Stabil-loc Systems, LLC. - 2.875" O.D.
Adjustable Head Assembly (Bracket)
Capacity Calculations - Bare Steel

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Client:	Stabil-loc Systems, LLC.
Job Number :	FC08472
Report Date:	3/21/2019 REV4

Adjustable Head Assembly (Bracket) Design Properties

Product:	6x4 Angle	A36 Steel
Thickness (in):	0.375	SPECIFIED
Angle Length (in):	15	SPECIFIED
Yield Strength (ksi):	36	SPECIFIED MINIMUM
Ultimate Strength (ksi):	58	SPECIFIED MINIMUM

Design References

AISC 14th Edition, AISC 360-16, 2017 AC358, 2015 IBC

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Capacities Summary Table

Capacity Type	Capacity (kips)	Min Cover (in)	Controlling Factor
Compression - Added Plate	93.0	14.0	Total Capacity of Adjustable Head Assembly (Bracket) with Pipe Supports (Gusset Welds)
Compression - No Plate	93.0	17.0	Total Capacity of Adjustable Head Assembly (Bracket) with Pipe Supports (Gusset Welds)
Compression - No Plate (Alt. #1 Concrete Parameters)	32.6	8.0	Concrete Two-Way Shear (Punching Shear): **Note: This requires a 24" wide footing**
Compression - No Plate (Alt. #2 Concrete Parameters)	55.5	12.0	Concrete Two-Way Shear (Punching Shear): **Note: This requires a 24" wide footing**

Note: Capacities may be limited by shaft capacities.

3/21/2019 REV4

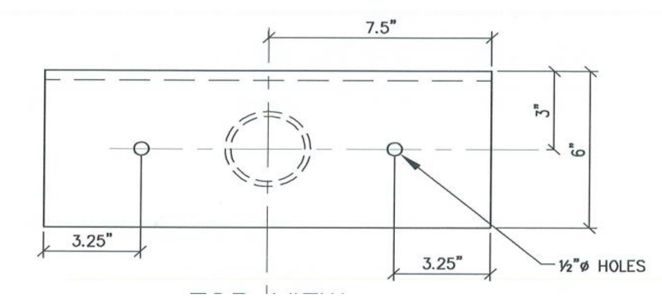
By **Date**

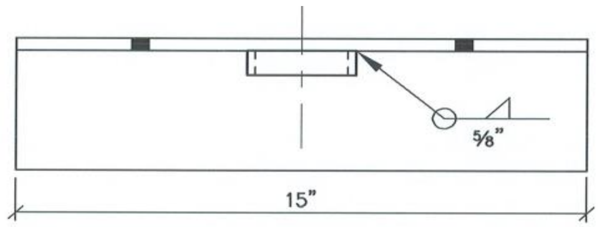
COLORADO LICENSED MATTHEW SCOTT GOODERHAM 0054286 PROFESSIONAL ENGINEER

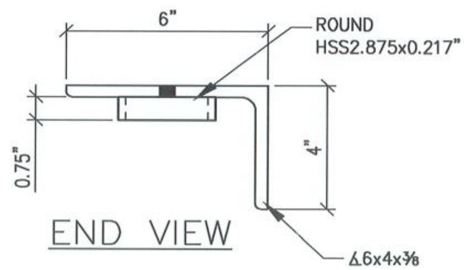
Mar 21 2019 8:03 AM

Reviewed By DocuSign

DIMENSIONS AND PROPERTIES







Known Head Assembly Angle Properties:

d =	6.00	Angle width (in)	
b =	15.00	Angle length (in)	
h =	4.00	Angle leg height (in)	
t =	0.375	Angle thickness (in)	
F_y =	36	Steel yield strength of angle (ksi)	
F_u =	58	Steel tensile strength of angle (ksi)	
t_g =	0	Galvanized coating thickness (in)	*[assumed min. AC358 3.9]*
t_c =	0.036	Corrosion loss (in)	*[0.013 galv., 0.036 bare per AC358 3.9]*

