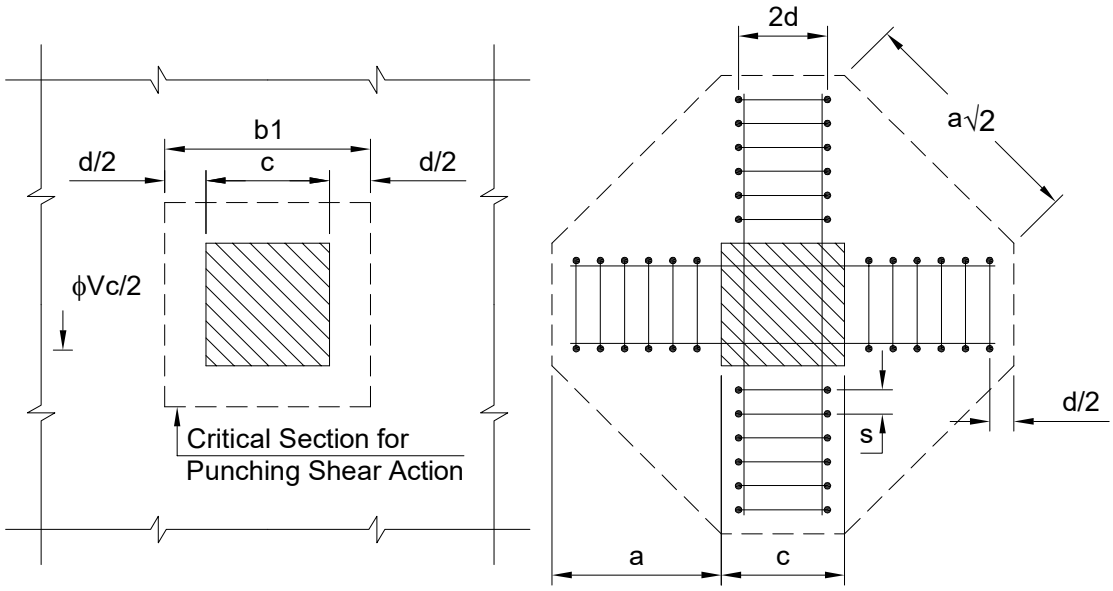
Design Shear Reinforcement for Slab which to resist Punching Stress around Interior Square Column

As per ACI318-11 Chapter 11



System

Column Dimension, c=			12.0 in
Thickness of Concrete Slab, h=			7.5 in
Concrete Cover, co=			1.5 in
Effective Depth of Concrete Section, d=	h - co = 7.5 - 1.5	=	6.0 in
Bar Diameter of Shear Reinforcement, Dia=			0.375 in

Load

Ultimate Shear Force, V_u=			120.0 kips

Material Properties

Concrete Strength, f'_c=			4000 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

Determine Concrete Shear Strength

b_1=	c + d	=	18.0 in
Perimeter of Critical Section, b_0=	4 * b_1	=	72.0 in

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

V_c=	$4*\lambda*\sqrt{f'_c}*b_0*d/1000$	=	109.3 kips
Punching Shear Reinforcement is : IF(V_u>Φ∗V_c;"Required";"Not Required")		=	Required

Determine Area of Shear Reinforcement

Minimum Effective Depth of Slab with Shear Reinforcement (According to Cl.11.11.3 of ACI318),

d_{min}= MIN(6;16*Dia) = 6.0 in

Effective Depth of Slab : IF(d>d_{min};"Should Increase";"OK") = OK

Maximum Shear Strength of Slab with Shear Reinforcement (According to Cl.11.11.3.2 of ACI318),

V_n= $6*\sqrt{f'_c}*b_0*d/1000$ = 163.9 kips

Validity : IF(V_u>Φ*V_n;"Not Valid";"Valid") = Valid

Shear Strength provided by Concrete with Shear RFT (According to Cl.11.11.3.1 of ACI318),

V_{ci}= $2*\lambda*\sqrt{f'_c}*b_0*d/1000$ = 54.6 kips

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

V_s= $\frac{V_u - \Phi * V_{ci}}{\Phi}$ = 105.4 kips

Spacing of Provided Bars, s= 3.0 in

Required Area of Reinforcement, A_v= $\frac{V_s * s * 1000}{f_y * d}$ = 0.88 in^2

Required Area of Reinforcement for each side of Column, A_{v_side}= $A_v/4$ = 0.22 in^2

Perimeter of Critical Section where Shear Reinforcement may be terminated,

b'_0= $\frac{V_u * 1000}{\Phi * 2 * \lambda * \sqrt{f'_c} * d}$ = 210.8 in

Distance from Column Face where Shear Reinforcement may be terminated,

a= $\left(\frac{b'_0}{4} - c\right)/\sqrt{2}$ = 28.8 in

Design Summary

Required Area of Reinforcement, A_v= A_v = 0.88 in^2

Distance from Column Face where Shear Reinforcement may be terminated: a = 28.8 in