeal, WBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.
- B. Check elevations on each side of expansion joint gap to ensure flush slab-to-slab transition.
- C. Check anticipated or actual minimum and maximum joint openings. Compare to manufacturer's movement specifications and make joint sizing recommendations.
- D. Coordinate and verify that related Work meets following requirements:
 - 1. Check adhesion to substrates and recommend appropriate preparatory measures.
 - 2. Curing compounds used on concrete surfaces are compatible with Work to be installed.
 - 3. Concrete surfaces have completed proper curing period for system selected.
 - 4. Coordinate expansion joint system with other related Work before installation of expansion joint.
 - 5. Verify expansion joints are compatible with Joint Sealants and traffic toppings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids or spalls. Repair with approved material prior to installation of expansion joint.
- G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

- A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations.

B. Surface Preparation:

1. Acid etching: Prohibited.
2. Prepare substrates according to joint system manufacturer's written instructions.
3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.
- B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.
- C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.
- D. Terminate exposed ends of joint assemblies with factory-fabricated termination devices.
- E. Seal all openings to occupied spaces to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- F. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections: Prior to opening to traffic, test joint seal for leaks by maintaining continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. **Repeat test and repairs until all leaks stopped.**
- B. Manufacturer Services: Provide qualified manufacturer's technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation and waterproofing system installation.

3.5 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

- B. Protect installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of Work.

END OF SECTION 079500

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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 surface preparation and the application of paint systems on the following exterior substrates:

W.I. 45.2 "PAINT COLUMNS" (ALTERNATE)

W.I. 45.3 "PAINT – EXTERIOR BUMPER WALLS" (ALTERNATE)

W.I. 45.4 "PAINT – PERMANENT SHORES" (ALTERNATE)

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. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
- E. Sample Warranty: For each system indicated.
- F. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims, including:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.

1.4 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 Owner/Engineer at no added cost to Owner.

B. Pre-construction Testing:

1. No testing has been performed on any of the existing coatings. There are no existing records for paint type and/or lead/hazardous material content. The age of the existing paint systems is unknown.
2. Contractor is responsible for pre-construction testing required to comply with all Federal, State, and Local requirements regarding painting preparation and application work. See section "Scope of Work" under "Part 3 – Execution" in this Section for additional information.

1.5 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.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 gallons of each material and color applied.

1.8 WARRANTY

- A. Paint Materials: Furnish Owner with written **5-year** warranty that paint products will not experience the following due to material defects:
 - 1. Check, crack, blister, or delaminate from the substrate.
 - 2. Fade or change color.
 - 3. Weather or exhibit loss of gloss.
 - 4. Chalking.
- B. Paint System (Includes Preparation & Installation Procedures): Furnish Owner with written **5-year** Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements. Warranty shall state that Paint system will be free of any defects listed under note 1.8A above related to material deficiency as well as any deficiencies related to preparation or installation procedures for a period of 5 years from date of Substantial Completion.
- C. Perform any repair under this warranty at no cost to Owner.
- D. Address and state following in terms of Warranty:
 - 1. Length of warranty.
 - 2. Change in value of warranty – if any – based on length of remaining warranty period.
 - 3. Transferability of warranty.
 - 4. Responsibilities of each party.
 - 5. Notification procedures.
 - 6. Dispute resolution procedures.
 - 7. Limitations of liability for direct and consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products listed in the Exterior Painting Schedule at end of this Section.

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.
 - 3. Contractor responsible to verify compatibility of existing coatings with new paint products.
- B. Colors: In general, match color of existing adjacent surfaces to Owner's satisfaction. Provide samples/mockups for Owner selection and approval of colors.
- C. See Section 3 – Execution for schedule of paint systems to be used on this project.

PART 3 - EXECUTION

- A. Preparation and painting are required as described in this Section and noted on the Drawings and in Section 020010.
- B. Minor items that are not specifically listed may also require preparation and painting as part of base bid work scope, and are incidental to the project scope of work.
- C. Mockups
 - 1. Provide Mockups for each type of paint and substrate combination. Obtain Owner/Engineer approval of surface preparation and finished painting work product for all applicable combinations of substrate, surface preparation procedures, and paint products, colors, and finishes prior to proceeding with Work. Install additional mockups as needed to obtain approval.
- D. Existing Paint Information
 - 1. No testing of existing paint materials to establish type of existing paints has been completed or is available.

