SECTION 13 1204 – WATER FEATURE CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Concrete Materials
2. Admixtures
3. Miscellaneous Materials
4. Concrete Mixes
5. Cementitious and Reactive Waterproofing

B. Related Sections:

1. SECTION 03 0000 - CONCRETE
2. SECTION 13 1201 – WATER FEATURE LIGHTWEIGHT STRUCTURAL FILL
3. SECTION 13 1202 – WATER FEATURE STEEL REINFORCEMENT
4. SECTION 13 1203 – WATER FEATURE CONCRETE FORMWORK
5. SECTION 13 1205 – WATER FEATURE SHOTCRETE
6. SECTION 13 1305 – WATER FEATURE ACCESSORIES
7. SECTION 13 1401 – WATER FEATURE PIPE AND FITTINGS
8. SECTION 13 1403 – WATER FEATURE PIPE HANGERS, SUPPORTS, AND ANCHORS
9. SECTION 13 1404 – WATER FEATURE WHITE GOODS
10. SECTION 31 0000 – EARTHWORK

C. References:

1. Project Documents: Geotechnical Soils Report
2. ACI 107 – SPECIFICATION FOR TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS
3. ACI 211.5R – GUIDE FOR SUBMITTAL OF CONCRETE PROPORTIONS
4. ACI 301 – SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS
5. ACI 302.1R – GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION
6. ACI 303.1 – STANDARD SPECIFICATION FOR CAST-IN-PLACE ARCHITECTURAL CONCRETE
7. ACI 304 – MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE
8. ACI 305R – SPECIFICATION FOR HOT WEATHER CONCRETING
9. ACI 306.1 – STANDARD SPECIFICATION FOR COLD WEATHER CONCRETING
10. ACI 308.1 – STANDARD SPECIFICATION FOR CURING CONCRETE
11. ACI 318 – BUILDING CODE REQUIREMENTS
12. ACI 350 – CODE REQUIREMENTS OF ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES
13. ACI 503.2 – BONDING PLASTIC CONCRETE TO HARDENED CONCRETE WITH A MULTI-COMPONENT EPOXY ADHESIVE
14. ASTM C33 – STANDARD SPECIFICATION FOR CONCRETE AGGREGATES
15. ASTM C88 – STANDARD TEST METHOD FOR SOUNDNESS OF AGGREATES BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE
16. ASTM C94/C94M – STANDARD SPECIFICATION FOR READY-MIX CONCRETE
17. ASTM C150 – STANDARD SPECIFICATION FOR PORTLAND CEMENT
18. ASTM C260 – STANDARD SPECIFICATION FOR AIR-ENTRAINING ADMIXTURES FOR CONCRETE
19. ASTM C309 – STANDARD SPECIFICATION FOR LIQUID MEMBRANE-FORMING COMPOUNDS FOR CURING CONCRETE
20. ASTM C494 – STANDARD SPECIFICATION FOR CHEMICAL ADMIXTURES FOR CONCRETE
21. ASTM C618 – STANDARD SPECIFICATION FOR COAL FLY ASH AND RAW OR CALCINED NATURAL POZZOLAN FOR USE IN CONCRETE
22. ASTM C948 – STANDARD TEST METHOD FOR DRY AND WET BULK DENSITY WATER ABSORPTION AND APPARENT POROSITY OF THIN SECTIONS OF GLASS-FIBER REINFORCED CONCRETE

D. Related Products Installed But Not Supplied Under This Section:

1. Inserts, bolts, boxes, templates, and fastening devices for other Work, Including those for bases for Mechanical and Electrical.
2. Concrete Accessories.

1.2 SUBMITTALS FOR REVIEW

A. SECTION 01 3300 – SUBMITTAL PROCEDURES

B. Product Data: Submit Manufacturer's product literature for each type of admixture, bonding agent, curing compound, non-shrink grout, epoxy, and sealer for approval by the Engineer.

C. Concrete Mix Design: Submit Concrete Mix Design for each concrete mix type to be used. Include the following information:

1. Mix Identification Designation
2. Statement of Intended Use for Mix
3. Mix Proportions, including Admixtures
4. Wet and Dry Unit Weight
5. Entrained Air Content
6. Design Slump
7. Design Compressive Strength
8. Water/Cementitious Material Ratio
9. Aggregate Source
10. Admixtures
11. Strength Qualification Data:

a. Submit required average strength qualification data and documentation per ACI 301 4.2.3.
b. If trial batches are used to qualify average strength, mix design shall be prepared by an independent testing laboratory and shall achieve average compressive strength of a minimum of 1,200 psi (8.25 MPa) greater than specified strength with slump within 1-inch (25mm) of maximum permitted and air content within 0.05-percent of maximum allowable.
c. If field test data is used to qualify average strength, submit separate qualification data for each production facility that will supply concrete to the project, include copies of concrete testing agency's reports from which the data was compiled.

