

SECTION 03001

CONCRETE

1. PART 1 GENERAL

1.1 WORK INCLUDED

- A. Formwork, shoring, Bracing, and Anchorage.
- B. Concrete Reinforcement and Accessories.
- C. Cast-in-Place Concrete.

1.2 WORK INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A. REFERENCES

- 1. ACI 301 - Specifications of Structural Concrete for Buildings.
- 2. ACI 302 – Guide for Concrete Floor and Slab Construction.
- 3. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- 4. ACI 305R – Hot Weather Concreting.
- 5. ACI 306R – Cold Weather Concreting.
- 6. ACI 308 – Standard Practice for Curing Concrete.
- 7. ACI 318 – Building Code Requirements for Reinforced Concrete.
- 8. ACI 347 – Recommended Practice for Concrete Formwork.
- 9. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- 10. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- 11. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- 12. ASTM C33 - Concrete Aggregates.
- 13. ASTM C94 - Ready-Mixed Concrete.
- 14. ASTM C150 - Portland Cement.
- 15. ASTM C260 - Air Entraining Admixtures for Concrete.
- 16. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- 17. ASTM D2103 - Polyethylene Film and Sheeting.
- 18. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.
- 19. MDOT 2003 – Standard Specifications for Construction.
- 20. CRSI – Concrete Reinforcing Steel Institute Manual of Practice.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with ACI Codes and MDOT Standards.
- B. Maintain copy of each document on Site.
- C. Acquire cement and aggregate from same source for all Work.
- D. Conform to ACI 305R when concreting during hot weather.
- E. Conform to ACI 306R when concreting during cold weather.

1.4

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 01600 – Material and Equipment.
- B. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

1.6 COORDINATION

- A. Coordinate Work under provisions of Section 01039 – Coordination and Meetings.
- B. Coordinate reinforcement with placement of formwork, formed openings and other Work.
- C. Reposition formwork that is placed after reinforcement which results in insufficient concrete cover over reinforcing steel. Minimum clearances may not be less than stated.
- D. Notify Engineer 72-hours in advance of placing concrete that reinforcing steel and formwork is installed according to plans and specifications and that it is ready to be inspected. Engineer will not allow placement of concrete prior to inspection.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection of formwork, shoring, bracing, resteel and concrete work to conform to the required shape, line and dimension.

1.8 TESTS

- A. Testing and analysis of concrete will be performed under provisions of Section 01400 – Quality Control.
- B. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work.
- C. Geotechnical Engineer will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- D. Four concrete test cylinders will be taken for every 75 or less of each class of concrete placed each day.
- E. Two additional test cylinders will be taken during cold weather and be cured on site under same conditions as concrete it represents.
- F. One slump test will be taken for each set of test cylinders taken.

1.9 SHOP DRAWINGS

- A. Submit shop drawings of reinforcing steel, form release agent, form ties, water stops, concrete mix, joint devices, curing compounds, attachment accessories, and mixtures under provisions of Section 01300 – Submittals.
- B. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, supporting and spacing devices, and construction joints shop drawings shall be clearly readable and include pertinent reference and elevation marks.

- C. Indicate formwork dimensioning, materials, arrangement of joints and ties.
- D. Prepare shop drawings under seal of a licensed professional engineer registered in State of Michigan with a structural background.

2. PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Conform to ACI 301.

2.2 REINFORCING STEEL

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet steel plain and deformed bars; uncoated finish.
- B. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated finish.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, normal - Type 1 Air Entraining Portland, grey color.
- B. Fine and Coarse Aggregates: ASTM C33 and MDOT 2NS and 6AA.
- C. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES.

- A. Air Entrainment Admixture: ASTM C260.
- B. Chlorine based admixtures are prohibited in al reinforced concrete.

2.5 ACCESSORIES

- A. Bonding Agent: Two component epoxy resin;SIKADUR 32 HI-MOD manufactured by SIKA Corp. or equal.
- B. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 2400 psiin 48 hours and 7000 psi in 28 days.
- C. Dovetail Anchor Slots: Minimum 22 gage thick galvanized steel; foam filled; release tapes; sealed slots; bent tab anchors .
- D. Water stops: Polyvinylchloride; 4 inches wide.
- E. Construction Joints: As approved by Engineer.
- F. Expansion Joints: ANSI/ASTM D1751, fiber type; 1/4 inch to 1 inch thick, manufactured by A.C.D. International W.R. Meadows, or equal.
- G. Epoxy Adhesive: Two component epoxy resin adhesive; sikadur 35, Hi-Mod LV manufactured by Sika Corporation (708) 924-7900.

