

**SECTION 03 30 20
CONCRETE SLAB ON GRADE**

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.
- B. Section 03 30 00: Cast-In-Place Concrete.
- C. Vapor retarder is specified in Section 31 23 01.

1.2 DESCRIPTION OF WORK

- A. This section supplements Section 03 30 00: Cast-In-Place Concrete, with specific emphasis on concrete slabs on grade. The general requirements of Section 03 30 00 pertain to this section unless otherwise specified in this section.

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. ACI 302 "Guide for Concrete Floor and Slab Construction."
- B. Hold a slab preconstruction meeting at least 14 days prior to initial planned date of slab placement. Discussion shall include reinforcing and dowel placement, slab joints, concrete mix designs, and procedures for concrete placement, finishing, curing, and protection. Attendees shall include Contractor, Placement Subcontractor, Concrete Supplier, Special Inspector, Testing Agency, Engineer, and Architect.
- C. Provide protection for slab on grade from direct exposure to sun, wind, precipitation, and excessive cold or hot temperatures starting during placement and lasting until end of curing period.
 - 1. After curing period, provide protection from precipitation for slab openings (column blockouts, mechanical blockouts, expansion/isolation joints, etc.) to prevent moisture from migrating between the structural slab and topping slab.
 - 2. Contractor shall be responsible for cost of repairing slab defects resulting from deficient protection methods.
 - 3. One method of protection is installing roof membrane and roof drains prior to installing slab on grade.

1.4 SPECIAL INSPECTIONS

- A. Refer to Specification Section 01 45 29 and Schedule of Special Inspections.

1.5 MATERIAL EVALUATION/QUALITY CONTROL

- A. Contractor shall secure services of a company field advisor from manufacturer of concrete surface treatment products, including sealers, hardeners, sealants, and finishes. Field advisor shall be certified in writing by manufacturer to be technically qualified in product installation. Personnel involved solely in sales do not qualify. Field advisor shall be present at beginning of installation of product and as required during duration of project to:
 - 1. Render technical assistance to Contractor regarding installation procedures of product to satisfy warrantee or guarantee requirements.
 - 2. Provide specialized training in use of product to Contractor's personnel.

3. Verify surface preparation procedures and suitable substrates for material application.
 4. Verify proper mixing proportions and procedures for product.
 5. Verify proper temperature and other environmental controls.
 6. Verify proper tools and application procedures.
 7. Verify proper curing and protection of installed product.
 8. Familiarize Contractor/Owner/Architect/Engineer with entire system, including inspection techniques.
 9. Answer questions that arise.
- B. Field advisor shall prepare a written report summarizing information listed above. Submit report to Special Inspector, Contractor, Owner, Architect, and Engineer.
- C. Contractor shall be responsible for expenses of field advisor and verifying credentials of advisor.

1.6 SUBMITTALS

- A. Comply with Section 03 30 00.
- B. Submit option for slab placement (see Part 3 of this section) and layout of slab joints.
- C. Prior to slab placement, submit to Special Inspector and Engineer for information only a written protection program for slab topping.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C 150. Type II or Type I/II only.
- B. Reinforcement: ASTM A 615, Grade 60 for uncoated deformed bars.
 1. ASTM A 775 for epoxy-coated, deformed bars.
- C. Supports for Reinforcement: Use wire bar-type supports complying with CRSI specifications. Use chairs with sand plates or horizontal runners where base material will not support chair legs.
 1. Concrete bricks may be used to support reinforcing. Stagger brick locations.
 - a. Do not use clay bricks.
 - b. Do not use bricks to support epoxy-coated reinforcing.
 2. Supports for epoxy-coated reinforcing shall be either wire bar-type coated with epoxy, plastic, or vinyl compatible with concrete for minimum distance of 2 inches from point of contact with reinforcing or all plastic-type.
 3. Finish for supports formed from reinforcing bars shall match finish of supported reinforcing.
- D. Minimum 16-gauge annealed tie wire, ASTM A 82.
 1. Provide coated wire ties for use with epoxy-coated or galvanized bars. Acceptable coatings include epoxy, nylon, or vinyl. Do not use plain wire ties.
- E. Aggregates: NYSDOT-approved, Section 703-02 (normal weight), one source and as herein specified.
 1. Fine Aggregate: Coarse, clean, sharp, uniformly graded natural sand free of loam, clay, lumps or other deleterious substances. Less than 10 percent passing No. 100 sieve and less than 3 percent

passing No. 200 sieve.

