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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 2.1 – Professional Surveying – Elevations

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 of water through fire hydrants and disposal of wastewater per 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 upon Award of Project, 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.

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 repairs. Provide signs indicating route to follow for additional areas of parking, and route to follow to exit structure, at all levels in (2) 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 or flying-debris producing activities occur.
2. A critical component of this Work is providing protection around the hydro-demolition work areas on the roof level of the structure to contain all dust/debris/water within these work areas and not affect the nearby highway, roads, sidewalks, and all other areas adjacent to the structure. **Contractor shall submit their proposed roof level protection plan to be reviewed by Owner/Engineer prior to Award of Contract.** As a minimum, roof level protection shall comply with performance requirements in this Work Item.
 - a. Contractor shall be responsible to continuously monitor hydro-demolition work and effectiveness of perimeter protection, particularly on roof level.
 - b. Contain all debris within work area.
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 lower levels 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. Minimum requirements on the roof level:
 - a. 8-ft. high plywood barriers shall be installed around entire perimeter where hydro-demolition is occurring, and as required to protect the public. Secure adequately to withstand wind loading per ASCE 7. Submit calculations from Engineer licensed in Michigan for record. (See Detail 3.7/R-501 for existing vehicle barrier that plywood barrier can be mounted to).
 - b. Perimeter barriers shall be maintained until after concrete placement has been completed.
 - c. Utilize additional protective shroud(s) around hydro-demolition equipment.
 - d. 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 towers adjacent to the required hydro-demolition work to prevent pedestrian access to the work areas (all levels). See Drawings for specific requirements.
3. Roof level barriers and protection shall be sufficient to protect nearby highway, roads, sidewalks, and all areas adjacent to structure 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 roof level 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 of perimeter protection.
 - d. Proposed method of installing/anchoring perimeter protection to structure.
 - e. 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).
 - f. Any other relevant information regarding contractor's proposed roof level 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 2.1 PROFESSIONAL SURVEYING – ELEVATIONS

A. Scope of Work

1. This Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to perform elevation surveys as required in parking structure work areas to establish and document elevations prior to placing concrete to ensure proper drainage. Surveys shall be performed by a licensed and qualified professional surveying firm, subject to Engineer's approval.
2. Perform elevation surveys and set grades at all floor surfaces to receive overlay repair per W.I. 3.7 as shown on Drawings to ensure proper drainage will be achieved prior to placing concrete. Professional surveyor shall also be responsible for setting new drain elevations.
3. This Work Item shall be lump sum to perform all elevation survey work as specified in this Section and as required to perform W.I. 3.7.

B. Materials (NOT APPLICABLE)

C. Execution

1. Prior to start of Work, Contractor and Surveyor shall verify with Engineer minimum required elevation reference points and benchmarks. Benchmarks shall be clearly marked and protected throughout construction, to prevent damage or shifting.
2. Horizontal spacing for control points shall be as needed to ensure positive drainage and prevent ponding, but not more than 15-ft. apart in any direction.
3. Within the specified work area, Professional Surveyor shall be responsible to set/verify final elevations and slopes prior to concrete placement per W.I. 3.7. Deliverables to be submitted to Engineer include:
 - a. Plan drawing of existing slab surface elevations prior to concrete removals.
 - 1) Professional surveyor required to obtain existing slab surface elevations at 5-ft. on center maximum spacing. Submit for record prior to performing concrete removals.
 - 2) In the event Contractor makes claim for payment under W.I. 3.11 "Floor Repair – Additional Depth", Professional Surveyor will be required to obtain and submit elevations of concrete removal surfaces after hydro-demolition and surface preparation have been completed (prior to placing concrete) and elevations of bottom layer of reinforcement in top mat. Elevations of removal surfaces and rebar shall be obtained at same locations as existing slab surface

elevations (5-ft. on center spacing maximum), and shall be referenced to same benchmark(s).

- b. Plan drawing of elevations in overlay repair areas required to ensure proper drainage of repairs prior to placing concrete per W.I. 3.7.
 - c. Plan drawing of actual elevations achieved, in same locations as initial survey(s), after concrete has been placed per W.I. 3.7.
- 4. Professional Surveyor shall be onsite to set and verify final elevations, grades, and slopes for all concrete pours per W.I. 3.7.
- 5. Elevations for screeds and pad for final floor elevations shall be set/verified prior to concrete placement and shall be placed and recorded as necessary to ensure proper drainage, but as a minimum, at all of the following locations in the work area:
 - a. Top of all floor drains.
 - b. All high points on drainage profile layout (5-ft. maximum spacing).
 - c. At points between high points and drains not exceeding 5-ft. on center in east-west and north-south directions.

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 3.1A 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 must still be performed by hydro-demolition. This Work Item only pertains to the removal method of debris after hydro-demolition is completed. Proposed method of removal shall not damage existing reinforcing steel.

WI 3.2 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 3.2 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, 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 Drawing R-201. 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 level 6 in bays 5 & 6 as shown on Drawing R-201. 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".
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. Verify in field with Engineer. Refer to Drawings for further phasing requirements.
2. Perform required Elevation Surveys per W.I. 2.1.

3. 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.
4. Temporary shoring at the cantilevered edges shall bear on existing foundations at grade level. Verify in field with Engineer.
5. **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.**
6. 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.
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.
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 1% to 2% slope on repaired surfaces to nearest drains. 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. In general, maintain existing thickness of slab, except as needed to provide proper drainage. Notify Engineer of proposed change(s) to slab thickness and verify drainage requirements prior to placing concrete.

17. Contractor shall completely protect existing light fixtures, exit lights, pull alarms, signs, conduit, security cameras, elevators, galvanized 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.
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 3.8 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 (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 3.11 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 Elevation Surveys per W.I. 2.1 (before and after concrete removals as required) and submit to Owner/Engineer as documentation of removal depths. See W.I. 2.1 for specific requirements.
 - 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 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. 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. 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.
9. Contractor shall take care to protect adjacent areas from overspray if "Shotcrete" is used. Area adjacent to repair shall be cleaned to Owner's satisfaction prior to leaving site.

WI 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 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 level 6 in bays 5 & 6 (from column line "8.5" to "12.5"). For bidding purposes, the length of required expansion joint replacement is approximately 124 lineal feet. Contractor is required to verify extent of expansion joint replacement in field prior to submitting Bid. This lineal footage number is provided for reference only and is based on original drawings. No extras will be allowed for discrepancy between this number and actual lineal footage of expansion joint replacement, unless Contractor is specifically directed by Engineer to replace additional expansion joints.
 - 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.
- C. Execution
 - 1. Contractor shall remove existing expansion materials in manner that minimizes damage to adjacent concrete. Expansion joint blockout 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 11.1 OVERLAY CONTROL JOINT SEALANT (INCIDENTAL)

A. Scope of Work

1. Work consists of furnishing all labor, materials, equipment, supervision and incidentals necessary to provide tooled joints in overlay concrete repair areas (W.I. 3.7) and install sealant as required on Drawings. Refer to Detail 11.1 for specific requirements. Refer to Detail 1/R-001 for typical joint layout.
2. This Work is incidental to W.I. 3.7 and is NOT a separate pay item.

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 locate and provide control joints at all column grid lines and at all existing control and construction joints. See Drawings for typical layout. Locate existing construction joints prior to performing concrete removals.
2. Joints shall be tooled in plastic concrete. Saw-cutting of joints in hardened concrete will NOT be allowed.
3. Tooled joints shall be of proper dimension in plastic concrete as shown on Detail 11.1.
4. Approved joint materials shall be installed as specified in Section "Concrete Joint Sealants".
5. Sealant manufacturer shall verify that joint sealant type is compatible with traffic coating specified in Section "Traffic Coatings".

WI 11.2 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 11.2 for specific requirements.
2. Payment for this Work Item shall be per lineal foot of work actually performed, measured in field with Owner/Engineer.

3. Note: Sealing of control/construction joints at floor overlay repair areas is covered under W.I. 11.1 and is NOT eligible for payment under this Work Item.

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 (per W.I. 11.1), but may be used on random cracks per this Work Item.
3. Cavities shall be thoroughly cleaned by either sand-blasting or grinding to remove all laitance, unsound concrete, and curing compounds which may interfere with adhesion. Groove shall be air-blasted to remove remaining debris.
4. Sealant materials and associated reference specifications are listed in Article "Materials" above. Sealant installation procedures shall be in accordance with referenced specifications for selected material.
5. Sealant type shall be compatible with traffic coating specified in Section "Traffic Coatings".

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 lump sum to install traffic topping in Bays 5 & 6 on level 6 as shown on Drawing R-201. For bidding purposes, the required traffic topping installation floor area shown on Drawing R-201 is approximately 30,500 S.F. Contractor is required to verify extent of traffic topping installation in field prior to submitting Bid. This square footage number is provided for reference only and is based on original drawings. No extras will be allowed for discrepancy between this number and actual square footage of traffic topping installed, unless Contractor is specifically directed by Engineer to extend traffic topping installation outside of work areas shown on Drawing R-201.

WI 16.9 SCALED SURFACE REPAIR (EPOXY/SAND)

- A. Scope of Work
 1. Work consists of furnishing all labor, materials, equipment, supervision, and incidentals necessary to scarify, shotblast, and prepare surface of concrete slab and install epoxy/sand overlay on prepared concrete surface. Refer to Detail 16.9 for specific requirements.
 2. Payment for this Work shall be per square foot of epoxy/sand repair material installed.
- B. Materials
 1. MasterSeal 350 with DynaGrip Aggregate #8, by BASF.
 2. PolyCarb Mark 171 with Washington Stone, Dow Chemical Company.
 3. Neogard Epoxy/sand system with #16 aluminum oxide.
 4. Engineer-approved equivalent.
 5. For any selected product:
 - a. Submit color samples for Owner approval.
 - b. Sand shall be 12-20 size minimum (or equivalent) unless noted otherwise. Submit various sized samples for Owner/Engineer approval.

- c. Provide non-sag additive as required to prevent epoxy/sand from sagging. Seed stone until rejection.
- d. For the topcoat, provide 5-10 mil epoxy lock coat to lock in top sand layer.