Calculated Head Assembly Angle Properties: per AISC Table 17-27, page 17-36

d' =	5.964	Angle width with corrosion loss (in)
b' =	14.964	Angle length with corrosion loss (in)
b'_{eff} =	14.964	Effective angle length with corrosion loss (in)
h' =	3.982	Angle length with corrosion loss (in)
t' =	0.339	Angle thickness with corrosion loss (in)
A' =	89.245	Angle area with corrosion loss (in^2)
I' =	4.368	Moment of Inertia (per AutoCAD) with corrosion loss (in^2)
y' =	3.045	Distance from Neutral Axis (per AutoCAD) with corrosion loss (in^2)
S' =	1.434	Elastic Section Modulus (bracket top plate) with corrosion loss (in^2)

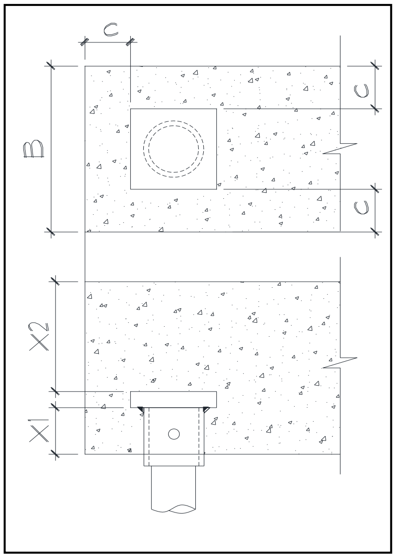
Known Allthread Properties:

D=	1.320	Diameter - Root of Allthread	
F_u =	125.000	Steel tensile strength of allthread (ksi)	
t_g =	0.000	Galvanized coating thickness (in)	*[assumed min. AC358 3.9]*
t_c =	0.036	Corrosion loss (in)	*[0.013 galv., 0.036 bare per AC358 3.9]*
E =	29000	Modulus of elasticity (ksi)	

Calculated Allthread Properties: *per AISC Table 17-27, page 17-39*

D'=	1.192	Diameter with corrosion loss (in) - (7% reduction per AISC Part 1)

DIMENSIONS AND PROPERTIES - CONT'D



Known Concrete Properties (No Plate):

X1 =	N/A	Bottom clear dist. (in)	*[Post-Contruction Application]*
X2 =	17.0	Top clear distance (in)	*[Assumed min.]*
c =	17.0	Side clear distance (in)	*[Min. 4" per IBC 1810.3.11]*
f_c' =	3,000	Concrete compressive strength (psi)	

Calculated Concrete Properties :

B =	40.0	Concrete width (in)

Known Concrete Properties (Added Plate):

X1 =	N/A	Bottom clear dist. (in)	*[Post-Contruction Application]*
X2 =	14.0	Top clear distance (in)	*[Assumed min.]*
c =	14.0	Side clear distance (in)	*[Min. 4" per IBC 1810.3.11]*
f_c' =	3,000	Concrete compressive strength (psi)	

Calculated Concrete Properties :

B =	38.0	Concrete width (in)

*Note: Clear distances are to either a concrete edge or to reinforcement.

Known Head Assembly Sleeve Properties:

D=	3.500	Sleeve Diameter	
M=	0.188	Sleeve Wall Thickness (in)	
A=	8.500	Length of Sleeve (in)	
F_y =	42	Steel yield strength of sleeve (ksi)	
F_u =	58	Steel tensile strength of sleeve (ksi)	
t_g =	0	Galvanized coating thickness (in)	*[assumed min. AC358 3.9]*
t_c =	0.036	Corrosion loss (in)	*[0.013 galv., 0.036 bare per AC358 3.9]*
E =	29000	Modulus of elasticity (ksi)	
D'=	3.464	Sleeve outer diameter with corrosion loss (in)	
M'=	0.139	Sleeve wall thickness with corrosion loss (in) - (7% reduction per AISC pg. 1-5)	

Known Head Assembly Gusset Plate Properties:

d =	6.00	Gusset length (in)	
b =	5.00	Gusset depth (in)	
t =	0.25	Gusset thickness (in)	
F_y =	36	Steel yield strength of gusset (ksi)	
F_u =	58	Steel tensile strength of gusset (ksi)	
t_g =	0	Galvanized coating thickness (in)	*[assumed min. AC358 3.9]*
t_c =	0.036	Corrosion loss (in)	*[0.013 galv., 0.036 bare per AC358 3.9]*
d' =	5.982	Gusset length with corrosion loss (in)	
b' =	4.982	Gusset depth with corrosion loss (in)	
M'=	0.214	Gusset thickness with corrosion loss (in)	

DIMENSIONS AND PROPERTIES - CONT'D

Note: Top plate may be added in the field between the footing and the adjustable head assembly angle.

