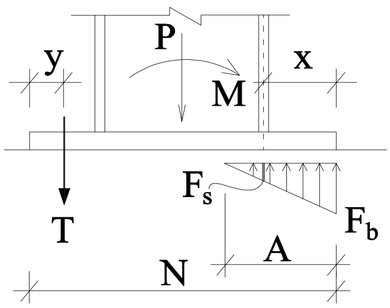
Design of Base Plate Bearing on Concrete Subjected to Large Eccentricity, $e \geq N/2$



Loads

Dead Load, P_D=			21 kips
Live Load, P_L=			39 kips
Moment from D.L., M_D=			171 kip*in
Moment from L.L., M_L=			309 kip*in

Base Plate Material Properties

Grade:	SEL("Material/ASTM"; NAME;)	=	A36
Yield stress, f_{yp}=	TAB("Material/ASTM";F_y;NAME=Grade)	=	36 ksi

Column, Base Plate and Pedestal Dimensions

Concrete strength for pedestal (f'_c):

f'_c=			3 ksi
Sec.:	SEL("AISC/W"; NAME;)	=	W8X35
Pedestal depth, P_d=			28 in
Pedestal width, P_w=			28 in
Base plate depth, N=			14 in
Base plate width, B=			14 in
Distance to bolt, y=			1.50 in
Depth of column, d=	TAB("AISC/W";d; NAME=Sec.)	=	8.1 in
Flange of column, b_f=	TAB("AISC/W";b_f;NAME=Sec.)	=	8.0 in

Check Eccentricity Size

M_t=	M_D+M_L	=	480 kip*in
P_t=	P_D+P_L	=	60 kips
e=	M_t/P_t	=	8.00 in
Check_e=	IF(e> N/2;"O.K.";"not O.K.")	=	O.K.

(Note that: if this check was not O.K., this template will give a wrong solution)

The Ultimate Load and Moment

(Chapter 2 of ASCE/SEI 7)

P_u=	1.2*P_D+1.6*P_L	=	88 kips

M_u= $1.2*M_D+1.6*M_L$ = 700 kip*in

The Maximum Bearing Stress, F_b

Φ_c= 0.60

A_1= N*B = 196.00 in^2

A_2= P_d*P_w = 784.00 in^2

F_{b1}= $0.85*\Phi_c*f'_c*\sqrt{(A_2/A_1)}$ = 3.06 ksi

F_{b2}= $1.7*f'_c$ = 5.10 ksi

F_b= $MIN(F_{b1};F_{b2})$ = 3.06 ksi

N'= N-y = 12.50 in

F'= $$\frac{F_b*B*N'}{2}$$ = 267.8 ksi

Distance from the base to bolt centers (A') is:

A'= $$\frac{N}{2}-y$$ = 5.50 in

M_1= $P_u*A'+M_u$ = 1184 kip*in

A_1= $$\frac{F'+\sqrt{(F')^2-4*\frac{F_b*B}{6}*M_1}}{\frac{F_b*B}{3}}$$ = 32.4 in

A_2= $$\frac{F'-\sqrt{(F')^2-4*\frac{F_b*B}{6}*M1}}{\frac{F_b*B}{3}}$$ = 5.1 in

A= $MIN(A_1 ; A_2)$ = 5.1 in

Check_A= IF(A<N';"O.K.";"not O.K.") = O.K.

(If this check was not O.K., increase plate dimensions to find a solution or check inputs)

Tension in Bolts

T= $$\frac{F_b*A*B}{2}-P_u$$ = 21.2 kips

Base Plate Thickness

The critical section is at distance (x) from the plate edge, where:

x= $$\frac{N-0.95*d}{2}$$ = 3.15 in

The distance form the zero stress point to this section (x_1) and the stress at this section (F_s) can be calculated as:

x_1= A - x = 1.95 in

F_s= $x_1/A*F_b$ = 1.17 ksi

The factored moment for a 1-in strip at this section (M_{s1}) can be determined from the bearing stress distribution as follows:

$$M_{s1} = \frac{F_s*x^2}{2} + (F_b - F_s)*\frac{x^2*0.67}{2} = 12.09\ kip*in$$

Also, The moment based on the critical section on the anchor bolt side is determined as follows (it is assumed that the critical plate width is based on the load spreading out at 45 degrees:

M_{s2}= T/2*(x-y)/(2*(x-y)) = 5.30 kip*in

So, the critical moment is the maximum from M_{s1} and M_{s2} as follows:

M_s= MAX(M_{s1};M_{s2}) = 12.09 kip*in

$$t_{p,min} = \sqrt{\frac{4*M_s}{0.9*f_{yp}}} = 1.22\ in$$

Summary: Use Plate with The following Minimum Dimensions

Plate length= N = 14 in

Plate width= B = 14 in

Plate thickness= $t_{p,min}$ = 1.22 in