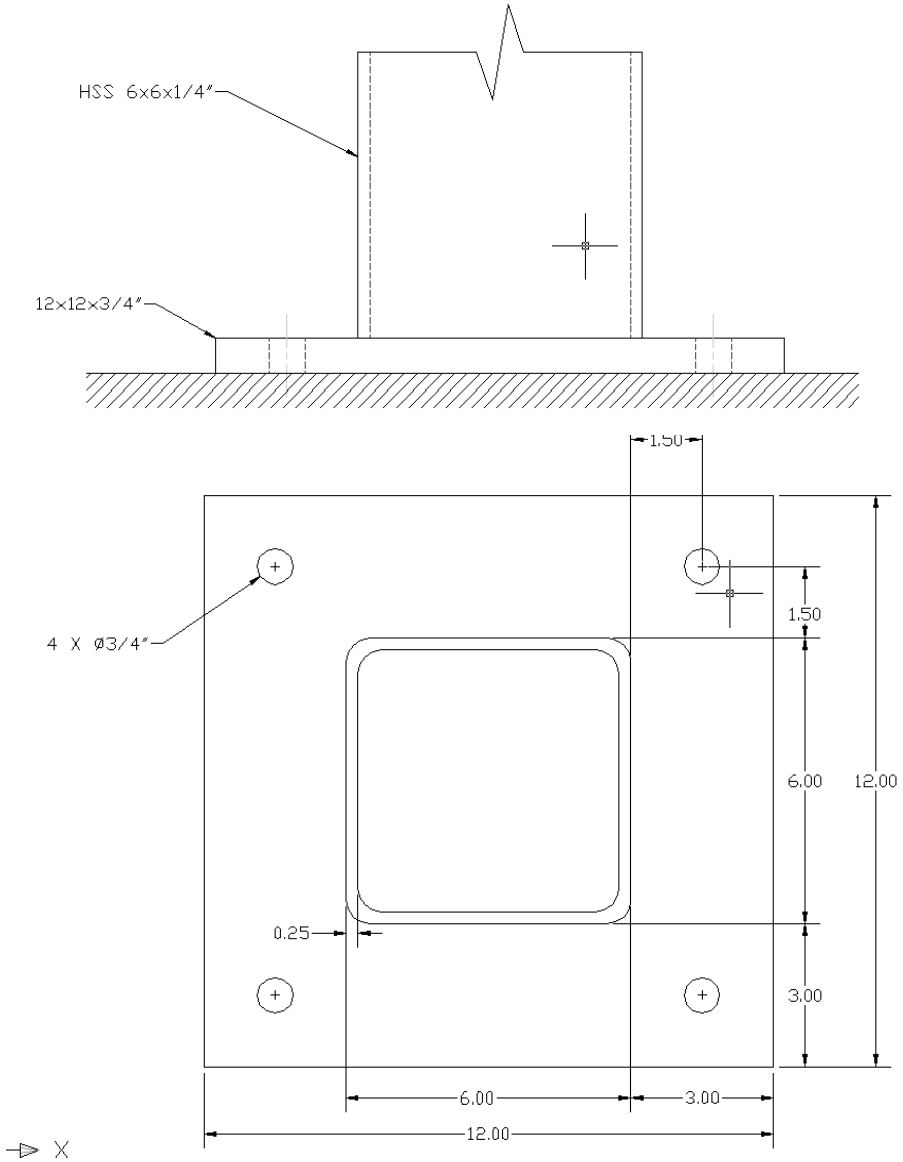
Connection Limit Conditions

The column to base connection has three important limit conditions. These conditions are due to the plate thickness, bolt size, load applied, and other material characteristics. The construction materials were a HSS 6x6x¼ inch column connected by a weld to a 12x12x¾ inch gusset plate. These were connected to a concrete footing by four ¾ inch bolts. These bolts were anchored into the concrete footing. Once these conditions are analyzed, they then can be used to find the allowable dead, live, snow, and wind load combinations for the designed structure. The connection analyzed was found to have the following limits as calculated in appendix A:

- Block Shear Rupture P_u=220 kips
- Bolt Shear Rupture P_u=64 kips
- Bolt Tension due to Uplift Force P_u=60 kips

Connection Property Assumptions

- 6x6x¼ HSS column
  AISC Table 1-12 [p1-91]
  - A36
  - A_g=5.24 in
- ¾ in A325N bolts
  AISC J3.2 [p16.1-104]
  - A_b=0.442 in^2
  - F_{nt}=90 ksi
  - F_{nv}=48ksi
- 12x12x¾ gusset plate
  - A36
- A36 Steel
  AISC Table 2-3 [p2-39]
  - F_y=36 ksi
  - F_u=58 ksi