E. Metal Content Testing Results:

1. No testing of existing paint materials for hazardous metal content has been completed or is available.

3.2 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Remove all debonded coatings. Remove all laitance and surface contaminants, including oil, grease, and dirt as specified by manufacturer's written recommendations to provide warranty.
- D. 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 Paint Testing:** Testing of existing paint materials for lead and other hazardous materials content has **not** been conducted. Testing of existing paint for lead content and other hazardous materials content is responsibility of Contractor and is incidental to this project.
- F. **Preconstruction Adhesion Testing:** Adhesion testing of the generic paint systems specified has **not** been conducted. Coordination of the following preconstruction testing is responsibility of Contractor:
 1. Using the specific paint product manufacturer and paint products to be used for painting work, Owner will engage an independent paint materials testing laboratory technician (acceptable to Owner/Engineer) to perform ASTM D4541 - 09e1 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers. Successful adhesion test results at representative areas (minimum 5 S.F. in area), on each substrate prepared and the new paint system applied according to this specification shall be tested prior to acceptance of a full-scale application of the paint products. Successful adhesion test results shall be demonstrated prior to proceeding with painting work. Test locations include, but are not limited to:
 - a. All applicable combinations of substrates, locations, and paint products to be utilized.
- G. **Ongoing Adhesion Testing:** In addition to the pre-construction adhesion testing outlined above, the Owner reserves the right to perform adhesion testing throughout

the project for verification as painting work progresses. Ongoing adhesion testing is to be performed after all specified preparation work is completed.

- H. **Paint Thickness Testing:** Owner will engage an independent testing agency to document (time, location, and result) wet film thickness testing. Contractor in conjunction with paint manufacturer shall develop a project standard that correlates minimum wet film thickness readings required to achieve the required dry-film thicknesses (DFT).
 - 1. Contractor shall also utilize wet film thickness testing at the beginning of work on any new substrate, in order to assist with developing the final application technique.
- I. **Paint Manufacturer's Technical representative:** A technical representative of the paint manufacturer to be used for this project shall be present on site during representative and critical examination tasks, including pre-construction and ongoing adhesion testing operations.

3.3 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Provide mockups of surface preparation procedures for Owner/Engineer approval.
- C. See section 3.2 "Examination" for additional tasks required prior to preparation and painting work, including testing to be performed and demonstrated prior to proceeding with paint preparation and painting.
- D. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to re-install items that were removed. Remove surface-applied protection.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- E. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, bird droppings, failed existing coatings, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.
- F. Perform surface preparation to all surfaces/substrates as outlined elsewhere in this specification document. Containment, collection, and disposal of all preparation debris

shall be responsibility of Contractor. Submit plan to Owner/Engineer prior to start of Work. Minimum requirements include:

1. Provide containment and collection procedures to not affect nearby vehicles, patrons, or other operational areas.
 2. Contain and/or collect preparation debris and dispose of in manner acceptable to Owner/Engineer. Preparation debris shall not be allowed into existing drainage system. Disconnect and/or protect existing drainage system.
- G. Perform additional mechanical preparation to remove unsound coatings, corrosion, etc. down to bare metal as outlined elsewhere in this specification document.
- H. Transitions between different layers of substrates/coatings shall be mechanically feathered together to provide a sound and tight transition for over-coating.
- I. **All Painting Work Items:** All surfaces shall receive a 2,000-psi power wash with a paint manufacturer-approved and Owner-approved bio-degradable detergent to remove all "chalking", dirt, grease, bird droppings, and material that could inhibit bond of new paint materials. Contractor to confirm power-washing procedure does not damage existing construction prior to proceeding with full-scale operation. After power-washing, all surfaces shall be thoroughly rinsed to remove all remaining detergent residue and contaminants.
1. Do not use high-pressured power washers that may cause damage. Confirm that 2,000 psi washing will not damage surfaces, and adjust accordingly as necessary.
 2. Power washing shall not be used near elevator towers as it may damage operation of the elevator. Solvent cleaning and power tool cleaning/abrading shall be utilized in lieu of power washing in these areas. Protect elevator towers from dust/debris and water entering into shaft.
- J. **Steel Substrates:** Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer. All existing painted surfaces shall be cleaned and prepared according to SSPC-SP3 "Hand / Power Tool Cleaning" to provide a mechanically abraded / profiled surface to promote a mechanical bond.
1. Corroded and/or exposed steel shall be prepared by the following, prior to spot priming:
 - a. SSPC-SP11 "Power Tool Cleaning to Bare Metal".
 2. Proper containment, collection, and disposal of preparation debris shall be the responsibility of the Contractor.
- K. **All Painting Work Items:** After mechanically preparing all areas, **all** surfaces shall be thoroughly rinsed to remove all remaining laitance to provide suitable final substrate for painting. Comply with manufacturer's written requirements.
- L. Boundaries between different layers of existing coatings and between existing coatings and bare steel shall be feathered together prior to application of primer paint materials.

