SECTION 03320

CONCRETE SLAB PATCHING AND REPAIR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes all cast-in-place portland cement concrete work on site and in the building, including all interior concrete work where cuts are made in floor slab for new piping installed as part of this work, interior curbs, and Canopy seats, benches and curbs.

1.3 DEFINITIONS

A. Shrinkage Joints (S.J.), also known as Control or Contraction Joints, are saw-cut joints made after slab finishing to control slab breaks caused by concrete shrinkage, to keep cracks in straight lines under the saw-cuts.

B. Construction Joints (C.J.) are joints formed between adjacent slab panels where panels are separate concrete pours.

C. Expansion Joints (E.J.) are joints formed between adjacent slab panels where panels are separate concrete pours and the panels are separated with pre-molded joint filler topped with sealant to allow for thermal expansion/contraction of the concrete.

D. Isolation Joints (I.J.) are created with pre-molded joint filler to separate concrete slabs/walks from buildings, columns and other structures that penetrate the slab.

1.4 ACTION SUBMITTALS

A. Concrete Mix Design: 15 days prior to placing concrete, submit written mix designs of each proposed mix for each class of concrete to Architect for review. Present documentation that the proposed mix design, using actual aggregates, additives, and cement of the proposed mix for this project meets the requirements described herein.

1. Review of mix design does not relieve Contractor of responsibility of concrete performance.

B. Product Data: For proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water-stops, joint systems, curing compounds, and others if requested by Owner’s Representative.

C. Test Reports: For concrete materials and mix design test.

D. Batch Ticket Information: Deliver a computer-generated concrete mix data with each concrete delivery, accurately listing the specific components in the load as delivered to the site. Include the following information as separate line items --
1. Batch Number, Truck Number, Batch Time, and Mix Number,
2. Weight and classification of coarse aggregates,
3. Weight and classification of fine aggregates,
4. Weight and classification of Portland cement,
5. Weight of Water,
6. Admixtures used, and the amount in the mix.

1.5 CONFORMANCE SUBMITTALS

A. Conformance Submittals will be allowed for products described below, and will not require Architect’s approval before incorporating the material into the work.

1. Where products in this section are incorporated into the work are exactly as specified, use the “Product Conformance Certification” Form included in Division 1 Section “Submittal Procedures.”
2. Substitute Products: Where products are proposed for use, but are not as specified, approval of a substitute product is required. Use “Substitution Request Form” included in Bidding Requirements, Document 00100 “Instructions to Bidders” and send to Architect for review and approval.

B. Curing Compound:

1. Product Data: Include Curing Agent manufacturer's specifications, together with surface preparation and application instructions.

C. Sealer-Hardener-Densifier: Submit to the Architect the following:

1. Materials list of items proposed to be provided under this section, together with manufacturer's specifications.
2. Proof of USDA approval for use in food preparation areas
3. Manufacturer's recommended installation procedures which, when reviewed by the Architect, became the basis for installation procedure used.
4. Letter from product manufacturer approving applicator for this project. Do not proceed with application of these products until after Architect has returned reviewed submittals.
5. Material Safety Data Sheet (MSDS) for products provided.
6. List of trained, certified applicator subcontractors allowed to bid the application of the product specified. The manufacturer shall also designate a technical representative responsible for this project.

D. Joint Fillers:

1. Submit manufacturer's data describing joint armor material to be used for Architect's review.
2. Submit manufacturer's data describing shrinkage joint filler to be used for Architect's review. Submit letter from manufacturer stating application is approved by manufacturer.
3. Submit manufacturer's data describing exterior construction joint filler to be used for Architect's review.

1.6 QUALITY ASSURANCE
A. **Codes and Standards:** Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

2. ACI 301, "Specifications for Structural Concrete for Buildings”.
3. ACI 302, “Guide for Concrete Floor and Slab Construction”.
4. ACI 304 “Guide for Measuring, Mixing, Transporting and Placing Concrete”
5. ACI 305 “Hot Weather Concreting”
6. ACI 306 "Cold Weather Concreting”
7. ACI 309 “Standard Practice for Consolidation of Concrete”
8. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
10. ASTM C309 “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete”.
11. ASTM C171 “Standard Specifications for Sheet Materials for Curing Concrete”.
12. ACI 308R: Guide to Curing Concrete”.
13. CAN/CSA A23.1/A23.2 “Concrete Materials and Methods of Concrete Construction / Methods of Test for Concrete”, if applicable.

1.7 **DEFECTIVE WORK**

A. Protect concrete against damage from rain, weather, and vandalism. Concrete slabs that are pitted, rough, or cracked will not be accepted.

B. Remove and replace concrete work, which is damaged, improperly cured, or improperly finished, resulting in a surface with curled edges, spalled joints, whitening, dusting, map or spider cracks, delamination, or other similar conditions.

1.8 **COORDINATION**

A. Coordinate placing embedded items to avoid impairing structural strength of concrete or displacing reinforcing steel. General Contractor is responsible for all embedded items and for the supervision of the placement by all trades.