D. Test Reports: Provide Test Reports of control tests, special tests, and core tests prepared and distributed by an independent testing laboratory.

E. Samples: Submit one (1) 12-inch by 12-inch (300 by 300mm) sample of colored concrete for color verification

1.3 QUALITY ASSURANCE

A. Testing Agency: All testing shall be conducted by an approved testing laboratory. Test results will be submitted to the Engineer before final acceptance.

B. Records of Work: Maintain and keep accurate records listing time, location, and date of concrete placement. Include delivery tickets from concrete supplier. Delivery Tickets shall show the following information:

1. Name of Ready-Mix batch plant
2. Serial number of Ticket
3. Date and truck number
4. Name of Contractor
5. Name and Location of the Project
6. Amount of Concrete

7. Time Loaded
8. Type, Name, and Amount of Admixtures used
9. Amount and Type of Cement
10. Total Water Content
11. Sizes, Weights, and Types of sand and aggregates

C. MOCKUP

1. Construct and erect a field sample for Architectural Concrete surfaces receiving special treatment or finish as a result of Formwork in location specified by the Engineer or Architect.
2. Sample shall be of sufficient size, approximately 4-feet by 8-feet (1.2 by 2.4m), to indicate and detail special treatment or finish, including any scoring, joints, joint sealants, etc that will be in the finished Work.
3. Remove panels at the completion of the Project.

1.4 PROJECT CONDITIONS

A. Environmental Requirements

1. Cold Weather Concreting Procedures

a. When ambient air temperatures on the day of placement are expected to drop below 40 °F (4.4 °C), placement, preparation, protection, and curing of concrete shall comply with ACI 306.1.
b. Minimum temperature of concrete upon delivery shall conform to ACI 301 4.2.2.7. Concrete temperature at placement shall conform to minimum values of ACI 306.1 Table 3.2.1 and shall not exceed minimum values.
c. No frozen material shall be used.
d. Forms, reinforcement, and fillers shall be free from frost.
e. Do not place concrete on frozen ground.

2. Hot Weather Concreting Procedures

a. When placing concrete in hot weather follow the recommendations of ACI 305R.
b. When ambient air temperatures on the day of placement are expected to exceed 90 °F (32.2 °C), mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
c. Protect and prevent rapid drying. Start finishing and curing as soon as possible. The Engineer may approve the use of fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

3. Concrete shall not be placed during rain, sleet, or snow. Precipitation shall not be allowed to increase the mixing water nor damage the finish surface. The Engineer may approve placement of concrete if it is determined that there is adequate protection from damage due to environmental conditions.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement:

1. General Usage: ASTM C150, Type II with C3A ≤ 5% or Type V, provided from one (1) source.

B. Coarse Aggregate:

1. Meet requirements of ASTM C33 or nonconforming aggregate that by test or actual service produces concrete of required strength and conforms to local governing codes.
2. Aggregate shall be uniformly graded as follows:

a. Flat Work – Size No. 67

Sieve No. (U.S. Series)	**Opening Size** inches (mm)	**Percent Passing** (% by weight)
1 in.	1.0 (25)	100
3/4 in.	0.75 (19)	90 to 100
3/8 in.	0.375 (9)	20 to 55
4	0.187 (4.75)	0 to 10
8	0.0937 (2.36)	0 to 5

b. All Other – Size No. 57

Sieve No. (U.S. Series)	**Opening Size** inches (mm)	**Percent Passing** (% by weight)
1-1/2 in.	1.5 (37)	100
1 in.	1.0 (25)	95 to 100
1/2 in.	0.5 (12)	25 to 60
4	0.187 (4.75)	0 to 10
8	0.0937 (2.36)	0 to 5

C. Fine Aggregates:

1. Clean, washed hardrock having hard, strong, durable particles, which do not contain deleterious substances, such as clay lumps, shale, schist, alkali, mica, coated grains, or soft and flaky particles.
2. Clean natural sand, which does not contain deleterious substances, such as clay lumps, shale, schist, alkali, mica, coated grains, or soft and flaky particles.
3. Aggregate shall be uniformly graded as follows:

Sieve No. (U.S. Series)	**Opening Size** inches (mm)	**Percent Passing** (% by weight)
3/8 in.	0.375 (9)	100
4	0.187 (4.75)	95 to 100
8	0.0937 (2.36)	80 to 100
16	0.0469 (1.18)	50 to 85
30	0.0234 (0.60)	25 to 60
50	0.0117 (0.30)	10 to 30
100	0.0059 (0.15)	2 to 10

D. Mix Water:

1. Clean potable water conforming to ASTM C94.
2. Free from deleterious amounts of acids, alkalis, salts, and organic matter.