C. Execution

- 1. Contractor shall locate scaled surface repair areas and verify with Engineer prior to start of Work. See Drawing R-201 for general locations.
- 2. All loose/delaminated existing concrete shall be removed by scarifying to ¼" amplitude.
- 3. After scarification, shotblast surface per manufacturer's recommendations. Sand-blasting and/or water-blasting shall then be performed to remove all dust/debris/laitance. Additional surface preparation shall be performed as needed in strict accordance with manufacturer's recommendations.
- 4. Install 10-ft.x10-ft. trial section of epoxy/sand system for Owner/Engineer approval, utilizing scarification, shot-blasting, sand-blasting, water-blasting, and other surface preparation as required. Do not proceed with further material application until trial sections accepted in writing by Owner. Remove and replace rejected trial sections until approval is obtained (incidental).
- 5. Install the epoxy/sand overlay per manufacturer's recommendations to minimum depth shown on Detail (in multiple lifts as required).
- 6. Manufacturer's technical representative shall be onsite during surface preparation and epoxy/sand installation.
- 7. Provide 5-year warranty for labor and material for any material and adhesion/bonding failures.

WI 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 Drawing R-201 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 AND COLUMN 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 breakdown of work and costs as requested by Owner.

WI 25.2 MECHANICAL – REPLACEMENT FLOOR DRAINS

- 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 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, and shall be incidental to this Work and not eligible for payment under any other Work Items.
3. Install and epoxy-anchor supplemental reinforcement as shown on Detail 25.2, incidental to this Work and not eligible for payment under any other Work Item.
4. Concrete removals required to install replacement drains and reinforcement shall be performed with conventional chipping hammers. Saw-cutting through slab NOT allowed. Do not cut existing reinforcement.
5. Drains shall be installed as shown on Detail 25.2.
6. Professional Surveyor per W.I. 2.1 shall set and verify all final drain elevations prior to placing concrete.

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.

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 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. Stairs “B” and “E” will be closed for the duration of the project to facilitate the overlay strip repairs (W.I. 3.7). In addition, Contractor may close (1) of Stairs “D” and “F” at a time to complete landing repairs. Landing repairs in Stairs “A” and “C” shall be performed only after Stairs “B” and “E” have been re-opened for normal use, and shall then only be closed one at a time. At no time shall more than 1 of the 3 stairs on the south side of the structure (“A”, “B”, and “C”) be closed at any one time. Elevators “A” and “C” shall remain open for normal use at all times throughout the duration of the project, no exceptions. Contractor to phase landing repairs accordingly.

WI 41.3 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 patching material and paint delineation strip. Refer to Detail 41.3 for specific requirements.
 - 2. Stairs “B” and “E” will be closed for the duration of the project to facilitate the overlay strip repairs (W.I. 3.7). In addition, Contractor may close (1) of Stairs “D” and “F” at a time to complete tread repairs. Tread repairs in Stairs “A” and “C” shall be performed only after Stairs “B” and “E” have been re-opened for normal use, and shall then only be closed one at a time. At no time shall more than 1 of the 3 stairs on the south side of the structure (“A”, “B”, and “C”) be closed at any one time. Elevators “A” and “C” shall remain open for normal use at all times throughout the duration of the project, no exceptions. Contractor to phase tread repairs accordingly.
- 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 sawcutting 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.

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 all levels, 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. 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".

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 shop drawings that indicate the measures proposed for use, proposed locations, and proposed time frame for their operation. Modify and re-submit as necessary to obtain Owner approval.
 - 1. Comply with minimum requirements of W.I.'s 1.5 & 1.6.
- 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 structure and of Owner's partial occupancy of completed Work.
- D. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining/adjacent construction and site improvements, including finished 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, if applicable.

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 temporary shoring requirements and 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 continue to occupy portions of structure 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 purpose 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 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 similar to existing materials.
 - 1. Use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses specified requirements. Verify with Engineer.
- 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 (as applicable).
- 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 determine the nature and extent of conflict. Promptly 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 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 structure.

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 routes around closed or obstructed traffic ways as 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 weather-tight 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.
 - 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. Protect floor drains as required to ensure dust/debris does not enter drainage system.
 - 3. Wet mop floors to eliminate trackable dirt and wipe down walls/doors/etc.
- 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 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 (see phasing requirements on Drawings). 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. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, columns, or framing.
 7. Dispose of demolished items and materials promptly.
 8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with Owner'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/label 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/label 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 and Owner, 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. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations. Proposed repair procedures shall be approved by Engineer prior to performing repairs.
- 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 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 or repair 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 deg of perpendicular of finished surface.
- C. **SPALLS:** Potholes, cavities, or voids in floor slabs, beams, columns, and walls. Usually result of delamination migrating to face of concrete member. When fracture finally reaches surface, concrete encompassed by delamination breaks away, resulting in spall.
- D. **UN SOUND CONCRETE:** Concrete exhibiting one or more of:
 - 1. Incipient fractures present beneath existing delaminated or spalled surfaces.
 - 2. Honeycombing.
 - 3. Friable or punky areas.
 - 4. Deterioration from freeze-thaw action.
- E. **SCALING:** Deterioration which attacks mortar fraction (paste) of concrete mix. First appears as minor flaking and disintegration of concrete surface. Scaling eventually progresses deeper into concrete, exposing aggregate which breaks away. Concrete scaling is caused by freeze-thaw action. If concrete is frozen in saturated state, excess water freezing in concrete causes high internal stresses.
- F. **SHOTBLASTING:** Scarification of concrete surfaces using an abraded metal shot-rebound. See Corps of Engineer's Manual EM 1110-2-2002 and the National Cooperative Highway Research Program's Report #99 for a more detailed definition.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 025130

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SECTION 025140 - SURFACE PREPARATION FOR PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 REFERENCES

- A. "Specifications for Structural Concrete for Buildings" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.
- B. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown on Drawings or specified herein:
 - 1. "Guide for Repair of Concrete Bridge Superstructures" (ACI 546.1), American Concrete Institute.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 INSPECTION

- A. Floor Slabs:
 - 1. Floor Slab Delaminations: Locate by sounding surface with hammer, rod, or chain drag.
 - 2. When delaminated area is struck, distinct hollow sound is heard.
 - 3. Contractor: Sound all work area floors for delaminations.
 - 4. 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 vertical and overhead surfaces that show evidence of cracking and/or salt and water staining.

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

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

E. Engineer will define and mark additional unsound concrete areas for removal with Contractor, as 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 other embedded items in repair area and mark these locations for reference during concrete removal. Do **NOT** nick or cut any embeds unless approved by Engineer.

3.2 PREPARATION

A. **Temporary shoring, in addition to requirements of W.I. 18.1, may be required at localized concrete floor/ceiling repair areas (outside of W.I. 3.1/3.7 work areas) and at any column repair. Contractor: Review all marked removal and preparation areas and request clarification by Engineer of shoring requirements in questionable areas. Provide additional shores at localized floor, ceiling, or column repairs as required by Engineer per W.I. 18.2. Shores shall be in place prior to concrete removal in any area requiring shores.**

B. Delaminated, Spalled, and Unsound Concrete Floor Areas: Mark boundaries. All concrete shall be removed from within marked boundary to minimum depth of 0.75 in. using 15 to 30 lb chipping hammers equipped with chisel point bits. When directed by Engineer, chipping hammers less than 15 lb shall be used to minimize damage to sound concrete. If delaminations exist beyond minimum removal depth, chipping shall continue until all unsound and delaminated concrete has been removed from cavity.

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

- D. If rust is present on embedded reinforcement where it enters sound concrete, additional removal of concrete along and beneath reinforcement required. Additional removal shall continue until non-rusted reinforcement is exposed as Engineer directs.
- E. Sawcut to depth of 0.75 in. into floor slab, unless otherwise noted. For vertical and overhead surfaces, marked boundary may be sawcut, ground, or chipped to depth of 0.5 in. to 0.625 in. into existing concrete, measured from original surface. All edges shall be straight and patch areas square or rectangular-shaped. Diamond blade saw or grinder with abrasive disk suitable for cutting concrete is acceptable for performing work. Edge cut at delamination boundary shall be dressed perpendicular to member face. It shall also be of uniform depth, for entire length of cut. Exercise extra caution during saw-cutting to avoid damaging existing embedded reinforcement and electrical conduit, and any other embedded items near surface of concrete. Any damage to existing reinforcement or other items during removals shall be repaired by Contractor with Engineer-approved methods at no additional cost to Owner.

3.3 INSPECTION OF REPAIR PREPARATION

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

3.4 REINFORCEMENT AND EMBEDDED MATERIALS IN REPAIR AREAS

- A. All embedded reinforcement exposed during surface preparation that has lost more than 15% (10% if 2 or more consecutive parallel bars 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 shall be protected by Contractor during removal operations. Damage due to removal operations shall be repaired by Contractor in accordance with national code requirements at no cost to Owner.** Embedded materials which are defective due to pre-existing conditions may be repaired or replaced by Contractor or abandoned at Owner's option and cost.
- C. Supplement defective or damaged embedded reinforcement by addition of reinforcement of equal diameter with Class "B" minimum splice per ACI 318 beyond damaged portion of reinforcement. Secure new reinforcement to existing reinforcement with wire ties and/or approved anchors. Supplemental reinforcement

shall be ASTM A615 Grade 60 steel installed in accordance with Section "Cast-in-Place Concrete".

- D. Loose and supplemental reinforcement exposed during surface preparation shall be securely anchored prior to patch placement. Loose reinforcement shall be adequately secured by wire ties to bonded reinforcement or shall have drilled-in anchors installed to original concrete substrate. Drilled-in anchors shall be Powers "Tie-Wire Lok-Bolt" anchors, ITW Ramset/Red Head "TW-1400" anchor, or approved equivalent. Supplemental reinforcing needed to be held off substrate shall be adequately secured by drilled-in anchors installed to original concrete substrate with Powers "Tie-Wire Spike", ITW Ramset/Red Head Redi-Drive "TD4-112" anchors, or approved equivalent. Engineer will determine adequacy of wire ties and approve other anchoring devices prior to their use. Securing loose and supplemental reinforcement is incidental to surface preparation and no extras will be allowed for this Work.
- E. Concrete shall be removed to provide minimum of 3/4 in. clearance on all sides of defective or damaged exposed embedded reinforcement that is left in place. Minimum of 1.5-in. concrete cover shall be provided over all new and existing reinforcement.
- F. Supplemental reinforcement and concrete removals required for repairs of defective or damaged reinforcement shall be paid for as follows:
 - 1. Concrete removals and supplemental reinforcement required for repairs of DEFECTIVE reinforcement shall be paid for by Owner at unit price bid.
 - 2. Concrete removals and supplemental reinforcement required for repairs of DAMAGED reinforcement shall be paid for by Contractor.

