

SPECIFICATIONS

FOR

**Replacement of Concrete Ramp Fire Station 131
Repair of Concrete at Fire Station 134**

Owner:

**Mifflin Township, Franklin County, Ohio
475 Rocky Fork Blvd. Gahanna, Ohio
422 McCutcheon Road Gahanna, Ohio**

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION

- A. Basic specification: Perform work of this Section according to ACI 301-16, "Specifications for Structural Concrete", except as specifically modified herein.
- B. Work included: All cast-in-place concrete work shown on the Drawings and required by these Specifications. Allow for the installation of cast-in items furnished under other Sections. Install anchor bolts for structural steel. Provide and install grout under steel column base plates and beam bearing areas. Provide and install dowels for masonry walls.
- C. Related work specified elsewhere: The general provisions of the Contract apply to the work of this Section, as though reproduced herein. Carefully examine all other Sections and all Drawings for related work such as concrete pads, piers, curbs, and bases required for equipment of all trades. Coordinate dimensions and details of equipment being supplied, prior to placing concrete. Cooperate with other trades who will provide and install items of work (sleeves, piping, conduit, inserts, etc.) to be cast in the concrete. Place no concrete until all such items are in place.

1.03 QUALITY ASSURANCE

- A. Reference standards:
 - 1. ACI 301, Specifications for Structural Concrete
 - 2. ACI 318, Building Code Requirements for Structural Concrete.
 - 3. ACI 117, Specification for Tolerances for Concrete Construction and Materials
 - 4. ACI 347R, Guide to Formwork for Concrete.
 - 5. ACI 302.1R, Guide to Concrete Floor and Slab Construction.
 - 6. "Placing Reinforcing Bars", CRSI & WCRSI Recommended Practices.
 - 7. ACI 439.5R, Comprehensive Guide for the Specification, Manufacture and Construction Use of Welded Wire Reinforcement.
 - 8. ACI 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 9. ACI 305.1, Specification for Hot Weather Concreting.
 - 10. ACI 306R, Guide to Cold Weather Concreting.

CAST-IN-PLACE CONCRETE

11. ACI Field Reference Manual, SP-15.

1.04 SUBMITTALS

- A. Submit a mix design for each type of concrete mix required in accordance with ACI 301, Section 1.5.
 - 1. Acceptable methods of determining concrete proportions shall be in accordance with one of the following methods per ACI 301, Section 4:
 - a. Establish based on previous field strength test data with standard deviation calculations.
 - b. Establish based on trial mixtures with tested strength data relative to each mix design.In either case, provide accurate test data within allowable time periods indicated in ACI 301. Incorrect or missing data will cause for rejection of submittals.
- B. Submit Placing Drawings for all reinforcing. Indicate strength, size, and details of all bar reinforcing, and style and specification of all welded wire fabric. Details must indicate clear cover used to determine chair heights.
- C. Submit test data for aggregates proposed for use, indicating source and compliance with specification requirements.
- D. Submit product literature for admixtures and curing compounds proposed for use.
- E. Submit product literature on all proprietary materials including joint systems, waterstops, hooked anchorage systems, sealers, and patching compounds.
- F. For slabs on metal deck, provide a proposed layout of construction joints and placement methods to verify construction live load used in the design of supporting framing members will not require additional shoring or re-design by the Engineer of Record.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement: Portland Cement, ASTM C150, Type I or Type II or ASTM C1157, Type LH or GU. All cement to be from the same mill.
- B. Supplementary Cementitious Materials
 - 1. Fly Ash: ASTM C618, Type C or F
 - 2. Ground Granulated Blast-Furnace Slag, GGBF Slag: ASTM C989, Grade 100 or 120
 - 3. Silica Fume, Microsilica: ASTM C1240
- C. Water: Potable.

