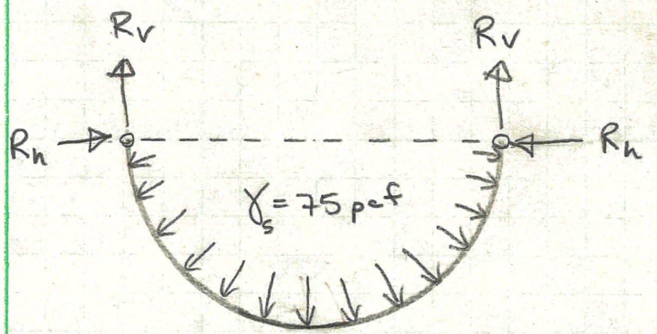
- COMPUTE FLUID PRESSURE ON 5 ft RADIUS FLUME & COMPUTE TENSILE STRENGTH OF FLUME CORRUGATED STRUCTURAL PLATE.
- ASSUME FULL DEPTH SLURRY, $\gamma_s = 75\ \text{lb/ft}^3$



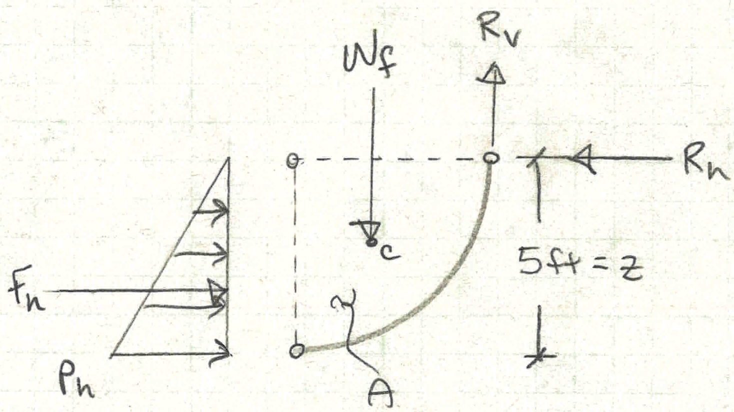
CORRUGATED STRUCTURAL PLATE (CSP)

5 ft RADIUS

2" DEEP × 6" SPACING CORRUGATION

12 GAGE (PRELIM. ASSUMPTION) = 0.111 in

CARBON STEEL: $F_y = 33$ ksi, $F_u = 45$ ksi



- CENTROID, c: $\left(\frac{4r}{3\pi}, \frac{4r}{3\pi}\right)$

  (2.1 ft, 2.1 ft)

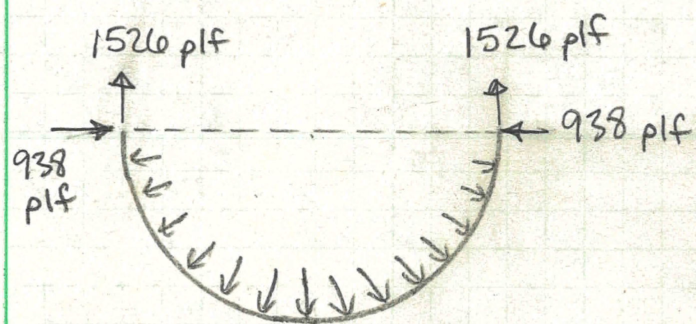
- QUARTER-CIRCLE AREA, A

  $= \frac{\pi r^2}{4} = 19.63\ ft^2$

- FLUID WEIGHT, W_f

  $= \gamma_s A = 75\ pcf (19.63\ ft^2)$

  $W_f = 1472.25$ plf



- HORIZONTAL FLUID PRESSURE, f_h

  $P_h = \gamma_s z = 75 pcf (5 ft)$

  $= 375$ psf

  $F_h = \frac{1}{2}\gamma z^2 = \frac{1}{2}(75 pcf)(5 ft)^2$

  $F_h = 937.5$ plf

- GROSS AREA OF CSP IN TENSION (in^2/ft)

  $= 1.556\ in^2/ft$

TENSILE YIELDING:

$\frac{P_n}{\Omega} = \frac{A_g F_y}{\Omega} = \frac{1.556 in^2/ft (33 ksi)}{1.67}$

$P_n/\Omega = 30.7$ klf

- WEIGHT OF CSP (FROM TABLE) [STRUCTURAL PLATE DESIGN GUIDE, 8th ED. BY CONTECH]

  HALF-CIRCLE: 106 plf

  QUARTER-CIRCLE: 53 plf Self-weight

- NET AREA OF CSP IN TENSION (in^2/ft)