- M. Provide barriers and containment as required by applicable regulations to contain all airborne debris.
- N. **Paint Manufacturer's Technical representative:** A technical representative of the paint manufacturer to be used for this project shall be present on site during representative and critical preparation tasks, and shall view and approve representative results of surface preparation work prior to paint application operations.

3.4 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated. Application by roller, brush, or spray shall be pre-approved by manufacturer and Engineer.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces.
- B. If undercoats or other conditions show through topcoats, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.5 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner may engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.6 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect existing construction and 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 Owner/Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 EXTERIOR PAINTING SCHEDULE

- A. Minimum dry-film thicknesses (DFT) shall be verified with manufacturer's recommendations for each system.
- B. Submit color samples to Owner for final approval of paint color and finish.
- C. **W.I. 45.2 "PAINT COLUMNS" (ALTERNATE)**
 - 1. Paint shall be exterior-grade, low-gloss, two-part acrylic polyurethane, by Carboline, Tnemec, PPG, or Sherwin Williams. Color: white (confirm with Owner). Install primer as needed/recommended by manufacturer. Apply minimum two topcoats.
- D. **W.I. 45.3 "PAINT – EXTERIOR BUMPER WALLS" (ALTERNATE)**
 - 1. Detail Coat: Carbomastic 615. Apply to all exposed steel surfaces. Apply by brush/roller to ensure coverage of 8-10 mils dry.
 - 2. Epoxy Primer: Carboguard 635. Apply by brush/roller to ensure coverage.
 - 3. Topcoat (2 coats): Carbothane 133 LH.
 - 4. Engineer-approved equivalent system by PPG or Tnemec.
- E. **W.I. 45.4 "PAINT – PERMANENT SHORES" (ALTERNATE)**
 - 1. Carboline:
 - a. Base Coat: Carboline 615.
 - b. Topcoat (2 coats): Carbothane 133 LH.
 - 2. PPG:
 - a. Base Coat: Pittguard 97-145.
 - b. Topcoat (2 coats): Pitthane 95-812.
 - 3. Tnemec:
 - a. Base Coat: Series 135 Chembuild.

- b. Series 73 EnduraShield.
- 4. Engineer-approved equivalent.

END OF SECTION 099113

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SECTION 099121 - PAVEMENT MARKING - RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and application of high build paint systems to replace existing for the items of types, patterns, sizes, and colors described in this article.
- B. Provide the following systems as described in Section 020010:
 - 1. Parking Stall Stripes.
 - 2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.
 - 3. International Symbol of Accessibility.
- C. Provide painting of curbs and curb ramps as described in the following paragraphs:
 - 1. Paint vertical surface and the first 6 in. of the abutting horizontal surface at the top of curbs and islands (including PARCS equipment islands) within parking facility.
 - 2. Paint color for curbs and curb ramps shall be yellow.
- D. Proportion International Symbol of Accessibility in accordance with ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.
- E. Related Work:
 - 1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Provide product data as follows:
 - 1. Manufacturer's certification that the material complies with standards referenced within this Section.
 - 2. Intended paint use.
 - 3. Pigment type and content.
 - 4. Vehicle type and content.

- C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

1.4 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

- A. Provide written 1-year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement marking materials shall meet Federal, State and Local environmental standards.
- B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.
- C. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59.
- D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 PAVEMENT MARKING PAINTS:

- A. 100% acrylic waterborne - paint shall be used for white and yellow pavement markings and shall meet requirements of MPI #70.
 - 1. Available Products: Subject to compliance with the requirements, products that may be incorporated into the Work include, but are not limited to the following:

- a. Hi-Build Latex "Liquid Thermoplastic" Traffic & Zone Marking Paint, 5430/5431, by RAE Products & Chemicals Corporation
 - b. Setfast Acrylic Waterborne Marking Paint, TM 226/227 by Sherwin Williams Company
 2. 100% acrylic waterborne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.
- B. All products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.

