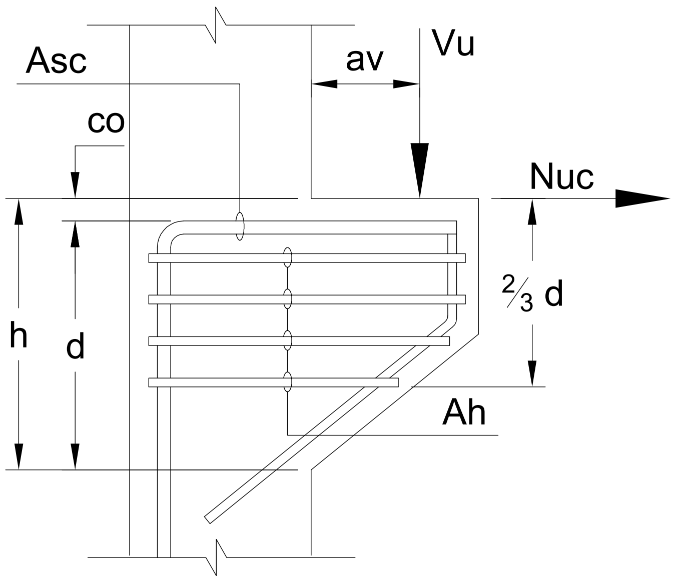
Chapter 1: Concrete Design

Design of Corbel as per ACI 318-11 Chapter 11



System

Corbel Width, b=			14.0 in
Corbel Height, h=			12.0 in
Concrete Cover, co=			1.0 in
Corbel Depth, d=	h - co = 12.0 - 1.0	=	11.0 in
Distance from Column Face to Vertical Load, a_v=			3.0 in

Load

Ultimate Vertical Load, V_u=	88.8 kips
Ultimate Horizontal Load, Nuc=	32.0 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=			0.75
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

Check Vertical Load Capacity

V_{n1}= $0.2*f'_c*b*d/1000$ = 154.0 Kips

V_{n2}= $(480+0.08*f'_c)*b*d/1000$ = 135.5 Kips

V_{n3}= $1600*b*d/1000$ = 246.4 Kips

Nominal Vertical Capacity (According to Cl.11.8.3.2.1 of ACI318),

ΦV_n= $\Phi * MIN(V_{n1}; V_{n2}; V_{n3})$ = 101.6 Kips

Vertical Load Capacity= IF(V_u>ΦV_n;"Not Pass";"Pass") = Pass

Determine Shear Friction Reinforcement (A_{vf})

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

A_{vf}= $V_u \times 1000/(\Phi \times f_y \times \mu)$ = 1.41 in²

Determine Direct Tension Reinforcement (A_n)

Minimum Horizontal Force on Corbel, Nuc_min= $0.2 \times V_u$ = 17.8 Kips

Horizontal Force on Corbel, Nuc_act= MAX (Nuc ; Nuc_min) = 32.0 kips

Required Area of Reinforcement for Direct Tension (According to Cl.11.8.3.1 of ACI318),

A_n= $Nuc\_act * 1000/((\Phi)*f_y)$ = 0.71 in²

Determine Flexural Reinforcement (A_f)

M_u= V_u*a_v+Nuc_act*(h-d) = 298.4 kip*in

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

A_f= $M_u \times 1000/(\Phi \times f_y \times 0.9 \times d)$ = 0.67 in²

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}) + A_n ; A_f + A_n) = 1.65 in^2

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

A_{sc_min}= $0.04*f'_c/f_y*b*d$ = 0.51 in²

A_{sc_Req}= MAX (A_{sc}; A_{sc_min}) = 1.65 in²

Provided Reinforcement, Bar= SEL("ACI/Bar"; Bar;) = No.9

Provided Area of Bar Reinforcement, A_{sb}= TAB("ACI/Bar"; Asb; Bar=Bar) = 1.00 in^2

Number of Provided Bars, n= 2

Provided Area of Reinforcement, A_{sc_Prov}= n * A_{sb} = 2.00 in^2

Check Validity= IF($A_{sc\_Prov} \geq A_{sc\_Req}$; "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_Req}=	$0.5*(A_{sc\_Prov}-A_n)$	=	0.65 in²
Provided Reinforcement, Bar=	SEL("ACI/Bar"; Bar;)	=	No.3
Provided Area of Bar Reinforcement, A_{sb}=	TAB("ACI/Bar"; Asb; Bar=Bar)	=	0.11 in^2
Number of Provided Bars, n=			6
Provided Area of Reinforcement, A_{h_Prov}=	$n * A_{sb}$	=	0.66 in^2
Check Validity=	IF($A_{h\_Prov} \geq A_{h\_Req}$; "Valid"; "Invalid")	=	Valid

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

Design Summary

Area of Reinforcement for Primary Tension A_{sc}=	A_{sc_Prov}	=	2.00 in²
Area of Reinforcement for Horizontal Shear, A_h=	A_{h_Prov}	=	0.66 in²

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