1.9 **WARRANTY**

A. Floor Joint Filler Warranty: Manufacturer's standard form in which manufacturer warrants the following:

1. The semi-rigid Joint Filler product used in the project meets the formulation standards and has the physical properties specified herein, and represented in manufacturer's data sheets and technical literature.
2. The manufacturer agrees to furnish sufficient material to repair or replace installed material that does not have the properties specified herein, within the warranty period.

   a. Warranty Period: 5 years from date of Substantial Completion.
   b. Excluded in the warranty: Movement of the floor slab if concrete thermal and drying shrinkage exceeds 0.003 percent and the resulting stresses on the filler exceeds filler manufacturer's written specifications for elongation, adhesion, or cohesion.
B. Seal and Hardener Warranty:

1. Furnish the Owner and Architect with a written warranty that slab will not dust from abrasion for a period of 20 years of use as part of the facility for which the project was intended and built.
2. Include provisions that Seal and Hardener manufacturer will reseal defective areas, including both material and labor, for the duration of this warranty period.

PART 2 PRODUCTS

2.1 AGGREGATE BASE COURSE UNDER FLOOR SLAB

A. Provide a 6-inch (150-mm) minimum thick base under floor slabs using crushed, partially crushed, or naturally occurring fractured face granular material from sources approved by the Geotechnical Engineer as described in Division 2 Section “Earthwork”.

B. Use a plant-mix material meeting the state standard specification for road and highway construction, “Aggregates for Ballast and Crushed Surfacing” for ‘crushed surfacing’ with 3/4-inch (19 mm) maximum grading.

C. Place in lifts not exceeding 6 inches (150 mm) in thickness. Use equipment with laser-guided grader blade or moldboard system to assure flat and level aggregate base course placement.

D. Compact lifts to at least 95 percent of ASTM D-1557-70 maximum dry density. Proof-roll the entire area under slabs.

E. Compacted aggregate base under the floor slab shall be stable, trimmable, and deflect less than 1/4-inch (6 mm) when loaded equivalent to a ready-mix concrete truck. If deflection exceeds maximum, contact Architect before proceeding with work.

2.2 CONCRETE

A. General: Use only ready-mix concrete furnished by an established supplier, conforming to ASTM C 94 “Specification for Ready-Mixed Concrete”.

1. Concrete at general slab pours where curing time can be 28 days: Use Type I Cement, as indicated on Structural Notes.
2. Concrete at slab repairs, at trench cuts, at interior curbs, and at Canopy benches and curbs: Use Type III Cement for high early strength.

B. Concrete Quality:

1. Concrete shall attain the ultimate strength called for in Structural Notes and shall be determined by standard 3, 7, and 28 day (Type I and III cement) cylinder tests, ASTM C 31 / C 31M and C 150.
2. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

   a. Ramps, Slabs, and Sloping surfaces: 4-inch (100 mm) maximum.
b. Walls, Footings, and Foundation: Not less than one inch and not more than 4 inches (100 mm).

c. Concrete containing high-range water-reducing admixture (super-plasticizer): Not more than 8 inches (200 mm) after adding admixture to site-verified 2 to 3 inch (50 to 75 mm) slump concrete.

d. Other Concrete: Not more than 4 inches (100 mm).

e. See Structural General Notes.

C. Components:


   a. Aggregates: Free of materials with deleterious reactivity to alkali in cement which causes A.S.R. (alkaline-silica or alkaline-carbonate reactivity).

      1) Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

   b. Fine: Natural sand.

   c. Coarse: Natural gravel size No. 467 or 1-1/2 inches (38 mm) to No. 4 size, free from deleterious substances.

   d. Walls and Vertical Faces: Use aggregate gradation the same as slab on grade, except limit maximum aggregate size to one inch.

3. Water:

   a. Clean and free from deleterious substances and shall be potable.

   b. Maximum water to cement ratio: 0.49

   c. Limit water to cement ratio to 0.45 and use Type V cement where soils water soluble sulfate exceeds 0.20 percent by weight.

   d. Add no water to concrete at the site.

   e. If increased workability is required, submit mix design with super-plasticizer admixture to be added at the concrete plant.

4. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

   a. Admixtures which may be submitted for approval for use on this project include the following:

      1) Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

      2) Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

      3) Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

      4) High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5) High-Range, Water-Reducing and Retarding Admixture: 
ASTM C 494/C 494M, Type G.

b. All admixtures must be accepted in writing by the Structural Engineer prior to use.

5. Bonding Agent:

a. "Flex-Con" by Euclid Chemical Company, 19218 Redwood Road, Cleveland, 
OH 44110, ph: (800) 321-7628 or (216) 531-9222, fax: (216) 531-9596, 

b. "Everbond", by L & M Construction Chemicals, Inc., 14851 Calhoun Road, 
Omaha, NE 68152, ph: (800) 362-3331 or (402) 453-6600, fax: (402) 453- 
0244, Contact: Bill Pavitt (425) 785-3242, www.lmcc.com

D. Related Materials:

1. Reglets: Where sheet flashing or bituminous membranes are terminated in 
reglets, provide reglets of not less than 0.0217 inch (0.55 mm) thick galvanized 
sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or 
debris.

2. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch 
(0.85 mm) thick with bent tab anchors. Fill slot with temporary filler or cover face 
opening to prevent intrusion of concrete or debris.