2. Coarse Aggregate: Uniformly graded to 1 1/2 inches, clean, processed, crushed stone with low absorption and free of flat/elongated particles. NYSDOT-approved, size 3A gravel can be used to meet large diameter requirement. Gradation similar to blended NYSDOT Type CA 2 and size 1A or ASTM C 33 Type 57 and Type 8, blended and modified as follows:

Sieve Size	Percent Passing
1 inch	95 to 98.5
3/4 inch	75 to 94
1/2 inch	25 to 50
3/8 inch	10 to 25
No. 4	0 to 10

- F. Water: Clean, fresh, drinkable.
- G. Fly Ash: ASTM C 618, Type F, with loss on ignition of less than 4 percent.
- H. Ground-Granulated, Blast-Furnace Slag: ASTM C 989, Grade 120.
- I. Air Entraining: ASTM C 260.
- J. Set-Control Admixtures: Not permitted.
- K. Calcium Chloride: Not permitted.
- L. High-Range, Water-Reducing Admixture (Superplasticizer): "Eucon 37" by Euclid Chemical Co. or "Sikament" by Sika Chemical Corp. Admixture shall conform to ASTM C 494, Type F or G, and not contain more chloride ions than in municipal drinking water.
- M. Water-Reducing Admixture: ASTM C 494, Type A.
- N. Mid-Range, Water Reducer/Finish Enhancer: ASTM C 494, Type A/F. "Daracem 55" or "Daracem 65" by W.R. Grace or accepted equivalent.
- O. Dowel Bars:
 1. Construction Joints.
 - a. 1-inch-square steel bars with 1/4-inch-compressible foam on vertical faces.
 2. Contraction Joints.
 - a. 1-inch-diameter steel bars, greased and supported by dowel baskets.
- P. Premolded Joint Filler: Provide resilient and nonextruding, premolded, bituminous fiberboard units complying with ASTM D 1751; 1/2-inch-thick, full slab depth.
- Q. Construction Joint Form: Square edge form only. Keyed joint not permitted.
- R. Joint Sealant for Interior Slabs: "Sikadur 51SL" by Sika; "Spec-Joint CJ" by Conspec Manufacturing Co.; "Masterfill CJ" by Master Builders, Inc.; "Euco 700" or "Euco QUIKjoint 200" by Euclid Chemical Co.; or accepted equivalent.
- S. Joint Sealant for Exterior Slabs: "Sikaflex-2c SL" by Sika; "Sonolastic SL2" by Sonneborn Building Products; "Eucolastic 2 SL" by Euclid Chemical Co.; "Urexpan NR-200" by Pecora Corporation; or accepted equivalent.

- T. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 ounces a square yard and complying with AASHTO M 182, Class 2.
- U. Curing-Sheet Materials: ASTM C 171; waterproof paper, polyethylene film, or polyethylene-coated burlap.
1. For slabs exposed to view, provide one of the following or accepted equivalent:
 - a. "HydraCure S16" by PNA Construction Technologies.
 - b. "UltraCure NCF/SUN" by McTech Group.
- V. Penetrating Exterior Anti-Spalling Sealer: "Euco-Guard VOX" by Euclid Chemical Co. (mixed to 17.5 percent concentration); "Masterseal SL 40" by Master Builders; "Enviroseal 40" by Hydrozo, Inc.; "Aquapel+Plus" by L&M Construction Chemicals; or accepted equivalent.
- W. Evaporation Retarder: Monomolecular, film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss. "Aquafilm" by Conspec Manufacturing Co.; "Eucobar" by Euclid Chemical Co.; "Confilm" by Master Builders, Inc.; or accepted equivalent.
- X. Crack Repair Material: "Sika Pronto 19" by Sika; "Crack-Fill 4" by Metzger/McGuire; or accepted equivalent.
- Y. Hardener: "Lapidolith" by Sonneborn Building Products or accepted equivalent for exposed slabs.