2.3 COLOR OF PAINT

- A. Color of paint shall match existing:
1. White: Match federal color chip 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
 2. Yellow: Match federal color chip No. 33538. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
 3. Blue: Match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Document the location of existing striping and traffic marking, and colors utilized prior to removal of traffic lines and markings for surface preparation.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- E. Striping shall not be placed until full cure of concrete repairs, sealers or coatings.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Do not paint or finish any surface that is wet or damp.
- C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, release agents, curing compounds, efflorescence, chalk, and incompatible paints and encapsulants.
- D. Concrete Substrates: Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Lay out all striping on each tier, using existing layout, dimensions and details unless otherwise noted on Contract Drawings.
- F. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.
- G. Where existing painted pavement markings and/or stripes conflict with new striping layout or must be removed due to installation which does not conform to contract requirements, remove existing paint markings, using care to avoid scarring substrate surface.
1. Concrete and asphalt surfaces: Material shall be removed by methods acceptable to 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 pavement as a result of removal shall be removed as work progresses. Accumulation of material, that might interfere with drainage or might constitute a hazard to traffic, prohibited.
5. Curing compounds on new concrete surfaces (less than 1 yr old) shall be removed per existing pavement marking removal requirements prior to installation of new pavement markings.

H. Work Areas:

1. Store, mix, and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

I. Mixing:

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

J. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

- A. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40 deg F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.
1. Total wet mil thickness of 0.015 in (minimum).
 2. Total dry film thickness of 0.008 in (minimum).
- B. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).
- C. All lines shall be 4-inches wide unless otherwise noted.

END OF SECTION 099121

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SECTION 101400 – SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes following types of signs:
 - 1. Non-reflective pedestrian directional and informational signs (PP- Signs).
 - 2. Brailled ADA Compliant Identification Signs (A-Signs).

1.2 SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:
 - a. Permanently Designated Rooms and Spaces: A- Signs.
 - b. Elevator Signs.
 - c. Stairway Identification.
- B. Provide written 5-year full replacement warranty to Owner that all signage will be free of defects due to workmanship and materials including, but not limited to, fading, peeling, delamination, and installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by other manufacturers specified.
- B. Manufacturers: Acceptable manufacturers include, but are not limited to the following:
 - 1. Manufacturers of panel signs, including V-,R-,W-, PP-,PS-,VR-, D- and EP-signs:
 - a. ABC Architectural Signing System, Division of Nelson-Harkins Industries.
 - b. Alcan Composites, Benton, KY.
 - c. Allenite, A Division of Allen Marking Products, Inc.
 - d. Andco Industries Corp.
 - e. APCO Graphics, Inc.
 - f. Architectural Graphics, Inc.
 - g. ASI Sign Systems, Inc.
 - h. Best Manufacturing Co.
 - i. Interstate Highway Sign Corp.
 - j. Henry Graphics.
 - k. Jarob Design, Inc.
 - l. Pannier Graphics.
 - m. Tapco.
 - n. Vomar.
 - 2. Manufacturers of Brailled Signs (A-):
 - a. Supersine Company.
 - b. Jet Signs.

2.2 MATERIALS

- A. Graphics:
 - 1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
 - 2. Silk screening: Where specified or permitted, silk screening shall be highest quality, with sharp lines, no sawtooths, or uneven ink coverage.
 - a. Where reflective messages are specified or permitted to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.

- b. Where reflective messages are specified or permitted to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3930 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.
 3. Pressure applied graphics:
 - a. Where pressure-applied graphics applied to a painted background are specified or permitted, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
 - b. Where pressure-applied, reflective graphics on an opaque painted background are specified or permitted, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Where pressure-applied, reflective graphics on a reflective background are specified or permitted, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cutable Film Series 1170, colors as noted on drawings or equivalent.
 - c. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchcal Electrocut 7725 film.
- B. Inks and Paints:
1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
 2. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
 3. Paints: all materials best quality. Products of DuPont DeNemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.
- C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.
1. Aluminum:
 - a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish

indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.