E. Proportioning and Design of Concrete Mixes:

1. Refer to Structural Notes for specific proportions.

2. Prepare design mix for each type and strength of concrete by either laboratory trial 
batch or field experience methods as specified in ACI 301 (CAN/CSA A23.1/A23.2, 
if applicable). If trial batch method used, use an independent testing facility 
acceptable to Architect/Structural Engineer for preparing and reporting proposed 
mix designs. The testing facility shall not be the same as used for field quality 
control testing.

3. Use no fly ash in concrete.

4. Use no air entrainment for interior slab on grade.

5. Adjustment to Concrete Mixes: Mix design adjustments requested by Contractor, 
when characteristics of materials, job conditions, weather, test results, or other 
circumstances warrant, shall be at no additional cost to Owner. Laboratory test 
data for revised mix design and strength results shall be submitted to and 
accepted by Architect before using in work.

6. Add no water to concrete at site.

7. Admixtures:

a. Use approved admixtures, water-reducing or high-range water-reducing 
admixtures, (super-plasticizer) in concrete as required for placement and 
workability.

b. Use high-range water-reducing admixture in pumped concrete, concrete for 
heavy-use industrial slabs, architectural concrete, parking structure slabs, 
concrete required to be watertight, and concrete with water-cement ratios 
below 0.49.
c. Use air-entraining admixture in exterior exposed concrete slabs unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 3 to 4 percent air.
d. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

8. Ready-Mixed Concrete:

a. Comply with requirements of ASTM C 94/C 94M, and as specified. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.3 EVAPORATION RETARDER

A. Evaporation Retarder: For slabs poured in hot, dry, and windy conditions, provide waterborne, monomolecular film forming, manufactured for application to fresh concrete to temporarily reduce moisture loss from concrete surfaces awaiting finishing in hot, dry, and windy conditions. Use one of the following:

1. "E-Con" manufactured by L & M Construction Chemicals, Inc., 14851 Calhoun Road, Omaha, NE  68152, Ph: (800) 362-3331 or (402) 453-6600, Fax: (402) 453-0244, Contact:  Bill Pavitt (425) 785-3242, www.lmcc.com

2. “Day-Chem Sure Film (J-74)” manufactured by Dayton Superior Chemical and Cement Products, 4226 Kansas Avenue, Kansas City, KS  66106, (866) 329-8724 or (877) 416-3439, Fax: (913) 371-3330, Contact:  Todd Fraker (303) 289-4808, email: toddfraker@daytonsuperior.com, www.daytonsuperiorchemical.com

2.4 CONCRETE POWER SAW

A. Use Motor Powered, Self Propelled, Special Concrete Saw manufactured for cutting new concrete floor slabs. Use units manufactured by Husqvarna Construction Products, 17400 West 119th Street, Olathe, Kansas 66061, Ph: (800) 288-5040, Fax: (913) 438-7951, http://us.husqvarnacp.com.

1. Recommended minimum operational characteristics for a unit on the site, are based on “Husqvarna Soff-Cut 2500 Series”:

   Straight Blade Cut Depth..............to 1-1/4 inch (32 mm)
   Straight Blade Cut Width ..............1/8 inch wide (3 mm)
   Sawing Speed............................16 to 30 ft/min
   Saw Blade Diameter....................10 inches (250 mm)

2. Newer and larger power saw units, including Husqvarna Soff-Cut 4000 series may be used.

3. Have at least two fully equipped and operational power saw units ready on the site when a slab pour operation exceeds 1,000 square feet in area.

4. Include a Soff-Cut compatible industrial-grade vacuum, one per power saw unit.
B. Saw Blades and Skid Plates: Use a compatible “Soff-Cut Blade and Skid Plate”. Have a new blade and skid plate replacements on the site for every 500 lineal feet (150 lineal meter) of saw-cuts to be performed.

1. Use skid plate pads to prevent scratching of the fresh concrete slab.

C. Cross-Cutting Joint Protector: Where new joints are cut across a previous fresh cut, use a “Soff-Cut Joint Protector” in the previous cut to prevent corner and edge raveling.

2.5 CURING AGENTS

A. Material for Covered Curing:

1. Moisture-Retaining Curing Cover: Use material that meets or exceeds ASTM C171 / C 171M standard specification for sheet material for curing concrete slabs. Use one of the following products:


   b. “Transguard 4000” moisture-retaining coverings, a natural-colored, non-staining cellulose fabric with a 4 mil white impervious coating applied to one side, manufactured by Armorlon Division of Reef Industries, 9209 Almeda Genoa Road, Houston, TX 77075, ph: (800) 231-6074, fax: (713) 507-4295, www.reefindustries.com.


2. Potable Water: Use water with less than 15 PPM dissolved minerals, including dissolved calcium, magnesium or other material that would stain or leave residue after evaporation.

3. Roller Squeegee Tool: Hand-operated tool designed to roll curing cover out flat, without air bubbles or wrinkles. Use “UltraSqueeg” manufactured by McTech Group, Inc.for this application.

B. Non-Residual Concrete Curing Agents:

1. Use a clear, water-based, VOC-compliant, non-residual concrete curing agent that penetrates surfaces to cure the concrete from within.

   a. Use an alkaline silicate material that is compatible with the Penetrating Seal and Hardener.

   b. Use one of the following products:

      1) “L & M Cure” manufactured by L & M Construction Chemicals, Inc., contact Bill Pavitt at (425) 785-3242.