APPENDIX A: LIMIT STATES

Assuming A36 steel for plates, and A325N steel for bolts

Block Shear: $\phi P_{nb} = 0.75 \min \begin{Bmatrix} 0.6F_u A_{nv} + F_u A_{nt} \\ 0.6F_y A_{gv} + F_u A_{nt} \end{Bmatrix}$ **AISC:J4-5**

A36 Steel F_u=58 ksi
F_y=36 ksi

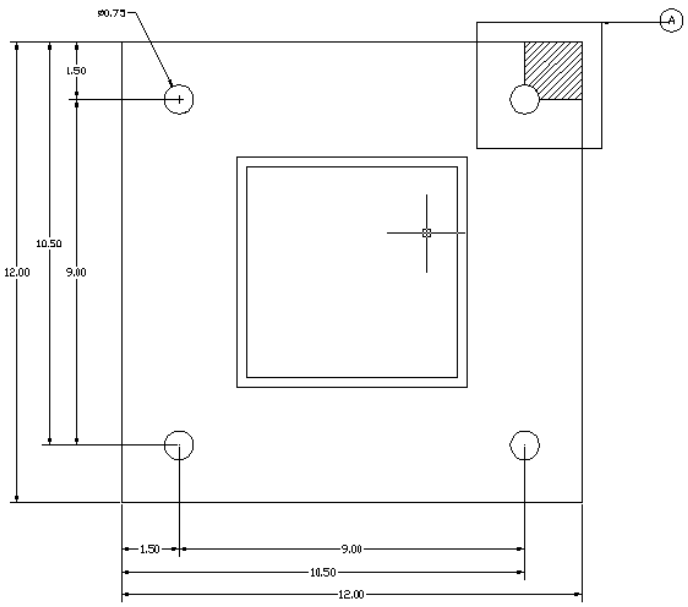
Block Area #1: $A_{gv} = A_{gt} = 1.5" \times \frac{3}{4}" = 1.125 in^2$

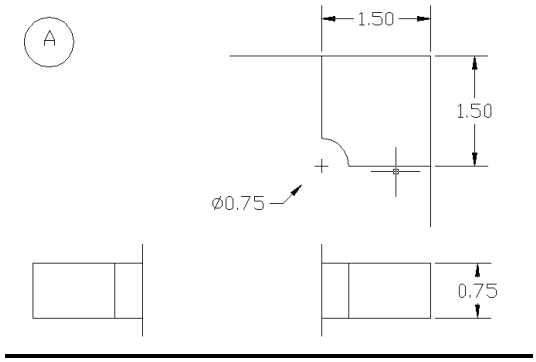
$A_{nv} = A_{nt} = 1.125 in^2 - \frac{1}{2}(\frac{3}{4}")(\frac{3}{4}") = 0.844 in^2$

Block Area #2: $A_{gv} = A_{gt} = 9" \times \frac{3}{4}" = 6.75 in^2$

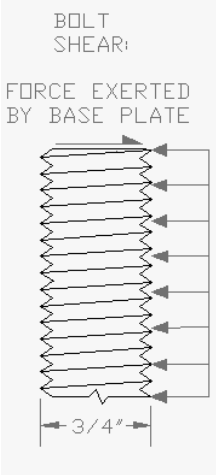
$A_{nv} = A_{nt} = 6.75 in^2 - 1.5(\frac{3}{4}")(\frac{3}{4}") = 5.91 in^2$

$\boxed{\phi P_{nb} = 220 kips}$





Bolt Strength (shear): $R_s = F_{nv}A_b = F_{nv}\left(\frac{\pi}{4}\right)d_b^2$ **AISC:J3-1**



$P_u = \phi R_s(\#bolts)(\#shearsurfaces)$

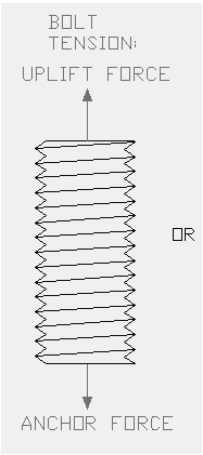
$\phi = 0.75$

A325N Steel F_{nv}=48 ksi

$A_b = 0.442in \Rightarrow R_s = 21.2k\_per\_shearsurface(1)\_per\_bolt(4)$

$$\boxed{P_u = 63.6kips}$$

Bolt Tension (from uplift force): $R_n = F_{nt}A_b = F_{nt}\left(\frac{\pi}{4}\right)d_b{}^2$ **AISC:J3-1**