- H. Form Ties: Steel Construction of adequate strength and of suitable design. Wire ties will not be permitted. Use 1 inch deep break off ties for hydraulic structures and 1/2 inch dry locations.
- I. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
- J. Form Release Agent: Colorless material which will not stain concrete, absorb moisture manufactured by Wir, Meadows, Inc. or equivalent.
- K. Corners: Chamfered, wood strip type 1 inch x 1 inch size.

2.6 CURING MATERIALS

- A. Water: Potable.
- B. Absorptive Mat: Cotton fabric of 8 ounces/square yard, clean, roll goods.
- C. Absorptive Mat: Burlap-polyethylene, 8 ounces/square yard, bonded to prevent separation during use.
- D. Membrane Curing Compound: ASTM C309, Type I, Class B clear, non-yellowing curing and sealing compound; manufactured by W.R. Meadows, Inc. (708) 683-4500.

2.7 CONCRETE SEALER

- A. Transparent, one component epoxy ester base, resinous sealer-dust proofer.
- B. Product: Son-no-mor, as manufactured by Sonneborn Chemical and Refining Corporation, or equivalent.

2.8 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94. and MDOT Specifications.
- B. Class A:
 - 1. Compressive Strength
 - a. 7 days 2600 psi
 - b. 28 days 4000 psi
 - 2. Slump: 4-2 inch
- C. Class B:
 - 1. Compressive Strength
 - a. 7 days: 1950 psi
 - b. 28 days: 3000 psi
 - 2. Slump: 5-2 inch
- D. Class C:
 - 1. Compressive Strength
 - a. 7 days: 1300 psi
 - b. 28 days: 2000 psi
 - 2. Slump: 6-3 inch
- E. All concrete exposed to weathering shall be air entrained with 5 percent to 7 percent total air content by volume.

3. PART 3 EXECUTION

3.1 FORMWORK ERECTION

- A. Verify lines, levels, and measurement before proceeding with formwork.
- B. Hand trim sides and bottom of earth forms; remove loose dirt.
- C. Perform work in accordance with applicable ACI Codes.
- D. Clean and remove foreign matter within forms as erection proceeds.
- E. Clean formed cavities of debris prior to placing concrete.
- F. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301. Unless noted otherwise, all Work shall be formed.
- G. Arrange and assemble formwork to permit dismantling and stripping.
- H. Align form joints.
- I. Obtain approval before framing openings in structural members which are not indicated on plans.
- J. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.
- K. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- L. Install chamfered wood strips at all exposed corners unless stated otherwise.
- M. Install and secure all formwork prior to placing concrete.
- N. Do not damage concrete during stripping. Permit removal of remaining principal shores.

3.2 REINFORCEMENT

- A. Prior to placement, clean reinforcing steel and dowels of loose rust, scale, dirt, grease, and other materials which could reduce or destroy bond.
- B. Place, support, and secure reinforcement against displacement.
- C. Locate reinforcing splices at as shown on the plans.
- D. Notify Engineer one working day prior to placing concrete to check reinforcement.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301, ACI 304, and MDOT Standards.
- B. Remove debris from the space to be occupied by the concrete secure reinforcement in position and obtain approval of the Engineer before concrete placement.

- C. Notify Engineer a minimum of one working day prior to concrete placement.
- D. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and accessories are not disturbed.
- E. Place concrete continuously between predetermined expansion, control and construction joints.
- F. Do not interrupt successive placement; do not permit cold joints to occur.
- G. Thoroughly compact concrete immediately after placing by means of mechanical vibrators or other suitable tools approved by the Engineer.
- H. Concrete transported in a truck mixer, agitator or other transportation device shall be discharged at the job within 1 1/2 hours after the cement has been added to the water or aggregates.
- I. When hand mixing is authorized, it shall be done on a watertight platform and in such a manner as to ensure a uniform distribution of the materials throughout the mass. Mixing shall continue until a homogeneous mixture of the required consistency is obtained.
- J. Retempering of partially hardened concrete will not be permitted.
- K. Saw-cut joints within 72 hours after placing concrete, using 3/16 inch thick blade cut into 1/4 depth of slab thickness.

3.4 FLOOR SLABS

- A. Place floor slabs in checkerboard pattern.
- B. Saw cut control joints at an optimum time after finishing. Cut slabs with 3/16 inch thick blade, cutting 1/4 of depth of slab thickness.
- C. Separate slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface.
- D. Broom or belt Non-slip finish surfaces as directed by Owner's representative.

3.5 TOLERANCES

- A. Provide Class A tolerance to floor slabs according to ACI 301. Pitch to drains 1/8 inch per foot.