      2) “Day-Chem Sil-Cure (J-13)” manufactured by Dayton Superior Corporation, contact Todd Franker at (800) 745-3708.

2. If this material is used for curing, then select a product by the same manufacturer as the Penetrating Sealer-Hardener-Densifier.

2.6 SEALER-HARDENER-DENSIFIER

A. Sealer-Hardener-Densifier: A water-based, reactive silicate or siliconate solution, surface applied, deep penetrating, VOC compliant, USDA accepted, liquid sealer-hardener-densifier that reacts with concrete surfaces to produce a hard, dense, and glossy finish that seals out contaminants.

B. Do not use material containing fluorine, fluosilicate-base materials, or material that dries to a film on the concrete surface.

C. Use one of the following Seal and Hardener products:


2. “Day-Chem Sure Hard J-17” alkaline siliconate hardener manufactured by Dayton Superior Chemical and Cement Products, 4226 Kansas Avenue, Kansas City, KS 66106, Ph: (866) 329-8724 or (877) 416-3439, Fax: (913) 371-3330, Contact: Todd Fraker at (303) 289-4808, email: toddfraker@daytonsuperior.com, www.daytonsuperiorchemical.com

3. “Pentra-Sil” alkaline silicate hardener manufactured by Convergent Concrete Technologies, 115 North 1380 West, Orem, UT 84057, ph: (866) 375-2280 or (801) 375-2280, Fax: (801) 375-2971, Contact Shane Vest ext. 106.


6. No alternate material, or substitutions will be considered or accepted.

2.7 INTERIOR SLAB JOINT MATERIALS

A. Polymer Filler Resin: Provide a semi-rigid two-part polyurea resin manufactured and distributed for use as a floor joint filler material to protect concrete joint edges. Use a rapid set, cold applied, gray colored, self-leveling filling system composed of 100 percent solids.

B. Floor Joint Filler Material for Concrete Slab Inside Building:
1. Product Physical Properties:

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<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>PROPERTY VALUE</th>
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<tr>
<td>Shore A Hardness</td>
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<tr>
<td>Tensile Lap Shear</td>
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<tr>
<td>Tensile Strength</td>
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<td>Elongation</td>
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<tr>
<td>Movement Capability</td>
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</table>

Accepted by USDA for use in areas of incidental food contact.

2. Approved Products:

a. “Penatron 3004” as manufactured by ASTC Polymers, Inc., 3207 W. Warner Avenue, Santa Ana, CA 92704, Ph: (714) 966-2893, fax: (714) 966-9105, cell: (714) 747-5785, contact Dick Peckenpaugh at (714) 803-1274, email: info@astcpolymers.com, www.astcpolymers.com.

b. “VersaFlex SL/85” as manufactured by VersaFlex, Inc., P.O. Box 32226, Kansas City, MO 64171, ph: (800) 561-6191 or (913) 321-9000, fax: (913) 321-1490, Contact: Roy Harvey at (913) 948-1006, email: royharvey@versaflex.com, www.versaflex.com.

c. No Joint Filler alternate or substitution will be considered.

C. Floor Joint Filler Material for Concrete Slab Under Entry Canopy:

1. Product Physical Properties:

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<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>PROPERTY VALUE</th>
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<tr>
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<tr>
<td>Movement Capability (maximum)</td>
<td></td>
<td>±25 percent</td>
</tr>
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</table>

Accepted by USDA for use in areas of incidental food contact.

2. Approved Products: Subject to compliance with requirements, products that may be incorporated into the Work include the following:


b. “VersaFlex SL/60” as manufactured by VersaFlex, Inc., 87 Shawnee Avenue, Kansas City, KS 66105, ph: (800) 561-6191 / (913) 321-9000, fax: (913) 321-1490, Contact Roy Harvey, email: roy@versaflex.com, cell: (913) 948-1006, www.versaflex.com.

c. No Joint Filler alternate or substitution will be considered.

D. Joint Filler Backing Rod:

1. General: Provide filler backings of material and type that are compatible with joint substrates, and are approved for applications indicated by filler manufacturer based on field experience and laboratory testing.
2. Use material meeting ASTM C 1330, either Type C (closed-cell material with a surface skin), or Type B (bicellular material with a surface skin), as approved in writing by Joint Filler manufacturer for use, and of size and density to control filler depth.
   a. Select backer rod size to allow at least 1-1/4 inch (32 mm) filler depth.
   b. Do not use backing rod in Saw-Cut Shrinkage Joints.

2.8 EXPANSION JOINTS AT FREEZER SLABS

A. Pre-molded Expansion Gasket:
   1. “Sealtight Sponge Rubber”, 1/2 inch (12 mm) thick, with matching width, removable “Sealtight Snap-Cap” to protect gasket top during construction.

B. Filler: “Penatron 3004”, or “VersaFlex SL/85” two-part flexible joint filler system described above, placed after removal of joint cap.

2.9 MISCELLANEOUS

A. Non-Metallic, Non-Shrink Grout:
   2. "Duragrout" by L & M Construction Chemicals, Inc.
   3. See Structural notes.

PART 3 EXECUTION

3.1 PRE-CONCRETE INSTALLATION CONFERENCE

A. The primary objective of this work is to deliver to the Owner, at the completion of this project, a hard, dense, flat, smooth, and crack-free concrete floor slab with a hard-burnished and glossy finish. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials.

