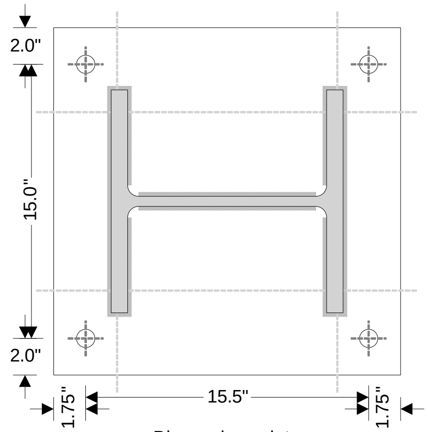
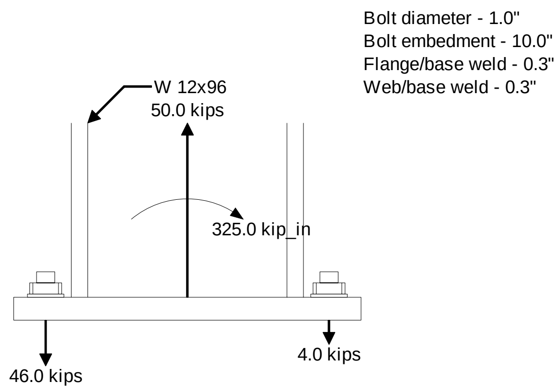
COLUMN BASE PLATE DESIGN (AISC360-05)

AISC 360-10

TEDDS calculation version 2.0.07



Plan on baseplate



Elevation on baseplate

Design forces and moments

Axial force P_u = **-50.0** kips (Tension)

Bending moment M_u = **325.0** kip_in

Shear force F_v = **0.0** kips

Eccentricity $e = ABS(M_u / P_u)$ = **6.500** in

Anchor bolt to center of plate $f = N/2 - e_1$ = **7.750** in

Column details

Column section W 12x96

Depth d = **12.700** in

Breadth b_f = **12.200** in

Flange thickness t_f = **0.900** in

Web thickness t_w = **0.550** in

Baseplate details

Depth N = **19.000** in

Breadth B = **19.000** in

Thickness t_p = **1.250** in

Design strength F_y = **36.0** ksi

Foundation geometry

Member thickness h_a = **20.000** in

Dist center of baseplate to left edge foundation x_{ce1} = **30.000** in

Dist center of baseplate to right edge foundation x_{ce2} = **30.000** in

Dist center of baseplate to bot edge foundation y_{ce1} = **30.000** in

Dist center of baseplate to top edge foundation y_{ce2} = **30.000** in

Holding down bolt and anchor plate details

Total number of bolts N_{bolt} = **4**

Bolt diameter d_o = **1.000** in

Bolt spacing s_{bolt} = **15.000** in

Edge distance	e_1 = **1.750** in
Minimum tensile strength of steel	F_y = **36** ksi
Compressive strength of concrete	f'_c = **3** ksi

Strength reduction factors

Compression	ϕ_c = **0.65**
Flexure	ϕ_b = **0.90**
Weld shear	ϕ_v = **0.75**
Compression force in concrete	$f_{p,max}$ = 0 ksi
Tension force in one half of bolts (max)	$T_{u,max} = M_u / (N - 2 \times e_1) - P_u / 2$ = **46.0** kips
Tension force in other half of bolts (min)	$T_{u,min} = -(M_u / (N - 2 \times e_1) + P_u / 2)$ = **4.0** kips
Max tensile force in single bolt	$T_{rod} = T_{u,max} / N_{bolty}$ = **23.0** kips

Base plate yielding

Bolts are located outside the section so distribute bolt forces to the flanges

Effective width for bending with 45deg distribution	$b_{eff} = 2 \times ((N - d)/2 - e_1)$ = **2.800** in
Bending moment in plate	$M_{up} = (T_{u,max} / N_{bolty}) \times (b_{eff} / 2)$ = **32.18** kip_in
Thickness of plate required	$t_{p,req} = ((4 \times M_{up}) / (b_{eff} \times \phi_b \times F_y))^{0.5}$ = **1.191** in

