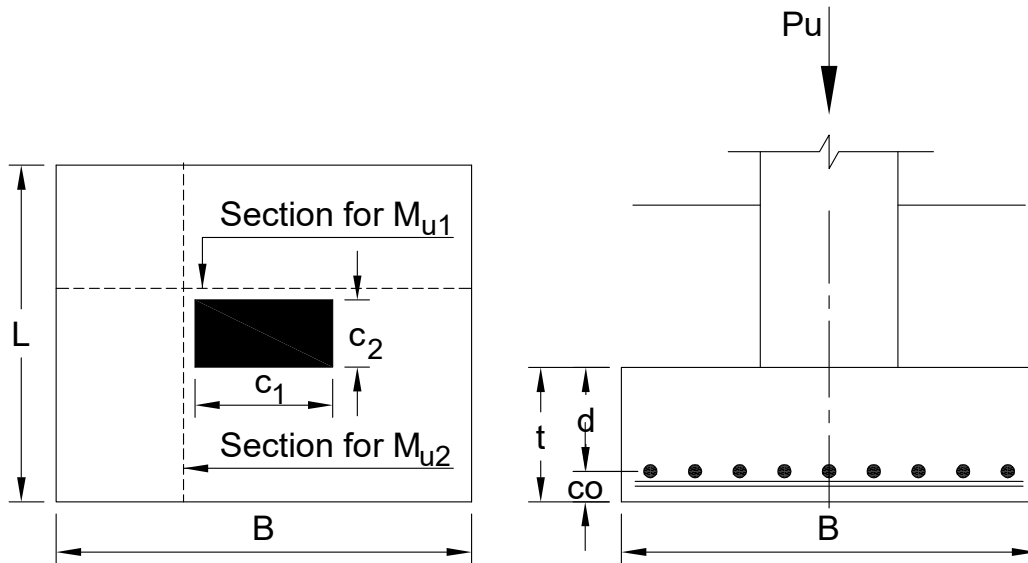




Design of Reinforcement for Shallow Foundation as per ACI 318-11 Chapter 15



System

Width of Column, c_1 =		30.0 in
Length of Column, c_2 =		12.0 in
Width of Footing, B =		13 ft
Length of Footing, L =		13 ft
Area of Footing, A_f =	$B * L$	= 169 ft ²
Depth of Footing, t =		30.5 in
Concrete Cover, co =		2.5 in
Effective Depth of Footing, d =	$t-co$	= 28.0 in

Load

Service Dead Load, P_D =		350 kips
Service Live Load, P_L =		275 kips
Ultimate Load, P_u =	$1.2 * P_D + 1.6 * P_L$	= 860 kips
Ultimate Pressure, q_s =	P_u / A_f	= 5.09 ksf

Material Properties

Concrete Strength, f'_c =		3000 psi
Yield Strength of Reinforcement, f_y =		60000 psi
Tension Strength Reduction Factor (According to Cl.9.3.2 of ACI318), Φ =		0.90

Determine Area of Reinforcement Distributed in Footing Width (B)

$$M_{u1} = q_s * B * \left(0.5 * \left(L - \frac{c_2}{12} \right) \right)^2 / 2 = 1191 \text{ kip*ft}$$



$$R_{n1} = \frac{M_{u1} * 12000}{\Phi * B * 12 * d^2} = 130 \text{ psi}$$

$$\rho_1 = \frac{0.85 * f_c}{f_y} * \left(1 - \sqrt{1 - \frac{2 * R_{n1}}{0.85 * f_c}} \right) = 0.0022$$

Minimum Reinforcement Ratio (According to Cl.7.12.2 of ACI318),

$$\rho_{min} = \text{IF}(f_y \leq 50000; 0.002; \text{IF}(f_y \geq 77143; 0.0014; 0.0018)) = 0.0018$$

$$\text{Required Area of Reinforcement, } A_{s1_Req} = \text{MAX}(\rho_{min}; \rho_1) * B * d * 12 = 9.61 \text{ in}^2$$

$$\text{Provided Reinforcement, Bar} = \text{SEL}(\text{"ACI/Bar"}; \text{Bar};) = \text{No.8}$$

$$\text{Provided Reinforcement, } A_{sb1} = \text{TAB}(\text{"ACI/Bar"}; \text{Asb}; \text{Bar}=\text{Bar}) = 0.79 \text{ in}^2$$

$$\text{Number of Bars, } n_1 = 13$$

$$\text{Provided Area of Reinforcement, } A_{s1_Prov} = n_1 * A_{sb1} = 10.27 \text{ in}^2$$

$$\text{Check Validity} = \text{IF}(A_{s1_Prov} \geq A_{s1_Req}; \text{"Valid"}; \text{"Invalid"}) = \text{Valid}$$

Determine Area of Reinforcement Distributed in Footing Length (L)

$$M_{u2} = q_s * L * \left(0.5 * \left(B - \frac{c_1}{12} \right) \right)^2 / 2 = 912 \text{ kip*ft}$$

$$R_{n2} = \frac{M_{u2} * 12000}{\Phi * L * 12 * d^2} = 99 \text{ psi}$$

$$\rho_2 = \frac{0.85 * f_c}{f_y} * \left(1 - \sqrt{1 - \frac{2 * R_{n2}}{0.85 * f_c}} \right) = 0.0017$$

Minimum Reinforcement Ratio (According to Cl.7.12.2 of ACI318),

$$\rho_{min} = \text{IF}(f_y \leq 50000; 0.002; \text{IF}(f_y \geq 77143; 0.0014; 0.0018)) = 0.0018$$

$$\text{Required Area of Reinforcement, } A_{s2_Req} = \text{MAX}(\rho_{min}; \rho_2) * L * d * 12 = 7.86 \text{ in}^2$$

$$\text{Provided Reinforcement, Bar} = \text{SEL}(\text{"ACI/Bar"}; \text{Bar};) = \text{No.8}$$

$$\text{Provided Reinforcement, } A_{sb2} = \text{TAB}(\text{"ACI/Bar"}; \text{Asb}; \text{Bar}=\text{Bar}) = 0.79 \text{ in}^2$$

$$\text{Number of Bars, } n_2 = 11$$

$$\text{Provided Area of Reinforcement, } A_{s2_Prov} = n_2 * A_{sb2} = 8.69 \text{ in}^2$$

$$\text{Check Validity} = \text{IF}(A_{s2_Prov} \geq A_{s2_Req}; \text{"Valid"}; \text{"Invalid"}) = \text{Valid}$$

Design Summary

$$\text{Area of Reinforcement Distributed in Footing Width, } A_{s1} = A_{s1_Prov} = 10.27 \text{ in}^2$$

$$\text{Area of Reinforcement Distributed in Footing Length, } A_{s2} = A_{s2_Prov} = 8.69 \text{ in}^2$$