3.5 CLEANING OF REINFORCEMENT WITH DELAMINATION AND SPALL CAVITIES

- A. All exposed steel shall be cleaned of rust to bare metal by sandblasting. Cleaning shall be completed immediately before patch placement to insure that base metal is not exposed to elements and further rusting for extended periods of time. Engineer may require entire bar diameter be cleaned.
- B. After all sandblasting operations and cleanup are completed, paint all exposed steel with an approved epoxy. Protect prepared surfaces from damage prior to and during patch placement.
 - 1. Installation of epoxy material not required in hydro-demolition repair areas.

3.6 PREPARATION OF CAVITY FOR PATCH PLACEMENT

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

END OF SECTION 025140

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SECTION 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 and required by Specifications, using hydro-demolition, and preparation of exposed surfaces created by removal to receive overlay strip patching repairs including, but not limited to:
 - 1. Removal of floor slab concrete (partial-depth) by means of hydro-demolition, including adjustment of removal equipment as needed to maintain acceptable removal depths throughout repair areas as Detailed.
 - 2. Removal of concrete material inaccessible to hydro-demolition equipment within specified work areas by means of conventional chipping hammers (incidental).
 - 3. Removal of concrete “shadows” beneath rebar.
 - 4. Transportation, treatment, and disposal of hydro-demolition waste water, including all temporary drains, piping, pumps, filters, containment tanks, etc. for a complete and operational system to comply with City of Detroit requirements.
 - 5. Preparation and cleaning of exposed surfaces created by the removals to receive concrete overlay.

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 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 shall be used to demonstrate that equipment, personnel, and methods of operation are capable of producing results satisfactory to Engineer. Trial area shall consist of 2 sections, approximately 200 S.F. each, one section deteriorated concrete and one section sound concrete, as determined by Engineer.
- B. In deteriorated or sound concrete areas, adjust equipment to remove concrete to depth shown on Drawings. Multiple passes may be required.
- C. After completion of above test sections, 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. 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 HYDRO-DEMOLITION 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 Owner/Engineer-approved hydro-demolition equipment.
- C. Hydro-demolition Contractor: Supply necessary equipment and manpower to maintain pre-established production rate and assure adherence to specified construction schedule shown on Drawings.
- D. Equipment shall be capable of performing bulk concrete removals to depths shown on Drawings at average production rate capable of meeting specified Project schedule requirements, including required concrete placement dates and hydro-demolition completion date.
- E. Hydro-demolition unit weight shall not exceed 8,000 lbs. See temporary shoring requirements for additional restrictions.
- F. At specified rebar location, hydro-demolition 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, Monday thru Saturday.**
 - 2. **Cleanup Only (no demolition/construction activities): 7:00pm thru 9:00pm, Monday thru Saturday.**
 - a. **Cleanup (non-noise activities) from 7:00pm thru 9:00pm, Monday thru Saturday, allowed only with Owner review/approval of sound levels to adjacent residences remaining within acceptable limits.**
 - 3. **No Work of any kind allowed on Sundays, and 9:00pm thru 7:00am, Monday thru Saturday.**

PART 3 - EXECUTION

3.1 LOCATION AND MARKING OF WORK AREAS

- A. Boundaries of overlay strip patching repair areas (W.I. 3.7) shall be sounded 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 floors within work areas 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 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. Saw-cutting and chipping is required at perimeter of removals, and at boundaries shown on Drawings.

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 HYDRO-DEMOLITION EQUIPMENT

- A. Once operating parameters of hydro-demolition equipment are defined and calibrated, they shall be monitored by Contractor as machine progresses across work areas, 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.
- B. Operation of hydro-demolition equipment shall be performed by and supervised by qualified experienced personnel, acceptable to Owner/Engineer.
- C. All water used for hydro-demolition shall be potable. Stream or lake water 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 hydro-demolition 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 temporary lighting as required to perform repairs.
- N. Contractor shall maintain, on job site, inventory of common wear parts, replacement accessories, and tools required to assure repairs of hydro-demolition and waste water containment equipment will be addressed in a timely manner and 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 hydro-demolition techniques. Concrete shall be removed to depth of 0.75 in. below lowest bars in top mat of reinforcement. Removals shall be performed in manner that avoids excessive concrete removals between reinforcement.
- E. Provide vertical edge along all perimeters of repair areas and around perimeter of all columns. Care shall be exercised to avoid undermining columns at floor slab/column interfaces. Column cross section, as a minimum, shall be same as above and below floor slab at all times, throughout entire 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 bonding of repair materials 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 and debris. 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 hydro-demolition process, to prevent debris from re-settling or re-adhering to surface of remaining sound concrete. If debris build-up is observed, Contractor shall clean surface as directed by Engineer 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 is 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. 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.
- M. Removals in work area locations that are not accessible for hydro-demolition operations shall be performed using conventional methods as specified in Section "Surface Preparation for Patching". Inaccessible areas shall be brought to Engineer's attention before hydro-demolition begins.

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 for compliance with requirements of Article "Reinforcement in Repair Areas". Where Engineer finds unsatisfactory surface preparation, Engineer will direct Contractor to perform additional removals. Engineer 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 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.

- D. After inspections are complete and all preparation accepted, Engineer and Contractor shall measure and document removal and replacement quantities for payment as applicable.

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 hydro-demolition process. If for any reason hydro-demolition cannot clean reinforcement to bare metal, Contractor shall clean reinforcement by sandblasting (incidental). All rusting shall be removed from surface of reinforcement prior to concrete placement.

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.**
- B. 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 Section "Cast-in-Place Concrete".
- 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 existing concrete at 4-ft. intervals maximum. Engineer shall determine adequacy of wire ties and approve other anchoring devices prior to their use. **Tying loose reinforcement to bonded/embedded 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:
 - d. Concrete removals and supplemental reinforcement required for repairs of DEFECTIVE reinforcement shall be paid for by Owner at unit price bid.
 - e. 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 STRIP PATCH PLACEMENT

- A. In preparation for placement of new concrete, exposed concrete surface to be overlaid shall be water-blasted to remove all laitance, oil, grease, rust, debris, slurry, dust, or other foreign material. Water jet pressure of water-blasting equipment shall have minimum operating pressure of 8,000 psi with minimum flow rate of 18 gal/min working at 8 in. from concrete surface. Water-blasting shall be done sufficiently ahead of concrete placement to prevent areas of sitting water on surface.
- B. Floor slab and cavity surfaces will be examined by Engineer prior to overlay and strip patch placement. Where Engineer finds unsatisfactory surface preparation, Engineer 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 proportions, placement procedures, finishes, and other miscellaneous items related to cast-in-place concrete.
- B. Cast-in-place concrete includes project requirements specified herein and on the Drawings and other applicable Specification Sections:
 - 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".

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. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- B. Requests For Information
 - 1. Engineer reserves the right to reject, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.

2. Engineer reserves the right to reject, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.
- C. Submit Product data for concrete component materials and other concrete related items including, but not limited to:
1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
 - a. Cementitious materials and aggregates.
 - b. Admixtures.
 - c. Form materials and form-release agents.
 - d. Steel reinforcement and accessories.
 - e. Epoxy coating.
 - f. Fiber reinforcement.
 - g. Curing materials.
 - h. Repair materials.
 2. Submit certification that curing compound or evaporation reducer, if used, is compatible with products specified in Division 07 Sections.
 3. Submit certification that curing compound or evaporation reducer, if used, is compatible with pavement markings specified in Division 09 Section "Pavement Marking".
- D. Submit materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specified requirements.
- E. Submit evidence of licensure in Michigan for professional engineer providing professional services as required for Contractor in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures.
1. Contractor's responsibilities include formwork, shoring and re-shoring procedures, and other work described in Article "Contractors Professional Design Services", Article "Formwork", and Article "Shores and Re-shores".
 2. Performance and design criteria are shown on the Drawings and in Article "Contractor's Professional Services - Performance and Design Criteria".
 3. Contractor's Professional Engineer shall furnish Owner a Certificate of Professional Liability Insurance in minimum amount of \$1,000,000 per claim.
 4. Submit 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.

- F. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
 2. Proportion mixtures as defined in ACI 301 Section 4 header "Proportioning". Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
 3. Proportion mixtures to minimize effects of thermal and drying shrinkage.
 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 (as applicable).
 - i. Freeze-thaw resistance, ASTM C457 and C666. If super-plasticized concrete cannot meet hardened air content requirements of Part 2, ASTM C666 laboratory test result of specimens with concrete mixture proportions similar to proposed mixture for project shall be submitted for review by Engineer. Report air void parameters (spacing and specific surface area in accordance with ASTM C457) (at point of placement) of specimens tested. Test specimens shall contain specified air system (within plus or minus 1.5 percent) and high-range water-reducer (superplasticizer) used in concrete for project. Report relative durability factor of concrete for specimens tested in accordance with Procedure A of ASTM C666. Acceptable concrete durability factor greater than 90 percent (> 90%) at 300 test cycles. Relative durability factor of concrete containing superplasticizer greater than or equal to 80 percent ($\geq 80\%$) compared with reference.
 - j. Density (Unit weight) of concrete: ASTM C138.
 - k. Strength at 4, 7, and 28 days: ASTM C39. Contractor shall coordinate testing of additional cylinders with Testing Agency as necessary for early form removal.
 - l. Water soluble chloride ion content of concrete: ASTM C 1218.
 - m. Mill test report of silica fume: Provide report for each 400 cu. yd. or fraction thereof, of concrete placed on project. Provide to Owner from independent

