

Concrete Specification for Cooling Tower and Basin

1.0 SUMMARY

Includes:

1. Structural Capabilities
2. Fabrication Tolerances
3. Placing, finishing and curing ready-mix concrete.
4. Formwork, complete with required shoring, bracing, and anchorage.
5. Placing reinforcing, complete with required supports, spacers and accessories.
6. Place anchorage, attachment inserts and miscellaneous accessories.
7. Miscellaneous boxes, etc., required for mechanical and electrical work.
8. Quality Assurance
9. Concrete Specification and Mix Requirements
10. Precast Work
11. Defect Repair

1.1 SPECIFICATIONS AND DIMENSIONS

A. FABRICATION TOLERANCES

- a. Casting Tolerances: Over-all height and width measured at face adjacent to mold when concrete is cast:
 - i. Members ten feet or under: plus or minus 1/8 inch
 - ii. Members ten to twenty feet or under: Plus 1/8 inch, minus 3/16 inch
 - iii. Members twenty to thirty feet or under: Plus 1/8 inch, minus 1/4 inch
 - iv. Member thickness: Plus 1/4 inch, minus 1/8 inch
 - v. Out of square (diagonal): 1/8 inch per six feet or 1/4 inch total maximum.
- b. Location Tolerances: Cast in place items shall have the following setting tolerances
 - i. Inserts, pipe sleeve, bolts, etc.: Plus or minus 3/8 inch
 - ii. Reglets: plus or minus 1/8 inch in six feet or 1/4 inch total
 - iii. Grooves width for shroud: Plus or minus 1/8 inch
- c. Coordinate the installation of all related materials with placement of forms, reinforcing and the subsequent concrete placement.

B. STRUCTURAL LOAD BEARING CAPABILITY

- a. Support for Internal Structure estimated weight of 178,500 pounds at a minimum excluding the weight of the concrete support beams, lateral beams, and header beam
- b. Water Loading of 48,000 pounds
- c. Basin water loading of 4320 cubic feet at approximately 10ft operating water depth, (nominal basin size is 36ft wide x 12ft length x 12ft height at full capacity of water)

1.2 QUALITY ASSURANCE

- A. Reference Standards: As listed herein by publications numbers, furnish items of work and materials in compliance with the latest issue of the followings:
 1. American Concrete Institute ACI
 2. Pre-stressed Concrete Institute PCI
 3. Portland Cement Association PCA
 4. American Society for Testing and Materials ASTM

1.3 TESTING

- A. Testing of fresh concrete by independent Testing Laboratory shall be paid for by the concrete supplier and in accordance to the following.
- B. Test Cylinders
 - 1. Six concrete test cylinders shall be taken and tested for every 20 cubic yard of concrete delivered per following sequence:
 - Two cylinders shall be tested at four (4) days for lifting strength purpose
 - Two cylinders shall be tested at seven (7) days for information purpose
 - Two cylinders shall be tested at twenty-eight (28) days for design strength
 - 2. The strength test (average of the two test samples) shall not fall below the design strength by more than 500 PSI. All three consecutive strength tests shall meet or exceed the design strength of F'c.
- C. Slump Tests:
 - 1. Slump tests shall be taken at the mixer's discharge point. Slump tests shall be taken in accordance to ASTM C143.
 - 2. After slump is approved and accepted, water shall not be added to the concrete mix.
- D. Air-Entrainment :
 - 1. Air content of freshly mixed concrete shall be tested twice daily and whenever directed by the engineer in accordance to the ASTM C231 or ASTM C 173.

PART 2-PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement shall be normal type Portland, gray color meeting ASTM C150 Type I HE or type III. Use one brand of cement throughout unless specifically noted.
- B. Normal weight Aggregate meeting ASTM C 33 from a single source. Do not use aggregates that contain substances causing unacceptable concrete.
- C. Water shall be clean and free from deleterious amount of acids, alkali or organic materials.
- D. Admixtures shall not contain more that 0.1 percent chloride ions.
- E. Air-Entraining Admixtures meeting ASTM C 260 and certified by manufacturer for Compatibility with other admixture shall be used.
- F. Water-Reducing Admixture shall conform to the requirements of ASTM C 494 Type A.

2.2 CONCRETE MIX PROPOTION AND SUBMITTAL

- A. Prepare design mixes for each type and strength of concrete by either laboratory or trial batch as specified in the ACI 301. Reports to include complete list of ingredients with their respected ASTM certifications proposed mixtures, slump, air contents and the ready mix plant location.

