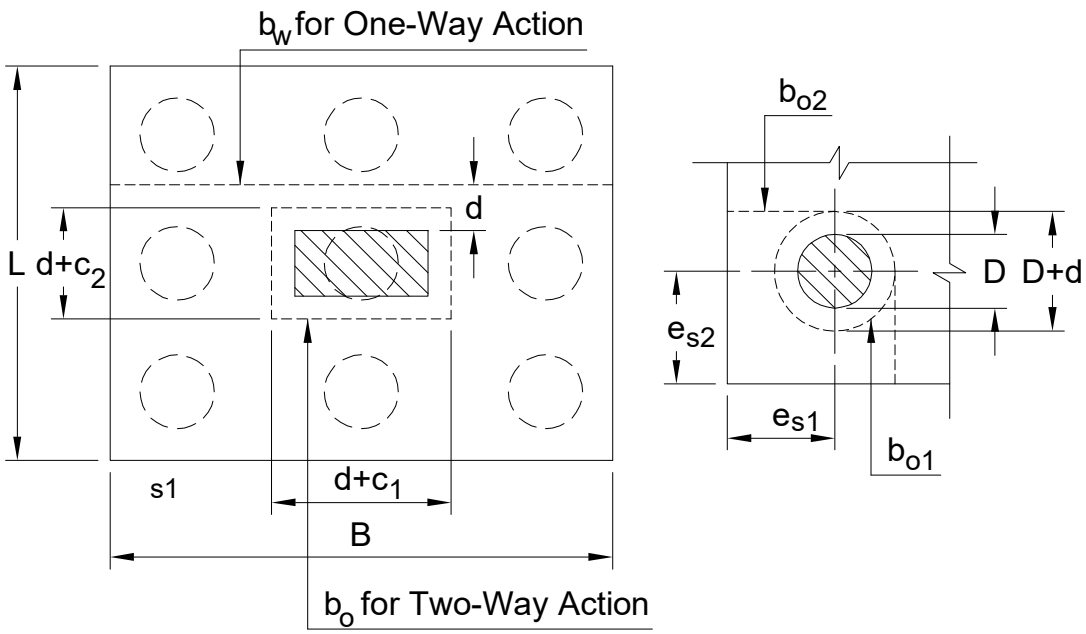
Design Depth for Pile Cap as per ACI 318-11 Chapter 11



System

Width of Column, c_1=			16.0 in
Length of Column, c_2=			16.0 in
Pile Diameter, D=			12.0 in
Edge Distance for Corner Pile, e_{s1}=			15 in
Edge Distance for Corner Pile, e_{s2}=			15 in
Width of Pile Cap, B=			8.5 ft
Length of Pile Cap, L=			8.5 ft
Concrete Cover, co=			7.0 in

Load

Pile Service Dead Load, P_D=			20 kips
Pile Service Live Load, P_L=			10 kips
Ultimate Pile Load, P_u=	$1.2*P_D+1.6*P_L$	=	40 kips

Material Properties

Concrete Strength, f'_c=			4000 psi
Shear Strength Reduction Factor (According to Cl.9.3.2 of ACI318), Φ=			0.75
Modification Factor for Lightweight Concrete, λ=			1.00

Calculation of Required Thickness due to One-Way Shear

Assume that Thickness of Pile Cap, t=			22 in
Depth of Pile Cap, d=	t - co	=	15 in
Width of Critical Section for One-Way Shear, b_w= MIN(B ; L)		=	8.5 ft
Number of Piles fall within Critical Section for One-Way Action, n_{r1}=			3

Ultimate Shear force at Critical Area Section, V_{u1}= $P_u * n_{r1}$ = 120 kips

Nominal Concrete Shear Strength, $\Phi V_c = \Phi * 2 * \lambda * \sqrt{f'_c} * \frac{b_w * 12 * d}{1000}$ = 145 kips

Check Validation = IF($\Phi V_c > V_{u1}$; "O.K."; "Increase Depth") = O.K.

Calculation of Required Thickness due to Two-Way Shear for Group Piles

Perimeter of Critical Section for Two-Way Shear, b_0= $2*(c_1+d) + 2*(c_2+d)$ = 124.0 in

Number of Piles fall within Critical Section for Two-Way Action, n_{r2}= 8

Ultimate Shear force at Critical Area Section, V_{u2}= $P_u * n_{r2}$ = 320 kips

Column Type= SEL("ACI/Alfa S";Type;) = Interior

Alfa Constant, α_s= TAB("ACI/AlfaS"; Alfa; Type=Type) = 40.00

Ratio of Long to Short Column Dimensions, β= $MAX(c_1;c_2)/MIN(c_1;c_2)$ = 1.00

Concrete Shear Strength (According to Eq. 11-31 of ACI318),

V_{c1}= $\left(2 + \frac{4}{\beta}\right) * \lambda * \sqrt{f'_c} * \frac{b_0 * d}{1000}$ = 706 kips

Concrete Shear Strength (According to Eq. 11-32 of ACI318),

V_{c2}= $\left(\alpha_s * \frac{d}{b_0} + 2\right) * \lambda * \sqrt{f'c} * \frac{b_0 * d}{1000}$ = 804 kips

Concrete Shear Strength (According to Eq. 11-33 of ACI318),

V_{c3}= $4 * \lambda * \sqrt{f'_c} * \frac{b_0 * d}{1000}$ = 471 kips

Nominal Concrete Shear Strength, $\Phi V_c = \Phi * MIN(V_{c1}; V_{c2}; V_{c3})$ = 353 kips

Check Validation = IF($\Phi V_c > V_{u2}$; "O.K."; "Increase Depth") = O.K.

Calculation of Required Thickness due to Two-Way Shear for Single Corner Pile

Perimeter of Critical Section for Two-Way Shear, b_{01}= $\pi * (D + d)$ = 84.8 in

Perimeter of Critical Section for Two-Way Shear, b_{02}= $\pi * (D+d)/4 + e_{s1} + e_{s2}$ = 51.2 in

Perimeter of Critical Section for Two-Way Shear, b_0= $MIN(b_{01} ; b_{02})$ = 51.2 in

Perimeter Ultimate Shear force at Critical Section, V_{u3}= $P_u * 1.0$ = 40 kips

Column Type= SEL("ACI/Alfa S";Type;) = Corner

Alfa Constant, α_s= TAB("ACI/AlfaS"; Alfa; Type=Type) = 20.00

Ratio of Long to Short Column Dimensions, β= $MAX(c_1;c_2)/MIN(c_1;c_2)$ = 1.00

Concrete Shear Strength (According to Eq. 11-31 of ACI318),

V_{c1}= $\left(2 + \frac{4}{\beta}\right) * \lambda * \sqrt{f'_c} * \frac{b_0 * d}{1000}$ = 291 kips

Concrete Shear Strength (According to Eq. 11-32 of ACI318),

V_{c2}= $\left(\alpha_s * \frac{d}{b_0} + 2\right) * \lambda * \sqrt{f'c} * \frac{b_0 * d}{1000}$ = 382 kips

Concrete Shear Strength (According to Eq. 11-33 of ACI318),

V_{c3}= $4 * \lambda * \sqrt{f'_c} * \frac{b_0 * d}{1000}$ = 194 kips

Nominal Concrete Shear Strength, $\Phi V_c = \Phi$ * MIN(V_{c1}; V_{c2}; V_{c3}) = 146 kips

Check Validation = IF($\Phi V_c > V_{u3}$; "O.K."; "Increase Depth") = O.K.

Calculation Summary

Thickness of Pile Cap, t= t = 22 in