- testing lab showing chemical analysis in percent by weight of silica fume solids supplied and used.
- n. Silica fume concrete admixture: Comply with ASTM C1240 and following additional requirements:
 - 1) Silicon dioxide content: 90 percent (minimum).
 - 2) Loss on ignition (LOI): 6 percent (maximum).
 - 3) Surface area (nitrogen absorption): 15,000 m²/kg.
 - 4) Crystallinity: Non-crystalline within limits of detection less than or equal to 0.5 percent ($\leq 0.5\%$) depending upon x-ray machine used by x-ray diffraction.
 - 5) Oversize foreign materials (in fume): 5% maximum on 45 micron sieve (wet).
 - o. Certificate of Analysis of Coal Fly Ash or Processed Ultra-fine Fly Ash: Comply with ASTM C618, Class F only; Class C Fly Ash Prohibited.
- G. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:
- 1. See Article "Quality Assurance".
 - 2. Density (unit weight) of concrete: ASTM C 138.
 - 3. Slump: ASTM C 143.
 - 4. Air content of freshly mixed concrete by pressure method: ASTM C 231 or volumetric method, ASTM C 173.
 - 5. Air content and parameters of air-void system by microscopical determination, ASTM C 457 (as applicable).
 - 6. Concrete Temperature at Placement Time. ASTM C 1064.
 - 7. Air temperature at placement time.
 - 8. Strength determined in accordance with ASTM C 39.
 - 9. Calcium Nitrite Presence in Plastic Concrete: See Part 3 heading "Quality Control".
- H. Contractor: Submit grout temperature limitations with grout submittal.
- I. Submit current certification of welders.
- J. 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.
- K. Submit samples of materials as requested by Engineer, including names, sources, and descriptions as follows:
- 1. Normal weight aggregates.

2. Fibrous reinforcement.
 3. Reglets.
- L. Submit laboratory test reports for concrete materials and mixtures.
- M. Submit Minutes of concrete pre-installation conference.

1.5 CONTRACTOR'S PROFESSIONAL SERVICES - PERFORMANCE AND DESIGN CRITERIA

- A. Provide professional services for temporary conditions during construction and portions of the Work required to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. Specific requirements and criteria include, but are not limited to:
1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 and ACI 347 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. The Contractor is responsible for layout and design, reviews, approvals, and inspections.
 2. Design formwork, shoring, bracing, and other conditions for structural requirements and stability during construction and until repair project 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 original 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 multi-story 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 re-testing at any time during progress of work.** Tests, including re-testing of rejected materials for installed work, shall be done at Contractor's expense.
- F. **At least 35 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:**
 - 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 and Owner's representative.
 - 8. At the pre-concrete meeting the Contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.
- G. **Welders and welding procedures shall conform to requirements or AWS D1.1.**
- H. **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.

- I. Testing Agency Qualifications:
 - 1. Independent agency, acceptable to authorities having jurisdiction, and acceptable to engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 2. Testing laboratory shall submit documented proof of ability to perform required tests.
 - 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4, according to ACI CP-1 or an equivalent certification program.
- J. 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.
- K. Proportioning, production, and finishing of silica fume and processed ultra-fine fly ash concrete shall be reviewed by and have approval of silica fume and processed ultra-fine fly ash manufacturers.
- L. Submit following Field Test information for Project Concrete unless modified in writing by Engineer:
 - 1. Project name and location.
 - 2. Contractor's name.
 - 3. Testing Agency's name, address, and phone number.
 - 4. Concrete supplier.
 - 5. Date of report.
 - 6. Testing Agency technician's name (sampling and testing).
 - 7. Placement location within structure.
 - 8. Time of batching.
 - 9. Time of testing.
 - 10. Elapsed time from batching at plant to discharge from truck at site.
 - 11. Concrete mixture data (quantity and type):
 - a. Cement.
 - b. Fine aggregates.
 - c. Coarse aggregates.
 - d. Water.
 - e. Air entraining admixtures.
 - f. High-range water-reducing admixture.
 - g. Other admixtures, including supplementary cementitious materials.
 - 12. Weather data:
 - a. Air temperatures.
 - b. Weather.
 - c. Wind speed.

13. Field test data:

- a. Date, time, and place of test.
- b. Slump.
- c. Concrete Temperature.
- d. Air content.
- e. Density (Unit weight).

14. Compressive test data:

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

- M. 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.
- N. 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.
- O. 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.
- P. Testing Agency: Identify those trucks of concrete supplier's which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.7 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO, "Standard Specifications for Highway Bridges".
 - 2. AASHTO T 318, "Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying".
- B. American Concrete Institute (ACI):
 - 1. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - 2. ACI 214R, "Evaluation of Strength Test Results of Concrete".

3. ACI 301, "Specifications for Structural Concrete".
4. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
5. ACI 305R, "Hot Weather Concreting".
6. ACI 306.1, "Cold Weather Concreting".
7. ACI 308R, "Guide to Curing Concrete".
8. ACI 308.1, "Standard Specifications for Curing Concrete".
9. ACI 318, "Building Code Requirements for Structural Concrete & Commentary".
10. ACI 347, "Guide to Formwork for Concrete".
11. ACI 347.2 "Guide to Shoring/Reshoring of Concrete Multistory Buildings".
12. ACI 362.1, "Guide for the Design of Durable Parking Structures".
13. ACI SP15, "Field Reference Manual".

C. American Iron and Steel Institute (AISI):

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

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

1. ASTM A 36, "Standard Specification for Carbon Structural Steel".
2. ASTM A 185, "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement".
3. ASTM A 497, "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement".
4. ASTM A 615, "Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement".
5. ASTM A 706, "Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement".
6. ASTM A 775, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars".
7. ASTM A 884, "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement for Reinforcement".
8. ASTM A 934/A 934M, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars".
9. ASTM B 633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel".
10. ASTM C 31, "Standard Practice of Making and Curing Concrete Test Specimens in the Field".
11. ASTM C 33, "Standard Specification for Concrete Aggregates".
12. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".
13. ASTM C 94, "Standard Specification for Ready-Mixed Concrete".
14. ASTM C 109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)".
15. ASTM C 138, "Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete".
16. ASTM C 143, "Standard Test Method for Slump of Hydraulic Cement Concrete".
17. ASTM C 150, "Standard Specification for Portland Cement".
18. ASTM C 157, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete".
19. ASTM C 171, "Standard Specification for Sheet Materials for Curing Concrete".
20. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete".

21. ASTM C 173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method".
22. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method".
23. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete".
24. ASTM C 309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete".
25. ASTM C 311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete".
26. ASTM C 330, "Standard Specification for Lightweight Aggregates for Structural Concrete".
27. ASTM C 457, "Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete".
28. ASTM C 494, "Standard Specifications for Chemical Admixtures for Concrete".
29. ASTM C 567, "Standard Test Method for Determining the Density of Structural Lightweight Concrete".
30. ASTM C 595, "Standard Specification for Blended Hydraulic Cements".
31. ASTM C 618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete".
32. ASTM C 666, "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing".
33. ASTM C 672, "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals".
34. ASTM C 989, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars".
35. ASTM C 1064/C 1064M "Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete".
36. ASTM C 1077, "Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation".
37. ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete".
38. ASTM C 1202, "Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration".
39. ASTM C 1218, "Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete".
40. ASTM C 1240, "Standard Specification for Silica Fume Used in Cementitious Mixtures".
41. ASTM C 1260, "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)".
42. ASTM C 1293, "Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction".
43. ASTM C 1315, "Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete".
44. ASTM C 1567, "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerate Mortar Bar Method)".
45. ASTM C 1602/C 1602M, "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete".

46. ASTM C 1610/C 1610M, "Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique".
 47. ASTM C 1611/C 1611M, "Standard Test Method for Slump Flow of Self-Consolidating Concrete".
 48. ASTM C 1621/C 1621M, "Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring".
 49. ASTM D 448, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction".
 50. ASTM D 3963/D 3963M, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars".
 51. ASTM E 96/E 96M, "Standard Test Methods for Water Vapor Transmission of Materials".
 52. ASTM E 1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".
 53. ASTM E 1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs".
 54. ASTM F1637 02, "Standard Practice for Safe Walking Surfaces".
- E. American Welding Society (AWS):
1. AWS D1.1, "Structural Welding Code-Steel".
 2. AWS D1.4, "Structural Welding Code-Reinforcing Steel".
- F. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI MSP, "Manual of Standard Practice".
- G. US Army Corps of Engineers (CE):
1. CE CRD-C 513 "Specifications for Rubber Waterstops".
 2. CE CRD-C 572 "Specifications for Polyvinyl Chloride Waterstops".
 3. CE CRD-C 662 "Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar Bar Method)".
- H. Prestressed Concrete Institute (PCI):
1. PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products".
 2. PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products".
 3. PCI MNL 120, "Design Handbook Precast Prestressed Concrete".
 4. PCI MNL 122, "Architectural Precast Design Handbook".
 5. PCI MNL 129, "Parking Structures-Recommended Practice for Design and Construction".
 6. PCI MNL 135, "Tolerances for Precast and Prestressed Concrete Construction".
 7. PCI "Code of Standard Practice for Precast Concrete".