PASS - Thickness of plate exceeds required thickness

Flange weld

Flange weld leg length	t_{fw} = **0.3125** in
Tension capacity of flange	$P_{tf} = b_f \times t_f \times F_y$ = **395.3** kips
Force in tension flange	$F_{tf} = M_u / (d - t_f) - P_u \times (b_f \times t_f) / A_{col}$ = **47.0** kips
Critical force in flange	F_f = min(P_{tf}, max(F_{tf}, 0kips)) = **47.0** kips
Flange weld force per in	$R_{wf} = F_f / (2 \times b_f - t_w)$ = **2.0** kips/in
Electrode classification number	F_{EXX} = **70.0** ksi
Nominal weld stress	$\phi F_w = \phi_v \times 0.60 \times F_{EXX} \times (1.0 + 0.5 \times (\sin(90deg))^{1.5})$ = **47.250**ksi
Design strength of weld per in	$R_{nf} = F_w \times t_{wf} / \sqrt{(2)}$ = **10.4** kips/in

PASS - Available strength of flange weld exceeds force in flange weld

Transverse web weld

Web weld leg length	t_{ww} = **0.3125** in
Effective width for bending with 45deg distribution	$b_{eff} = 2 \times ((N - d)/2 - e_1)$ = **2.800** in
Web weld force	$F_{tw} = abs(P_u) \times (A_{col} - 2 \times b_f \times t_f) / A_{col}$ = **11.064** kips
Web weld force per in	$R_{wt} = F_{tw} / (2 \times (d - 2 \times t_f))$ = **0.508** kips/in
Electrode classification number	F_{EXX} = **70.0** ksi
Nominal weld stress	$\phi F_w = \phi_v \times 0.60 \times F_{EXX} \times (1.0 + 0.5 \times (\sin(90deg))^{1.5})$ = **47.250**ksi
Design strength of weld per in	$R_{nt} = F_w \times t_{ww} / \sqrt{(2)}$ = **10.4** kips/in

PASS - Available strength of transverse web weld exceeds force in transverse web weld

ANCHOR BOLT DESIGN (ACI318-08)

TEDDS calculation version 2.0.07

Anchor bolt geometry

Type of anchor bolt	Cast-in headed end bolt anchor
Diameter of anchor bolt	d_a = **1** in
Number of bolts in x direction	N_{boltx} = **2**
Number of bolts in y direction	N_{bolty} = **2**

Total number of bolts	$n_{total} = (N_{boltx} \times 2) + (N_{bolty} - 2) \times 2 =$ **4**
Total number of bolts in tension	$n_{tens} = (N_{boltN} \times 2) + (N_{bolty} - 2) \times 2 =$ **4**
Spacing of bolts in x direction	$s_{boltx} =$ **15.5** in
Spacing of bolts in y direction	$s_{bolty} =$ **15** in
Number of threads per inch	$n_t =$ **8**
Effective cross-sectional area of anchor	$A_{se} = \pi / 4 \times (d_a - 0.9743 \text{ in} / n_t)^2 =$ **0.606** in^2
Embedded depth of each anchor bolt	$h_{ef} =$ **10** in

Material details

Minimum yield strength of steel	$f_{ya} =$ **36** ksi
Nominal tensile strength of steel	$f_{uta} =$ **68.4** ksi
Compressive strength of concrete	$f'_c =$ **3** ksi
Concrete modification factor	$\lambda =$ **1.00**

