

SCOPE

- I 1.1 This practice covers the design of reinforced concrete foundations bearing on soil or supported on piles and anchor bolts.
- I ↗ 1.2 **An asterisk (*)** indicates that additional information from the Owner, or approval by the Owner is required.

SUMMARY OF ADDITIONAL REQUIREMENTS

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

TABLE 1

STANDARD AND SPECIFICATION	
ACI Standard	
318	Building Code Requirements for Reinforced Concrete
AISC Specification	
	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings

TABLE 2

STANDARDS	
ACI Standard	
349	Code Requirements For Nuclear Related Concrete Structures, Appendix B - Steel Embedments
ASTM Standards	
A36	Structural Steel
A193	Alloy-Steel and Stainless Bolting Materials for High-Temperature Services
A194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A325	Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
A354	Quenched and Tempered Allow Steel Bolts, Studs, and Other Externally Threaded Fasteners
A563	Carbon and Alloy Steel

DESIGN

- R * 3.1 **Allowable soil bearing pressures** shall be based on the results of a soils investigation, and a consideration of permissible total and differential settlements. The allowable soil bearing pressure shall be subject to Owner's approval.
- R ↗ * 3.2 **Footing size and shape** shall be determined by the following criteria:
 - a. Maximum soil pressure shall not exceed the applicable allowable value.
 - b. Under the action of vertical loads and overturning moment, the ratio of stabilizing moment to overturning moment shall not be less than 1.5 under all conditions.
 - c. For foundations bearing on cohesionless soil supporting towers or other slender structures with heights greater than 100 ft (30 m) and a ratio of total height to skirt or base diameter greater than 10: 85% of the foundation shall be in compression for the design overturning moment during erection and 100% of the foundation shall be in compression for the design overturning moment during normal operation.
- R 3.3 The **bottoms of soil bearing foundations for all major structures and equipment** shall be located below the frost line.
- R 3.4 **Top of concrete** shall be a minimum of 8 in. (200 mm) above finished grade or high point of paving for foundations under the following equipment:
 - a. Steel column bases of open structural framing.
 - b. Pipe supports.
 - c. Pumps, fans, compressors, and legs or skirts of towers, drums and exchangers.

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- R 3.5 **Piers under base plates and pedestals supporting vessels with skirts** shall extend 1-1/2 in. (38 mm) minimum beyond the base plates, or skirt base rings and lugs, in all directions.
- R 3.6 **Piers and pedestals** shall be reinforced to resist thermal stresses due to expansion of base plates, soleplates, rails, skirt base rings and lugs, anchor bolts, and concrete. Pedestals are supports having a ratio of height to least width dimension of not more than 3. Piers are supports with a ratio of height to least width dimension of 3 or more. As a minimum, **vertical reinforcing shall be tied** as follows:
- In **piers**, vertical reinforcing shall be enclosed in lateral ties per **ACI 318** requirements for tie reinforcement for compression members.
 - In **pedestals**, vertical reinforcing shall be enclosed by closed ties meeting the size and spacing requirements per **ACI 318** for tie reinforcement for compression members.
 - The spacing between the top two ties in piers and pedestals shall not be more than 4 in. (100 mm).
- R 3.7 **Concrete in piers and pedestals, and grout** shall not extend above the bottom face of base plates, soleplates, rails, skirt base rings and lugs.
- S 3.8 **Anchor bolts** shall be sized using allowable stresses given in the AISC Specification. Anchor bolt sizes determined by this method, **which have not been galvanized, inorganic zinc coated or fluorocarbon coated**, shall have their diameters increased by 1/8 in. (3 mm) as a corrosion allowance. Anchor bolts shall be developed as ductile connections with all anchor loads transferred to reinforcing steel per ACI 318 for hooked bolts, or be designed per ACI 349 Appendix B for bolts with an anchor head, nut, plate or similar device. Anchor bolt material shall be as follows:
- Material for carbon steel anchor bolts shall be per ASTM A 36 or ASTM A 307, unless otherwise specified. The nuts for carbon steel anchor bolts and headed bolts shall be per ASTM A 536, Grade A, heavy hex. ASTM A 36 or ASTM A 307 anchor bolts can be hot dip galvanized.
 - Material for alloy steel anchor bolts shall be per ASTM A 354, Grade BC, unless otherwise specified. The nuts for A354 bolts shall be per ASTM A 563, Grade DH, heavy hex. ASTM A 354 Grade BC anchor bolts can be hot dip galvanized.
 - When anchor bolts will be subjected to elevated temperatures significantly above normal atmospheric temperatures, the alloy bolting material shall be per ASTM A 193, Grade B7, and the nuts shall be per ASTM A 194, Grade 2H, heavy hex. ASTM A 193 Grade B7 anchor bolts **cannot** be hot dip galvanized.
- R 3.9 **Pedestals for vessels with skirts** shall have the area within the skirt sloped for drainage, and a suitable embedded pipe or opening in the grout for discharge to the pavement outside the skirt.
- R 3.10 **Foundations supporting rotating equipment not classified as heavy equipment** shall be as follows:
- The ratio of weight of concrete to weight of equipment shall not be less than 3:1 for rotary equipment and 5:1 for reciprocating equipment.
 - In addition to reinforcing steel required by design, a minimum of two rows of ties shall be provided around anchor bolts in the top of machine pedestals. A horizontal layer of temperature steel shall be provided in the top of pedestals or slabs.
- R 3.11 When **anchoring to existing concrete**, expansion type anchors shall not be used when anchoring rotating equipment, and in any other application where the anchor bolts will be subjected to vibratory loads.
- R 3.12 There shall be no pipelines, **sewers or conduit located within a zone bounded by the bottom of the foundation** and planes projected 45° downward and outward from the bottom edge of the foundation.

Revision Memo

9/68 Original Issue of Basic Practice
6/72 Revision 1
6/75 Revision 2

6/85 Revision 3
12/93 Revision 4

3/98 Revision 0 - Original Issue of International Practice

Par. 2.2 new. **Par. 3.2a** editorial. **Par. 3.2b** lowered factor of safety for overturning from 1.8 to 1.5 to be consistent with prevailing industry practice. **Par. 3.5** deleted. **Par. 3.6** clarified requirements for reinforcing tier in piers and pedestals. **Par. 3.8** eliminated restriction on increasing allowable stresses for wind and earthquake.

Old Par. No.

3.6-3.12

New Par. No.

3.5-3.11

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