- D. Aggregates:
1. Normal weight aggregates: conform to ASTM C33, (4.2.1.2).
 2. Coarse aggregate:
 - a. Fill on stair pans: Gradation #8.
 - b. All other classes: Gradation #57.
 3. For architecturally exposed concrete, use a single source of uniform quality throughout the work.
- E. Admixtures, where required or permitted per ACI 301, Section 4:
1. Water-Reducing: ASTM C494, Type A or D.
 2. Mid-Range Water-Reducing admixture: ASTM C494, Type A.
 3. Air-entraining: ASTM C260 (4.2.1.4).
 4. High-Range Water-Reducing admixture (Superplasticizer): ASTM C494, Type F or G.
 5. Non-Chloride, Non-Corrosive accelerator: ASTM C494, Type C or E.
 6. Fly Ash: ASTM C618, Type C or F.
 7. Ground Granulated Blast-Furnace Slag, GGBF Slag: ASTM C989.
 8. Calcium Chloride and admixtures containing more than 0.06% chloride ions are NOT permitted.
 9. Use of admixtures other than those listed will be permitted only when approved prior to bid.
- F. Reinforcing:
1. Deformed bars - Uncoated: ASTM A615 or A706. Minimum yield strength to be 60 ksi.
 2. Welded Wire Fabric:
 - a. Plain welded wire reinforcement: ASTM A1064. Provide in sheet form for all uses other than slabs-on-grade. Minimum yield strength is to be 65 ksi.
 - b. Lap sheets a minimum distance of cross wire spacing plus two inches.
 3. Smooth joint dowel bars: ASTM A36, plain steel bars, cut true to length with square ends.
 4. Reinforcing support accessories:
 - a. Provide reinforcement accessories, consisting of bar supports, spacers, hangers, chairs, ties, and similar items as required for spacing, assembling, and supporting reinforcement in place. Conform with CRSI RB4.1 and Manual of Standard Practice and the following requirements:
 - b. For footings, grade beams, and slabs on grade, provide supports with precast concrete or mortar bases or plates or horizontal runners where wetted base materials will not support chair legs.
 - c. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms or are in close proximity to finish surfaces, provide supports with legs which are galvanized, plastic-protected, or stainless steel.
- G. Premolded expansion joint filler: ASTM D1751.
- H. Curing and Sealing Compound (VOC Compliant, 350 g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type complying with

ASTM C1315, Type I, Class B, 25% solids content minimum. Moisture loss shall be not more than 0.40 kg/m² when applied at 300 ft²/gal. Manufacturers' certification is required. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile resilient flooring, vinylbacked carpet, wood, terrazzo, epoxy or urethane overlays or adhesives, or other coating or finishing products. Subject to project requirements, provide one from the following manufacturers:

1. BASF Construction Chemicals.
2. Euclid Chemical Company.
3. W.R. Meadows

I. Curing Compound (Strippable): The compound shall conform to ASTM C309 and is to be used on slabs that are to receive subsequent applied finishes and where noted on the drawings. Install in strict accordance with the manufacturer's recommendations and supervision. Verify compound is compatible with the applied finish prior to placement. Subject to project requirements, provide one from the following manufacturers:

1. BASF Construction Chemicals.
2. Euclid Chemical Company.
3. W.R. Meadows

J. Grout for masonry core fill: ASTM C476, coarse type.

K. Grout under steel base plates and bearing plates: Non-shrinking, non-metallic, with minimum 28-day strength of 5,000 psi, when mixed to a fluid consistency. Subject to project requirements, provide one from the following manufacturers:

1. BASF Construction Chemicals.
2. Euclid Chemical Company.
3. Kaufman Company.

L. Vapor Retarder:

1. Conform to ASTM E1745 "Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs", Class A.
2. Vapor retarders are required under all slabs on grade which are to receive moisture-sensitive floor covering, and in humidity-controlled areas. Vapor retarders are not required under industrial slabs on grade nor under those in non-humidity-controlled areas.
3. Vapor retarder shall be installed in accordance with ASTM E1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs. The vapor retarder/barrier shall be a minimum of 15 mils thick and placed directly on the granular fill, below the concrete floor slab. Lap joints a minimum of 6 inches and seal with manufacturer's recommended tape or adhesive.

M. Granular fill below slabs on grade: Provide as recommended in project specific soils report. If soils report is not provided for project, use 4" deep of compacted ODOT 304 or approved equivalent AASHTO dense graded base course.

- N. Waterstops: Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints. Provide either premolded polyvinylchloride or swellable type.
 - 1. Premolded, flexible, polyvinylchloride, with center bulb. CRD C572
 - 2. Rubber and Swellable Clay CRD C513

- O. Structural Bonding Compound: Epoxy adhesive, 100% solids, two-component material suitable for use on dry or damp surface. Subject to project requirements, provide one from the following manufacturers:
 - 1. Euclid Chemical Company.
 - 2. Kaufman Company.
 - 3. Sika Corporation.