Known Top Plate Properties:

d =	10.000	Top Plate width (in)	
b =	20.000	Top Plate length (in)	
t =	0.625	Top Plate thickness (in)	
F_y =	36	Steel yield strength of plate (ksi)	
F_u =	58	Steel tensile strength of plate(ksi)	
t_g =	0	Galvanized coating thickness (in)	*[assumed min. AC358 3.9]*
t_c =	0.036	Corrosion loss (in)	*[0.013 galv., 0.036 bare per AC358 3.9]*
E =	29000	Modulus of elasticity (ksi)	
d' =	9.964	Plate width with corrosion loss (in)	
b' =	19.964	Plate length with corrosion loss (in)	
t' =	0.589	Top plate thickness with corrosion loss (in)	

Known Weld Properties:

Size =	10	Weld size in 16th (in)
F_{EEX} =	70	Weld yield strength (ksi)

Known Shaft Tested Capacities:

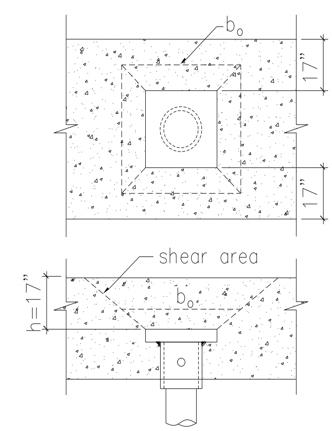
Ps=	105.5	Max Allowable Shaft Compression Capacity (kips) - FROM TESTING
Pb=	96.9	Max Allowable Bracket Compression Capacity (kips) - FROM TESTING

COMPRESSION CAPACITY - CONNECTION OF BRACKET TO STRUCTURE (NO PLATE)

ACI 318, Chapter 14, Section 14.5.5.1

Concrete Two-Way Shear (Punching Shear): $\phi = 0.60$

$$V_n = \left[\frac{4}{3} + \frac{8}{3\beta}\right]\sqrt{f_c^{'}}\,b_o h \le 2.66\sqrt{f_c^{'}}\,b_o h$$ *[ACI Table 14.5.5.1]*



β = ratio of long side to short side of top plate

β = 2.51

b_o = shear perimeter = 2*(d'+17")+2*(b'+17")

b_o = 109.86 in

h = X2 = 17.0 in

V_n = 245.1 k

$$V^{'} = 0.7*\phi*V_n$$ *[AC358 3.7.1.2]*

V' = **102.94 k**

*Note: It is the designer's responsibility to check one way shear in concrete beam applications.

ACI 318, Chapter 14, Section 14.5.6.1

Concrete Bearing: $\phi = 0.60$

$$B_n = 0.85*f_c^{'}*A_1\sqrt{\frac{A_2}{A_1}}$$ *[ACI Table 14.5.6.1]* Where: $\sqrt{\frac{A_2}{A_1}} \le 2$

A_1 = loaded area = Adjustable Head Assembly Angle Area

A_1 = 89.2 in^2

A_2 = projected area = (Adjustable Head Assembly Angle Width+17"*2)^2

A_2 = 1956.8 in^2

$\sqrt{\frac{A_2}{A_1}} =$ 2.0

B_n = 455.2 k

$$B^{'} = 0.7*\phi*B_n$$ *[AC358 3.7.1.2]*

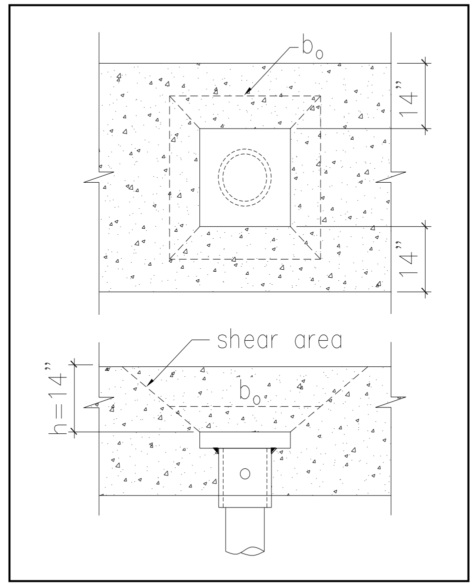
B' = **191.16 k**

COMPRESSION CAPACITY - CONNECTION OF BRACKET TO STRUCTURE (ADDED PLATE)