B. Before any floor slab concrete is placed, schedule and hold a meeting, to be led by the Architect’s representative, to review the project requirements and the expected end product results. Notify and require representatives of each entity directly concerned with the floor slab to attend, including qualified representatives of the following:

   1. General Contractor’s Superintendent.
   2. Concrete Subcontractor, Concrete Finishing Foreman.
   3. Independent testing agency responsible for concrete design mixes.
   5. Representatives for:
a. Floor Joint Filler Manufacturer.
b. Interior Floor Slab Curing Manufacturer.
c. Penetrating Seal and Hardener Manufacturer.
d. Polymer Flooring Subcontractor.

3.2 PREPARATION
A. Notify the Architect, and appropriate material testing agencies at least 24 hours before an intended pour.
B. Make sure no concrete is placed until all reinforcing, steel pipes, conduits, sleeves, hangers and all other work required to be built into concrete is inspected by required testing agencies and approved by local building officials.
C. Verify grade elevations prior to placing concrete.

3.3 AGGREGATE BASE COURSE UNDER SLABS/WALKS
A. Provide a minimum thickness of 6-inches of compacted aggregate base course placed in maximum of 6-inch lifts.
B. Compact aggregate base course to 95% ASTM D1557 maximum dry density.
C. Thoroughly moisten aggregate base course immediately before placing concrete.

3.4 FLOOR DRAINS, TRENCH DRAINS AND CLEANOUTS
A. See Division 9, Section “Polymer Flooring” for coordination and placement requirements for floor drains, sinks, and utility boxes in areas where polymer flooring finish occurs.
B. Embed floor drains, trench drains and floor cleanouts into concrete at least 24 hours before the floor slab is placed.
   1. Where slab slopes to a drain, place and slope concrete for a minimum of 40-inch (1016-mm) radius around drain, and steel trowel to hard finish.

3.5 CONCRETE PLACEMENT, GENERAL
A. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
B. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

3.6 CONCRETE PLACEMENT IN FORMS
A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete", (CAN/CSA A23.1/A23.2, if applicable), and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309 (CAN/CSA A23.1/A23.2, if applicable).

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into proceeding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

3.7 CONCRETE PLACEMENT IN SLABS

A. Use agitator type trucks and place within 1-1/2 hours after introduction of water. Keep equipment clean and free of dried concrete.

B. Coat existing concrete to be joined with new concrete with bonding agent, where called for in structural drawings, applied in accordance with manufacturer's instructions. Cold joints will not be allowed.

C. Concrete Placing, once started, shall be carried on as a continuous operation until placing of section is complete.

1. Convey in a method to insure no separation, segregation or intrusion of foreign matter.

2. Thoroughly consolidate concrete by means of mechanical vibrators.

3. Use a screeding equipment that disperses concrete by auger, consolidating and vibrating the concrete with self-leveling, laser-guided screeding heads, as follows:

   a. "Laser Screed" equipment by Somero Enterprises, 82 Fitzgerald Drive, Jaffrey, NH 03452, Ph: (603) 532-5900, or other approved, laser-guided equipment.

4. Maintain joint edges as indicated on Drawings.

5. Do not wet concrete surfaces with water during screeding, initial floating, or finishing operations. Over-watering the slab may cause delaminating or scaling of the surface.
D. Evaporation Retarder: Apply evaporation retarder to concrete slab surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. foot per hour before and during finishing operations. Apply according to manufacturer's written instructions after placing and screeding, but before finishing.

3.8 FORMED CONCRETE JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Owner’s Representative.

B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

C. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

3.9 FORMED SLAB JOINTS

A. Make formed Construction Joints (C.J.) and Closure Strip Joints (C.S.J.) between adjacent slab panels, where panels are separate concrete pours:
   1. Edges: Do not tool or finish concrete construction joint edges to a radius edge.
   2. Keep joints between adjacent slabs as pours as plain, straight, vertical butt-joints, with sharp, square concrete corners to prevent 'feathering' of Joint Filler described in Division 3 Section “Floor Joint Filler”.
   3. When making the second pour at a formed construction joint, keep the material of the second pour from accumulating on top of the first pour. If the newly placed concrete hardens on top of the previously placed slab, remove it by grinding to get a smooth and level transition with clean, flush, and straight edges on both slabs so a precise Joint Filler installation is possible.

B. Construction Joint Reinforcing: Discontinue slab reinforcing and use dowels at each edge of each pour, as indicated on the drawings.

3.10 BLOCK-OUTS AT COLUMNS

A. Where concrete walls extend above the floor, provide a minimum 1/2-inch deep block-out in the concrete at the face of each steel column.
   1. The length of the block-out shall extend beyond the edge of each column flange or beam depth by 6-inches.
   2. Extend the block-out from the top of the wall to the column base plate.

3.11 INSTALLING EMBEDDED ITEMS

A. Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

3.12 FINISHING FORMED SURFACES
A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. 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.

3.13 FINISHING INTERIOR CONCRETE SLAB

A. IMPORTANT: The primary objective of the slab finishing is to produce a hard, dense, flat, smooth, and crack-free concrete floor slab with a hard-burnished and glossy finish at the completion of this work.

