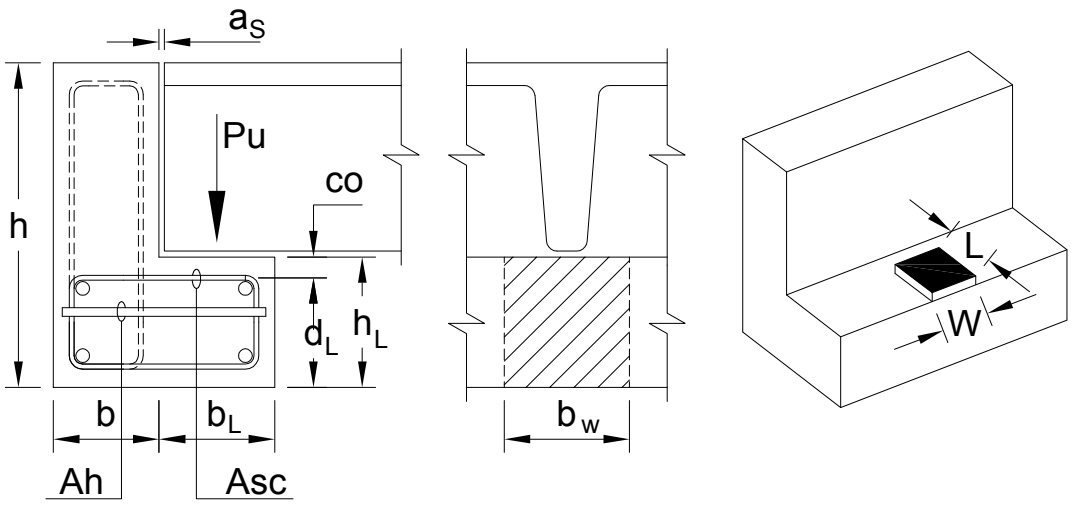
Design of Beam Ledge as per ACI 318-11 Chapters 9 & 11



System

Width of Beam, b=			7.0 in
Height of Beam, h=			36.0 in
Width of Beam Ledge, b_L=			6.0 in
Height of Beam Ledge, h_L=			12.0 in
Concrete Cover, co=			1.25 in
Width of Bearing Pad, W=			4.5 in
Length of Bearing Pad, L=			4.5 in
Thickness of Bearing Pad, t_b=			0.3 in
Gap Spacing, a_s=			1.0 in
Shear Spacing, a_v=	$2/3 * L + a_s$	=	4.0 in
Flexural Spacing, a_f=	a_v + co	=	5.25 in
Effective Width According to Shear Requirements, b_{ws}=	$W + 4 * a_v$	=	20.5 in
Effective Width According to Flexural Requirements, b_{wf}=	$W + 5 * a_f$	=	30.8 in
Effective Depth of Beam Ledge, d_L=	h_L - co	=	10.75 in

Load

Dead Load, P_D=			11.0 kips
Live Load, P_L=			6.5 kips
Service Load, P=	$P_D + P_L$	=	17.5 kips
Ultimate Load, P_u=	$1.2 * P_D + 1.6 * P_L$	=	23.6 kips

Material Properties

Concrete Strength, f'_c=	5000 psi
Yield Strength of Reinforcement, f_y=	60000 psi
Shear Strength Reduction Factor (According to Cl.9.3.2 of ACI318), Φ_s=	0.75

Bearing Strength Reduction Factor (According to Cl.9.3.2 of ACI318), Φ_b= 0.65

Modification Factor for Lightweight Concrete, λ= 1.00

Friction Factor (According to Cl.11.6.4.3 of ACI318), μ= 1.4* λ = 1.40

Maximum Service Load for Bearing Pads, q= 1000 psi

Check Bearing Plate Dimension

Capacity of Bearing Plate, B_p= W * L * q /1000 = 20.25 kips

Check Validity= IF(B_p>P;"Valid" ;"Increase Dimension") = Valid

Check Concrete Bearing Strength

Bearing Strength of Concrete, $\Phi P_{nb} = \Phi_b * 0{,}85 * f'_c * L * W / 1000$ = 55.9 kips