(2) 3/4" BOLTS PER FT → (2) 7/8" HOLES PER FT

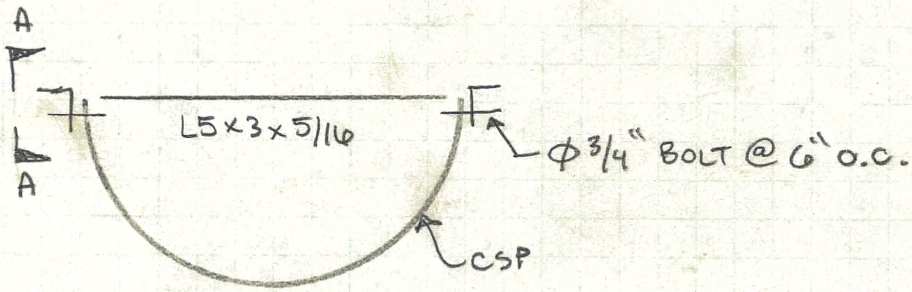
$$A_{hole} = 2(7/8")(0.111 \text{ in thick}) = 0.194 \text{ in}^2/\text{ft}$$

$$A_g - A_{hole} = 1.556 - 0.194 = A_{net} = 1.362 \text{ in}^2/\text{ft}$$

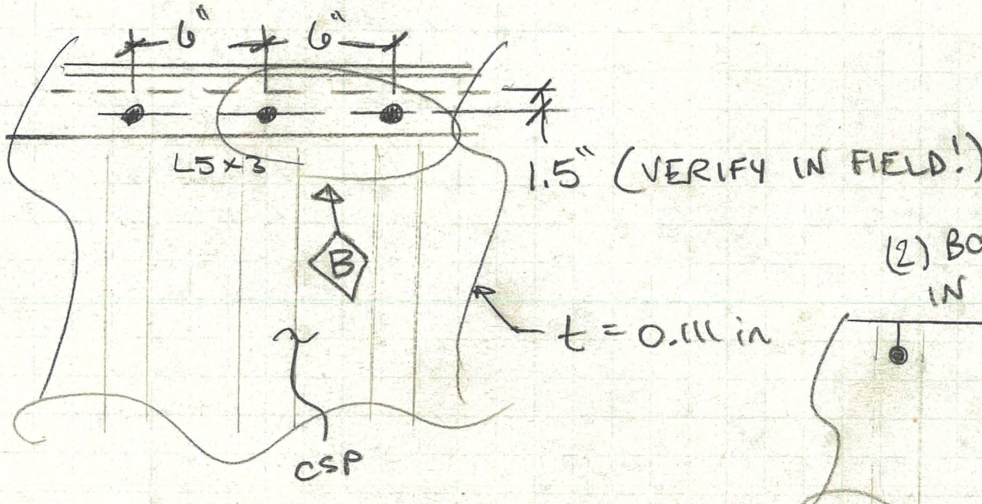
TENSILE RUPTURE:

$$\frac{R_n}{\Omega} = \frac{A_n F_u}{\Omega} = \frac{1.362 \text{ in}^2/\text{ft}(45 \text{ ksi})}{2.0} = P_n/\Omega = 30.6 \text{ klf}$$

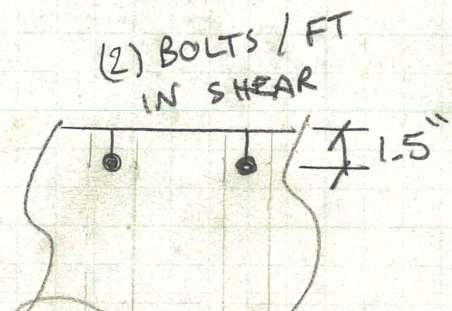
CONTROLS



FLUME SECTION



SECTION A-A



DETAIL B

SHEAR YIELDING:

$$\frac{R_n}{\Omega} = \frac{0.6 F_y A_{gv}}{\Omega} = \frac{0.6(33 \text{ ksi})(0.111 \text{ in})(1.5 \text{ in})(2 \text{ qty})}{1.5} = 4.4 \text{ klf}$$

SHEAR RUPTURE:

1/2 of 7/8" hole ↓

$$\frac{R_n}{\Omega} = \frac{0.6 F_u A_{nv}}{\Omega} = \frac{0.6(45 \text{ ksi})(0.111 \text{ in})(1.5 \text{ in} - 0.4375 \text{ in})(2 \text{ qty})}{2.0}$$

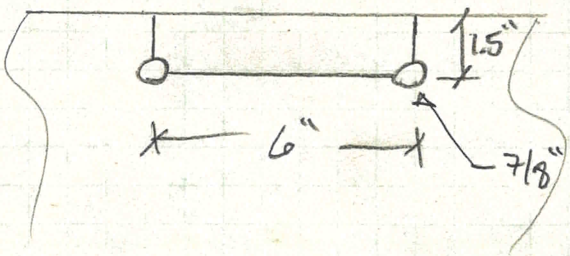
$$\frac{R_n}{\Omega} = 3.18 \text{ klf}$$ CONTROLS

