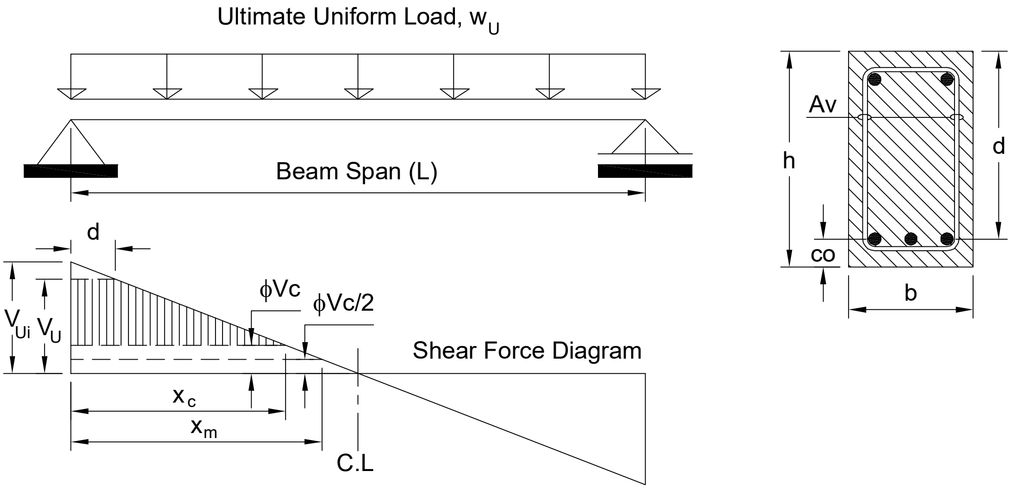
Design of Shear Reinforcement for Section Subject to Shear & Flexure as per ACI318-11 Chapter 11



System

Width of Concrete Section, b=			13.0 in
Depth of Concrete Section, h=			22.5 in
Concrete Cover, co=			2.5 in
Effective Depth of Concrete Section, d=	$h - co = 22.5 - 2.5$	=	20.0 in
Beam Span, L=			30.0 ft

Load

Ultimate Uniform Load, w_u=			4.5 kip/ft
Ultimate Shear Force at Support, V_{ui}=	$w_u*L/2$	=	67.5 kips
Ultimate Shear Force at Distance [d] from Support, $V_u = V_{ui} - w_u*(d/12)$		=	60.0 kips

Material Properties

Concrete Strength, f'_c=	3000 psi
Yield Strength of Reinforcement, f_y=	40000 psi
Shear Strength Reduction Factor (According to Cl.9.3.2 of ACI318), Φ=	0.75
Modification Factor for Lightweight Concrete, λ=	1.00
Concrete Density, w_c=	150 psi

Determine Concrete Shear Strength

Nominal Shear Strength provided by Concrete (According to Eq. 11-3 of ACI318),

$$V_c = 2*\lambda*\sqrt{f'_c}*\frac{b*d}{1000} = 28.5 \text{ kips}$$

Shear Reinforcement is : IF(V_u>Φ∗V_c;"Required";"Not Required") = Required

Determine Area of Shear Reinforcement

Nominal Shear Strength provided by Reinforcement (According to Eq. 11-2 of ACI318),

$$V_s = \frac{V_u - \Phi*V_c}{\Phi} = 51.5 \text{ kips}$$

Maximum Allowable Shear Strength provided by Reinforcement (According to Cl.11.4.7.9 of ACI318),

V_{s_max}= $8 \cdot \sqrt{f'_c} \cdot \frac{b \cdot d}{1000}$ = 113.9 kips

IF(V_s>V_{s_max}; "Increase Beam Dimension"; "OK") = OK

Spacing of Provided Stirrups, s= 6.0 in

Required Area of Reinforcement, A_v= $\frac{V_s \cdot s \cdot 1000}{f_y \cdot d}$ = 0.39 in^2

Minimum Area of Reinforcement (According to Cl.11.4.6.3 of ACI318),

A_{v_min1}= $\frac{0.75 \cdot \sqrt{f'_c} \cdot b \cdot s}{f_y}$ = 0.08 in^2

A_{v_min2}= $\frac{50 \cdot b \cdot s}{f_y}$ = 0.10 in^2

A_{v_min}= MAX(A_{v_min1} ; A_{v_min2}) = 0.10 in^2

Required Area of Reinforcement, A_{vc_Req}= MAX(A_v; A_{v_min}) = 0.39 in^2

Provided Reinforcement, Bar= SEL("ACI/Bar"; Bar;) = No.4

Provided Reinforcement, A_{sb}= TAB("ACI/Bar"; Asb; Bar=Bar) = 0.20 in^2

Number of Stirrups, n= 1

Provided Area of Reinforcement, A_{vc_Prov}= A_{sb} * n * 2 = 0.40 in^2

Check Validity= IF($A_{vc\_Prov} \geq A_{vc\_Req}$; "Valid"; "Invalid") = Valid

Determine Maximum Permissible Spacing of Stirrups

Allowable Shear Strength provided by Reinforcement for Spacing Limit (According to Cl.11.4.5.3 of ACI318),

V_{s_limit}= $4 \cdot \lambda \cdot \sqrt{f'_c} \cdot \frac{b \cdot d}{1000}$ = 57.0 kips

Factor for Maximum Spacing of Stirrups, Fac= IF($V_s \leq V_{s\_limit}$;1;0.5) = 1.0

Maximum Spacing of Stirrups (According to Cl.11.4.5.1 of ACI318),

s_{max}= MIN(d/2;24) * Fac = 10.00 in

Check Validity= IF($s \leq s_{max}$;"Valid"; "Invalid") = Valid

Determine Distribution Distance of Shear Reinforcement

Distance from Support beyond which Minimum Shear Reinforcement is Required,

x_c= $\frac{V_{ui} - \Phi \cdot Vc}{w_u}$ = 10.3 ft

Distance from Support beyond which Concrete can carry Shear Force,

x_m= $\frac{V_{ui} - \Phi \cdot Vc / 2}{w_u}$ = 12.6 ft

Design Summary

Provided Area of Shear Reinforcement, A_{vc_Prov}= A_{vc_Prov} = 0.40 in^2

Distance from Support beyond which Minimum Shear Reinforcement, x_c= x_c = 10.3 ft

Distance from Support beyond which Concrete can carry Shear Force, x_m= x_m = 12.6 ft