Check Validity= IF(ΦP_{nb}>Pu;"Valid" ;"Invalid") = Valid

Check Maximum Nominal Shear-Transfer by Effective Section

Nominal Shear by Effective Section (According to Cl.11.9.3.2.1 of ACI318),

V_{n1}= $0.2 * f'_c * b_{ws} * d_L$ /1000 = 220.4 kips

V_{n2}= $(480 + 0.08 * f'_c) * b_{ws} * d_L$ /1000 = 193.9 kips

V_{n3}= $1600 * b_{ws} * d_L$ /1000 = 352.6 kips

ΦV_n= Φ_s * MIN(V_{n1}; V_{n2}; V_{n3}) = 145.4 kips

Check Validity= IF(ΦV_n>P_u;"Valid" ;"Increase Dimension") = Valid

Determine Shear Friction Reinforcement (A_{vf})

Required Reinforcement for Shear Friction (According to Cl.11.6.4.1 of ACI318),

A_{vf}= $P_u * 1000 / (\Phi_s * f_y * \mu)$ = 0.37 in^2 per bws

Determine Direct Tension Reinforcement (A_n)

Required Reinforcement for Direct Tension (According to Cl.11.8.3.4 of ACI318),

A_n= $0.2 * P_u * 1000 / (\Phi_s * f_y)$ = 0.10 in^2 per bwf

Determine Flexural Reinforcement (A_f)

M_u= $P_u * a_f + 0.2 * P_u * (h_L - d_L)$ = 129.8 kip*in

Required Reinforcement for Flexural (According to Cl.11.8.3.3 of ACI318),

A_f= $M_u * 1000 / (\Phi_s * f_y * 0.8 * d_L)$ = 0.34 in^2 per bwf

Determine Primary Tension Reinforcement (A_{sc})

Required Area of Reinforcement for Primary Tension (According to Cl.11.8.3.5 of ACI318),

A_{sc}= MAX ($2/3 * A_{vf}/b_{ws} + A_n/b_{wf}$; $A_f/b_{wf} + A_n/b_{wf}$) = 0.015 in^2 per in

Minimum Area of Reinforcement for Primary Tension (According to Cl.11.8.5 of ACI318),

A_{sc_min}= $0{,}04 * f'_c / f_y * d_L$ = 0.036 in^2 per in

A_{sc_req}= MAX (A_{sc}; A_{sc_min}) = 0.036 in^2 per in

Provided Reinforcement, Bar=	SEL("ACI/Bar"; Bar;)	=	No.5
Spacing between Bars, s=			8.0 in
Provided Reinforcement, A_{sb}=	TAB("ACI/Bar"; Asb; Bar=Bar)	=	0.31 in^2
Check Validity=	IF(A_{sb}/A_{sc_req}>s; "Valid"; "Invalid")	=	Valid

Determine Horizontal Reinforcement (A_h)

Required Area of Reinforcement for Horizontal Shear (According to Cl.11.8.4 of ACI318),

A_h=	$0.5*(A_{sc\_req}-A_n/b_{wf})$	=	0.016 in^2 per in
Provided Reinforcement, Bar=	SEL("ACI/Bar"; Bar;)	=	No.4
Provided Reinforcement, A_{sb}=	TAB("ACI/Bar"; Asb; Bar=Bar)	=	0.20 in^2
Check Validity=	IF(A_{sb}/A_h>s; "Valid"; "Invalid")	=	Valid

Design Summary

Primary Tension Reinforcement, A_{sc_req}=	A_{sc_req}	=	0.036 in^2 per in
Horizontal Shear Reinforcement, A_h=	A_h	=	0.016 in^2 per in

Distribute in two-thirds of Effective Ledge Depth adjacent to A_{sc}