- B. Submit written proposed mix design to Tower Tech, Inc. for each class of concrete at least fifteen 15 days prior to the concrete placement. Do not begin concrete production until the mix is approved by Tower Tech, Inc.
- C. XC Furnish design mixes to provide normal weight concrete with the following properties:
 - 1. 5000 PSI, 28 days strength having maximum water cement ratio of 0.44 for non-entrained and 0.35 for air-entrained concrete. The concrete mix shall have 3000 PSI strength at 4 days under normal curing condition
- D. Slump: fresh concrete slump shall not be more than three inches. The slump for mixes with high-range water-reducing admixtures (super-plasticizer) shall not be more than eight inches.
- E. Adjustment to the concrete mix: Mix design adjustment may be requested when characteristic of materials, job condition, weather, or other circumstances would warrant the change.
- F. Comply with the ACI 304, "Guide for Measuring, Mixing, Transporting and Placing Concrete," as specified. Maximum concrete mix temperature during placing shall be 90 degree Fahrenheit. Concrete with mixing time of more than thirty minutes are not allowed. Tower Tech will maintain records of poured concrete items, date, quantity, air temperature, and test samples for record and will distribute copies to the concrete supplier.

2.3 RELATED MATERIALS:

- A. Bonding Compound subject to compliance provide one of the following materials
 - 2. Euco Weld by the Euclid Chemical Company
 - 3. Weldcrete by the Larson Company
- B. Epoxy Adhesive shall be two-part component, 100% solids, 100% reactive compound suitable for use on dry or damp concrete surfaces. Subject to compliance the following two products can be used:
 - 1. Sikadur Hi-Mod by Sika Chemical Corp.
 - 2. Euco Epoxy by Euclid Chemical Company
- C. Waterstop shall be centerbulb-type at construction joint of the basin.

2.4 FORM MATERIALS:

- A. General:
 - 1. Conform to the requirements of ACI 301
 - 2. Formwork design is the contractor's responsibility.
 - 3. Construct forms, unless otherwise noted, of wood, steel in accordance to the ACI 347.
 - 4. Design forms to resist subjected concrete pressure in addition to any other temporary construction forces that the formwork may be subjected to.
 - 5. Obtain approval of the manufacturer's standard forming system prior to use.
- B. Wood:
 - 1. All wood formwork shall be new and free of imperfections. Construct basin wall forms with ¾ inch thick water-resistant plywood.
 - 2. Plywood may be reused for the basin roof slab, provided holes are filled flush and any damaged portions are repaired satisfactory

- C. Form Release Agent:
 - 1. Provide commercial type form release agent with approved volatile organic compounds that would eliminate bonding and staining, and/or adversely effecting the concrete surfaces and/or the final concrete surface treatment.

2.5 REINFORCING MATERIALS:

- A. Reinforcing Bars shall meet the requirements of ASTM A615 Grade 60.
- B. Epoxy-Coated bars shall meet the requirements of ASTM A 767
- C. Welded Wire Fabric shall be plain type meeting the requirements of ASTM A 185
- D. Steel Wires shall be plain cold-drawn meeting ASTM A 775 requirements.
- E. Supports for Reinforcing such as chairs, bolsters, spacers and other devices for spacing, supporting and fastening the reinforcing shall be of approved materials complying with the CRSI specifications.
 - 1. For mat slab and all foundation work use sand plates.
 - 2. For all exposed-to-view concrete surfaces where support legs are in contact with formwork, provide supports with plastic coated legs or stainless steel meeting the CRSI requirements.

2.6 PLACING REINFORCEMENT

- A. Coat form surfaces that will be in contact with concrete with an approved, non-residual, form-coating compound before placing reinforcing. Coat steel forms with a non-staining, rust-preventive as recommended by form supplier. Do not allow excess form-coating material to accumulate in forms or come in contact with fresh concrete.
- B. Comply with Concrete Reinforcing Steel Institute's (CRSI) recommended practice for "Placing Reinforcing Bars," for details, placement and support of reinforcing.
- C. All reinforcing shall be cleaned of rust, dirt, ice and any other material that may reduce or destroy its bond to the concrete.
- D. Reinforcing shall be placed to maintain minimum coverage as shown for concrete protection. Arrange, space and secure reinforcing to their supports. All wire tie ends shall be orientated into the concrete and away from the exposed concrete surfaces.

2.7 INSTALLING EMBED ITEMS

- A. Set and build into the formwork anchorage devices and other embedded items required. Use setting drawings, diagrams, instructions, and directions provided by the suppliers of items.
- B. Install reglets; dovetail anchor slots in concrete structures as indicated on drawings.

2.8 PLACING CONCRETE

- A. Prior to concrete placement, inspect and recheck formwork, reinforcing steel installation and items to be embedded or cast-in. Notify related trades to permit installation of their work.

