

DIVISION 03 – CONCRETE

03 00 00 CONCRETE

03 01 00 Maintenance of Concrete

- 03 01 10 Maintenance of Concrete Forming and Accessories
- 03 01 20 Maintenance of Concrete Reinforcing
- 03 01 23 Maintenance of Stressing Tendons
- 03 01 30 Maintenance of Cast-in-Place Concrete
 - 03 01 30.51 Cleaning of Cast-in-Place Concrete
 - 03 01 30.61 Resurfacing of Cast-in-Place Concrete
 - 03 01 30.71 Rehabilitation of Cast-in-Place Concrete
 - 03 01 30.72 Strengthening of Cast-in-Place Concrete
- 03 01 40 Maintenance of Precast Concrete
 - 03 01 40.51 Cleaning of Precast Concrete
 - 03 01 40.61 Resurfacing of Precast Concrete
 - 03 01 40.71 Rehabilitation of Precast Concrete
 - 03 01 40.72 Strengthening of Precast Concrete
- 03 01 50 Maintenance of Cast Decks and Underlayment
 - 03 01 50.51 Cleaning Cast Decks and Underlayment
 - 03 01 50.61 Resurfacing of Cast Decks and Underlayment
 - 03 01 50.71 Rehabilitation of Cast Decks and Underlayment
- 03 01 60 Maintenance of Grouting
- 03 01 70 Maintenance of Mass Concrete
- 03 01 80 Maintenance of Concrete Cutting and Boring

03 05 00 Common Work Results for Concrete

03 06 00 Schedules for Concrete

- 03 06 10 Schedules for Concrete Forming and Accessories
- 03 06 20 Schedules for Concrete Reinforcing
 - 03 06 20.13 Concrete Beam Reinforcing Schedule
 - 03 06 20.16 Concrete Slab Reinforcing Schedule
- 03 06 30 Schedules for Cast-in-Place Concrete
 - 03 06 30.13 Concrete Footing Schedule
 - 03 06 30.16 Concrete Column Schedule
 - 03 06 30.19 Concrete Slab Schedule
 - 03 06 30.23 Concrete Shaft Schedule
 - 03 06 30.26 Concrete Beam Schedule
- 03 06 40 Schedules for Precast Concrete
 - 03 06 40.13 Precast concrete Panel Schedule
- 03 06 50 Schedules for Cast Decks and Underlayment
- 03 06 60 Schedules for Grouting
- 03 06 70 Schedules for Mass Concrete
- 03 06 80 Schedules for Concrete Cutting and Boring

03 08 00 Commissioning of Concrete

03 10 00 CONCRETE FORMING AND ACCESSORIES

03 11 00 Concrete Forming

03 11 13 Structural Cast-in-Place Concrete Forming

03 11 13.13 Concrete Slip Forming

03 11 13.16 Concrete Shoring

03 11 13.19 Falsework

03 11 16 Architectural Cast-in-Place Concrete Forming

03 11 16.13 Concrete Form Liners

03 11 19 Insulating Concrete Forming

03 11 23 Permanent Stair Forming

03 15 00 Concrete Accessories

03 15 13 Waterstops

03 20 00 CONCRETE REINFORCING

03 21 00 Reinforcing Steel

03 21 13 Galvanized Reinforcing Steel

03 21 16 Epoxy-Coated Reinforcing Steel

03 22 00 Welded Wire Fabric Reinforcing

03 22 13 Galvanized Welded Wire Fabric Reinforcing

03 22 16 Epoxy-Coated Welded Wire Fabric Reinforcing

03 23 00 Stressing Tendons

03 24 00 Fibrous Reinforcing

03 30 00 CAST-IN-PLACE CONCRETE

03 30 53 Miscellaneous Cast-In-Place Concrete

SECTION 03 31 00
STRUCTURAL CONCRETE

CONSULTANT DESIGN GUIDELINE

Special care should be taken by the design team to provide concrete mix designs appropriate to the strength and finish requirements needed.

Special emphasis should be given when specifying mix requirements for flatwork exposed to ambient outside weather conditions. Northwest Arkansas aggregate sources can have a high content of chert which has a deleterious effect on concrete surfaces over time.