2.2 PROPORTIONING AND MIX DESIGN

A. CONCRETE QUALITY

Location	Required 28-Day Compressive Strength (psi)	Approximate Cement Content (pounds)	Maximum Water/Cement Ratio	Percent Entrained Air
Interior slabs on grade	3,500	530	0.50 (265 pounds maximum total water)	2*
Exterior slabs on grade	4,500	611	0.45	6 **

* Do not add air-entraining admixtures. Air entrainment occurs as result of mixing.

** Plus or minus 1.5 percent.

- B. Slump: 5-inch maximum for normal and mid-range, water-reduced mixes.
- C. Concrete containing a high-range, water-reducing admixture (superplasticizer) shall have maximum slump of 6 inches unless otherwise accepted by Engineer. Concrete shall arrive at job site at slump of 2 to 3 inches, be verified, then high-range, water-reducing admixture added to increase slump as required for placement and workability.
- D. Use 6.0 sacks maximum of cement for each cubic yard for interior slabs and minimum sand content.
- E. Quantity of coarse aggregate in pounds must be in range of 1.25 to 1.5

times quantity of fine aggregate in pounds. Provide minimum of 1,800 pounds of coarse aggregate for each cubic yard of concrete.

F. Pozzolans:

1. Pozzolans may be substituted for cement in normal-weight concrete for interior slabs, including fly ash at a maximum rate of 20 percent by weight or ground-granulated, blast-furnace slag at a maximum rate of 35 percent by weight.
2. Pozzolans are not permitted for exterior slabs.
3. Submittals shall include actual mix design, including percentage of pozzolans and test results showing mix meets specified 7-day compressive strength where indicated, 28-day compressive strength, and air content.
4. Protect and heat concrete containing pozzolans during cold-weather conditions. Maintain protection and heat until 70 percent of specified design strength is achieved.

- G. Pumping concrete is permitted only if mix designs specifically prepared and used previously for pumping are submitted. Mix designs not previously used for anticipated pump line lengths shall be tested by Contractor to verify suitability for project before use at site. Pump line shall have 5-inch-minimum inside diameter and be used with 5-inch pumps.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine conditions under which work shall be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 OPTION FOR SLAB PLACEMENT

- A. For placement of slabs that will be exposed in final structure, place construction and contraction joints as shown in drawings or as recommended by ACI 302 if not shown.
- B. For placement of slabs that will be subsequently concealed with an architectural finish material, Contractor has two options. Option 1 is to place slabs with few joints or construction joints only. Option 2 is to place slabs with construction and contraction joint spacings as recommended by ACI 302, "Guide for Concrete Floor and Slab Construction." Contractor shall submit option to be used and joint layout to Architect and Engineer for review.
- C. If Option 1 is selected, shrinkage cracking will likely occur but potential for curling will be reduced. Contractor shall be responsible for repairing cracks and curled areas. If Option 2 is selected, probability of shrinkage cracking will be less but probability of curling will increase. Contractor shall be responsible for repairing cracks and curled areas.

3.3 PRECONCRETE PLACEMENT

- A. Just before concrete placement, the slab subbase shall be dry.
- B. Whenever possible, air temperature should be rising after concrete placement. Attempt to schedule slab placements according to favorable weather reports.
- C. Subgrade shall be frost-free.

3.4 EDGE FORMS AND SCREED STRIPS FOR SLABS

- A. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surfaces. Provide secure edge forms or screed strips to support strike-off

templates or compacting vibrating-type screeds. Wet screeding is not permitted.