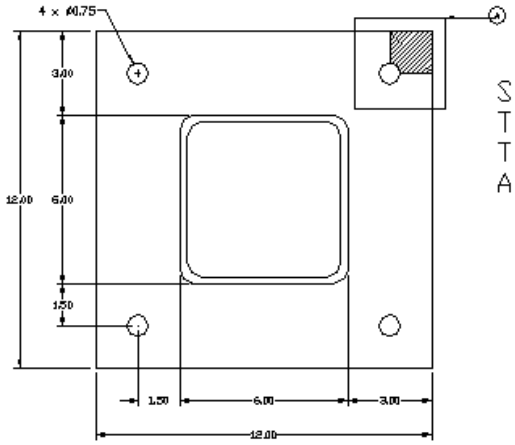


$P_u = \phi R_n(\#bolts)$

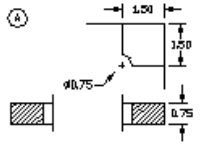
F_{nt}=90 ksi

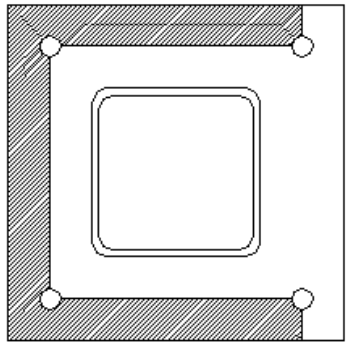
$A_b = 0.442in^2 \Rightarrow R_n = 39.8k/bolt(2)$

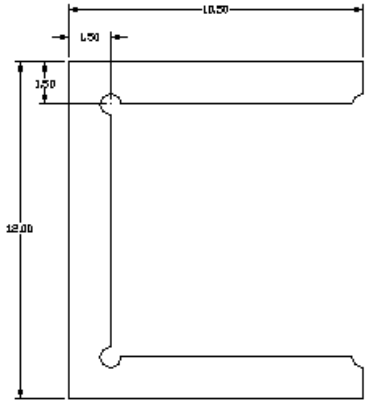
$$\boxed{P_u = 59.64kips}$$

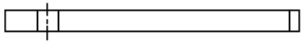


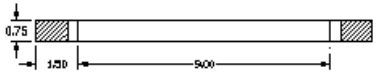
SECTIONS ANALYZED FOR BLOCK SHEAR CONSIDERATION:
THROUGH ONE HOLE (1/4 OF FORCE BUT LITTLE AREA)
THROUGH ALL HOLES (ALL OF FORCE BUT VERY LARGE AREA)