INCLUDE IN CONSTRUCTION DOCUMENTS

Stamp "S" in edge of concrete curb or concrete walk to indicate location of sleeve location.

EXECUTION

Placing Concrete: Contact the Facilities Management Construction Coordinator a minimum of 24 hours prior to any concrete placement. It is not the intent of the University to delay the Contractor. With proper University notification, the Contractor can, without University inspection, place concrete at the previously designated time.

VIBRATION: Use vibration for all concrete placements except concrete slabs on grade to prevent voids and air pockets and to ensure concrete is in proper contact with steel reinforcement.

END SECTION

03 31 13 Heavyweight Structural Concrete
03 31 16 Lightweight Structural Concrete
03 31 19 Shrinkage-Compensating Structural Concrete
03 31 23 High-Performance Structural Concrete
03 31 26 Self-Compacting Concrete

03 33 00 Architectural Concrete

03 33 13 Heavyweight Architectural Concrete
03 33 16 Lightweight Architectural Concrete

03 34 00 Low Density Concrete

03 35 00 Concrete Finishing

03 35 13 High-Tolerance Concrete Floor Finishing

SECTION 03 35 13

HIGH TOLERANCE CONCRETE FLOOR FINISHING

CONSULTANT DESIGN GUIDELINE

Mechanical Room Floor Finish. Specify all mechanical and electrical equipment rooms to have a smooth trowel concrete floor coated with a surface hardener.

INCLUDE IN CONTRACT DOCUMENTS

BLANK

EXECUTION

BLANK

END SECTION

03 35 16 Heavy-Duty Concrete Floor Finishing

SECTION 03 35 19
COLORED CONCRETE FINISHING

CONSULTANT DESIGN GUIDELINES

INCLUDE IN CONSTRUCTION DOCUMENTS

BLANK

EXECUTION

BLANK

END SECTION

03 35 23 Exposed Aggregate Concrete Finishing
03 35 26 Grooved Concrete Surface Finishing
03 35 29 Tooled Concrete Finish

03 37 00 Specialty Placed Concrete

Senior Walk Construction – As mentioned earlier, chert and other absorbent aggregates can have a deleterious effect on the surface of exterior concrete, particularly flatwork. When a contractor is asked to construct a senior walk sidewalk, the university intends to engrave the concrete surface at a later date, with names or other effects. Surface blemishes must be minimized. The intent of the monumental concrete specification is to provide adequate hardness for the engraving process to provide crisp, clean engravings and to provide a surface that is very durable over time, free from “pop-outs” and other defects.

Other specialty placed concrete – There may be occasions where concrete flatwork is desired to have a durable surface, free from future defects, but where we do not intend to engrave the surface. In these cases the sample specification below may be modified to reduce the ultimate strength. However, we should not reduce below 3500 psi.

MONUMENTAL CONCRETE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Formwork, complete with required shoring, bracing and anchorage.**
- B. Control joints and expansion joints.**

C. Concrete joints and expansion joints.

D. Cast-in-place concrete.

E. Work associated to Senior Walks.

1.2 RELATED WORK

A. Section 01 45 29 – Testing Laboratory Services.

1.3 SUBMITTALS

A. Concrete mix design and strength test results for each specified strength.

1.4 QUALITY ASSURANCE

A. Perform cast-in-place concrete work in accordance with ACI 301, unless specified otherwise in this Project Manual.

B. Keep copy of ACI 301-99 in field office for duration of project.

1.5 TESTING AGENCY

A. Field testing of the concrete mix will be performed by an independent testing laboratory in accordance with Sections 01 45 29. The testing agency will be 3rd party and not the responsibility of the contractor to pay for. However, the contractor shall notify the testing agency giving adequate time for inspection and testing.

B. Provide free access to work and cooperate with the appointed laboratory.

C. Tests of cement and aggregates may be performed to ensure conformance with requirements state herein.

1.6 REFERENCE STANDARDS

A. ACI-301-99, Specifications for Structural Concrete.

B. ACI Manual of Concrete Practice, Parts 1, 2, and 3.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Allowable Concrete Mix Temperatures: ACI 301 -99 Section 4.2.2.7.

