

## CODE

## COMMENTARY

is adequately protected from possible deleterious action due to soil constituents, changing water levels, or other factors indicated by boring records of site conditions.

closed ties or spirals required in an uncased concrete pile and eliminates the need for confinement ties.

**18.13.5.9 Concrete-filled pipe piles****R18.13.5.9 Concrete-filled pipe piles**

**18.13.5.9.1** For structures assigned to SDC C, D, E or F, concrete-filled pipe piles shall have longitudinal reinforcement in the top of the pile with a total area of at least  $0.01A_g$  and with a minimum length within the pile equal to two times the required embedment length into the pile cap, but not less than the development length in tension of the reinforcement.

**R18.13.5.9.1** For resistance to uplift forces, concrete bond to the steel pipe is to be ignored in determining anchorage of the pile. Concrete shrinkage can be detrimental to bond, therefore shrinkage should be controlled, or force transfer via other methods such as headed studs or surface irregularities on the pipe should be considered. Reinforcement at the top of the pile is extended into the pile cap to tie the elements together and assist transfer of force to the pile cap.

**18.13.5.10 Precast concrete piles****R18.13.5.10 Precast concrete piles**

**18.13.5.10.1** For precast concrete driven piles, the length of transverse reinforcement provided shall be sufficient to account for potential variations in the elevation of pile tips.

**R18.13.5.10.1** The potential for driving precast piles to a tip elevation different than that specified in the construction documents should be considered when detailing the pile. If the pile reaches refusal at a shallower depth, a longer length of pile will need to be cut off. If this possibility is not foreseen, the length of transverse reinforcement required by these provisions may not be provided after the excess pile length is cut off.

**18.13.5.10.2** Precast nonprestressed concrete piles for structures assigned to SDC C shall satisfy (a) through (d):

- (a) Minimum longitudinal steel reinforcement ratio shall be 0.01.
- (b) Longitudinal reinforcement shall be enclosed within a minimum of No. 10 closed ties or 10 mm diameter spirals, for up to 500 mm diameter piles, and No. 13 closed ties or 13 mm diameter spirals, for larger diameter piles.
- (c) Spacing of transverse reinforcement within a distance of 3 times the least cross-sectional dimension of the pile from the bottom of the pile cap shall not exceed the lesser of 8 times the diameter of the smallest longitudinal bar and 150 mm.
- (d) Transverse reinforcement shall be provided throughout the length of the pile at a spacing not exceeding 150 mm.

**18.13.5.10.3** For structures assigned to SDC D, E, or F, precast nonprestressed concrete piles shall satisfy the requirements of 18.13.5.10.2 and the requirements for uncased cast-in-place or augered concrete piles in SDC D, E, or F in Table 18.13.5.7.1.

**18.13.5.10.4** For structures assigned to SDC C, precast-prestressed concrete piles shall satisfy (a) and (b):

- (a) If the transverse reinforcement consists of spirals or circular hoops, the volumetric ratio of transverse reinforcement,  $\rho_s$ , in the upper 6 m shall not be less than that

**R18.13.5.10.4(a)** In a study of minimum confinement reinforcement for prestressed concrete piles (Sriharan et al. 2016), the relationship between curvature ductility demand