- P. Patching Compound, Epoxy Type: 100% solids, suitable for use on dry or damp surface. Subject to project requirements, provide one from the following manufacturers:
 - 1. Euclid Chemical Company.
 - 2. Sika Corporation.
 - 3. W.R. Meadows

- Q. Patching Compound, Cementitious Type: Subject to project requirements, provide one from the following manufacturers:
 - 1. Euclid Chemical Company.
 - 2. Sika Corporation.
 - 3. W.R. Meadows

- R. Curing sheets for wet curing – the following materials are approved:
 - 1. Sisalcraft Sk-10 (C171).
 - 2. Burlap
 - 3. Filter Fabric (8-ounce minimum)
 - 4. Visqueen plastic, 8 mils minimum.
 - 5. Bur-lene curing blankets.

2.02 MIXES

- A. The following mixes of concrete are required:

Mix Usage	f _c at 28 days	Exposure Class	Maximum Water Cementitious Ratio	Air Content
Lean Concrete & Mud Slabs	1,500 PSI	F0	---	---
Footings & Interior Column Piers	3,500 PSI	F1	0.55	optional
Interior Slabs on Grade	4,000 PSI	F0	0.45	optional
Interior Slabs on Metal Deck	3,500 PSI	F0	0.45	optional
Stair Pan Fill	3,500 PSI	F0	0.45	optional
Structural Slabs	5,000 PSI	F0	0.42	optional
Exterior Foundation Walls & Exterior Column Piers	4,500 PSI	F2, C1	0.45	5%-7%
Exterior Slabs on Grade and Exterior Concrete Not Otherwise Identified	4,500 PSI	F2, C1	0.45	5%-7%

Concrete Mix Notes:

- 1) Exposure class requirements are achieved through the F_c, w/cm, and air content requirements provided to ensure adequate durability conforms to Freeze/Thaw exposures (F) or Corrosive exposures (C).
- 2) For all slab mixes, provide a minimum cementitious content of 520 lbs.
- 3) Use No. 8 coarse aggregate for metal stair pan fill.
- 4) Slump: Maximum 5" for all members. If a superplasticizer is used, initial slump to be 3", increased to 8" maximum after addition (at the job site) of the superplasticizer.
- 5) Fly ash is permitted in all mixes but shall not exceed 25% of cement weight indicated above and can be included in the water-to-cementitious ratio.
- 6) Ground granulated blast-furnace slag is permitted in all mixes but shall not exceed 35% of the cement weight indicated above and can be included in the water-to-cementitious ratio.
- 7) Silica fume (microsilica) is permitted in all mixes but shall not exceed 10% of the cement weight indicated above and can be included in the water-to-cementitious ratio.
- 8) Total supplemental cementitious material shall not exceed 35% of the total cement weight.
- 9) Mixes to be pumped are to be so identified on the mix design submittal. All pumped mixes are to have a mid-range or high-range water reducer.
- 10) Concrete for slabs on grade must include a mid-range or high-range plasticizer.
- 11) All admixtures (other than superplasticizer) are to be added at the batch plant. Superplasticizers, designed for addition to the mix at the plant, may be added at the batch plant with verification from the Engineer of Record and verification that the water-to-cement ratio has not been exceeded.
- 12) Maximum water-soluble chloride ion content shall not be more than the ACI limits set forth for defined corrosion classes.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Verify that excavations are free of water and ice, are of the required dimensions, and have been approved by the Soils Engineer, prior to placing concrete.
- B. Determine field conditions by actual measurement.
- C. Notify Architect not less than 24 hours in advance of placing concrete. Place concrete only when Construction Manager is present, unless this requirement is specifically waived.

3.02 FORMWORK AND REINFORCING

- A. All formwork shall follow the guidelines of ACI 347R resulting in final formed surfaces within the tolerances of ACI 117.
- B. Footings may be cast against earth cuts when soil conditions permit.
- C. Removal of forms and shoring:
 - 1. Remove no forms within 24 hours after placement.
 - 2. Shoring is to remain in place until concrete reaches its design strength. Windsor Penetrometer is to be used to verify in-place strength if forms are removed prior to 28 days after casting concrete.
- D. Reinforcing:
 - 1. Welding of reinforcing is prohibited, except where shown.
 - 2. Use plastic-tipped or stainless-steel bar supports for surfaces exposed to view in finished structure.

3.03 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install all embeds shown on contract documents, including but not limited to: headed stud embeds, and anchor bolts.
 - 2. Install sleeves for mechanical, electrical, and plumbing penetrations.
- B. Aluminum conduit shall not be installed in concrete.