ACI 318, Chapter 14, Section 14.5.5.1

Concrete Two-Way Shear (Punching Shear): $\phi = 0.60$

$$V_n = \left[\frac{4}{3} + \frac{8}{3\beta}\right]\sqrt{f_c^{'}}\,b_o h \leq 2.66\sqrt{f_c^{'}}\,b_o h$$ *[ACI Table 14.5.5.1]*



β = ratio of long side to short side of top plate

β = 2.00

b_o = shear perimeter = 2*(d'+14")+2*(b'+14")

b_o = 115.86 in

h = X2 = 14.0 in

V_n = 236.3 k

$$V^{'} = 0.7 * \phi * V_n$$ *[AC358 3.7.1.2]*

V' = **99.25 k**

*Note: It is the designer's responsibility to check one way shear in concrete beam applications.

ACI 318, Chapter 14, Section 14.5.6.1

Concrete Bearing: $\phi = 0.60$

$$B_n = 0.85 * f_c^{'} * A_1\sqrt{\frac{A_2}{A_1}}$$ *[ACI Table 14.5.6.1]* Where: $\sqrt{\frac{A_2}{A_1}} \leq 2$

A_1 = loaded area = Adjustable Head Assembly Angle Area

A_1 = 198.9 in^2

A_2 = projected area = (Adjustable Head Assembly Angle Width+14"*2)^2

A_2 = 1820.9 in^2

$\sqrt{\frac{A_2}{A_1}} =$ 2.0

B_n = 1014.5 k

$$B^{'} = 0.7 * \phi * B_n$$ *[AC358 3.7.1.2]*

B' = **426.09 k**

COMPRESSION CAPACITY - CONNECTION OF BRACKET TO STRUCTURE - CONT'D

AISC Section F10.1

Yielding of Adjustable Head Assembly Angle with No End Supports: $\Omega = 1.67$

$Mn = 1.5My$ where, $My =$ S*Fy

$My =$ 51.63 k-in

$Mn =$ 77.45 k-in

$w = \frac{2Mn}{l^2}$ where, $l =$ 7.48 in (angle length/2)

$w =$ 2.77 k/in

$b' =$ 14.964 in (angle length)

$P = wb =$ 41.40 k

$\frac{Pn}{\Omega} =$ **24.79 k** **GREATER CAPACITY ACHIEVED W/ END SUPPORTS**

AISC Page 14-4 to 14-6

Bending of Top Plate with No End Supports: $\Omega = 1.67$

$$\frac{P_n}{\Omega} = \frac{\left(\frac{t'}{l}\right)^2 F_y BN}{3.33}$$ *[AISC Page 14-6]*

B = d' = 9.96 in (top plate width)

N = b' = 19.96 in (top plate length)

D' = 1.192 in (all thread diameter)

t' = 0.589 in (top plate thickness with corrosion loss)

λ = 1 (page 14-5)

$l = \max(m, n, \lambda n')$ Where: $m = \frac{N - 0.95(D')}{2}$ $n = \frac{B - 0.8(D')}{2}$ $n' = \frac{\sqrt{(D')(D')}}{4}$

m = 9.416 n = 4.505 n'= 0.298

l = 9.42 in

$\frac{P_n}{\Omega} =$ **8.41 k**

Total Capacity of Angle and Additional Top Plate: $\frac{P_n}{\Omega} =$ **33.21 k** **GREATER CAPACITY ACHIEVED W/END SUPPORTS**

Note: Field cut-to-fit pipe supports are required at the ends of the angle, between the angle and head plate.

COMPRESSION CAPACITY - INTERNAL STRENGTH OF BRACKET W/ PIPE SUPPORTS

Note: In order to prevent yielding of the adjustable head assembly angle due to bending, field cut-to-fit pipe supports must be installed on each side of the angle between the angle and the head assembly head plate. The pipe must be A500 steel with a minimum 2 3/8" diameter and have a minimum thickness of 3/16".

Note: Per AISC Section J2.2b, maximum weld size shall be not greater than the thickness of the material if material is less than 1/4" thick, or not greater than the material thickness minus 1/16" if material is greater than 1/4".