- B. Comply with the ACI 304, "Guide for Measuring, Mixing, Transporting and Placing Concrete," as specified. Maximum concrete mix temperature during placing shall be 90 degree Fahrenheit. Concrete with mixing time of more than thirty minutes is not allowed. Maintain records of poured concrete location, date, quantity, air temperature, and test samples taken. Notify the Tower Tech Inc representative prior to the concrete placing.
- C. Deposit concrete continuously into the formwork in layers of such thickness that no fresh concrete will be placed on sufficiently hardened concrete that may cause seams or weak plane. Avoid concrete segregation by placing it as close as possible to its final location. When placing concrete in forms in multiple layers, place each layer not deeper than 24 inches and avoid inclined joints.
- D. Consolidate placed concrete by mechanical vibrator or by hand spading, rodding, and/or tamping. Do not use vibrators to disperse concrete inside the forms. Insert and withdraw vibrators vertically and uniformly no farther than the effectiveness of the machine. Place vibrator to penetrate the top layer and six inches into the preceding layer. Do not insert vibrator into lower layers of concrete that have begun to set.

2.9 CURING AND FORM REMOVAL

- A. Protect freshly placed concrete from premature drying and excessive temperature change. In hot, dry, and windy weather protect concrete from rapid moisture loss with an approved evaporation control method. Keep concrete continuously moist and above 50 deg F during its initial curing by moisture retaining cover, moist curing or by combination thereof.
- B. Do not remove forms, shores and braces until concrete has gained sufficient strength to carry its own weight in addition to any other imposed construction or design load. Wall formwork may be removed after the initial curing period.
- C. Remove formwork progressively and in accordance with code requirement. Maintain work scheduling such that shock or unbalanced loading is not imposed on structure. Loosen forms carefully without prying action against hardened concrete surfaces. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- D. Clean and repair surfaces of forms to be reused in the Work. Split, delaminated or otherwise damaged forms shall not be acceptable for reuse.

3.0 CONCRETE SURFACE REPAIRS

- A. Patch: The non-structural defective areas shall be patched with cement mortar immediately after form removal. Mix dry-pack mortar, consisting of one part Portland cement to 2- 1/2 parts fine aggregates passing a No. 16 mesh sieve and enough water as needed for handling. Cut out defective area, voids over 1/2 inch in any dimension, tie rod holes to solid concrete but not less than 1" deep. Thoroughly clean, dampen with water, and brush coat the area with bonding agent. Conduct test at location not exposed to view for color match prior to patching. Compact mortars in place and strike-off slightly higher than the surrounding surfaces.
- B. Defect: Remove and replace not properly? concrete resulting in excessive honeycombing and/or other structural defects upon the express direction of the Tower Tech representative. Otherwise remove the defective areas with square cuts and expose reinforcing. Take extra care not to cut or damage any reinforcing bar. Dampen the damaged surfaces with bonding compound or epoxy adhesive. Fill voids with same class of concrete or epoxy concrete and cure as directed by Tower Tech.

- C. Shrinkage cracks: Fill shrinkage cracks with acceptable pressure epoxy grout under Tower Tech direction and as recommended by manufacturer.

3.1 CONSTRUCTING FORMS

- A. Design, erect, support and brace formwork to support vertical, lateral, static and/or dynamic loads that may be applied until concrete structure can support such loads. Construct formwork such that the concrete members are of correct size, shape, alignment and elevation. Maintain ACI construction tolerance for class C.
- B. Construct forms to size, shapes, lines, and dimensions shown. Obtain accurate alignment, location, grades, level, and plumb work in finished structure. Provide offsets, openings, keyways, recesses, reglets, chamfers, anchorage, inserts and other features required to complete the work. Joints shall be solidly butted with backup to prevent cement paste from leaking.
- C. Forms shall be fabricated for easy removal without hammering or prying against the concrete surfaces. Provide crush or wrecking plates where stripping may damage the concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and other features for easy removal.
- D. Chamfer exposed corners and edges as shown on the drawings, using wood, metal, PVC, or manufactured rubber chamfer strips to produce smooth and uniform lines.
- E. Provide opening in formwork for other trades as shown on the drawings. Coordinate exact size, location, recesses, and accurately place and secure support items into form.
- F. Thoroughly clean forms and adjust surfaces prior to concrete placement. Remove wood chips, dirt, debris and any other foreign materials before placing concrete. Retighten forms and braces as required to prevent cement paste leakage and to maintain proper alignment when concrete is placed.

3.2 FABRICATION OF PRECAST PARTS

- A. General: Manufacture precast members to dimensions, profile and sizes shown with clean true edges and surfaces. Install lifting devices for handling and erecting pieces as required.

3.4 ERECTION AND INSTALLATION

- A. General: Erect panels so as to prevent damage to mat slab. Raise and lift panels from casting bed as scheduled.
- B. Members shall be erected plumb in its accurate position and aligned. Use temporary wedges to correctly position the panels and anchor in place as shown on the drawings. Maximum offset in alignment with adjacent members shall be less than ¼ inch.
- C. Provide temporary bracing and supports until closures, columns, or other supporting structures have been installed. Connect members as shown on the shop drawings. Fill joints between panels with approved grout or dry pack as recommended.

END OF SECTION