3.04 DELIVERY AND PLACEMENT

- A. Preparation before placement:
 - 1. Remove all debris from forms and deck. Clean steel deck of grease, oil, and other substances that would reduce bond to concrete.

2. Standing water shall be removed from place of deposit before concrete is placed.
 3. Do not use additives or salts to remove ice. Non-chloride deicers may be used.
 4. In cold weather, comply with ACI 306R; maintain temperature of forms and reinforcing within a range of 55 - 90 degrees F.
 5. In hot weather, comply with ACI 305.1.
- B. Delivery is to conform to ASTM C94.
1. Delivery tickets to contain the following, in addition to the information required by C94:
 2. Reading of revolution counter at first addition of water.
 3. Type and brand of cement and supplementary cementitious materials.
 4. Cementitious content.
 5. Total water content by producer.
 6. Maximum size of aggregate.
 7. Secure Architect's written approval if non-agitating type equipment is to be used for transportation.
 8. ASTM C94 requires discharge within 1-1/2 hours or 300 revolutions; whichever comes first, after the introduction of water to cement and aggregates, or the introduction of cement to the aggregates. Architect may require an earlier discharge during hot weather, or when high-early strength cement is being used.
- C. Water addition at the site will not be permitted, except when the approved mix design has been formulated to allow for on-site addition of water. Water may only be added by personnel authorized by the Architect/Engineer and Concrete Producer.
- D. Conveying: Keep delivery carts and buggies on runways; do not allow them to bear on reinforcing or uncured concrete.
- E. Placement.
1. Place within 6 feet of final position. Spreading with vibrators is prohibited.
 2. In walls and columns, deposit concrete in uniform horizontal layers, with a maximum depth of 4 feet (18 inches for architectural concrete).
 3. Maximum free fall without chutes or elephant trunks to be 5 feet (3 feet for architectural concrete).
 4. Place concrete continuously to a designed joint such that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of cold joints or planes of weakness.
 5. Concrete shall be consolidated per guidelines in ACI 309.2R.
- F. Records: Keep a complete log of pours, including date, location, quantity, weather, and identification of test cylinders for each pour.

3.05 JOINTING

- A. Interior slabs on grade:

1. Locate control (contraction) joints as shown on the Drawings. In the absence of information on Drawings, locate at openings, walls, columns, grid lines, and inside corners. The maximum spacing of contraction (control) joints, for reinforced and unreinforced slabs, is to be 6 times the square root of the slab thickness (i.e. for a 4-inch slab the maximum spacing is 12 feet). Cut joints $\frac{1}{4}$ times the slab thickness. The Soff-Cut Saw shall be used immediately after final finishing. A conventional saw shall be used as soon as possible without dislodging aggregate. Schedule slab pours and saw-cutting operations such that sawing is completed prior to onset of shrinkage cracking.
 2. Provide isolation joints at columns ($\frac{1}{2}$ inch thick) and at walls ($\frac{1}{8}$ inch thick). Where isolation joint will be exposed to view, set top of joint filler below top of slab a distance equal to the filler thickness, to receive sealant. Where not exposed to view, set top of filler flush with top of slab.
- B. Exterior slabs on grade: Locate joints as shown on Drawings. In the absence of information on Drawings, provide the following (for sidewalks only):
1. Expansion joints: Full depth, with $\frac{1}{2}$ inch joint filler, where slabs abut vertical surfaces at intersections of sidewalks, at abrupt changes in width, and at a spacing not exceeding 30 feet.
 2. Control joints: Tooled, 1 inch deep, 4'-0" to 6'-0" on center between expansion joints.
- C. Construction Joints in supported slabs and slabs on metal deck: Locate per Contract Document requirements, and in accordance with ACI 301 section 2.2.2.5. Submit proposed construction joint locations for review prior to proceeding with construction.

3.06 FINISHES

- A. Schedule of finishes on flatwork per ACI 301, section 5 is as follows:
1. Typical interior floor areas to receive carpet, resilient floor covering, or to remain exposed - troweled finish.
 2. Interior floor areas to receive terrazzo, quarry tile, or ceramic tile - floated finish.
 3. Exterior slabs - broom finish.
- B. Surfaces of floor slabs shall be finished to the following tolerances, per ACI 117:
1. Minimum flatness of F(f) 30, and a minimum levelness of F(l) 20, are required for typical slabs on grade. Preceding values are average values to be obtained over a given area. Minimum local values (one-half bay) of F(f) 25 and F(l) 17 shall be obtained.
 2. Minimum flatness of F(f) 25 is required for elevated slabs. Preceding value is an average value to be obtained over a given area. Minimum local value (one-half bay) of F(f) 20 shall be obtained.
- C. Determination of the flatness and levelness of a concrete slab shall be made on the day following placement of the first concrete pour. Tests shall be made in accordance with ASTM E115. After it is established that proper procedures are

being utilized to obtain the desired results, flatness/levelness test shall be performed only as directed by the Owner.