1. Cold Weather: Minimum 35 degrees F.

2. Hot Weather: Maximum 95 degrees F.

B. Do not place concrete during rain, sleet, or snow unless protection is provided.

- C. Keep accurate thermometer in area where work is proceeding.

PART 2 - PRODUCTS

2.1 CEMENT (ACI 301-99 Section 4.2).

- A. Portland Cement: ASTM C150, Type 1.
- B. Use one brand and type of cement throughout project unless otherwise specified.

2.2 ADMIXTURES (ACI 301-99 Section 4.2)

- A. Add air-entraining agent as indicated in ACI 301-99 Section 4.2.1.4.
- B. Use of accelerating admixtures such as salts, chemicals, or other foreign materials in cold weather will not be allowed. Use no other admixtures without prior approval of the Architect/Engineer.
- C. Use of set – retarding admixtures during hot weather will not be allowed.
- D. Limited use of Class F fly ash may be allowed with approval from owner.

2.3 STRENGTH (ACI 301-99 Section 1.7.4)

- A. Provide concrete of following strength: Compressive strength (28 day): 5,500 psi, except where noted otherwise in the Contract Documents

2.4 AIR ENTRAINMENT (ACI 301-99 Section 4.2.1.4)

- A. Add air-entraining agent to concrete mix for concrete work exposed to exterior.

2.5 SLUMP (ACI 301-99 Section 4.2.2.2)

- A. Contractor shall provide slump cone and test slump for each load of concrete.
- B. Minimum, slump for all concrete work: 3 inches.
- C. Slump for consolidation by vibration: 4 inches maximum.
- D. Slump for slabs and consolidation other than by vibration: 5 inches maximum.

2.6 PROPORTIONS

- A. Selection of proportions for normal weight concrete: Method 1, Method 2, or Method 3, Contractor's Option.

- B. Fine aggregate shall conform to the requirements of ASTM Specification C-33, latest edition, and shall consist of clean, fresh water sand graded uniformly to conform to Paragraph 4 of the above referenced Specification C-33.
- C. Coarse aggregate shall conform to the requirements of ASTM Specification C-33, latest edition, using standard grading size 1 -1/2" to No. 4 of washed gravel or crushed stone meeting requirements above and soundness requirements of ASTM C-33 modified to include item E below.
- D. Water: Clean and free of injurious amounts of oil, acids, alkalis, organic materials, or other deleterious substances.
- E. No aggregate that will adversely affect the surface of the concrete shall be allowed. Examples include chert or any aggregate that is water absorbent or chemically reactive may be included within the mix.

2.7 REINFORCING STEEL (ACI 301-99 Section 3)

- A. Reinforcing Steel: 60 ksi yield grade; deformed billet steel bars, ASTM A615; plain finish.
- B. Welded Steel Wire Fabric: plain type, ASTM A 185; in coiled rolls, plain finish, 6x6-W1.4 x W1.4 or 6x6 – W2.9 X W2.9 as shown on the Drawings.

2.8 ACCESSORIES

- A. Premolded expansion joint fillers: ASTM D1751, ½ inch thick. Refer to ACI 301-99 Section 10.2.5.

2.9 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
- B. Mix concrete until there is a uniform distribution of the materials and the mass is homogeneous in consistency and colors. Continue mixing for at least 1 -1/2 minutes after all the ingredients are in the mixer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Notify Architect/Engineer at least 24 hours before the planned time to pour concrete.
- B. Inspection:
 - 1. Ensure that excavation and formwork are completed and within the allowed tolerances.

2. Ensure that ice and excess water are removed, no frost is present, and that ground is not frozen.
 3. Check that reinforcement is secured in place.
 4. Verify that insulation, anchors, and other embedded items are secured in position.
- C. Install concrete work in accordance with ACI 301-99 except as amended by this section.