Strength reduction factors

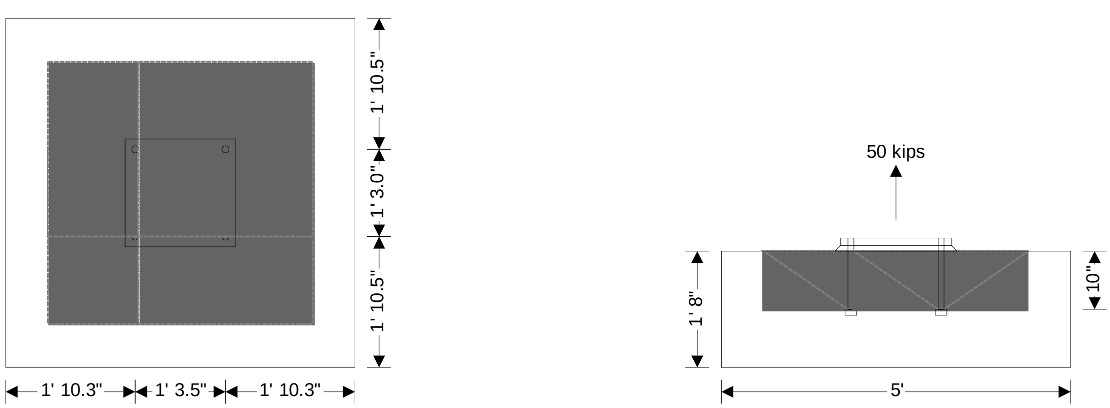
Tension of steel element	$\phi_{t,s} =$ **0.75**
Shear of steel element	$\phi_{v,s} =$ **0.70**
Concrete tension	$\phi_{t,c} =$ **0.65**
Concrete shear	$\phi_{v,c} =$ **0.70**
Concrete tension for pullout	$\phi_{t,cB} =$ **0.70**
Concrete shear for pryout	$\phi_{v,cB} =$ **0.70**

Steel strength of anchor in tension (D.5.1)

Nominal strength of anchor in tension	$N_{sa} = A_{se} \times f_{uta} =$ **41.43** kips
Steel strength of anchor in tension	$\phi N_{sa} = \phi_{t,s} \times N_{sa} =$ **31.07** kips

PASS - Steel strength of anchor exceeds max tension in single bolt

Check concrete breakout strength of anchor bolt in tension (D.5.2)



Plan on foundation

Section A-A

Concrete breakout - tension

Stength reduction factor	$\phi_t =$ **0.65**
Coeff for basic breakout strength in tension	$k_c =$ **24**
Breakout strength for single anchor in tension	$N_b = k_c \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times h_{ef}^{1.5} \times 1 \text{ in}^{0.5} =$ **41.57** kips
Projected area for groups of anchors	$A_{Nc} =$ **2047.5** in^2
Projected area of a single anchor	$A_{Nco} = 9 \times h_{ef}^2 =$ **900** in^2
Min dist center of anchor to edge of concrete	$c_{a,min} =$ **22.25** in

Mod factor for groups loaded eccentrically $\psi_{ec,N} = \min(1 / (1 + ((2 \times e'_N) / (3 \times h_{ef}))), 1) = \mathbf{0.698}$

Modification factor for edge effects $\psi_{ed,N} = 1.0 = \mathbf{1.000}$

Modification factor for no cracking at service loads $\psi_{c,N} = \mathbf{1.250}$

Modification factor for uncracked concrete $\psi_{cp,N} = \mathbf{1.000}$

Nominal concrete breakout strength $N_{cbg} = A_{Nc}/ A_{Nco} \times \psi_{ec,N} \times \psi_{ed,N} \times \psi_{c,N} \times \psi_{cp,N} \times N_b = \mathbf{82.47}$ kips

Concrete breakout strength $\phi N_{cbg} = \phi_{t,c} \times N_{cbg} = \mathbf{53.61}$ kips

PASS - Breakout strength exceeds tension in bolts

Pullout strength (D.5.3)

Net bearing area of the head of anchor $A_{brg} = \mathbf{1}$ in^2

Mod factor for no cracking at service loads $\psi_{c,P} = \mathbf{1.400}$

Pullout strength for single anchor $N_p = 8 \times A_{brg} \times f'_c = \mathbf{24.00}$ kips

Nominal pullout strength of single anchor $N_{pn} = \psi_{c,P} \times N_p = \mathbf{33.60}$ kips

Pullout strength of single anchor $\phi N_{pn} = \phi_{t,cB} \times N_{pn} = \mathbf{23.52}$ kips

PASS - Pullout strength of single anchor exceeds maximum axial force in single bolt

Side face blowout strength (D.5.4)

As h_{ef} <= 2.5 $\times$ min(c_{a1}, c_{a2}) the edge distance is considered to be far from an edge and blowout strength need not be considered