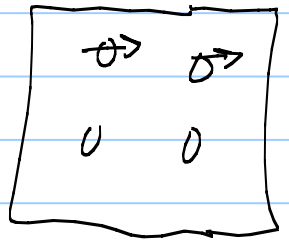
Note Title 2/20/2007

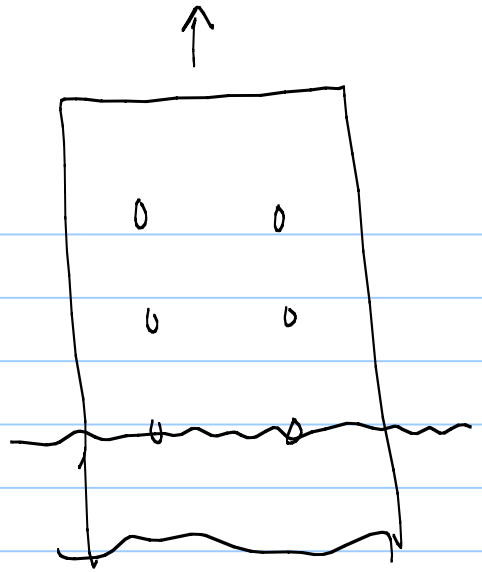
Homework #2
Due 2/27

Problems 3.2, 3.12 } compute An
3.30 → compute ϕP_n (same as ϕR_n)
$U = 1 - x/\ell$

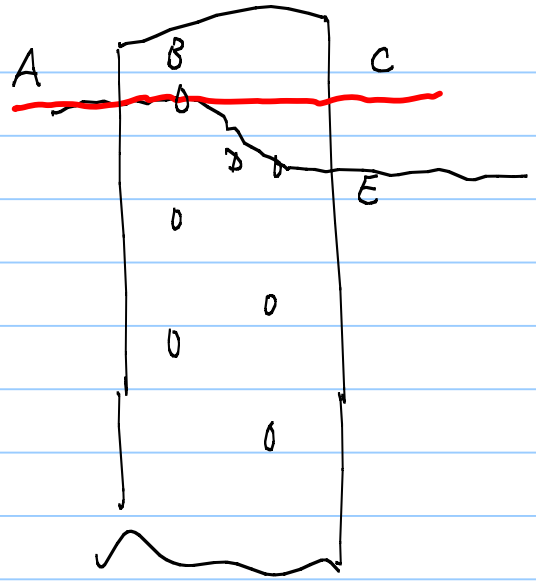


Review: Two Limit States
Yielding
Fracture

T



Staggered Bolts



- Gives a larger net area
- Might be used for odd # of bolts

Two possible fracture planes

A - B - C

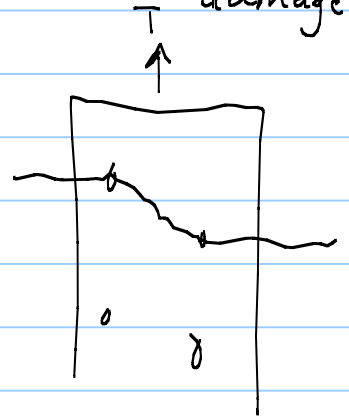
A - B - D - E

Fracture plane w/ smallest <u>net</u> <u>area</u> is the controlling case

Without stagger : $A_n = A_g - \sum_i (\text{bolt diameter} + 1/16 + 1/16)(t)$

for oversized hole

for damage

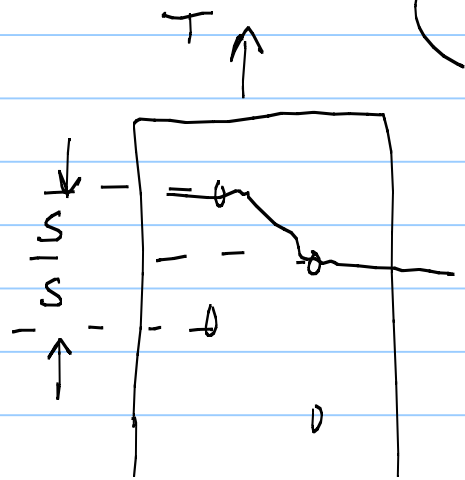


With Stagger : Need to account for :