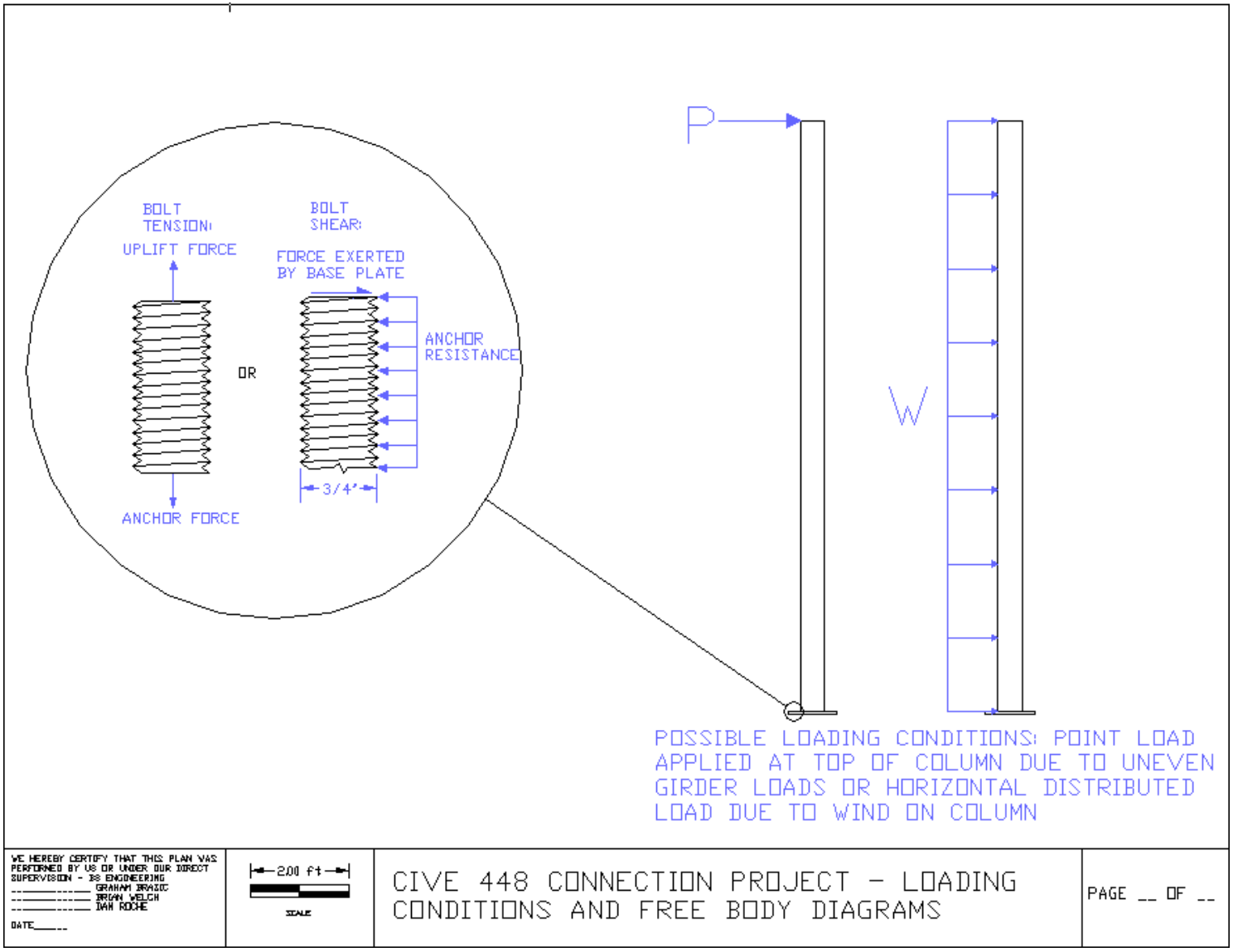


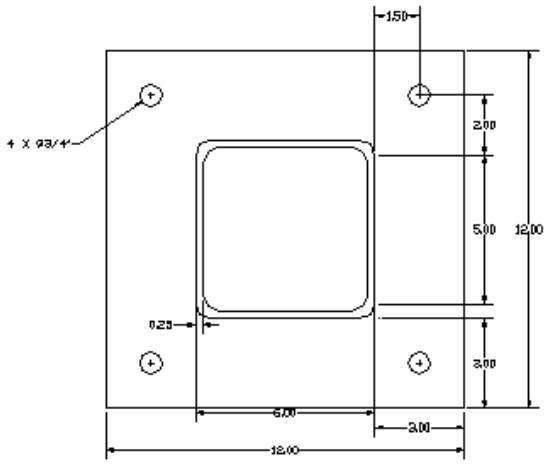


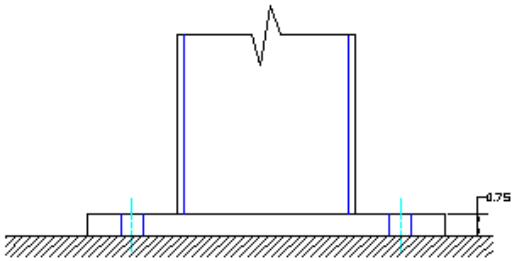


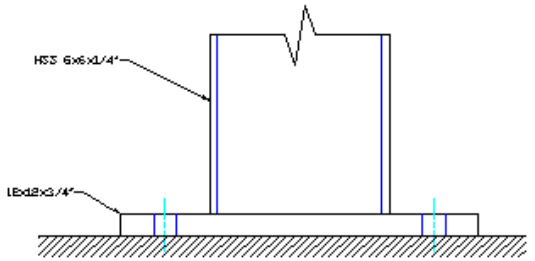


WE HEREBY CERTIFY THAT THIS PLAN WAS PERFORMED BY US OR UNDER OUR DIRECT SUPERVISION - BS ENGINEERING _____ GRAHAM BRASIC _____ BRIAN WELCH _____ DAN ROCHE DATE____	SCALE	CIVE 448 CONNECTION PROJECT - BLOCK SHEAR SECTIONS	PAGE __ OF __


BOLT TENSION:
UPLIFT FORCE
ANCHOR FORCE
OR
BOLT SHEAR:
FORCE EXERTED BY BASE PLATE
ANCHOR RESISTANCE
3/4"
P
W
POSSIBLE LOADING CONDITIONS: POINT LOAD APPLIED AT TOP OF COLUMN DUE TO UNEVEN GIRDER LOADS OR HORIZONTAL DISTRIBUTED LOAD DUE TO WIND ON COLUMN
WE HEREBY CERTIFY THAT THIS PLAN WAS PERFORMED BY US OR UNDER OUR DIRECT SUPERVISION - BS ENGINEERING
GRAHAM BRAZIC
BRIAN WELCH
IAN ROCHE
DATE____
2.00 ft
SCALE
CIVE 448 CONNECTION PROJECT - LOADING CONDITIONS AND FREE BODY DIAGRAMS
PAGE __ OF __







WE HEREBY CERTIFY THAT THIS PLAN WAS PERFORMED BY US OR UNDER OUR DIRECT SUPERVISION - B3 ENGINEERING
_____ GRAHAM BRASIC
_____ BRIAN WELCH
_____ DAN ROCHE

DATE____

4.00
SCALE

CIVE 448 CONNECTION PROJECT - DETAIL VIEW

PAGE __ OF __