

CODE

13.4.1.1 Number and arrangement of deep foundation members shall be determined such that forces and moments applied to the foundation do not exceed the permissible deep foundation strength. Permissible deep foundation strength shall be determined through principles of soil or rock mechanics in accordance with the general building code, or other requirements as determined by the building official.

13.4.1.2 Design of deep foundation members shall be in accordance with 13.4.2 or 13.4.3.

13.4.2 Allowable axial strength

13.4.2.1 It shall be permitted to design a deep foundation member using load combinations for allowable stress design in **ASCE/SEI 7**, Section 2.4, and the allowable strength specified in Table 13.4.2.1 if (a) and (b) are satisfied:

- (a) The deep foundation member is laterally supported for its entire height
- (b) The applied forces cause bending moments in the deep foundation member less than the moment due to an accidental eccentricity of 5 percent of the member diameter or width

Table 13.4.2.1—Maximum allowable compressive strength for deep foundation members

| Deep foundation member type | Maximum allowable compressive strength ^[1] | |
|--|---|-----|
| Uncased cast-in-place concrete drilled or augered pile | $P_a = 0.3f'_c A_g + 0.4f_y A_s$ | (a) |
| Cast-in-place concrete pile in rock or within a pipe, tube, or other permanent metal casing that does not satisfy 13.4.2.3 | $P_a = 0.33f'_c A_g + 0.4f_y A_s$ ^[2] | (b) |
| Metal cased concrete pile confined in accordance with 13.4.2.3 | $P_a = 0.4f'_c A_g$ | (c) |
| Precast nonprestressed concrete pile | $P_a = 0.33f'_c A_g + 0.4f_y A_s$ | (d) |
| Precast prestressed concrete pile | $P_a = (0.33f'_c - 0.27f_{pc})A_g$ | (e) |

^[1] A_g applies to the gross cross-sectional area. If a temporary or permanent casing is used, the inside face of the casing shall be considered the concrete surface.

^[2] A_s does not include the steel casing, pipe, or tube.

13.4.2.2 If 13.4.2.1(a) or 13.4.2.1(b) is not satisfied, a deep foundation member shall be designed using strength design in accordance with 13.4.3.

13.4.2.3 Metal cased cast-in-place concrete deep foundation members shall be considered to be confined if (a) through (f) are satisfied:

- (a) Design shall not use the casing to resist any portion of the axial load imposed.
- (b) Casing shall have a sealed tip and shall be mandrel-driven.

COMMENTARY

R13.4.1.1 General discussion on selecting the number and arrangement of piles, drilled piers, and caissons is provided in R13.2.6.1.

R13.4.2 Allowable axial strength

R13.4.2.1 Potential changes to lateral support of the deep foundation member due to liquefaction, excavation, or other causes, should be considered.

The values in the Table 13.4.2.1 represent an upper bound for well understood soil conditions with quality workmanship. A lower value for the maximum allowable compressive strength may be appropriate, depending on soil conditions and the construction and quality control procedures used. For auger-grout piles, where grout is placed through the stem of a hollow-stem auger as it is withdrawn from the soil, the strength coefficient of 0.3 is based on a strength reduction factor of 0.6. The designer should carefully consider the reliable grout strength, grout strength testing methods, and the minimum cross-sectional area of the pile, accounting for soil conditions and construction procedures. Additional information is provided in **ACI 543R**.

R13.4.2.3 The basis for this allowable strength is the added strength provided to the concrete by the confining action of the steel casing. This strength applies only to non-axial load-bearing steel where the stress in the steel is taken in hoop tension instead of axial compression. In this Code, steel pile casing is not to be considered in the design of the pile to resist a portion of the pile axial load. Provisions for