3.2 FORMWORK (ACI 301-99 Section 2)

- A. Obtain Architect/Engineer's review for use of earth forms. When using earth forms, hand-trim sides and bottoms, and remove loose dirt prior to placing concrete.
- B. Tolerances for Formed Services: (Comply with ACI 301-99 Section 2)

3.3 FORM SURFACES PREPARATION (ACI 301-99 Section 2)

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded parts. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

3.4 FINISHING FORMED SURFACES

- A. Formed Surfaces Finishes: Provide rough form finish (ACI 301-99 Section 2) at all surfaces not exposed to view. Provide smooth rubbed finished (ACI 301-99 Section 2) at all surfaces exposed to view.

3.5 REMOVAL OF FORMS (ACI 301-99 Section 2)

- A. Do not remove forms, shores, and bracing until concrete has gained sufficient strength to carry its own weight, construction loads, and design loads which are liable to be imposed upon it. Verify strength of concrete by compressive test results.

3.6 PLACING REINFORCING

- A. Reinforcing shall be unpainted and uncoated, free from rust or scale and shall be cleaned and straightened before being shaped and in position.
- B. Position reinforcing accurately and tie securely.
- C. Support foot reinforcing on support chairs or concrete grout at maximum 3 feet on center each way to insure proper depth from bottom.

- D. Wire dowels to longitudinal bars and place top bars in perfect alignment by the use of wood templates placed 2 inches from the top of the form.
- E. Support wire mesh on support chairs, or other approved means, at no greater than three feet on center way to hold reinforcing in the center of the slab or as shown on the drawings.
 - 1. Do not depend on lifting mesh as concrete is being poured.
 - 2. Lap sides and ends not less than one wire spacing in slabs on grade and not less than 12 inches in structural slabs.
- F. Provide 3 inches of concrete between reinforcing and the ground, unless detailed otherwise, where concrete is poured against the ground.
- G. If, after the removal of forms, concrete surfaces are to be in contact with the ground or exposed to the weather:
 - 1. Bars larger than No.5: Protect with 2 inches of concrete.
 - 2. No. 5 bars and smaller: Protect with 1 1/2 inches of concrete.
- H. Concrete covering for any reinforcing at surfaces not exposed directly to the ground or weather: Protect with 1 -1/2 inches of concrete.

3.7 PLACING CONCRETE

- A. Convey concrete from mixer to final position by method which will prevent separation or loss of material.
- B. Maximum height of concrete free fall; 60 inches.
- C. Regulate rate of placement so concrete remains plastic and flows into position.
- D. Deposit concrete in continuous operation until panel or section is completed.
- E. Do not use concrete that has set and do not re-temper or use concrete that has been mixed for more than 1½ hours.

3.8 CONSOLIDATING CONCRETE:

- A. Use mechanical vibrating equipment for consolidation.
- B. Vertically insert and remove hand-held vibrators at points 18 inches to 30 inches apart, inserting to within 6 inches of bottom of freshly poured concrete.
- C. Do not use vibrators to transport concrete forms.
- D. Minimum vibrators frequencies: 6000 impulses per minute.

- E. **Vibrate concrete minimum amount required for consolidation.**
- F. **Keep spare vibrator on hand during concrete placing operation.**
- G. **Make sure the concrete is thoroughly worked around the reinforcing, the embedded items, and into corners of forms.**

3.9 SLABS (ACI 301-99 Section 5)

- A. **Finish concrete slab surfaces in accordance with ACI 301-99 Section 5:**
 - 1. **Uniformly spread, screed, and float slabs. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration.**
 - 2. **Senior Sidewalks that are intended to have engravings or other treatments shall be finished totally smooth. No brooming or other surface finishes are desired.**
- B. **Sidewalks: Finish other than senior sidewalks in accordance with Section 32 13 76.**

3.10 CURING

- A. **Cure Slabs: Use damp method as per ACI 301-99 Section 5.**
- B. **Cure Walls above Grade: Use moisture-retaining covering as approved by Architect/Engineer in accordance with ACI 308.**