2.2 ADMIXTURES

A. Mineral

1. Fly Ash Pozzolan – Meets requirements of ASTM C618, Class F or C and with loss of ignition (LOI) of 3-percent maximum.

B. Chemical

1. No Admixture shall contain calcium chloride nor shall calcium chloride be used as an Admixture. All chemical admixtures used shall be from the same manufacturer.
2. Approved Manufacturer

a. Master Builders Incorporated
b. SIKA Corporation
c. W R Grace Construction Products

3. Air Entrainment Agent

a. Meets requirements of ASTM C260
b. Quality Standard – Daravair or Darex II AEA by W R Grace

4. Water Reducer

a. Meets requirements of ASTM C494, Type A
b. Quality Standard – Daracem 50/55, WRDA-64, or WRDA-82 by W R Grace

5. Water Reducer, Set Retarder

a. Meets requirements of ASTM C494, Type D
b. Quality Standard – Daratard-17 or Daratart-40 by W R Grace

6. High Range Water Reducer

a. Meets requirements of ASTM C494, Type F or G
b. Quality Standard – Darachem-100 or WRDA-19 By W R Grace

7. Non-Chloride Accelerator

a. Meets requirements of ASTM C494, Type C
b. Quality Standard – Daraset or Polarset by W R Grace

C. Evaporation Retardant

1. Approved Manufacturers

a. Sure Film J-74 by Dayton Superior
b. Confilm by Master Builders Incorporated

D. Bonding Agents

1. Approved Manufacturers

a. Day-Chem Ad Bond (J-40) by Dayton Superior

2.3 MISCELLANEOUS MATERIALS

A. Curing Compounds:

1. Do not use concrete curing compounds without the Engineer's or Architect's written approval.
2. Curing Compounds shall not be used to replace moist curing unless specifically accepted by the Engineer.

B. Non-shrink Grout:

1. Approved Manufacturers

a. Master Builders Incorporated – Master Flow 928
b. Dayton Superior – Sure-Grip
c. L&M Construction Chemicals – Crystex Non-Shrink Grout
d. Euclide Chemical Company – Hi-Flow Grout
e. U.S. Grout Corporation – Five Star Grout
f. A.C. Horn, Incorporated – Horn Non-Metallic Grout
g. UPCO Company – UPCON
h. Sonneborn Building Products – Sonogrout
i. Burke – Non-Ferrous, Non-Shrink Grout

2. Pre-packaged, non-shrink, non-metallic, natural aggregate grout conforming to ASTM C1107, Grade B or C.
3. Grout shall be fluid with extended working times and temperatures, capable of achieving at least 95-percent bearing strength under base plates and free of gas producing or gas-releasing agents.

C. Anchor Bolt Epoxy

1. Approved Manufacturers

a. Hilti Corporation
b. Approved Equal

2. Anchor Bolt Epoxy shall conform to the design strength requirements of ACI 318 and should follow the Manufacturer's recommendations.
3. Provide as an injectable adhesive, furnished in a side-by-side refill pack that keeps component A and component B separate and shall be designed to accept static mixing nozzle through which both components are thoroughly mixed.

D. Expansion Joint Filler

1. Wet Areas, such as pool decks:

a. Acceptable Products

i. Deck-O-Joint
ii. Deck-O-Foam
iii. Deck-O-Seal
iv. Approved Equal

b. Non-bituminous joint filler, 1/2-inch (12mm) thick by depth of concrete slab.

2. Non-Wet Areas:

a. Acceptable Manufacturers

i. A.C. Horn Company
ii. W R Meadows Company
iii. Approved Equal

b. Pre-molded asphalt-impregnated type, conforming to ASTM D1751.
c. Pre-compressed, neoprene rubber-impregnated, expanding foam may be used in lieu of pre-molded type.

2.4 CONCRETE MIXES

A. It is intended that concrete for all parts of the concrete Work be homogeneous, and when hardened, possess the required strength, durability, water tightness, appearance, resistance to deterioration and abrasion, and other qualities as specified or required.

