P_P = Service load capacity of pile (from geotechnical analysis)

= 120 kips = 60 tons

14-in.-square prestressed concrete pile:

f_c' = 5.00 ksi

f_{ci}' = 3.50 ksi

w_c = 0.150 kcf (normal weight concrete)

H = relative humidity = 75% [LRFD Fig. 5.4.2.3.3-1]

Properties of 14-in.-square pile:

A_g = 196 in.^{2}

I = 3201 in.^{4}

S = 457 in.^{3}

Strand pattern and properties:

Assume eight ½-in.-diameter, low-relaxation, Grade 270 (f_{pu} = 270 ksi) strands.

Strands are tensioned to 75% of the tensile strength of the strands:

f_{pj} = initial stress in strands before any losses

= $0.75f_{pu} = 0.75(270) = 202.5$ ksi

A_{ps} = area of one strand = 0.153 in.^{2}

F_{pj} = total prestress force in strands before any losses

= $8(0.153)(202.5) = 247.9$ kips

Yield strength of strands:

f_{py} = $0.90f_{pu} = 0.90(270) = 243.0$ ksi [LRFD Table 5.4.4.1-1]

20.9.2.1 Losses

Losses are computed in accordance with the *LRFD Specifications*, with modifications noted in Section 20.5.5.2 of this manual.

20.9.2.1.1 Losses due to Shrinkage, Relaxation, and Creep, Δf_{pLT}

The equation for estimating combined losses due to shrinkage, relaxation, and creep in prestressed concrete members, Δf_{pLT}, is:

$$\Delta f_{pLT} = 10.0\frac{f_{pi}A_{ps}}{A_g}\gamma_h\gamma_{st} + 12\gamma_h\gamma_{st} + \Delta f_{pR} \geq 0 \quad \text{[LRFD Eq. 5.9.3.3-1]}$$

where

$\gamma_h = 1.7 - 0.01H = 1.7 - 0.01(75) = 0.95$ [LRFD Eq. 5.9.3.3-2]

$\gamma_{st} = 5/(1 + f_{ci}') = 5/(1 + 3.5) = 1.11$ ksi [LRFD Eq. 5.9.3.3-3]

f_{pi} = 202.5 ksi (strand stress prior to transfer)

Δf_{pR} = Estimate of relaxation loss, taken as 2.4 ksi for low-relaxation strand

$$\Delta f_{pLT} = (10.0)\frac{(202.5)(8)0.153)}{196}(0.95)(1.11) + 12(0.95)(1.11) + 2.4 = 13.3 + 12.7 + 2.4 = 28.4 \text{ ksi} \geq 0$$