- b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
- c. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
 - 1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
 - 2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.

D. V- Signs: Vehicular signs with reflective graphics and retroreflective message on an opaque background.

1. Base materials:

- a. Aluminum with either reverse silk screened graphics or pressure-applied retroreflective letters.
- b. DiBond with either reverse silk screened graphics or pressure applied retroreflective letters.
- c. Sintra with either reverse silk screened graphics or pressure-applied retroreflective letters.
- d. FRP, but only with painted background and pressure applied retroreflective letters.

2. Background color for all V- Signs, vehicular directional signs, to meet MUTCD standard green, pantone color 342.

3. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.

- a. Pressure applied retroreflective white letters/symbols. Use 3M High Intensity Prismatic White Sheeting 3930.
- b. Silk screened; background inks shall be opaque, with retroreflective message.

E. R- Regulatory and W- Warning vehicular signs with retroreflective graphics and message on a retroreflective background.

- 1. All regulatory and warning signs to fully comply with MUTCD standards.
- 2. Base material: Aluminum.

3. R and W signs shall have retroreflective messages and retroreflective background using either silk screening or pressure applied retroreflective letters and symbols.
4. Retroreflective colors determined by 23 CFR Appendix to Subpart F of Part 655, Alternate Method to Determining the Color of Retro-reflective Sign Materials and pavement marking materials.
 - a. Federal Highway Authority (FHWA) Reflective Sheeting Identification Guide using ASTM D 4956-04.
 - b. Sheeting Types I through IX.
 - c. The daytime color of non-fluorescent retroreflective materials may be measured in accordance with ASTM Method E 1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry using Bi-directional Geometry of ASTM Test Method E 1347. Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry.
 - d. The geometric conditions to be used in both test methods are 0/45 or 45/0 circumferential illumination or viewing. The CIE standard illuminant used in computing the colorimetric coordinates shall be D 65.
 - e. For fluorescent retroreflective materials ASTM E991 may be used to determine the chromaticity provided that the D65 illumination meets the requirements for E 991.
 - f. The following 3M Diamond Grade DG³ Reflective Sheeting materials meet the MUTCD retroreflective requirements:
 - 1) White – DG³4090
 - 2) Red - DG³ 4092
 - 3) Blue – DG³4095
 - 4) Yellow - DG³ 4091
 - 5) Green – DG³ 4097
 - 6) Brown – DG³4099
 - 7) Fluorescent Yellow – DG³ 4081
 - 8) Fluorescent Yellow Green – DG³ 4083
 - 9) Fluorescent Orange - DG³4084

F. PP- Pedestrian Panel Wayfinding and Directional Signs.

1. Base materials:
 - a. Aluminum with either reverse silk screened graphics or pressure-applied letters.
 - b. Di-Bond with either reverse silk screened graphics or pressure applied letters.
 - c. Sintra with either reverse silk screened graphics or pressure-applied letters.
 - d. FRP, but only with painted background and pressure applied letters.
2. Background color for all PP signs, pedestrian directional signs, to meet MUTCD standard blue, pantone color 294.

3. For level designation sign colors refer to the list of MUTCD pantone colors:
 - a. Pantone Matching Colors and General MUTCD Meanings:
 - 1) Brown (469) – Recreational and cultural interest are guidance.
 - 2) Green (342) – Indicated movements permitted, directional guidance.
 - 3) Blue (294) – Road user services guidance, tourist information, and evacuation route.

Color coding can be used for floor designations except red (187), yellow (116) and orange (52) per MUTCD.

4. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
 - a. Pressure applied non-reflective letters/symbols.
 - b. Silk screened over a flat opaque background.
 - c. Original art and/or multi-color graphics shall be digitally produced on graphic media.
- G. PS-Supergraphics, Pedestrian Wayfinding and Directional Signs:
 1. Apply primer and/or background color as specified on the drawings to surface as required. Sign contractor shall assure that paint employed for graphics is compatible with surface treatment(s) by others, including but not limited to concrete sealers and/or form release agents.
- H. A- Signs: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1. latest editions.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

- A. Prepare and clean in strict accordance with paint manufacturer's instructions.

3.2 INSTALLATION

- A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.
- B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.

- C. Provide "Wet Paint" signs as required.

END OF SECTION 101400

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