- I. Accessibility Requirements:
 - 1. "Americans with Disabilities - Act Accessibility Guidelines for Buildings and Facilities", as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111, 1-800-872-2253, <http://www.access-board.gov/adaag/ADAAG.pdf>
- J. International Conference on Building Officials (ICBO).
- K. International Code Council (ICC):
 - 1. IBC, "International Building Code 2006".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.
- B. Deliver reinforcement to Project site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.
- D. Avoid damaging coatings on epoxy coated reinforcement:
 - 1. Contact areas of handling and hoisting systems shall be padded or be made of nylon or other acceptable material.
 - 2. Use spreader bars to lift bundles of coated bars to prevent bar-to-bar abrasion.
 - 3. Pad bundling bands or fabricate of nylon or other acceptable material.
 - 4. Store coated bars on padded or wooden cribbing.
 - 5. Do not drag coated bars.
 - 6. After placement, restrict traffic on coated bars to prevent damage.
 - 7. Repair damaged epoxy coatings according to ASTM D 3963.
- E. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. **For concrete with silica fume or processed ultra-fine fly ash, concrete shall be completely discharged within one hour after water has been added to cement or cement has been added to aggregates, in all weather conditions, hot or cold.** Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

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

2.2 STEEL REINFORCEMENT

- A. Epoxy-Coated Fabricated Reinforcing Bars: ASTM A775, and as follows:
 - 1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
 - 1. Welded Wire Reinforcement: Provide in mats only. Roll stock prohibited.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:
1. In manner acceptable to Engineer solely, bar and welded wire reinforcement supports shall be fabricated to resist overturning during construction operations.
 2. For slabs on ground, use all-plastic supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with ground so that they shall not allow clearance loss when reinforcement installed or concrete placed.
 3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids, and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
 4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
 5. For epoxy-coated reinforcement, use all-plastic bar supports.
 6. Acceptable manufacturers:
 - a. Aztec Concrete Accessories, Inc.
 - b. General Technologies, Inc.
 - c. Engineer-approved equivalent.
- 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. "Armotec 110", Sika Corporation.
 - c. "EMACO P22", BASF Construction Chemicals, LLC.
 - d. "Corr Bond" or "Duralprep AC", The Euclid Chemical Company.

- C. Epoxy Coating for Existing Exposed Non-prestressed Steel Reinforcement or Welded Wire Reinforcement:
 - 1. Provide one of following epoxy coatings:
 - a. "Sikadur 32 Hi-Mod", Sika Chemical Corp.
 - b. "Concresive Liquid LPL", BASF Construction Chemicals, LLC.
 - c. "Scotchkote 413 PC", 3M Company.
 - d. "Euco 452", The Euclid Chemical Company.
 - e. "Resi-Bond (J-58)", Dayton Superior Corporation.

2.4 CONCRETE MATERIALS

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

E. Normal Weight Aggregates (ACI 301, Section 4 header "Aggregates"):

1. Normal weight concrete aggregates:
 - a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
 - 1) All concrete: Class 5S.
 - b. No deleterious materials such as, but not limited to: chert or opaline.
 - c. Fine aggregate: Natural sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
 - d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.
2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.
3. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:
 - a. Repairs less than 3-inches thick in section: Size number 7 or 67.
 - b. Repairs greater than 3-inches thick in section: Size number 57.
4. Chloride Ion Level: ASTM C 1218.
5. Chloride Ion Content of Cement, Aggregates, and all Other Ingredients: Tested by laboratory making trial mixes.

F. Water: Comply with ASTM C 1602.

G. Storage of Materials (ACI 301, Section 4 header "Materials Storage and Handling").

2.5 ADMIXTURES

- A. Use high-range-water-reducing admixture (superplasticizer) in concrete as required for placement and workability.
- B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F as required for schedule.
- C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45.
- D. Use air-entraining admixture in exterior exposed concrete as indicated.

- E. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.
- F. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer's recommendations.
- G. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.
- H. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Catexol AE 260", Axim Concrete Technologies.
 - b. "Air-Mix", "Eucon Air-Series", or "AEA-92", Euclid Chemical Co.
 - c. "Daravair Series" or "Darex Series", W.R. Grace & Co.
 - d. "Micro-Air", "MB-VR", or "MBAE-90", BASF Construction Chemicals.
 - e. "Sika AEA Series" or "Sika AIR Series", Sika Corporation.
 - f. "Polychem VR", "VRC", or "AE", General Resource Technology.
 - g. "RSA-10", Russ Tech Admixtures, Inc.
- I. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 37", "Eucon SP-Series", or "Plastol Series", Euclid Chemical Co.
 - b. "Daracem Series" or "ADVA Series", W.R. Grace & Co.
 - c. "Rheobuild 1000", "PS 1466", or "Glenium Series", BASF Construction Chemicals.
 - d. "Sikament Series" or "Sika ViscoCrete Series", Sika Corporation.
 - e. "Catexol 1000 SP-MN", Axim Concrete Technologies.
 - f. "Melchem Series", General Resource Technology.
 - g. "Superflo 443" or "Superflo 2000 Series", Russ Tech Admixtures, Inc.
- J. High-Range Water-Reducing Retarding (superplasticizer): ASTM C 494 Type G:
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 537 or RD2", Euclid Chemical Co.
 - b. "Daracem 100", W.R. Grace & Co.
 - c. "Melchem", General Resource Technology.

- K. Corrosion Inhibiting Admixture capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Eucon CIA" or "Eucon BCN", Euclid Chemical Company.
 - b. "DCI" or "DCI-S", W.R. Grace.
 - c. "Rheocrete CNI", BASF Construction Chemicals.
 - d. "Sika CNI", Sika Corporation.
 - e. "Catexol 1000 CN-Cl", Axim Concrete Technologies.
 - f. "Polychem CI", General Resource Technology.
 - g. "Russ Tech RCI", Russ Tech Admixtures, Inc.
 2. Add at rate of 3 gal/cu yd of concrete, which shall inhibit corrosion to 9.9 lb of chloride ions per cu. yd. of concrete. Calcium Nitrite based corrosion inhibitor shall have a concentration of 30 percent, plus or minus 2 percent of solids content.

2.6 CURING MATERIALS

- A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Evaporation Retarder:
 - a. "Cimfilm", Axim Concrete Technologies.
 - b. "Aquafilm", Conspec Marketing & Manufacturing Co., Inc.
 - c. "Eucobar", Euclid Chemical Co.
 - d. "E-Con", L&M Construction Chemicals, Inc.
 - e. "Confilm", BASF Construction Chemicals, LLC.
 - f. "SikaFilm", Sika Corporation.
 - g. "Sure-Film (J-74)", Dayton Superior Corporation.
 - h. "EVRT", Russ Tech Admixtures, Inc.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Curing Compound: Prohibited for concrete with water/cementitious materials ratio less than 0.45.

2.7 CONCRETE MIXTURES

- A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 - 2. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.
- B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.
- C. Requirements for normal-weight concrete mix are shown on Drawings:
 - 1. Compressive strength.
 - 2. Slump.
 - 3. Water-cementitious materials ratio.
 - 4. Air content.
- D. Supplementary cementitious materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials according to ACI 318 requirements.
- E. Supplementary Cementitious Materials: Maximum weight of fly ash, natural pozzolans, silica fume, processed ultra-fine fly ash, or slag included in concrete shall not exceed percentages of total weight (see footnotes for ACI 301 Part 4 Table "Requirements for Concrete Exposed to Deicing Chemicals") of cementitious materials as follows:
 - 1. Fly Ash or Other Pozzolans Conforming to ASTM C 618: 25 percent.
 - 2. Slag Conforming to ASTM C 989: 50 percent.
 - 3. Silica Fume Conforming to ASTM C 1240: 10 percent.
 - 4. Processed Ultra-fine Fly Ash Conforming to ASTM C 618: 15 percent.
 - 5. Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume: 50 percent. Within the total, fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 6. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent. Within the total, fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Total of Fly Ash or Other Pozzolans and Processed Ultra-fine Fly Ash: 35 percent. Within the total, fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- F. Air Entrainment:
 - 1. See General Notes on Drawings for total average air content (percent by volume).
 - 2. Average air content shall exceed value stated in General Notes on Drawings.
 - 3. Permissible variation for any one test result from specified average total air content: plus or minus 1.5 percent.
 - 4. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void

volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article "Submittals".

G. Chloride Ion Content of Mixture:

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

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

1. Consider using high-range water-reducing admixture (superplasticizers) as required, for placement, workability, finishing, and when required, increased flowability.
2. Use high-range water-reducing admixtures in concrete with a water-cementitious materials ratio of 0.45 or less.
3. Use corrosion-inhibiting admixture in concrete mixes as indicated.

I. 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.
- J. 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.
- K. 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.

2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Truck-mixing prohibited. Mix at plant.
- B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.

2.10 TOOLS

- A. Slab Jointing:
 - 1. Concrete groovers: For tooled joints in concrete:
 - a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
 - b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
 - 2. Saw Cut Joints: Prohibited.
 - a. Joints shall be tooled in plastic concrete.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads and in accordance with Article 1.5 "Contractor's Professional Services - Performance and Design Criteria".
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, except as modified below:
 - 1. Slabs:
 - a. Variation in Thickness of Slabs: Plus 0.375 in., minus 0.25 in.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Kerf wood inserts for easy removal.
 - 3. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Re-tighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of 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 slabs and other structural elements that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.3 SHORES AND RESHORES

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

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain specified concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

- E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2-ft. on center, maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:
 - 1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
 - 2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
 - 1. Rest epoxy coated steel member supported from formwork on coated wire bar supports, or on bar supports made of dielectric material or other suitable material.
 - 2. Coat wire bar supports with dielectric material for minimum distance of 2 in. from point of contact with coated steel member.
 - 3. Fasten epoxy-coated steel members with nylon-, epoxy-, or plastic-coated tie wire, or other suitable material acceptable to Engineer.
 - 4. Repair all damage to epoxy coating to bars, welded wire reinforcement, and all other epoxy coated items. Use a mirror to view undersides of all items for possible damage so it can be repaired.
 - 5. Do not cut epoxy-coated steel unless permitted by Engineer. When cut, coat ends with material used for repair of coating damage.
- G. Splices:
 - 1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

3.5 JOINTS

- A. Joints in Concrete (ACI 301, Section 5):
 - 1. Construction, control, and isolation joints are located and detailed on Drawings:
 - a. Tool joints at time of finishing. Tool: Part 2 Article "Tools".
 - b. Saw Cut Joints: Prohibited.
- B. Place construction joints at mid-point between column strips. Continue reinforcement across construction joints.
- C. Joint sealant material is specified in Division 07 Sections.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer.
- C. Before placing concrete, water may only 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.
 - 2. Water may only be added onsite if water was with-held at plant (shown on plant batch ticket). Water added at site must not exceed amount with-held at plant.
- 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 repair sections, 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 and repair area perimeters where required, and provide positive drainage throughout repair areas.
 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 anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.
- I. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Finishes: As-cast concrete texture imparted by form-facing material in accordance with ACI 301 and as specified below in accordance with Class of Finish:
1. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Provide Class A finish as described in ACI 347. Class A permits gradual or abrupt irregularities of 1/8 inch.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture

matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom Finish":

1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:
 - a. Use minimal passes so as to not overwork the concrete.
 - b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.
2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
3. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5-in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
4. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.