3.11 WELDING (ACI 301-99 Section 3)

- A. **Welding Reinforcing Steel: Not allowed.**

3.12 CONSTRUCTION JOINTS

- A. **Install construction joints in accordance with ACI 301-99 Section 5**
- B. **Place expansion at 30 feet intervals and contraction joints at 15 feet (maximum) intervals. Where possible, make joints coincide with joints in adjacent concrete.**
- C. **Fit joints with filler of required profiles. Recess ¼ inch below finished concrete surface.**

3.13 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. **Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.**

- B. Coordinate work of other sections and cooperate with trade involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts. Any sleeve or object that extends above the horizontal surface of the concrete shall have the concrete shaped around the object in such a way as to not hold any water. Surface finishing, fillers, covers, etc. shall be installed with a slight conical shape as to avoid any water collection or water holding.

3.14 REPAIR OF SURFACE DEFECTS (ACI 301-99 Section 5.3.7)

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Modify or replace concrete not conforming to required lines, detail, and elevation.
- C. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, repair, or replace exposed architectural concrete except upon express direction of Architect/Engineer.

3.15 FIELD QUALITY CONTROL

- A. Four (4) concrete test cylinders will be taken by the testing laboratory for every 40 cu. yds., or fraction thereof, of concrete placed. Not less than one (1) set of test cylinders shall be taken for each day's pour.
- B. One (1) additional test cylinder will be taken during cold weather concreting and be cured on job site under same conditions as concrete it represents.
- C. One (1) slump test will be taken by the testing laboratory for each set of test cylinders taken and for each separate batch of concrete placed.
- D. Compression test cylinders: Test cylinders shall be cast on the project site by a representative of the testing laboratory.
 - 1. Make cylinders according to ASTM C31.
 - 2. Make additional sets of test cylinders for curing under job conditions:
 - a. When it is needed to determine when to remove forms.
 - b. When to put a structure into service.
 - c. When temperature extremes are expected during the curing test period.
 - 3. Make test cylinders in the presence of Architect/Engineer.
 - 4. Properly marked prepared test cylinders and fill out the card supplied by the testing laboratory with instructions on when to make test breaks and where to send the test results.
 - 5. Transport in a protected condition, each set of prepared and marked test cylinders to the designated testing laboratory for curing and testing as soon as the cylinders can be transported without damage.
- E. Compression Testing concrete Cylinders ASTM C-39: by commercial testing laboratory.

1. Cure cylinders in laboratory until time for testing.
2. Test each set of cylinders at 7 days and 28 days after pouring.
3. Tabulation of breakage schedule and action:

Specified strength of 5,500 psi at 28 days

	Test Break	Action
7 day	Less than 4200 psi	Contractor notify A/E
	4200-6000 psi	Break 28 day cylinder
	Over 6000 psi	Stop Testing
28 day	Less than 6000 psi	Contractor notify Architect, investigate reason for low break and report in writing to AE.

4. For testing cylinders for specified compressive strength other than 6,000 psi, see the Architect/Engineer.

F. In Case of Low Compression Test Results:

1. Architect/Engineer will have right to order change in the mix design, costs to be borne by the contractor.
2. Architect/Engineer will have right to order core tests of the concrete in accordance with SCI C42, or load tests of the structure, the cost to be borne by the Contractor for either test.

3.16 PROTECTION OF COMPLETED WORK

- A. During curing period, protect the concrete from damaging mechanical disturbances, water flow, loading, shock, and vibration.

END OF SECTION

03 37 13 Shotcrete

03 37 16 Pumped Concrete

03 37 19 Pneumatically Placed Concrete

03 37 23 Roller-Compacted Concrete

03 37 26 Underwater Placed Concrete

03 38 00 Post-Tensioned Concrete

03 38 13 Post-Tensioned Concrete Prep

03 38 16 Unbonded Post-Tensioned Concrete

CONSULTANT DESIGN GUIDELINES

INCLUDE IN CONSTRUCTION DOCUMENTS

Post-Tensioning Supplier Prequalification Requirements

- A. Supplier shall have successfully provided all materials for at least 5 post-tensioning installations with structural system similar to Project in previous 5 years.
- B. Provide post-tensioning strand systems produced in PTI-certified plant conforming to all material and installation requirements of ACI 301, ACI 318, ACI 423.6 and approved by International Conference of Building Officials (Uniform Building Code).