3.6 CONCRETE FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301.
- B. Formed Surface Finishes
 - 1. Rough form finish: No selection form facing material specified, patch tie holes and defects; remove fins exceeding 1/4 inch in height.
 - 2. Smooth form finish: Use selected forms producing a smooth, hard, uniform texture on the concrete. Patch tie holes and defects; completely remove all fins and burrs.
 - 3. Smooth rubbed finish: No later than a day following form removal, wet the surface and rub with carborundum brick or other abrasive until uniform texture

and color are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.

4. Bagged finish: Remove forms as soon as allowable; moisten the wall surface; apply a coating of portland cement grout with a rubber float or burlap taking special care to fill all water and air voids. Grout shall match the color of the base concrete.

- C. Provide formed concrete surfaces subject to backfill with a smooth form finish.
- D. Provide formed concrete surfaces not subject to backfill with a smooth form finish and a bagged finish.
- E. Unformed Surface Finished.
 1. Scratched finish: After the concrete has been placed consolidated, struck off and leveled to a 1/4 inch in 2 feet tolerance, roughen with stiff brushes or rakes before the final set.
 2. Floated finish: Place, consolidate, strike off and level concrete. After the concrete has stiffened sufficiently, floating shall begin using a hand float, power trowel with float shoes or powered disc float. Cut down high spots and fill low spots to a 1/4 inch in 10 feet tolerance. Float to a uniform sandy texture.
 3. Troweled finish: After a floated finish, provide a smooth surface, free of defects with a steel trowel. Follow the first troweling with a second troweling after the concrete has hardened sufficiently to produce a ringing sound as the trowel is moved over the surface. The finish surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to a 1/8 inch in 10 feet tolerance.
- F. Provide a troweled finish for all unformed surfaces floor slabs
- G. Provide a broom finish for exterior slabs sidewalks areas directed by the Engineer. Float and trowel surfaces prior to broom finish.
- H. Finish concrete floor surfaces in accordance with ACI 301.
- I. Steel trowel surfaces which are scheduled to be exposed.
- J. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains 1/8 inch per foot.

3.7 CURING AND PROTECTION

- A. Submit methods for curing for approval by the Engineer.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- D. Cure floor surfaces in accordance with ACI 301, 305, and 308.
- E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
- F. Absorptive Mat: Spread mat over floor slab areas. Spray with water until mats are saturated and maintain in saturated condition for days.

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Concrete
Section 03001

- G. Membrane Curing Compound: Apply curing compound in accordance with manufacture's instructions. Curing compound shall not contain any ingredients which might stain or otherwise injure the concrete or prevent a good bond for subsequent coatings or finishings.
- H. Protect finished work under provisions of Section 01500 – Construction Facilities and Temporary Controls.

3.8 -CONCRETE SEALER

- A. Apply in accordance with manufacturer's instructions.
- B. Apply to floor slabs receiving a troweled finish.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400 – Quality Control.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Notify Engineer 24 hours in advance of any scheduled placement of concrete.

3.10 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and approved by the Engineer.
- B. Results of tests may be used to verify the strength gain of the concrete prior to removal of forms. Contractor shall be responsible for coordination of and payment for additional test cylinders requested for this purpose.
- C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

3.11 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Openings shall be left in concrete walls or floors in which pipes or castings will later be placed or equipment will later be moved or placed as directed by the Engineer. Forms for such openings shall be neatly made and shall be so constructed as to leave an ample clearance for a keyway with waterstop, where required, around the entire opening, midway between the 2 faces of the wall or floor. Wherever steel reinforcement is removed or omitted on account of openings in forms, extra steel bars shall be provided as directed by the Engineer.
- B. After the pipes, castings, or equipment have been placed and aligned in final position, the openings in the concrete shall be filled with concrete or non-shrink grout in such a manner as to leave the finished wall or floor surface smooth, flush, and of neat appearance.
- C. Locate and set in place items which will be cast directly into concrete. Furnish all hardware in the completion of the work. All items of miscellaneous metals shall be positioned within the forms and cast into concrete.

- D. Embedded conduits and piping in concrete shall conform to ACI 318. Such items shall be so placed as to not reduce the strength of the structure. Conduits and pipes are permitted for embedment in concrete with approval from the Engineer, provided they do not replace structurally the displaced concrete.
- E. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.
- F. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.12 CONCRETE SCHEDULE

- A. Class A:
 - 1. Concrete Headworks at all road crossings.
 - 2. Inlet Control Structures.
 - 3. Outlet Works.
 - 4. Outlet Control Structure.
- B. Class B:
 - 1. Sidewalls.
 - 2. Approaches.
 - 3. Generator Pads.
 - 4. Equipment Pads.
 - 5. Mud Mats.
 - 6. Anti-seep Collars.
- C. Class C:
 - 1. Structure Slope Filling.

END OF SECTION