B. Flatwork in Stair Towers and Parking Garage Floor Subject to Pedestrian Traffic:

1. Concrete surfaces at all walking areas subject to pedestrian traffic shall provide a smooth, slip-resistant walking surface for pedestrians with these minimum requirements:
 - a. Shall provide walking surfaces in accordance with ASTM F 1637 "Standard Practice for Safe Walking Surfaces" and "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
 - b. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - 1) Changes in level of less than $\frac{1}{4}$ inch in height may be without edge treatment as shown in ADA Figure 303.2.
 - 2) Changes in Level between $\frac{1}{4}$ inch and $\frac{1}{2}$ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3.

- 3) Changes in level greater than $\frac{1}{2}$ inch in height are not permitted unless they can be transitioned by means of a ramp within minimum ADA guidelines.
 - 4) Openings in floor or ground surfaces shall not allow passage of a sphere more than $\frac{1}{2}$ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3.
- c. Walkway surfaces shall provide a slip-resistant surface.
- 1) Concrete surfaces shall be troweled and finished to provide a slip-resistant finish.
 - 2) Contractor shall provide sample area with slip resistant surface finish.

3.9 MISCELLANEOUS CONCRETE ITEMS

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

3.10 CONCRETE PROTECTION AND CURING

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

lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- E. Curing Compound: Prohibited for concrete with water/cementitious materials ratio less than 0.45.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas only as approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins, and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 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 material. Fill form-tie voids with specified repair materials.
 - 2. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct low areas scheduled to remain exposed with a repair topping. Remove concrete at low areas to ensure a minimum repair topping depth of 1 inch to match adjacent floor elevations.
 - 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or repair material. 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. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to

blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- D. Perform structural repairs of concrete, subject to Engineer's approval.
- E. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.12 FIELD QUALITY CONTROL

- A. Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sample concrete in accordance with ASTM C 172.
- C. 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.
- D. 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.
 2. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.
- E. Air Content:
 1. General Contractor: Coordinate all parties involved to produce conforming concrete.
 2. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172, C 173 and/or C 231 as applicable. One air content test required for each truck of ready-mix, air entrained concrete delivered to Project.
 3. Summary of Air Content Testing Requirements:
 - a. Minimum of one air content test at point of final placement (after pumping) for each ready-mix truck. Additional air content testing required if results are non-conforming (incidental).
 - b. Additional air content testing may be performed, at Contractor's option, at ready-mix trucks (before pumping) as needed to perform adjustments to maintain specified air content at point of final placement (after pumping).
 - 1) At beginning of Project, air content testing shall be performed both at the ready-mix trucks (before pumping) and at point of placement

(after pumping) to help with air content adjustments, if needed. Once Contractor shows that consistent air content results are being achieved at point of final placement, Contractor may (at Contractor's option) discontinue testing at ready-mix trucks (before pumping) only.

F. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:
 - a. Take minimum of eight cylinders for each 100 cu yd or fraction thereof, of each Mixture of concrete placed in any one day.
 - b. Additional cylinders shall be taken under conditions of cold weather concreting per Part 3 Heading "Concrete Curing and Protection".
 - c. Additional cylinders may be taken to verify concrete strength for early form removal. Contractor responsible to coordinate with Testing Agency.
 - d. Testing Agency: Provide and maintain site cure box for cylinders.
2. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
3. Cure test cylinders per ASTM C 31 as follows:
 - a. To verify compressive strength prior to form removal or for additional test cylinders required due to cold weather concreting conditions:
 - 1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
 - 2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.
 - b. To verify 28-day compressive strength:
 - 1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 deg F. and prevent loss of moisture from specimens.
 - 2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.
4. Compression testing:
 - a. Test 2 cylinders at 4 days.
 - b. Test 2 cylinders at 7 days.
 - c. Test 2 cylinders at 28 days.
 - d. Hold 2 cylinders in reserve for 56 days for use as Engineer directs. Unless directed otherwise, cylinders may be discarded after 56 days.

- G. 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.
- H. Report all non-conforming test results to Engineer and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.
- I. Monthly, submit a graph showing distribution of compressive strength test results and air content test results. Include microwave test results for concrete with a water-cementitious materials ratio less than or equal to 0.40 concrete.

3.13 EVALUATION AND ACCEPTANCE OF CONCRETE

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

3.14 ACCEPTANCE OF STRUCTURE

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

END OF SECTION 033000

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CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

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

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

WALKER SUBMITTAL STAMP

CONTRACTOR

SUBMITTAL STAMP

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

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

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

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

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

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

VIII. <u>STANDARD DEVIATION ANALYSIS:</u>		<u>Yes</u>	<u>N/A</u>
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)			
<u>Number of Tests Evaluated:</u> (One test is average of two cylinder breaks)		<u>Standard Deviation:</u> (Single Group)	
<u>Attach copy of test data considered:</u>		<u>Standard Deviation:</u> (Two Groups)	
Required average compressive strength: $f'_{cr} = f'_c + \underline{\hspace{2cm}}$ psi			
NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations: (4.-3) $f'_{cr} = f'_c + 1.34ks$ [s = calculated standard deviation] or (4-4) $f'_{cr} = f'_c + 2.33ks - 500$ or (4-5) $f'_{cr} = 0.9f'_c + 2.33ks$ (for $f'_c > 5,000$ psi) (Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)			
MIXTURE CHARACTERISTICS (As shown on drawings)			
Slump = <u> </u> in.		Air Content = <u> </u> %	
Unit Wet Wt. = <u> </u> pcf		Unit Dry Wt. = <u> </u> pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = <u> </u> in.		Final Slump <u> </u> in.	
Unit Wet Wt.= <u> </u> pcf.		Unit Dry Wt. = <u> </u> pcf.	
Air Content = <u> </u> %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

IX. <u>TRIAL MIXTURE TEST DATA:</u>		Yes	N/A
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)			
Age (days)	Mix #1 (comp. str.)	Mix #2 (comp. str.)	Mix #3 (comp. str.)
<u>7</u>			
<u>7</u>			
<u>28</u>			
<u>28</u>			
<u>28</u>			
<u>28</u> day average compressive strength, psi			
NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations: (Less than 3000) $f'_{cr} = f'_c + 1000$ or (3000 to 5000) $f'_{cr} = f'_c + 1200$ or (Over 5000) $f'_{cr} = 1.1f'_c + 700$ For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.			
MIXTURE CHARACTERISTICS (as shown on drawings)			
Slump = _____ in.		Air Content = _____ %	
Unit Wet Wt. = _____ pcf		Unit Dry Wt. = _____ pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = _____ in.		Final Slump _____ in.	
Unit Wet Wt. = _____ pcf.		Unit Dry Wt. = _____ pcf.	
Air Content = _____ %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

XI. Remarks:

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

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

Signature_____

Typed or Printed Name

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #
Project Name:

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

SECTION 033713 - SHOTCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes shotcrete applied by the dry-mix or wet-mix process.
- B. This Section includes the provision of all labor, materials, supervision, and incidentals necessary to install shotcrete to horizontal, vertical, and overhead surfaces to restore original surface condition and integrity.

1.3 DEFINITIONS

- A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.
- B. Dry-Mix Shotcrete: Shotcrete with most of the water added at nozzle.
- C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 SUBMITTALS

- A. Product Data: For manufactured materials and products, including reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.
- B. Shop Drawings: For details of fabricating, bending, and placing reinforcement. Include support and anchor details, number and location of splices, and special reinforcement required for openings through shotcrete structures.
- C. Design Mixes: For each shotcrete mix.
- D. Material Test Reports: For shotcrete materials.
- E. Material Certificates: For each material item, signed by manufacturers.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Shotcrete contractor shall have a minimum of three (3) years experience in the application performed. All Nozzlemen to perform work shall have a current ACI / ASA Nozzlemen Certification. A qualified installer employing nozzle operators who attain mean core grades not exceeding 2.5, according to ACI 506.2, on pre-construction tests.
- B. Testing Agency Qualifications: Independent and qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548, and acceptable to authorities having jurisdiction.
- C. Comply with provisions of the following, unless more stringent requirements are indicated:
 - 1. ACI 301, "Specification for Structural Concrete".
 - 2. ACI 506.2, "Specification for Shotcrete".
 - 3. CRSI's "Manual of Standard Practice".
- D. Pre-installation Conference: Conduct conference at Project site prior to start of Work. Coordinate with other scheduled meetings/site visits.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 FORM MATERIALS

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

2.2 SHOTCRETE MATERIALS

- A. Shotcrete Cement and Blended Cements
1. Portland Cement: ASTM C 150, Type I. Use only one brand and type of cement for Project. Select supplementary cementitious materials from subparagraphs below, if permitted. Blending of fly ash, slag, silica fume with Portland cement is done at ready-mix plant.
 2. Fly Ash: ASTM C 618, Class F only. Class C Fly Ash Prohibited.
 3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 4. Silica Fume: ASTM C 1240, amorphous silica.
- B. Normal-Weight Aggregates: ASTM C 33, from a single source, and as follows:
1. Aggregate Gradation: ACI 506R, Gradation No. 2 with 100 percent passing 1/2-inch (13-mm) sieve.
 2. Coarse-Aggregate Class: 3S.
- C. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored, water-reducing admixtures, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.
1. Color: Match existing adjacent surfaces.
- D. Water: Potable, complying with ASTM C 94, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.
- E. Ground Wire: High-strength steel wire, 0.8 to 1 mm in diameter.

2.3 CHEMICAL ADMIXTURES

- A. General: ASTM C 1141, Class A or B, but limited to the following admixture materials. Provide admixtures for shotcrete that contains not more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.
1. Air-Entraining Admixture: ASTM C 260.
 2. Water-Reducing Admixture: ASTM C 494, Type A.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
6. Accelerating Admixture: ASTM C 494, Type C.