1. Different # of holes
2. Longer fracture plane
3. Stress along incline is not pure tension

Use empirical to predict tension capacity change

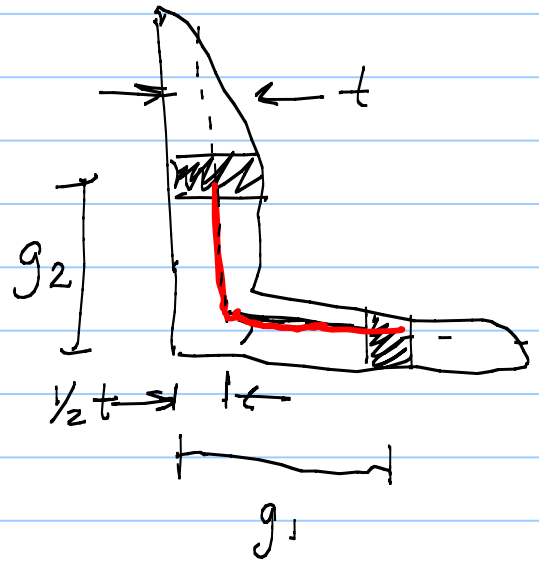
$s^2/4g$

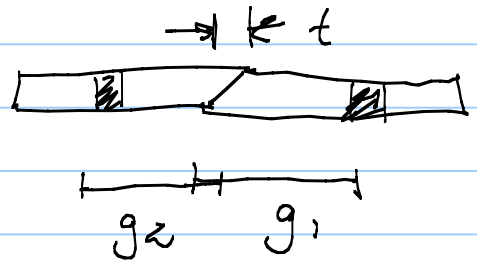


s = pitch

g = gage distance

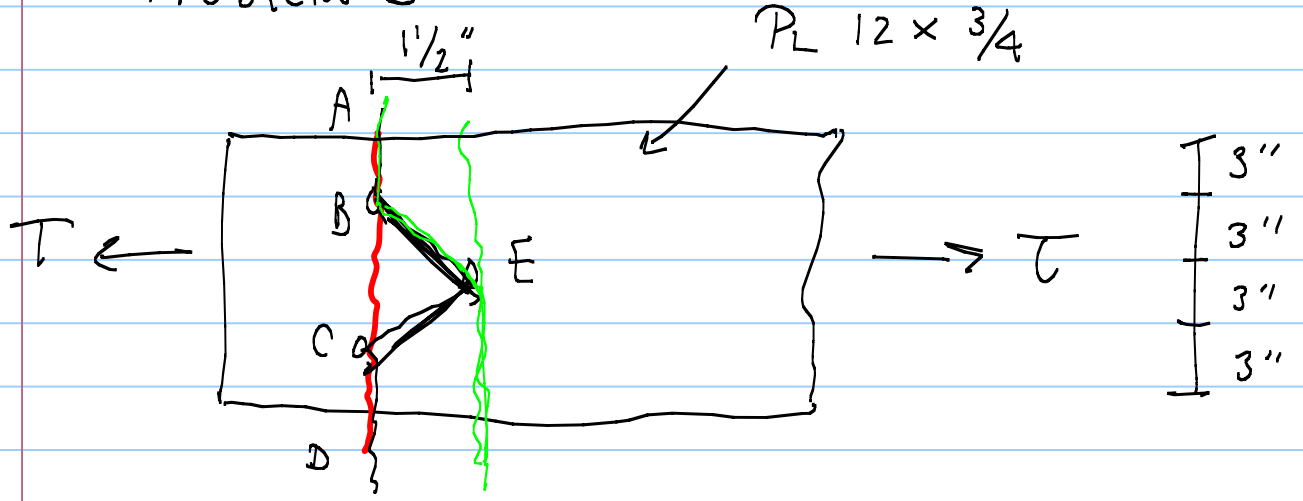
$$An = Ag - \sum (\text{bolt diameter} + 1/16 + 1/16)(t) + \left(\sum \frac{s^2}{4g}\right)(t)$$





$$g = g_1 - \tfrac{1}{2}t + g_2 - \tfrac{1}{2}t = g_1 + g_2 - t$$

Problem 3-10



Find Net Area.

¾" ϕ bolts

Check: A - B - C - D

A - B - E - C - D

From Inspection: E (1 bolt > 2 bolts)

A - B - E (2 bolts + stagger > 2 bolts w/o stagger)