B. No water shall be added at anytime during mixing cycle above the amount required to meet specified water/cement ratio. No reduction in the amount of cement will be allowed.

C. Mix Designs to meet the following requirements:

1. Mix No. 1 – 5,000 psi (34.4 MPa) concrete for use on water retaining structures.

a. Minimum weight of cement per cubic yard – 564 lbs.
b. Air Entrainment – 6 percent, +/- 1.5%.
c. Water/Cement Ratio – 0.40 maximum by weight.

2. Admixtures:

a. Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use. Do not use any admixture without the Engineer's/Architect's written approval.
b. Mineral – An amount equal to 15-percent of weight of cement may be added.
    i. If added, fly ash shall be considered with the cement in determining the amount of water necessary to provide the specified water/cement ratio.
c. Chemical:
    i. 4-inch (100mm) slump maximum prior to use of high range water reducer.
    ii. 8-inch (200mm) slump maximum with use of high range water reducer.
    iii. Use accelerator or retarder if necessary, to meet environmental conditions.

2.5 CEMENTITIOUS AND REACTIVE WATERPROOFING

A. Cementitious and Reactive Waterproofing should only be included in the mix design when specified by the Engineer.

B. Cementitious Waterproofing

1. Approved Manufacturers
    a. XYPEX Chemical Corporation
    b. Approved Equal
2. Obtain crystalline waterproofing products from a single manufacturer.
3. Product shall be added to concrete mix at time of batching.
4. Follow all Manufacturer recommendations and instructions for dose rates into concrete mix.

C. Reactive Waterproofing

1. Approved Manufacturers
    a. HYCRETE Incorporated
    b. Approved Equal
2. Obtain Reactive Waterproofing products from a single manufacturer.
3. Product shall be compatible with specified concrete mix design.
4. Follow all Manufacturer's recommendations and instructions for dose rates into the concrete mix.

PART 3 - EXECUTION

3.1 PREPARATION

A. Refer to overall Project Specifications for inspection requirements.

B. Verify requirements for concrete cover over reinforcement in accordance with SECTION 13 1202 – WATER FEATURE STEEL REINFORCEMENT.

C. Coordinate locations and install inserts, bolts, boxes, templates, pipes, conduits, and other accessories required by all other trades prior to inspection and placing concrete.

D. Verify area where concrete is to be placed is free from standing water, dirt, debris, etc.

E. Clean previously placed concrete with a steel brush, blowing the concrete clean using compressed air, and wetting or applying bonding agent in accordance with Manufacturer's instructions.

F. Verify that all grounding connections are installed prior to placing concrete. All Steel Reinforcement must be grounded in accordance with the National Electrical Code (NFPA 70).

3.2 PLACEMENT

A. Place concrete in accordance with ACI 318.

B. Place concrete on properly prepared undisturbed subgrade materials or engineered fill. Refer to the Geotechnical Soils Report for recommendations.

C. Maintain records of concrete placement as described in this section.

D. Place concrete continuously between predetermined expansion, control, and construction joints.

E. Do not interrupt successive placement; do not permit cold joints to occur.

F. Place concrete in nearly uniform layers.

G. Do not drop concrete in free fall over 5-feet (1.5m).

H. Consolidate concrete during and immediately after depositing using mechanical vibrators in accordance with ACI 301. Do not use vibrators to move or transport concrete inside of forms.

I. Do not use contaminated, deteriorated, or retempered concrete. Avoid accumulation of hardened concrete.

J. Do not use aluminum in concrete.

3.3 ACCEPTABLE TOLERANCES

A. All tolerances for concrete work shall be in accordance with ACI Standards unless specifically specified otherwise.

B. Tolerances for block outs and openings:

1. Size: ± 1/8-inch (3mm)
2. Location: ± 1/4-inch (6mm)

C. Tolerances for stairs and landings:

1. Treads: ± 1/8-inch (3mm)
2. Risers: ± 1/16-inch (1.5mm)

D. Walls and Slabs:

1. Variation from plumb: 1/4-inch (6mm) maximum
2. Variation from thickness: 1/4-inch (6mm)
3. Variation from location: 1/2-inch (12mm)

3.4 SPECIAL REQUIREMENTS

A. Footings:

1. Bear 18-inch (450mm) minimum into undisturbed earth or on mechanically compacted engineered fill. Step Footings at a ratio of 1.5 horizontal to 1 vertical (1.5:1) unless detailed otherwise. Exterior Footings shall bear below finish grades. See Contract Documents
2. Level tops to finish Footing and leave rough.
3. Where joints are required, bulkhead, waterstop, key horizontally, and dowel with two (2) #4 (T12) rebar, 4-feet (1.2m) long.