2.4 CURING MATERIALS

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

2.5 SHOTCRETE MIXES, GENERAL

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

2.6 NORMAL-WEIGHT SHOTCRETE MIXES

- A. Proportion dry mixes by field test data methods and wet mixes according to ACI 211.1 and ACI 301, using materials to be used on Project, to provide normal-weight shotcrete with the following properties:
 1. Compressive Strength (28 Days): 5,000 psi (34.5 MPa).
 2. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight, wet-mix shotcrete having an air content before pumping of 7 percent with a tolerance of plus or minus 1-1/2 percent.

2.7 SHOTCRETE EQUIPMENT

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

2.8 BATCHING AND MIXING

- A. Dry-Mix Process: Measure mix proportions by weight batching according to ASTM C 94 or by volume batching complying with ASTM C 685 requirements.
 - 1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
 - 2. 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.

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.
 - 1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
 - 2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.
- B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.
- C. Securely embed reinforcing anchors into existing substrates, located as required.
- D. Accurately position, support, and rigidly secure reinforcement against displacement by formwork, construction, or shotcreting. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

- E. Place reinforcement to obtain minimum coverages for shotcrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during shotcreting. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.
- F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 ALIGNMENT CONTROL

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

3.5 APPLICATION

- A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.
- B. Moisten wood forms immediately before placing shotcrete where form coatings are not used.
- C. Apply shotcrete according to ACI 506.2.
- D. Apply dry-mix shotcrete materials within 45 minutes after 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. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117R, increased by a factor of 2.

3.6 SURFACE FINISHES

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

3.7 CURING

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

3.8 FORM REMOVAL

- A. Forms not supporting weight of shotcrete may be removed after curing at not less than 50 deg F (10 deg C) for 24 consecutive hours after gunning, provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.
 - 1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

3.9 FIELD QUALITY CONTROL

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

3.10 REPAIRS

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

3.11 CLEANING

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

END OF SECTION 033713

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SECTION 033761 – CAST IN PLACE REPAIR MORTAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 QUALITY ASSURANCE

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

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

1.4 REFERENCES

- A. "Standard Specification for Structural Concrete" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as Specification for this structure except as otherwise specified herein.
- B. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown on Drawings or specified herein:
 - 1. "Building Code Requirements for Structural Concrete" (ACI 318), American Concrete Institute, herein referred to as ACI 318.
 - 2. "Hot Weather Concreting" reported by ACI Committee 305.
 - 3. "Cold Weather Concreting" reported by ACI Committee 306.
 - 4. "Standard Specification for Curing Concrete" (ACI 308).
- C. Contractor shall have following ACI publications at Project construction site at all times:
 - 1. "Standard Specifications for Structural Concrete (ACI 301) with Selected ACI and ASTM References". ACI Field Reference Manual, SP15.
 - 2. "Hot Weather Concreting" reported by ACI Committee 305.
 - 3. "Cold Weather Concreting" reported by ACI Committee 306.
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM C109, "Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)".
 - 2. ASTM C31, "Test Method for Compressive Strength of Cylindrical Concrete Specimens".

1.5 SUBMITTALS

- A. Make submittals as specified in this Section and as required by Owner/Engineer. Submit electronically (PDF files) OR provide (3) hard copies of submittals to

Engineer. Engineer response/comments will be returned to Contractor, forwarded to Owner, and retained by Engineer for record purposes.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

- C. Form and Pour/Pump Repair Mortar: Flow-able, one-component, high strength silica-fume-modified repair mortar with 0.375 in. aggregate extendable, and containing an integral corrosion inhibitor. The product shall achieve minimum 3,000 psi compressive strength at 1 day and 8000 psi compressive strength at 28 days per ASTM C39 extended at a 9-inch slump.

1. Acceptable materials for this Work are as follows:

a. Polymer/Silica fume modified:

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

2.2 MATERIAL ACCESSORIES

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

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

1. Acceptable materials for this Work are:

- a. "Emaco P24," by BASF Building Systems, Shakopee, MN.
- b. "Duralprep A.C.," by The Euclid Chemical Company, Cleveland, OH.
- c. "Planibond 3-C" or Mapefer 1K," by Mapei Corporation, Deerfield Beach, FL.
- d. "Sika Armatec 110 EpoCem", by Sika Corporation, Lyndhurst, NJ.

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

1. Acceptable materials for this Work are:

- a. "Concresive Liquid LPL", by BASF Building Systems, Shakopee, MN.
"Kemko 001 or 008", by ChemCo Systems, Inc., Redwood City, CA.
- b. "Euco #452 Epoxy," or "Duralcrete", by The Euclid Chemical Company, Cleveland, OH.
- c. "Planibond EBA" by Mapei Corporation, Deerfield Beach, FL.

- d. "Sikadur 32 Hi-Mod LPL", by Sika Corporation, Lyndhurst, NJ.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

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

3.3 CONCRETE PROTECTION AND CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305R for hot-weather protection during placement. Keep concrete continually moist prior to final curing by evaporation retarder, misting, sprinkling, or using absorptive mat or fabric covering kept continually moist.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.1 lb/sq. ft. x h before and during finishing operations. Apply material according to manufacturer's written instructions one or more times after placement, screeding and bull floating concrete, but prior to float finishing. Repeated applications are prohibited after float finishing has begun.

- 1. Acceptable evaporation retarder materials for this Work are:

- a. "Cimfilm", by Axim Concrete Technologies.
- b. "Confilm", by BASF Building Systems, Shakopee, MN.
- c. "Aquafilm", by Conspec Marketing & Manufacturing Co., Inc.
- d. "Sure-Film (J-74)", by Dayton Superior Corporation.
- e. "Eucobar" or "Tamms Surface Retarder", by The Euclid Chemical Company, Cleveland, OH.
- f. "E-Con", by L&M Construction Chemicals, Inc.
- g. "EVRT", by Russ Tech Admixtures, Inc.

- h. "SikaFilm", by Sika Corporation, Lyndhurst, NJ.
- C. Immediately upon conclusion of finishing operation, cure concrete in accordance with ACI 308 for duration of at least seven days by moisture curing or moisture retaining covering. Dissipating curing compounds complying with ASTM C309 may be used in accordance with recommendations of ACI 506.7, "Specification for Concrete". Provide additional curing immediately following initial curing and before concrete has dried.
 - 1. Continue method used in initial curing.
 - 2. Material conforming to ASTM C171.
 - 3. Other moisture retaining covering as approved by Engineer.
 - 4. During initial and final curing periods maintain concrete above 50 deg F.
 - 5. Prevent rapid drying at end of curing period.
- D. Horizontal concrete surfaces shall be cured with moisture curing or moisture-retaining cover only; curing compounds prohibited.
- E. Dissipating Curing Compound, for overhead or vertical surfaces only, (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 kg/m² when applied at 200 sq. ft./gal. Manufacturer's certification is required. Silicate based compounds are prohibited.
 - 1. Subject to project requirements provide one of the following products:
 - a. "Kurez DR VOX", "Kurez RC", or "Kurez RC Off", The Euclid Chemical Company.
 - b. "RxCure WB", "RxCure VOC", or "W.B. Cure VOC", Conspec Marketing & Manufacturing.
 - c. "Kure N Seal W" or "Kure N Seal WB", BASF Building Systems, LLC.
 - d. "MAPECURE DR", by MAPEI Corporation, Deerfield Beach, FL.
- F. Curing Methods: Cure formed and non-formed concrete moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: For overhead and vertical surfaces only; prohibited on horizontal surfaces. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.4 FIELD QUALITY CONTROL OF AGGREGATE EXTENDED MATERIAL

- A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency acceptable to the Engineer to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Perform tests according to ACI 301.
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Determine strength at 3, 7, and 28 days. Each test shall consist of two 6-inch diameter cylinders or three 4-inch diameter cylinders. Testing shall be in accordance with ASTM C39.

3.5 EVALUATION AND ACCEPTANCE OF WORK

- A. Acceptance of Repairs (ACI 301):
 1. Acceptance of completed concrete Work will be according to provisions of ACI 301.
 2. Repair areas shall be sounded by Engineer and Contractor with hammer or rod after curing for 72 hours. Contractor shall repair all hollowness detected by removing and replacing patch or affected area at no extra cost to Owner.
 3. If shrinkage cracks appear in repair area when initial curing period is completed, repair shall be considered defective, and it shall be removed and replaced by Contractor at no extra cost.

END OF SECTION 033761

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SECTION 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 Topping: 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: 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 topping performance. Require every party concerned with topping Work, or required to coordinate with it or protect it thereafter, to attend. Include manufacturer's technical representative and warranty officer. Coordinate with other scheduled meetings/site visits.
- 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 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. One 4-in. by 4-in. stepped sample showing each component for each system indicated.
- 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 the 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 topping.
 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 topping 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 the "Quality Assurance" article.
 - 2. Installer's qualifications as defined in the "Quality Assurance" article.
 - 3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 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 Topping shall satisfy the 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 of Michigan.
 3. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.
- C. At no time shall weight of stored material being placed on slab area exceed original design load of slab area.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

- A. System Manufacturer (New Application and 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). The 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 topping 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 topping 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 the following in the terms of the Warranty
 - 1. Length of warranty.
 - 2. Change in value of warranty – if any – based on length of remaining warranty period.
 - 3. Transferability of warranty.
 - 4. Responsibilities of each party.
 - 5. Notification procedures.
 - 6. Dispute resolution procedures.
 - 7. Limitations of liability for direct and consequential damages.
- F. Snowplows, vandalism, 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. Manufacturers: 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), Solon, 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 TOPPING

- A. Acceptable toppings are listed below. Toppings shall be compatible with all other materials in this Section and related work.
1. Heavy Duty:
 - a. Autogard HD-48, Neogard.
 - b. Elasto-Deck 5000-HT, Pacific Polymers.
 - c. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
 - d. Qualideck Heavy Vehicular (152/252/372/512), APT
 - e. Sikalastic 710/715, Sika.
 - f. Sonoguard Vehicular Deck System, BASF.
 - g. Vulkem 350/345/346/346 Deck Coating System, Tremco.
 - h. Pecora-Deck 800 Series/Carlisle CCW Deck Coating.
 - i. Flexodeck Mark 170.2 Solvent Free Heavy Duty, Poly-Carb.
 - j. Poly-I-Gard 246HD, Polycoat.
 - B. Recoating: Provide all wearing course components for system as specified for new heavy-duty applications.
 - C. Provide ultraviolet screening for all traffic topping placed on this project.
 - D. Finish top coat shall be colored grey.
 - E. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
1. SikaPronto 19TF, Sika.
 2. Degadeck, Crack Sealer Plus, BASF.
 3. Denedeck Crack Sealer, Deneef.
 4. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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. Shot-blast surfaces to be coated to remove all laitance and surface contaminants, including oil, grease and dirt. Prepare by sand-blasting all surfaces inaccessible to shotblast equipment.
- D. 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.
- E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.
- F. 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.
- G. Mask off adjoining surfaces not to receive traffic topping and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic topping.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to: moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.
- B. A primer coat is required for all systems. No exception.
- C. Do not apply traffic topping material until concrete has been air dried at temperatures at or above 40 deg F. for at least 30 days after curing period specified.
- D. 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.
- E. All adjacent vertical surfaces shall be coated with traffic topping 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.
- F. Complete all Work under this Section before installation of pavement markings.
- G. 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 trial section of topping system. Do not proceed with further topping application until trial section 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.
 - 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 cleaning before proceeding with topping application.

