5. Where the transverse reinforcement consists of circular spirals, the volumetric ratio of spiral transverse reinforcement in the ductile region shall comply with the following:

$$\rho_s = 0.25(f'_c / f_{yh})(A_g / A_{ch} - 1.0)[0.5 + 1.4P/(f'_c A_g)] \quad \textbf{(Equation 18-6)}$$

but not less than:

$$\rho_s = 0.12(f'_c / f_{yh})\,[0.5 + 1.4P/(f'_c A_g)] \geq 0.12\, f'_c / f_{yh} \quad \textbf{(Equation 18-7)}$$

and need not exceed:

$$\rho_s = 0.021 \quad \textbf{(Equation 18-8)}$$

where:

A_g = Pile cross-sectional area, square inches (mm^2).

A_{ch} = Core area defined by spiral outside diameter, square inches (mm^2).

f'_c = Specified compressive strength of concrete, psi (MPa).

f_{yh} = Yield strength of spiral reinforcement$\leq$ 85,000 psi (586 MPa).

P = Axial load on pile, pounds (kN), as determined from Equations 16-5 and 16-7.

ρ_s = Volumetric ratio (vol. spiral/ vol. core).

This required amount of spiral reinforcement is permitted to be obtained by providing an inner and outer spiral.

6. Where transverse reinforcement consists of rectangular hoops and cross ties, the total cross-sectional area of lateral transverse reinforcement in the ductile region with spacing, s, and perpendicular dimension, h_c, shall conform to:

$$A_{sh} = 0.3s\, h_c\, (f'_c / f_{yh})(A_g / A_{ch} - 1.0)[0.5 + 1.4P/(f'_c A_g)] \quad \textbf{(Equation 18-9)}$$

but not less than:

$$A_{sh} = 0.12s\, h_c\, (f'_c / f_{yh})\,[0.5 + 1.4P/(f'_c A_g)] \quad \textbf{(Equation 18-10)}$$

where:

f_{yh} = $\leq$ 70,000 psi (483 MPa).

h_c = Cross-sectional dimension of pile core measured center to center of hoop reinforcement, inch (mm).

s = Spacing of transverse reinforcement measured along length of pile, inch (mm).

A_{sh} = Cross-sectional area of tranverse reinforcement, square inches (mm^2).

f'_c = Specified compressive strength of concrete, psi (MPa).