Post-Tensioning Installer Prequalification Requirements

- A. Installer shall be accepted in writing by post-tensioning Supplier.
- B. Installer shall have successfully performed at least 5 previous post-tensioning installations per heading "Post-Tensioning Supplier Prequalification".

Warranty

- A. Warranty shall be 5 years, beginning at the date of Beneficial Occupancy.

END SECTION

03 38 19 Bonded Post-Tensioned Concrete

03 39 00 Concrete Curing

03 39 13 Water Concrete Curing

03 39 16 Sand Concrete Curing

03 39 23 Membrane Concrete Curing

03 39 23.13 Chemical Compound Membrane Concrete Curing

03 39 23.23 Sheet Membrane Concrete Curing

03 40 00 PRECAST CONCRETE

03 41 00 Precast Structural Concrete

03 41 13 Precast Concrete Hollow Core Planks

03 41 16 Precast Concrete Slabs

03 41 23 Precast Concrete Stairs

03 41 33 Precast Structural Pretensioned Concrete

03 41 36 Precast Structural Post-Tensioned Concrete

03 45 00 Precast Architectural Concrete

03 45 13 Faced Architectural Precast Concrete

03 45 33 Precast Architectural Pretensioned Concrete

03 45 36 Precast Architectural Post-Tensioned Concrete

03 47 00 Site-Cast Concrete

- 03 47 13 Tilt-Up Concrete
- 03 47 16 Lift-Slab Concrete

03 48 00 Precast Concrete Specialties

- 03 48 13 Precast Concrete Bollards
- 03 48 16 Precast Concrete Splash Blocks
- 03 48 19 Precast Concrete Stair Treads
- 03 48 43 Precast Concrete Trim

03 49 00 Glass-Fiber-Reinforced Concrete

- 03 49 13 Glass-Fiber-Reinforced Concrete Column Covers
- 03 49 16 Glass-Fiber-Reinforced Concrete Spandrels
- 03 49 43 Glass-Fiber-Reinforced Concrete Trim

03 50 00 CAST DECKS AND UNDERLAYMENT**03 51 00 Cast Roof Decks**

- 03 51 13 Cementitious Wood Fiber Decks
- 03 51 16 Gypsum Concrete Roof Decks

03 52 00 Lightweight Concrete Roof Insulation

- 03 52 13 Composite Concrete Roof Insulation
- 03 52 16 Lightweight Insulating Concrete
 - 03 52 16.13 Lightweight Cellular Insulating Concrete
 - 03 52 16.16 Lightweight Aggregate Insulating Concrete

03 53 00 Concrete Topping

- 03 53 13 Emery-Aggregate Concrete Topping
- 03 53 16 Iron-Aggregate Concrete Topping

03 54 00 Cast Underlayment

- 03 54 13 Gypsum Cement Underlayment
- 03 54 16 Hydraulic Cement Underlayment

03 60 00 GROUTING

- 03 61 00 Cementitious Grouting
 - 03 61 13 Dry-Pack Grouting
- 03 62 00 Non-Shrink Grouting
 - 03 62 13 Non-Metallic Non-Shrink Grouting
 - 03 62 16 Metallic Non-Shrink Grouting

03 63 00 Epoxy Grouting**03 64 00 Injection Grouting**

- 03 64 23 Epoxy Injection Grouting

03 70 00 MASS CONCRETE

- 03 71 00 Mass Concrete for Raft Foundations

03 72 00 Mass Concrete for Dams

03 80 00 CONCRETE CUTTING AND BORING

03 81 00 Concrete Cutting

03 81 13 Flat Concrete Sawing

03 81 16 Track Mounted Concrete Wall Sawing

03 81 19 Wire Concrete Wall Sawing

03 81 23 Hand Concrete Wall Sawing

03 81 26 Chain Concrete Wall Sawing

03 82 00 Concrete Boring

03 82 13 Concrete Core Drilling