B. Trowel Finish: Provide a hard-steel trowel finish per ACI 302.1R, Class 5, with a minimum of three troweling passes.

1. After applying float finish, apply trowel finish and consolidate concrete by power-driven trowel machine. Perform each subsequent troweling pass perpendicular to the previous pass. Allow a time lapse between successive trowelings to permit concrete to become harder.

2. Continue troweling passes until surface is free of trowel marks and is smooth and uniform in texture and appearance. Apply additional troweling passes as necessary to meet the primary objective of the finishing work.

C. Do not finish bleed water or surface contaminants (wind-blown soil, jobsite trash, fuel or lubricants) into the surface of the slab.

3.14 FINISHING SLAB OUTSIDE BUILDING INTERIOR

A. Entry Canopy Slab:

1. The elevation of the canopy slab along the Tire Center/Canopy wall is at a constant elevation that matches the Warehouse’s finished floor elevation unless otherwise noted or shown on the drawings.

   a. The pavement does not create a sloping-line along the wall.

B. Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with
power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes.

1. Cut down high spots, and fill low spots. Re-float surface immediately to uniform granular texture.
2. See Division 2 Section "Cement Concrete Pavement" for slip-resistive concrete finishing at slabs outside of building line.

3.15 SHRINKAGE JOINTS (S.J.)

A. Start cutting concrete when strength is between 150 psi to 800 psi, normally from 0 to 2 hours after final slab finish.

1. Perform Saw Cutting using a workman trained or approved by saw manufacturer.
2. Make saw-cuts in slabs at the same rate as the slab pouring and finishing operations. If a single power saw unit cannot cut at the same rate as slab placing operations, then have more than one saw operating simultaneously.

B. Provide cuts with clean, straight, un-chipped edges. Vacuum dry powder as soon as cut is made, before starting slab cure.

C. Complete saw-cuts by hand if necessary to extend saw-cuts to wall and column lines.

D. Use “Soff-Cut Joint Protectors” at intersection of cuts to maintain openness until joint filler is applied.

E. Cold weather concrete placements may extend the initial start of shrinkage joint cutting. To ensure desired performance, make a test cut of 24 to 72 lineal feet (600 to 1800 lineal mm) at proper depth. If desired results are achieved, continue to complete balance of cuts at control joint locations.

F. Sawblade and Skid-plate Replacements: Limit a sawblade to 500 lineal feet (150 lineal meter) of cut, unless direct observation of work in progress assures cut edges are clean, with square corners.

1. Replace both the blade and skidplate as a set before the cutting operation produces chipped, spalled, or raveled edges, or skidplates scratch the slab surface.
2. Do not use a sawblade if it makes chipped, spalled or raveled cuts, or use a skidplate that scratches the concrete surface.

G. Joints at Interior Curbs and at Entry Canopy Seats, Benches and Curbs:

1. Honor all joints in the floor slab. Locate joints in curbs, seats, and benches directly above and to align with joints in floor slab.
2. Install joint filler material as described above in this Section and in accordance with manufacturer’s installation instructions.

3.16 PREPARATION FOR FLOOR JOINT INSTALLATION
A. Clean interior sidewall faces of saw-cut shrinkage joints, and formed construction and closure joints to expose bare concrete. Remove all contaminants, including concrete laitance, cure material, hardener, construction dirt and other debris.

B. Protect saw-cut joint edges from damage until the filler is installed.

C. Joint Filler Backing Rod:

1. Use backing rod at formed construction and closure joints if the depth of the joint exceeds 1-1/2 inch (38 mm) due to concrete shrinkage.
2. Select a rod appropriate for the actual width of the joint.
3. Press the rod into the joint so filler will be at least 1-1/4 inch (32 mm) deep, but no more than 1-1/2 inch (38 mm) below the top of the slab.

3.17 JOINT FILLER INSTALLATION

A. Install joint filler in joints at the following locations:

1. Interior floor slabs.
2. Mezzanine floor slabs.
3. Interior curbs.
4. Entry Canopy slabs.
5. Entry Canopy seats, benches and curbs.
6. Other exposed interior concrete surfaces.

B. Joint Filling:

1. Fill all saw-cut shrinkage joints (S.J.), and formed construction and closure joints.
2. Install filler for the full depth of prepared joint.
3. Fill joint with filler so top of resin is slightly crowned above floor line. Monitor top to assure fill remains crowned.
4. After resin has cured, trim the overfill using a stiff, sharp razor so top of filler is flush with concrete floor on both sides.
   a. Do not tool top of filled joint.
   b. Allow 90 minutes for filler to cure.
   c. Do not shave filler until fully cured and not gummy, and slab temperature is nominally 70 degrees F.

5. Protect freshly placed material from traffic for one hour after installation.
6. If the filler top is concave, or not flush with the floor, remove the top 1/2 inch (12 mm) with a saw then clean and refill to get a flush profile.

3.18 FORMED CONCRETE CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent absorptive covers.

### 3.19 CONCRETE SLAB CURING

#### A. Concrete Curing and Protection

1. Start slab curing after final finishing operations are complete, and concrete surface glaze has disappeared.
2. Immediately following finishing, protect concrete from direct rays of sun, premature or excessive drying, temperature extremes, and physical damage. Keep moisture loss to a minimum, and maintain relatively constant temperature.
   a. If combustion heaters or internal combustion engines are used in the presence of newly poured concrete, provide adequate ventilation and take other measures necessary to prevent carbon dioxide from reacting with cement components, causing carbonization of concrete.
3. Cure for a minimum of 7 days or until 70 percent of the specified concrete strength has been reached.
4. During the curing period, protect concrete from damage by equipment, temperature change, stored materials, jobsite activities, rain, and running water.