3.5 REINFORCEMENT PLACEMENT

- A. Place slab reinforcing one-third of slab thickness below top surface of slab. Support reinforcement by metal chairs, runners, bolsters, or concrete brick as required.
- B. Dedicate workers to placement of reinforcement to continuously monitor and adjust reinforcement location during concrete placement.
- C. Touch up damaged epoxy-coated reinforcement in field after placement with epoxy patching material provided by coating manufacturer.

3.6 ISOLATION JOINTS

- A. Construct isolation joints in slabs on grade at points of contact with vertical surface and elsewhere as indicated.

3.7 CONSTRUCTION JOINTS

- A. Locate and install construction joints not shown in drawings so as not to impair strength and appearance of structure as acceptable to Engineer.
- B. Construction joints in exposed slabs shall be doweled joints.
- C. Continue half of bar reinforcement through construction joints in concealed slabs.

3.8 CONTRACTION JOINTS

- A. Saw cut contraction joints as soon as possible after finishing, generally within 4 to 16 hours. Make sample cut to determine if concrete surface is firm enough so it is not torn or damaged by blade.
- B. Use soft-cut contraction joints. Depth of cut shall be one-fifth of slab thickness with minimum of 1 inch.
- C. Obtain permission from Engineer if diamond blade cutting is to be used.
- D. Contraction joints in exposed slabs shall be doweled joints.
- E. Continue half of bar reinforcement through contraction joints in concealed slabs.

3.9 DOWELED JOINTS

- A. Install dowel bars parallel to slab surface and perpendicular to joints. Support dowel bars by use of parallel construction supports.
- B. Use square cushioned dowels or Diamond Dowel plates and sleeves in construction joints.
- C. Use round greased dowels in contraction joints.

3.10 PLACING CONCRETE SLABS

- A. Maximum of 2 1/2 gallons for each cubic yard of total mix design water can be added in field. Water must be added prior to discharging and testing concrete. At no time shall total water exceed amount listed in accepted mix design.
- B. Use strip pour methods and mechanical vibratory screed whenever possible.
- C. Deposit and consolidate concrete in continuous operation within limits of construction joints until placing of panel or section is complete.
- D. Consolidate concrete during placing operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

- E. Maximum placement width shall not exceed 20 feet for very flat and super-flat slabs.
- F. Bring slab surfaces to correct level with a straightedge and strike off. Uniformly slope to drains. Use darbies to smooth surface, leaving it free of humps or hollows. Do not sprinkle water or portland cement on plastic surface. Do not disturb slab surfaces before beginning finishing operations.
- G. Maintain reinforcement in proper position during concrete placement operations. See requirements for reinforcement placement.
- H. Slab thicknesses shown in drawings are minimum allowable. Maximum allowable thickness shall be 1 inch greater than specified thickness.
- I. For floor areas with drains, Contractor shall be responsible for finishing concrete slabs to proper elevations to ensure surface moisture will drain freely to floor drains and no puddle areas exist. Reference elevations shown in drawings.
- J. Cost of corrections to provide positive drainage shall be responsibility of Contractor.

3.11 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerances for floor flatness (F_F) of 15 and floor levelness (F_L) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- B. Power Float Finish: Apply power float finish to slab surfaces that will subsequently be trowel finished or covered with waterproofing membrane. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating using float blade or float shoes when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to overall tolerances of F_F 18 and F_L 13, and minimum local tolerances of F_F 13 and F_L 10. Cut down high spots and fill low spots. Uniformly slope surface to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin-film finish-coating system. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation. Surface shall be free of trowel marks, uniform in texture and appearance, and leveled to an overall tolerance of F_F 35 and F_L 25 and a minimum local tolerance of F_F 25 and F_L 17 for exposed slabs and thin-set finishes and an overall tolerance of F_F 25 and F_L 20 and a minimum local tolerance of F_F 17 and F_L 13 for other finishes. Grind smooth surface defects that would telegraph through applied floor-covering system. Exposed surfaces are to be overtrowelled to "burn" surface to a dense, hard, dark finish.
- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified and immediately follow with fine brooming to slightly scarify surface.