B. Foundations and Walls:

1. Leave Steel Reinforcement projecting where required for floor ties.

C. Exterior Slabs

1. Dusting with cement is not permitted.
2. For continuous placing and as shown on the Contract Documents, saw cut a 1-inch (25mm) deep control joint before shrinkage occurs.

D. Equipment Support Pads (Housekeeping Pads)

1. Coordinate the location of required equipment bases, support pads, etc with other trades and as required in all specification sections.
2. All equipment support pads shall be 4-inches (100mm) in height, unless otherwise noted on the Contract Documents.

E. Anchor Bolts:

1. Embedded Anchors:

a. Place Anchor Bolts not tied to reinforcement steel immediately following leveling of concrete. Reconsolidate concrete around Bolt immediately after placement. Do not place bolts during finishing process.

2. Epoxy Anchors:

a. Install as per the Manufacturer's recommendations and instructions.

F. Expansion Joints:

1. Install Expansion Joints only in locations as shown on the Contract Documents, or where approved by the Engineer.
2. Expansion Joint fiber can be held in place by nailing or taping the material to the existing section of concrete prior to placement.
3. Joint sealant compound shall be applied over the top of the fiber, flush with the finish surface and continuous along the entire joint. The joint shall be watertight.

3.5 CONCRETE FINISHES

A. All Concrete Finishes shall be coordinated with the Architect/Landscape Architect. The following are recommendations when no architectural finish is specified.

B. Finish No. 1 – Exposed Vertical Surfaces

1. Sack Rubbed Finish.
2. Immediately after removing forms, remove joints, marks bellies, projections, loose materials, and cut back metal ties from surfaces to be exposed.
3. Repair minor voids as specified in this section and rub exposed surface with carborundum to smooth.
4. Grind ridges smooth with the face of the exposed concrete.
5. Provide a smooth and even surface.

C. Finish No. 2 – Interior Flatwork

1. Steel Trowel Finish.
2. Float and Steel Trowel interior slabs after concrete has set enough to avoid bringing water and fines to the surface.
3. If power troweling is used, obtain approval or finish from the Engineer.

D. Finish No. 3 – Exterior Flatwork

1. Broom Finish.
2. Round edges including edges formed by expansion joints.
3. Remove edge marks.

3.6 CURING AND PROTECTION

A. Keep concrete moist a minimum of seven (7) days for regular concrete and three (3) days for high early strength concrete. Do not use concrete curing compounds without the Engineer/Architect's written approval. Curing Compounds shall not be used to replace moist curing unless accepted by the Engineer/Architect.

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 a period necessary to hydration of cement and hardening of concrete.

D. Protect newly placed concrete from precipitation until it has sufficiently hardened to avoid excess water in mix and damaging the surface finish. Concrete with damaged surfaces will be replaced at the direction of the Engineer.

3.7 FIELD QUALITY CONTROL

A. Provide free access to Work and cooperate with individuals performing tests, inspectors, Engineers and Architects.

B. Four (4) concrete cylinders shall be taken for every 75 or less cubic yards (60 cu. m) of each class of concrete placed.

C. One (1) additional test cylinder will be taken during cold weather concreting and cured on the job site under the same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken.

E. Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements will be noted as defective. Defective concrete will be removed and replaced or repaired as directed by the Engineer and at the Contractor's expense.

F. Contractor to perform water tightness testing in accordance with ACI-350.1-01 and inform owner and engineer of test results. Engineer reserves the right to reject concrete work if water tightness testing criteria are not met. In lieu of the aforementioned test, the contractor may request permission to perform a bucket test via the following: Place a bucket filled with water on a pool step (weighed down), ensure water level inside bucket is the same as in the pool, mark the water levels inside and outside the bucket, check and compare the marks 24 hours later.

3.8 PATCHING AND REPAIRING

A. Allow Engineer/Architect or inspector to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable and will be noted as defective. Defective concrete will be removed and replaced or repaired as directed by the Engineer and at the Contractor's expense.

C. Do not patch, repair, or replace exposed architectural finished concrete except upon the direction of the Architect or Engineer.

D. Minor defects, defects less than 1/2-inch (12mm) deep and tie holes, not exposing reinforcing can be repaired by chipping, cleaning, and applying epoxy adhesive. Apply non-shrink grout prior to development of tack-free condition of epoxy adhesive.

END OF SECTION