AISC Section J2.4

Welded Connection of Gusset Plate to Sleeve - Weld Metal: $\Omega = 2.0$

$R_n = A_{we}F_{nw}$ *[AISC Eq. J2-4]* Where: $A_{we} = t_e L$

material thickness= 0.188 "

weld size = 0.625 "

Max Weld = 0.188 "

t_e= 0.115 " (includes corrosion loss, one side of weld)

L= 4.982 " (gusset depth)

A_w= 0.573 in^2

$F_{nw} = 0.60F_{EXX}\left(1+0.5\sin^{1.5}(\theta)\right)$ *[AISC Equation J2-5]* θ= 90 °

F_w= 63 ksi

R_n= 36.07 k

$\frac{R_n}{\Omega}$ = 18.03 k (each gusset plate)

AISC Section J4.2

Welded Connection of Gusset to Sleeve - Base Metal:

Shear Yield- $R_n = 0.6F_yA_g$ *[AISC Equation J4-3]* $\Omega = 1.50$

Sleeve: A_g= 0.69 in^2

R_n= 17.43 k

Gusset: A_g= 1.07 in^2

R_n= 23.03 k

$\frac{R_n}{\Omega}$ = 11.62 k

Shear Rupture- $R_n = 0.6F_uA_{nv}$ *[AISC Equation J4-4]* $\Omega = 2.0$

Sleeve: A_g= 0.69 in^2

R_n= 24.07 k

Gusset: A_g= 1.07 in^2

R_n= 37.10 k

$\frac{R_n}{\Omega}$ = 12.04 k

$\frac{R_n}{\Omega}$ = 11.62 k [Min of above] - (each gusset plate)

Total Capacity of Adjustable Head Assembly (Bracket) with Pipe Supports (Gusset Welds)

Bracket capacity at each end of the head assembly angle = capacity of 2 gusset plates= 23.24 kips

Assuming a uniform load across the top of the angle, the load at the center support = 2*each end support

Total Capacity of the Head Assembly (Bracket) = 92.96 kips **MECHANICAL FAILURE**

SUMMARY	
For Concrete Capacity with End Supports and Added Top Plate:	
Compression	
93.0 k	**with b_oh =** 1621.98 in^2
Controlled by:	**Total Capacity of Adjustable Head Assembly (Bracket) with Pipe Supports (Gusset Welds)**

For Concrete Capacity with End Supports and No Top Plate:	
Compression	
93.0 k	**with b_oh =** 1867.55 in^2
Controlled by:	**Total Capacity of Adjustable Head Assembly (Bracket) with Pipe Supports (Gusset Welds)**

ALTERNATE CONCRETE PARAMETERS - DIMENSIONS AND PROPERTIES

Concrete Properties Alt. #1 (No Plate):

X1 =	N/A	Bottom clear dist. (in)	*[Post-Contruction Application]*
X2 =	8.0	Top clear distance (in)	*[Assumed min.]*
c =	9.0	Side clear distance (in)	*[Min. 4" per IBC 1810.3.11]*
f_c' =	3,000	Concrete compressive strength (psi)	

Calculated Concrete Properties :

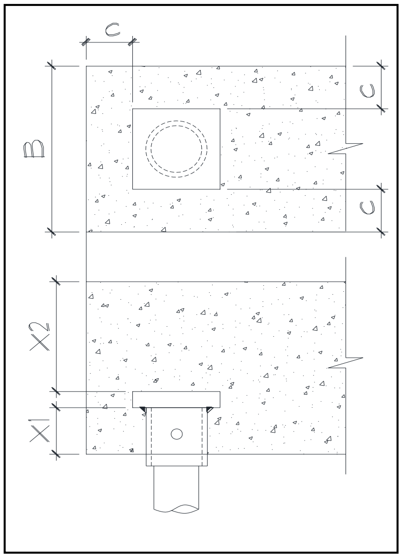
B =	24.0	Concrete width (in)

Concrete Properties Alt. #2 (Added Plate):

X1 =	N/A	Bottom clear dist. (in)	*[Post-Contruction Application]*
X2 =	12.0	Top clear distance (in)	*[Assumed min.]*
c =	9.0	Side clear distance (in)	*[Min. 4" per IBC 1810.3.11]*
f_c' =	3,000	Concrete compressive strength (psi)	

Calculated Concrete Properties :

B =	24.0	Concrete width (in)



*Note: Clear distances are to either a concrete edge or to reinforcement.