- E. Nonslip Broom Finish: Apply nonslip, heavy broom finish to exterior concrete slab surfaces. Immediately after trowel finishing, roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- F. Delay finishing as long as possible. Allow bleed water to evaporate before finishing.
- G. Finish slabs to specified tolerances given. Patching low spots shall not be permitted. Perform grinding as soon as possible, preferably within 3 days, but not until concrete is sufficiently strong to prevent dislodging coarse aggregate particles.

3.12 COLD-WEATHER CONCRETING

- A. Comply with Section 03 30 00.
- B. Provide temporary heat with vented heaters only.
- C. Use foggers to maintain humidity at 50 percent minimum.

3.13 HOT-WEATHER CONCRETING

- A. Comply with Section 03 30 00.

3.14 CURING AND PROTECTION

- A. Protect freshly placed slabs from premature drying and excessive cold or hot temperature. Maintain without drying at a relatively constant temperature for time period necessary for cement hydration and proper hardening.
- B. Cure exterior slabs completely by moist-curing using burlap absorptive cover, soaker hoses, and ponding for at least 7 days. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers. Avoid rapid drying at end of curing period. Allow absorptive cover to remain an additional 3 days.
- C. Cure interior slabs by sheet-curing by covering slabs with curing sheet material for 7 days minimum. Avoiding rapid drying at end of curing period. Place curing cover in widest practicable width with sides and ends lapped at least 3 inches and sealed with waterproof tape or adhesive. Immediately repair holes or tears in cover during curing period.
- D. Do not allow foot or other traffic over slabs during 7-day curing period.
- E. Cure slabs or pads 14 days minimum before placing equipment.
- F. Interior Nonexposed Slabs:
 - 1. Place finish toppings, coatings, tile, and other materials to be bonded to slabs when the following have been satisfied:
 - a. Slabs have cured minimum of 90 days.
 - b. Acceptable moisture vapor emission and alkalinity test results have been achieved.
 - c. Acceptable 72-hour Bond Test results have been achieved. Bond test by floor finish installer.
- G. Interior Exposed Slabs:
 - 1. Apply two coats of hardener after slabs have cured 28 days minimum at rate of 100 square feet/gallon in accordance with manufacturer's recommendations.
- H. Exterior Slabs:
 - 1. Apply penetrating exterior anti-spalling sealer to exterior

concrete slabs, walks, platforms, steps, ramps, and curbs according to manufacturer's directions.

3.15 JOINT SEALANT

- A. Install joint sealant in exposed construction, isolation, and contraction joints in accordance with manufacturer's recommendations.
- B. Clean joints thoroughly before applying sealant.
- C. Apply sealant after slabs have cured 90 days minimum.

3.16 REPAIR OF SURFACES

- A. Contractor shall be responsible for cost of repairing slab defects.
- B. Test surfaces for smoothness and level tolerances. Test uniform surfaces sloped to drain for trueness of slope.
- C. Correct flatness and levelness defects by grinding or removing and replacing slab. Patching low spots not permitted. Repair areas shall be remeasured and accepted by Owner.
- D. Repair cracks only when slab is more than 90 days old. Use crack repair material. For cracks over 1/8 inch, fill crack with oven-dried sand prior to application of crack repair material as recommended by manufacturer. Contractor has option to remove and rebuild areas of cracking. Mask cracks to limit crack repair material to crack only.
- E. Repair curling only when slab is more than 90 days old.
- F. Curling at slab edges exceeding 1/8 inch when measured with a 10-foot straightedge shall be made level by grinding or planing. Locate straightedge with its end at the slab edge, and measure space between straightedge and slab.
- G. If curling exceeds 1/4 inch, level slab by grinding or planing as stated above. In addition, core-drill slab 10 inches from joint at 2 foot intervals, alternating on each side of joint, and inject nonshrink grout to fill void beneath slab.
- H. Repair edge spalls occurring from shrinkage cracking or from Contractor's operations with methods acceptable to Engineer.

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