#### B. Covered Curing Material Application:

1. Soak surface of slab-on-grade with 1/8 to 1/4-inch (3 to 6 mm) of water so slab surface is saturated before applying curing cover. Roll the cover flat onto the slab, using a roller squeegee to prevent air bubbles or wrinkles from forming. Lap cover sides and ends at least 3 inches.
   a. Continuously inspect curing blanket to assure 100 percent contact is kept with concrete surface. Add water as required so moisture is maintained.
   b. Immediately repair any curing blanket holes or tears during curing period.
2. This method should not be considered if site soils will be adversely affected by moisture, or if solar exposure, air temperature, or wind makes water cure impractical.

#### C. Non-Residual Curing Agent Application:

1. Use in enclosed, well-vented areas, or on slabs not likely to be exposed to the elements.
2. Curing Agent Application:

   a. Immediately after Shrinkage Control Joints are cut, clean slab to a dirt and contamination-free condition. Use compressed air to blow out and clean at saw cuts, corners and column footings.
   b. During hot weather, fog surfaces with water at the rate of 1/4 to 1/2 gallon per minute prior to applying. Do not create water ponds or puddles.
   c. Uniformly apply directly to the concrete surfaces in continuous operation by low pressure power spray or roller according to manufacturer’s written instructions.

      1) Manufacturer’s recommended coverage rate for steel troweled concrete is 200 to 300 square feet per gallon. Closely observe results and adjust application rate as required.
      2) Wash off and squeegee excess cure to prevent white stains if cure is not absorbed within four hours of application.

D. Cleanup: After curing operation, examine dried slab. Where efflorescence is observed on surface, use a mild abrasive cleaning method that will not scratch concrete finish, to remove any efflorescence that may remain.

3.20 SEALER-HARDENER-DENSIFIER APPLICATION

A. General: Due to specified product differences, some variation in sealer-hardener-densifier application methods may be recommended by product manufacturers, but a hard, dense, burnished, and glossy slab is required at project completion.

B. Slab Cleaning Before Sealer-Hardener-Densifier Applications:

   1. Before any work of applying the sealer-hardener-densifier described in this section begins, take care to completely remove any curing compound, adhesives, and surface contaminants.
   2. Remove construction debris and stains, oils, and concrete laitance so slab surface is completely free of contaminants.
   3. Clean slab to a dirt-free condition by stripping or washing to prepare floor for densification (in accordance with manufacturers procedures), prior to each application of sealer-hardener-densifier.
   4. Use a self-propelled, riding sweeper / scrubber equipped with vacuum fan recovery system and cylindrical, soft nylon bristle brushes. Do not use brushes with polypropylene or abrasive bristles of any kind.

      a. For work on the mezzanine slab, use hand-operated “walk-behind” scrubbing machines appropriate for the mezzanine slab size.

   5. Clean using a mild pH (8 to 10), industrial detergent. Use “Formula 653 Light duty Liquid Cleaner” by Tennant Company, 701 North Lila Drive, P.O. Box 1452, Minneapolis, MN 55440, Ph: (800) 553-8033 / (763) 540-1200, Fx: (763) 513-2142, Em: info@tennantco.com or approved equal.

C. Protect adjacent surfaces/areas from damage due to sealer-hardener-densifier overspray; especially glass and painted surfaces.
D. A two-coat application of the sealer-hardener-densifier is required for all interior exposed concrete surfaces, including stair treads and curbs.

E. First Coat Application: Use low pressure sprayer to apply sealer-hardener-densifier onto slab.

1. Apply directly from sealer-hardener-densifier container onto prepared surfaces, undiluted, using a low pressure spray, at minimum rate of one gallon per 200 sq. ft.

2. Allow surfaces to remain wet with sealer-hardener-densifier for a 30 to 60 minute soak-in period, without allowing material to dry out or become slippery.
   a. In hot weather, if slipperiness appears before the 30 minute period, apply more sealer-hardener-densifier as required to keep the entire surface in a non-slippery condition.
   b. For the final 15 minutes of this period, gently apply water using spray mist to maintain non-slippery condition.
   c. When soak-in period is completed and surfaces become slippery under foot again, flush floor surface with water to remove residue.

3. Use the riding sweeper / scrubber described above, cleaning and scrubbing with water, making a minimum of three separate cleaning operations, starting with clean water each time.
   a. Do not allow excess material to remain on the floor surface that may result in white stains. If white stains occur, remove them immediately without damaging concrete surface.
   b. Depth of Seal and Hardener Penetration: Get 5 mm minimum penetration into concrete slab.
   c. Compressive Strength 12.9 percent increase.

4. For work in the Entry Canopy slab, apply multiple light coats of sealer-hardener-densifier (diluted at a ratio recommended by manufacturer) until fully saturated. Use a broom to work the sealer-hardener-densifier into the slab and to prevent puddles from sitting on top of the slab. DO NOT USE a scrubbing machine, which may result in diminishing or eliminating the broom-textured finish in the slab.

