

## SCOPE

- I 1.1 This practice covers the design and construction of concrete structures.
- I 1.2 **An asterisk (\*)** indicates that additional information from the Owner is required or approval by the Owner is required.

## SUMMARY OF ADDITIONAL REQUIREMENTS

- I ↗ 2.1 **Table 1** lists the standards which shall be used as specified in this practice.
- I ↗ 2.2 **Table 2** lists the practices, publications and standards which shall be used with this practice as applicable.

TABLE 1

| STANDARDS             |                                                                                            |
|-----------------------|--------------------------------------------------------------------------------------------|
| <b>ACI Standards</b>  |                                                                                            |
| 301                   | Specifications for Structural Concrete for Buildings                                       |
| 117                   | Standard Specifications for Tolerances for Concrete Construction and Materials             |
| 308                   | Standard Practice for Curing Concrete                                                      |
| 318                   | Building Code Requirements for Reinforced Concrete                                         |
| <b>ASTM Standards</b> |                                                                                            |
| A615                  | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| C31                   | Making and Curing Concrete Test Specimens in the Field                                     |
| C94                   | Ready-Mixed Concrete                                                                       |
| C150                  | Portland Cement                                                                            |
| C192                  | Making and Curing Concrete Specimens in the Lab                                            |

TABLE 2

| PRACTICES                  |                                                                                  |
|----------------------------|----------------------------------------------------------------------------------|
| IP 7-1-1                   | Fired Heaters                                                                    |
| IP 16-3-1                  | Wiring Methods and Material Selection                                            |
| STANDARDS AND PUBLICATIONS |                                                                                  |
| <b>ACI Publications</b>    |                                                                                  |
| 305R                       | Hot Weather Concreting                                                           |
| 306R                       | Cold Weather Concreting                                                          |
| <b>ACI Standards</b>       |                                                                                  |
| 350R                       | Environmental Engineering Concrete Structures                                    |
| <b>ASTM Standards</b>      |                                                                                  |
| A767                       | Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement |
| A775                       | Specification for Epoxy-Coated Reinforcing Steel Bars                            |

- I ↗ \* 2.3 **Local codes and standards** may be substituted for the ones referenced herein provided the following provisions are met:
  - a. The resultant design meets the safety and serviceability criteria attained through this practice.
  - b. Substitution is accepted by the authorities where the facility is to be located and by the Owner's Engineer.

## MATERIALS

- I 3.1 **Concrete** shall be per **ACI 318**.
- R 3.2 All **reinforcing bars** shall be **ASTM A615** Grade 60 unless specified otherwise.
- I \* 3.3 Contractor shall submit a statement detailing **the concrete mix design** for approval by the Owner's Engineer. This statement shall include properties of the materials, the proportions of cement, water and aggregates by weight and type and quantity of admixtures (if any) proposed for each class of concrete required.

- R ♦ 3.4 Design strength of concrete mixes shall be not less than those given in **Table 3** and the following:
- In countries where testing is done on cubes**, cylinders shall also be made and tested in order to establish a correlation between the required strengths for the cylinder and the cube specimens.
  - Lacking adequate laboratory facilities for testing such cylinders**, the 28-day compressive strengths of 4 in., 6 in. and 8 in. cubes (100, 150, and 200 mm) must be at least 130%, 125%, and 120% respectively, of specified cylinder strengths.

**TABLE 3**  
**APPLICATION AND COMPRESSIVE STRENGTHS OF CONCRETE**

| GROUP | APPLICATION                                                                                                                                                                        | COMPRESSIVE STRENGTH (2) |      |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|
|       |                                                                                                                                                                                    | psi                      | MPa  |
| A     | Concrete for structures exposed to sea water environment                                                                                                                           | 5000                     | 34.5 |
| B     | Prestressed or precast concrete structures                                                                                                                                         | 4000                     | 27.6 |
|       | Precast piling                                                                                                                                                                     |                          |      |
|       | Concrete for structures exposed continuously to fresh water environment                                                                                                            |                          |      |
|       | Liquid retaining structures                                                                                                                                                        |                          |      |
| C     | Concrete for fireproofing                                                                                                                                                          | 3500                     | 24.1 |
|       | Precast pipe                                                                                                                                                                       |                          |      |
|       | Precast concrete sills, copings, and all ornamental concrete                                                                                                                       |                          |      |
|       | Reinforced concrete chimneys                                                                                                                                                       |                          |      |
| D     | Foundations for tanks in sulfuric acid service                                                                                                                                     | 3000                     | 20.7 |
|       | Girders, beams, walls, slabs, piers, and columns                                                                                                                                   |                          |      |
|       | Superstructure for docks and bridges                                                                                                                                               |                          |      |
|       | Pipe supports                                                                                                                                                                      |                          |      |
|       | Concrete on or below grade: such as footings, cast-in-place piles, pile caps, tie beams, grade beams, anchor blocks, pump blocks, catch basins, manholes, sidewalks and paving (1) |                          |      |
| E     | Concrete for structures not listed                                                                                                                                                 | 2000                     | 13.8 |
|       | Concrete for underground electrical (protective cover, etc.)                                                                                                                       |                          |      |
| F     | Low strength concrete for filling purposes where mass, rather than strength, is the principal requirement                                                                          | 1500                     | 10.3 |

**Notes:**

- (1) **For concrete exposed to moderate sulfate attack (per ACI 318)** and where cement with less than 8% C<sub>3</sub>A is not available, cement with up to 12% C<sub>3</sub>A may be used if approved by Owner's Engineer and provided that concrete strength is increased to at least 3500 psi.
- (2) The values above represents the 28-day compressive strength of normal Portland cement concrete (or 7-day compressive strength of high-early strength concrete) as determined by tests on 6 in. diameter by 12 in. high (150 x 300 mm) cylinders per **ASTM C31** or **ASTM C192**.

- R ♦ 3.5 **Cement shall be per ASTM C150 and the selection of cement type** shall be governed by the following:
- For concrete exposed to soils or other materials having low pH values (less than 5.0 if continuous replenishment of acidity), special cement type or other measures may be required as directed by the Owner's Engineer.
  - Selection of cement type for **concrete for structures exposed to seawater environment** shall be per **ACI 318** for "moderate exposure" except that the maximum water-cement ratio shall be 0.40.
- R \* 3.6 **Admixtures shall be approved** by the Owner's Engineer and calcium chloride admixtures shall not be used.
- R 3.7 All reinforcement shall be bent-cold.
- R,M 3.8 All concrete used for **underground electrical** work shall be per **IP 16-3-1**.
- R 3.9 All concrete used for **underground air ducts** for fired heaters shall be per **IP 7-1-1**.