E. Determine overall topping system mil thickness:

1. Contractor shall provide 6 in. by 6 in. bond breaker (topping coupon) on concrete surface for each 25,000 sq ft, or fraction thereof, of topping to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
2. Contractor shall assist Testing Agency in removing topping coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per topping manufacturer's instructions.
3. Testing Agency shall determine dry mil thickness of completed Traffic Topping 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 topping 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 sealants for horizontal traffic bearing surfaces.
 - 2. Exterior sealants for vertical and horizontal non-traffic surfaces.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
 - 2. Distribute reviewed submittals to all others whose Work is related.
- B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- C. Requests For Information:
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.

1.4 ACTION SUBMITTALS

- A. Product Data: For each system indicated at least 60 days prior to application.
 - 1. Product description, technical data, appropriate applications, and limitations.
 - 2. Primer type and application rate.
- B. Samples:
 - 1. One for each system indicated.
- C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

- A. Certificates:
 - 1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
 - 2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.
- B. Field Quality Control:
 - 1. Two copies each of manufacturer's technical representative's log for each visit.
 - 2. Testing agency field and test reports.
- C. Qualification Statements:
 - 1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
 - 2. Installer's qualifications as defined in the "Quality Assurance" article.
 - 3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.
- C. At no time shall weight of stored material being placed on slab area exceed original design load of slab area.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

- A. System Manufacturer and Contractor shall furnish Owner written single source performance guarantee that the joint sealant system will be free of defects, water penetration, and chemical damage related to system design, workmanship, or material deficiency, consisting of:
 - 1. Any adhesive or cohesive failures.
 - 2. Weathering.
 - 3. Abrasion or tear failure resulting from normal traffic use.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5 year period commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to Owner.
- E. Address the following in the terms of the Warranty:
 - 1. Length of warranty.
 - 2. Change in value of warranty – if any – based on length of remaining warranty period.
 - 3. Transferability of warranty.
 - 4. Responsibilities of each party.
 - 5. Notification procedures.

6. Dispute resolution procedures.
 7. Limitations of liability for direct and consequential damages.
- F. Snowplows, vandalism, 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. Manufacturers: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
1. BASF Building Systems (BASF), Shakopee, MN.
 2. Dow Corning Corp. (Dow Corning), Midland, MI.
 3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
 4. Pecora Corporation (Pecora), Harleysville, PA.
 5. Sika Corporation (Sika), North Canton, OH.
 6. Sonneborn, a Division of BASF Construction Chemicals (BASF).
 7. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

- A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.
- B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.
- C. Color of sealants shall match adjacent surfaces.
- D. Closed Cell or Reticulated Backer Rods: Acceptable products:
1. "Sof Rod", Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
 2. "ITP Soft Type Backer Rod", Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
 3. "Sonneborn Soft Type Backer Rod", Sonneborn, Minneapolis, MN.
- E. Bond Breakers and Fillers: As recommended by system manufacturer.
- F. Primers: As recommended by sealant manufacturer.
- G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.

- H. Acceptable polyurethane control joint sealants (traffic bearing):
1. Sonolastic SL-2, BASF.
 2. Iso-flex 880 GB, Lymtal.
 3. Dynatrol II-SG or Urexpan NR 200, Pecora.
 4. Sikaflex-2c SL, Sika.
 5. THC-900/901, Vulkem 45SSL, or Vulkem 245, Tremco.
- I. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
1. Sikaflex-2c NS, Sika.
 2. Sonolastic NP-2, BASF.
 3. Dymeric 240/240FC or THC 901 (cove only), Tremco.
 4. Dynatred, Pecora.
 5. Iso-flex 881, Lymtal.
- J. Proposed Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

- E. Final preparation of joints shall be a sand-blast 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. Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.
 - 1. Fill horizontal joints flush with adjacent surfaces where traffic topping occurs.
- D. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.
- E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40 deg F.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency:
 - 1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.

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.

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. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.
- g. Coordinate layout of joint system and approval of methods for providing joints.

2. Joint Opening Width:

- a. Use manufacturer's 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.
- b. 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. Pre-installation 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. Coordinate with other scheduled meetings/site visits.
- C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- D. Requests For Information
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated:
 - 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. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10°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.

C. Samples: For each type of joint system indicated.**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.
3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
4. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.

B. Field Quality Control

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

C. Qualification Statements

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

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Maintenance Manual: 3 copies of System Maintenance Manual.
2. Five copies of snow removal guidelines for areas covered by warranty.

- B. Warranty Documentation: 3 executed copies of Labor and Material Warranty including all terms, conditions, and maintenance requirements.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Owner/Engineer retain 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.
 - 5. Evidence of compliance with "Single Installer" requirement.
 - 6. 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.
- B. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.
- C. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer.
- D. 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 labor and materials 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. Warranty shall be jointly executed by Manufacturer and Installer for labor and materials. Detail responsibilities of General Contractor, manufacturer and installer with regard to warranty requirements, as outlined in the Manufacturer's warranty and related Licensing/Certification documents. 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. Metal to non-metal vibration causing noises during use.
 - 4. Tears, weathering, or degradation in gland from normal use.

5. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of ½ inch below the floor surface.
- E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

2.2 PERFORMANCE REQUIREMENTS

- A. Intent of this section is to insure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and prevent water leakage.
- B. Expansion joint design shall meet or exceed all expected movements shown on drawings.
- C. Nominal form width shown on the drawings shall be adjusted for the ambient temperature at time of concrete placement and designer shall verify that width of joint at installation shall meet minimum installation requirements.
- D. Expansion joint systems shall be capable of resisting a differential vertical movement of ½ inch.
- E. 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.
 5. Extend joints into gap between columns/curbs/walls at all ends and upturn to provide positive drainage (incidental).
- F. Design system for passenger vehicles traveling at speeds normally expected within a parking structure.
- G. 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 within minimum 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. Lymtal International Inc. Lake Orion, MI (Lymtal).
 7. MM Systems Corporation, Atlanta, GA (MM).
 8. TechStar, Inc., Findlay, OH (TechStar).
 9. Tremco, Cleveland, OH (Tremco).

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

- G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

- A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations
- B. Surface Preparation:
 - 1. Acid etching: Prohibited.
 - 2. Prepare substrates according to joint system manufacturer's written instructions.
 - 3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.
- B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.
- C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40°F.
- D. Terminate ends of expansion joints by extending beyond face of columns/walls and upturn 45 deg (incidental). Verify requirements in field with Engineer.
- 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 observing during rain event or maintaining continuously wet. 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. Re-install cover plates or seals prior to Substantial Completion of Work.

END OF SECTION 079500

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SECTION 099120 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Provide product data as follows:
 - 1. Manufacturer's certification that the material complies with standards referenced within this Section.
 - 2. Intended paint use.
 - 3. Pigment type and content.
 - 4. Vehicle type and content.
- C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

1.4 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 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 meet requirements of MPI #70.
 - 1. All products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.
 - 2. 100% acrylic waterborne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.

2.3 COLOR OF PAINT

- A. Color of white paint shall match federal color chip 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

- B. Color of yellow paint shall match federal color chip No. 33538. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
- C. Color of blue paint shall match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
- D. Color of green paint shall match federal color chip No. 34108. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
- E. Color of red paint shall match federal color chip No. 31136. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
- F. Color of black paint shall match federal color chip No. 37038. Black paint shall also meet Federal Specification TT-P-110.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- D. Pavement markings shall not be placed until full cure of concrete slab and waterproofing materials.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Do not paint or finish any surface that is wet or damp.
- C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.
- F. Where existing painted pavement markings and/or stripes conflict with new striping layout or must be removed due to installation which does not conform to contract requirements, remove existing paint markings, using care to avoid scarring substrate surface.
 - 1. Concrete and asphalt surfaces: Material shall be removed by methods acceptable to Engineer and cause as little damage as possible to surface texture of pavement. Methods, that can provide acceptable results, are grinding and air or shot blasting. Use of chemicals to remove pavement markings prohibited. Collect residue generated by removal of pavement markings and dispose of as required by all applicable laws and regulations. If grinding is used, lightly grind floor surface using wheel mounted floor grinder or similar equipment with positive elevation control of grinder head. For all removal techniques: On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
 - 2. Traffic Topping/Membrane Surfaces: Remove existing pavement markings by solvent-washing or high-pressure water washing. Submit letter from traffic topping/membrane manufacturer certifying that solvents and/or water pressures are acceptable for this use and will not damage material. On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
 - 3. Contractor shall not use paint, bituminous bond coat or other methods of covering markings to obliterate existing pavement markings.
 - 4. Material deposited on existing surfaces as a result of removal shall be removed as work progresses. Accumulation of material, that might interfere with drainage or might constitute a hazard to traffic, prohibited.
 - 5. Curing compounds on new concrete surfaces (less than 1 yr old) shall be removed per existing pavement marking removal requirements prior to installation of new pavement markings.

G. Work Areas:

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

H. Mixing:

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

I. Disposal:

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

3.3 APPLICATION

- A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat.
1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
- B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40 deg F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.
- C. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

END OF SECTION 099120

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