- D. Any bay not conforming to the above flatness and levelness requirements is subject to: repair, or removal; replacement; and retesting; at no expense to the Owner.
- E. "F Numbers" shall be submitted to the Owner and Architect immediately after they are determined by the testing laboratory.

3.07 CURING AND PROTECTION

- A. Curing:
 - 1. Interior slab areas that will receive non-moisture sensitive terrazzo, ceramic tile, quarry tile, or a liquid sealer/densifier, are to be moist-cured for a minimum of 7 days, without the use of a curing compound.
 - 2. Interior slab on grade areas which will receive moisture sensitive floor coverings are to be cured with plastic sheeting, conforming to ASTM C171, for 7 days. Edges and joints are to be sealed. Rewetting of the slab at any time during construction should be avoided.
 - 3. All other slab areas which will receive non-moisture sensitive floor coverings may be either moist-cured or receive an application of curing compound, except that when concrete above grade is placed in the open, and the air temperature exceeds 60 °F, the concrete is to be moist-cured for the first 24 hours.
 - 4. Whichever curing method is used, it is to commence immediately after placement. Do not allow curing to be delayed overnight.
 - 5. Prevent excessive moisture loss from formed surfaces. If forms are removed before 7 days have elapsed, cure the formed surfaces by moist-curing or application of curing compound for the remainder of the curing period.
- B. Protection:
 - 1. When air temperature during placement is less than 40 °F, or will be within 24 hours, temperature of concrete as placed is to be between 50 °F and 90 °F (55 °F and 90 °F for sections less than 12 inches thick) and a non-chloride accelerator shall be used. Maintain concrete temperature within these limits for the full curing period of 7 days.
 - 2. When air temperature during placement is greater than 80 degrees, a water-reducing retarder shall be used. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

3.08 CLEANING AND REPAIR

- A. Repair any slabs that do not meet the finish requirements. The Architect will determine whether grinding, filling of cracks, or patching and leveling procedures are required.
- B. For slabs that are dusting, or showing other signs of improper curing, any corrective measures attempted will be subject to prior approval of the Architect and will be performed at Contractor's expense. These may include additional applications of sealer/densifier, or grinding, or covering with specified repair topping.
- C. Immediately prior to final acceptance, remove from all interior and exterior surfaces that are exposed to view, any stain-producing elements, such as pyrites, nail, wire, reinforcing steel, and form ties.
- D. Remove all stains completely. Use of weak acids or patented cleaners is acceptable, but surface is to be completely neutralized after use.
- E. All repairs shall conform to ACI 301, Section 5.3.7 except that the specified bonding compounds, cementitious, or epoxy repair materials must be used. Repair procedures must be submitted and reviewed by the Engineer of Record.
- F. As-cast formed finishes shall comply with the following:
 - 1. Concrete surfaces not exposed to view (Surface Tolerance Class D per ACI 117)
 - a. Patch voids larger than 1-1/2" wide or 1/2" deep.
 - b. Remove projections larger than 1".
 - 2. Concrete surfaces exposed to view (Surface Tolerance Class C per ACI 117)
 - a. Patch voids larger than 3/4" wide or 1/2" deep.
 - b. Remove projections larger than 1/2".
 - c. Patch tie holes.

3.09 ACCEPTANCE

- A. Concrete work with serious honeycombing, form misalignment, or other deviation from Contract requirements is subject to rejection per ACI 301, Section 1.
- B. When observations or tests indicate that the Contract requirements have not been met, the Contractor is to bear the costs of any additional testing and analysis to determine acceptability and also the cost of removal and replacement, if such is required per ACI 301, Section 1.

3.10 FIELD QUALITY CONTROL

- A. Inspection and testing shall be in accordance with Special Inspections designated for this project as approved by the Building Official. Special

Inspections must be documented with all corrective measures completed to satisfy compliance certificates as deemed necessary by the jurisdiction.

- B. All tests and inspection shall be per ACI 301, Section 1.6

END OF SECTION