F. Slab Care During Subsequent Construction Operations:

1. Treat oil spots on slab with oil absorber materials as soon as they occur.
2. Immediately wipe or scrape glue, paint, and other construction material dropped onto floor to maintain a clean slab surface. Where construction material cannot be scraped or wiped off, machine-sand floor surface with 200 grit medium pad or 400 grit resin diamond. Always start with the finest grit (higher #) that will remove contaminants without scratching the floor or exposing aggregate. Do not use grits lower than 200.
3. Keep entire floor area clean, using hand and power sweeping or scrubbing with soft poly brushes. Blow out all corners and at base of columns. Do not sweep or scrub the floor slab for a minimum of 7 days after concrete placement.

G. Second Coat Application:

1. Immediately before applying second coat, do the following:
a. Wet-soak the floor for a minimum of thirty minutes by flooding with a hose or using an automatic scrubber without vacuum or squeegee attachments.
b. Remove all traces of contamination and soap residue.

2. Use a low pressure sprayer to apply sealer-hardener-densifier onto slab at a rate of 400 sq. ft per gallon. Apply only to small areas at a time so material can be immediately burnished dry. Do not allow material to dry without being burnished.

3. Burnishing: Use a high-speed propane powered burnishing machine with the following properties:

a. Equip with 21 inch (533 mm) diameter abrasive stripping pad, rotating at 2,000 to 3,500 RPM.
b. Machine weight of at least 200 lbs (227 kg), delivering 38 to 42 pounds per square foot pressure on the rotating pad.

1) A suitable machine is an “Eagle Talon 2100”, manufactured by Parish Maintenance Supply, 114 Palmeter Street, Syracuse, NY 13206, ph (800) 836-0862 or (315) 433-9031, fax: (315) 433-9840.
2) Recommended Stripping Pad: “3M Brown Stripper Pad 7100”, or equivalent product approved by Architect.

c. Buff the surface by working the machine forward and back to create a wax-like sheen. Work backwards so applicator/operator does not walk on buffed areas or leave footprints on areas just completed.

4. Leave the slab surface clean and dry, with a high gloss finish.

3.21 EXISTING INTERIOR FLOOR SLAB CRACK REPAIR

A. Repair cracks and areas of noticeable spalling in existing slabs not placed as part of this project, that are within 10 feet (3 meter) of this work.

1. Fill exposed cracks wider than 1/8 inch (3 mm), and where noticeable spalling has occurred in existing slabs.
2. Cracks under furnishings or cabinets need not be repaired.
3. Where slab cracks are in an area scheduled receive polymer flooring, see Division 9 Section “Polymer Flooring” for method of crack repair.

B. Method of Crack Repair:

1. Rout out the crack with a concrete saw or special crack router, forming a groove at least one-inch deep with sharp, vertical sides. Make the groove wide enough to eliminate all spalled areas.
2. Blow the crack clean with compressed air.
3. Use backer rod to create a vertical dam at each end of the length to be filled. Do not use backer rod at the bottom of the crack.
4. For repair of joints 1/2-inch wide or smaller, fill the crack with joint filler following manufacturer’s instructions and as described in Control Joints Filler Installation.
5. If the repair is more than 1/2-inch (12 mm) wide, mix the polymer material with sand according to the manufacturer’s instructions, using one of the following products:
a. “Penatron 4034 Polyurea Concrete Repair Material” by ASTC Polymers.
b. “Armor-Hard Early Set Structural Epoxy” by Metzger /McGuire.
c. “Quick Mender Repair Polymer” by VersaFlex.

C. For small holes in concrete slabs:
   1. Blow the holes clean with compressed air. Remove completely all loose concrete, dirt, debris, grease, oil, and other contaminants that prohibit bonding of repair material to concrete substrates.
   2. Use one of the following products, following manufacturer’s written installation instructions:
      a. “Penatron 4034 Polyurea Concrete Repair Material” by ASTC Polymers.
      b. “Rapid Refloor” by Metzger /McGuire.
      c. “Quick Mender Repair Polymer” by VersaFlex.

3.22 MISCELLANEOUS

A. Concrete fill around pipes, ducts, and conduit passing through floors and walls.

B. At the fire protection sprinkler riser pipes, hold concrete 2-inches away from sprinkler riser pipe. Fill gap with sealant; DO NOT use concrete.

C. Provide Latex type flooring underlayment or approved; apply over interior concrete slabs which, in the Architect’s opinion, are too rough or uneven to provide a satisfactory base for floor finish materials.

D. Curbs: Provide monolithic finish to interior curbs and to Entry Canopy seats, benches and curbs, by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
   1. Locate joints in curbs to align with joints in floor slab.
   2. Install joint filler material as described above in this Section and in accordance with manufacturer’s installation instructions.

E. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.23 PROTECTION OF CONCRETE FLOOR SLAB

A. Take measures to protect the floor slab from stains, marks, scuffing, scratching, or similar damage by construction equipment during construction.

B. Allow no vehicles to park on the floor slab.

C. Do not use a pipe-cutting machine on the slab, or cut pipe with tools or equipment using liquid coolants or lubricants.
D. Place no steel parts directly on the slab. Support stored steel on dry wood crib-supports to avoid rust stain on slab.

END OF SECTION 03320