BOLT SHEAR STRENGTH:

$\phi 3/4"$ SINGLE-SHEAR, THREADS INCLUDED: $\frac{r_n}{\Omega} = 11.9\ k/bolt$

(2) BOLTS / FT → $\frac{r_n}{\Omega} = 23.8\ klf$

BLOCK SHEAR STRENGTH:



SHEAR: $2(1.5" - 0.4375") = 2.125"$

TENSION: $6" - 0.875" = 5.125"$

$A_{nv} = 0.111"(2.125") = 0.236\ in^2$

$A_{nt} = 0.111"(5.125") = 0.569\ in^2$

$A_{gv} = 0.111"(3") = 0.333\ in^2$

$U_{bs} = 1.0$

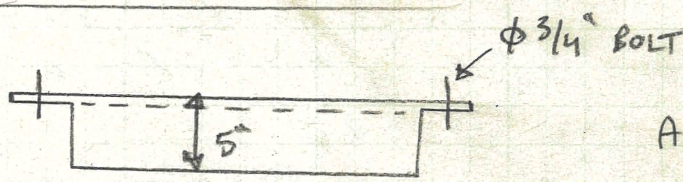
$$R_n = \text{MIN} \begin{cases} 0.6F_uA_{nv} + U_{bs}F_uA_{nt} = 0.6(45\ ksi)(0.236\ in^2) + 1(45\ ksi)(0.569\ in^2) \\ 0.6F_yA_{gv} + U_{bs}F_uA_{nt} = 0.6(33\ ksi)(0.333\ in^2) + 1(45\ ksi)(0.569\ in^2) \end{cases}$$

$$= \text{MIN} \begin{cases} 32\ klf \leftarrow \text{CONTROLS} \\ 32.2\ klf \end{cases}$$

$\frac{R_n}{\Omega} = \frac{32\ klf}{2.0}$ $\frac{R_n}{\Omega} = 16\ klf$

★ SHEAR RUPTURE CONTROLS

L5×3×5/16 TIE ANGLE:



$A_g = 2.41\ in^2$ $F_y = 36\ ksi$

$F_u = 58\ ksi$

$A_n = (0.3125\ in) * (3\ in - 0.875\ in) = 0.664\ in^2$

TENSILE YIELDING:

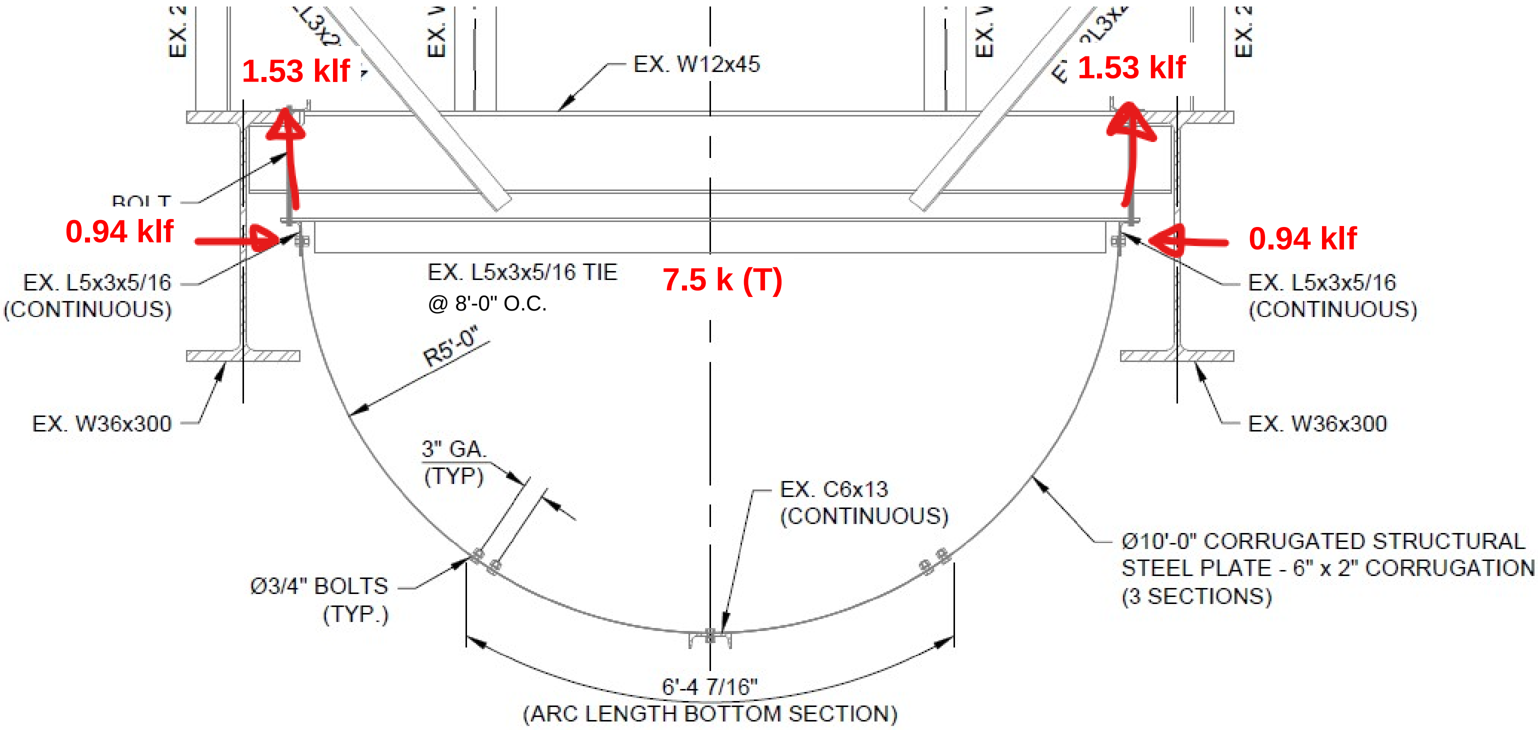
$P_n/\Omega = \frac{F_yA_g}{\Omega} = \frac{36\ ksi(2.41\ in^2)}{1.67} = 52\ k$