ALT. #1 CONCRETE COMPRESSION CAPACITY - BRACKET TO STRUCTURE (NO PLATE)

ACI 318, Chapter 14, Section 14.5.5.1

Concrete Two-Way Shear (Punching Shear): $\phi = 0.60$

$$V_n = \left[\frac{4}{3} + \frac{8}{3\beta}\right]\sqrt{f_c^{'}}b_o h \leq 2.66\sqrt{f_c^{'}}b_o h$$ *[ACI Table 14.5.5.1]*

β = ratio of long side to short side of top plate

β = 2.51

b_o = shear perimeter = 2*(d'+8")+2*(b'+8")

b_o = 73.86 in

h = X2 = 8.0 in

V_n = 77.5 k

$$V^{'} = 0.7 * \phi * V_n$$ *[AC358 3.7.1.2]*

V' = **32.57 k**

*Note: It is the designer's responsibility to check one way shear in concrete beam applications.

ACI 318, Chapter 14, Section 14.5.6.1

Concrete Bearing: $\phi = 0.60$

$$B_n = 0.85 * f_c^{'} * A_1\sqrt{\frac{A_2}{A_1}}$$ *[ACI Table 14.5.6.1]* Where: $\sqrt{\frac{A_2}{A_1}} \leq 2$

A_1 = loaded area = Adjustable Head Assembly Angle Area

A_1 = 89.2 in^2

A_2 = projected area = (Adjustable Head Assembly Angle Width+17"*2)^2

A_2 = 680.1 in^2

$\sqrt{\frac{A_2}{A_1}} =$ 2.0

B_n = 455.2 k

$$B^{'} = 0.7 * \phi * B_n$$ *[AC358 3.7.1.2]*

B' = **191.16 k**

ALT. #2 CONCRETE COMPRESSION CAPACITY - BRACKET TO STRUCTURE (NO PLATE)

ACI 318, Chapter 14, Section 14.5.5.1

Concrete Two-Way Shear (Punching Shear): $\phi = 0.60$

$$V_n = \left[\frac{4}{3} + \frac{8}{3\beta}\right]\sqrt{f_c^{'}}\,b_o h \le 2.66\sqrt{f_c^{'}}\,b_o h$$ *[ACI Table 14.5.5.1]*

β = ratio of long side to short side of top plate

β = 2.51

b_o = shear perimeter = 2*(d'+9")+2*(b'+12")

b_o = 83.86 in

h = X2 = 12.0 in

V_n = 132.1 k

$$V^{'} = 0.7 * \phi * V_n$$ *[AC358 3.7.1.2]*

V' = **55.47 k**

*Note: It is the designer's responsibility to check one way shear in concrete beam applications.

ACI 318, Chapter 14, Section 14.5.6.1

Concrete Bearing: $\phi = 0.60$

$$B_n = 0.85 * f_c^{'} * A_1\sqrt{\frac{A_2}{A_1}}$$ *[ACI Table 14.5.6.1]* Where: $\sqrt{\frac{A_2}{A_1}} \le 2$

A_1 = loaded area = Adjustable Head Assembly Angle Area

A_1 = 89.2 in^2

A_2 = projected area = (Adjustable Head Assembly Angle Width+14"*2)^2

A_2 = 987.7 in^2

$\sqrt{\frac{A_2}{A_1}} =$ 2.0

B_n = 455.2 k

$$B^{'} = 0.7 * \phi * B_n$$ *[AC358 3.7.1.2]*

B' = **191.16 k**

ALTERNATE CONCRETE PARAMETERS - SUMMARY				
For Concrete Capacity with Alternate #1 Concrete Parameters:				
Compression				
32.6 k	**With footing width =**	**24.0 in.**	**and footing thickness =**	**8.0 in.**
Controlled by:	**Concrete Two-Way Shear (Punching Shear):**			

For Concrete Capacity with Alternate #2 Concrete Parameters:				
Compression				
55.5 k	**With footing width =**	**24.0 in.**	**and footing thickness =**	**12.0 in.**
Controlled by:	**Concrete Two-Way Shear (Punching Shear):**			