TENSILE RUPTURE:

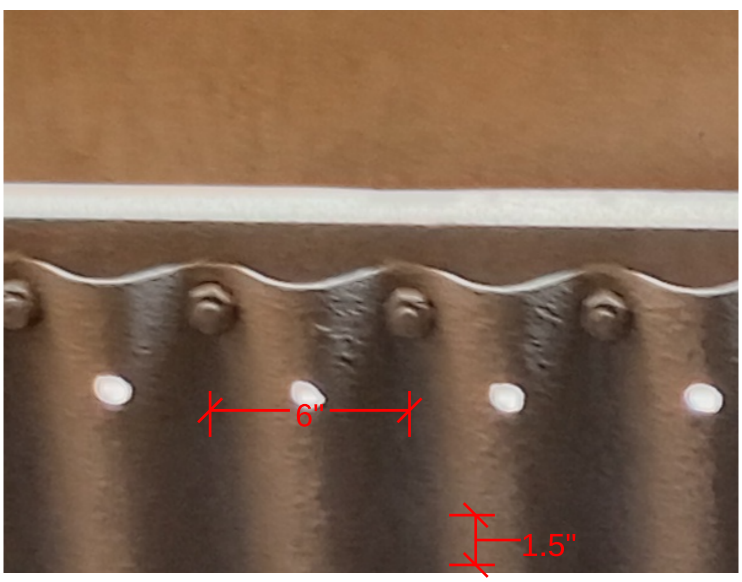
$\frac{P_n}{\Omega} = \frac{F_uA_n}{\Omega} = \frac{58\ ksi(0.664\ in^2)}{2.0} =$ P_n/Ω $19.3\ k \leftarrow$ CONTROLS

LOAD ON ANGLE: 938 plf (8 ft SPACING) = 7.5k < 19.3k OK

VERTICAL DEMAND: 1.5 klf < 3 1 klf SHEAR RUPTURE OK



Top connection (flume to continuous angle)
- shear rupture:



Section Properties

TABLE 5.
STEEL CONDUITS

Gage	Thickness (Inches)	6" x 2" Corrugations: Area of Section A_s Sq. In./Ft.	Radius of Gyration r (Inches)	Section Modulus S In.^{3}/In.	Moment of Inertia I In.^{4}/In.
12	0.111	1.556	0.682	0.0574	0.0604
10	0.140	2.003	0.684	0.0733	0.0781
8	0.170	2.449	0.686	0.0888	0.0962
7	0.188	2.739	0.688	0.0989	0.1080
5	0.218	3.199	0.690	0.1147	0.1269
3	0.249	3.650	0.692	0.1302	0.1462
1	0.280	4.119	0.695	0.1458	0.1658
5/16	0.318	4.671	0.698	0.1640	0.1900
3/8	0.380	5.613	0.704	0.1950	0.2320

TABLE 7.
MECHANICAL PROPERTIES FOR STEEL STRUCTURAL PLATE MATERIAL

f_u Minimum Tensile Strength (psi)	f_y Minimum Yield Point (psi)	E_m Modulus of Elasticity (psi)
45,000	33,000	29 x 10^6