ABCD : $A_n = A_g - 2(3/4 + 1/8)(3/4)$

$A_n = (12)(3/4) - 2(7/8)(3/4)$

$A_n = 9 -$

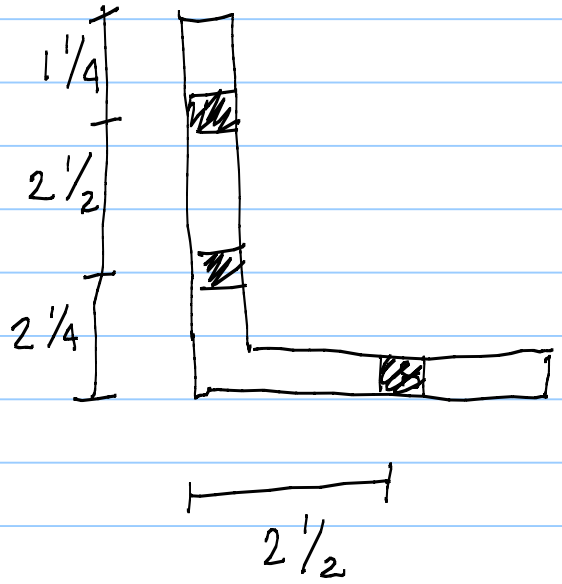
$A_n = 7.69 \text{ in}^2$

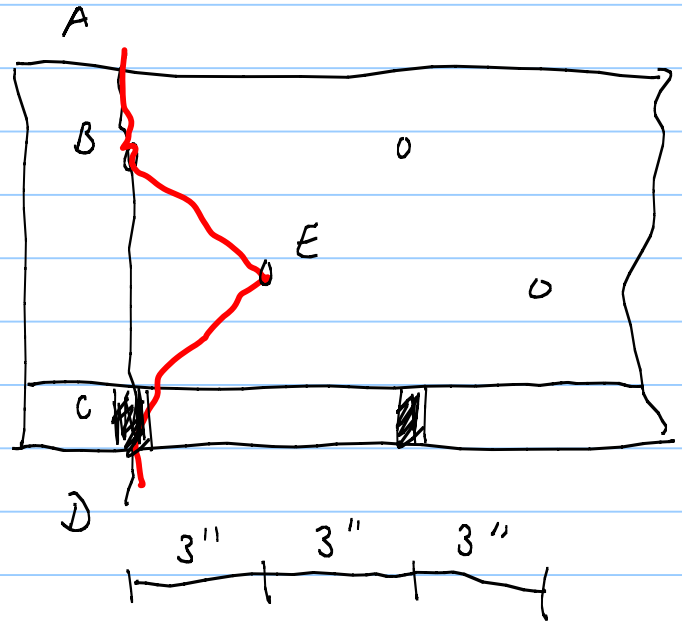
ABECD : $A_n = A_g - 3(3/4 + 1/8)(3/4) + \sum \frac{s^2}{4g}(t)$

$A_n = 12(3/4) - 3(7/8)(3/4) + (2)\frac{1.5^2}{4(3)}(3/4)$

$\boxed{A_n = 7.31 \text{ in}^2}$

Example 2: L 6 x 4 x ½ , ⅞" diameter bolts





- A - B - C - D
- A - B - E - C - D

$A_g = 4.75\ in^2$

w/out stagger, A-B-C-D : $A_n = 4.75 - 2\left(\frac{7}{8} + \frac{1}{8}\right)\left(\frac{1}{2}\right)$

$$\boxed{A_n = 3.75 \text{ in}^2}$$

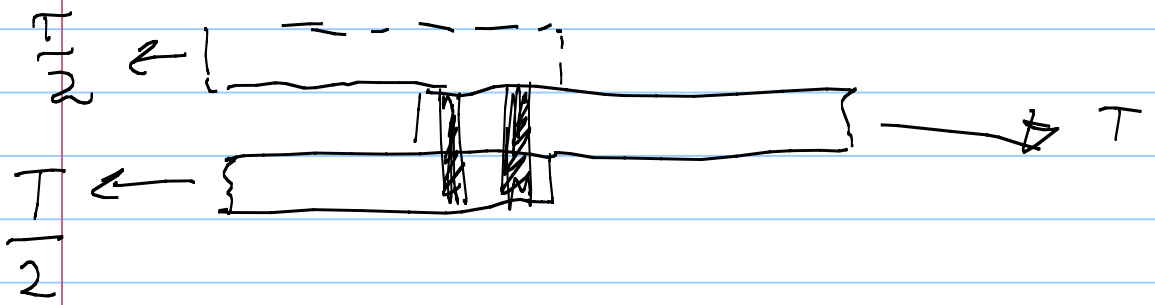
w/stagger : A-B-E-C-D : $A_n = 4.75 - 3\left(\frac{7}{8} + \frac{1}{8}\right)\left(\frac{1}{2}\right) +$

$$\left[\frac{3^2}{4(2.5)} + \frac{3^2}{4(4.25)}\right] \frac{1}{2}$$

$2\frac{1}{4} + 2\frac{1}{2} - \frac{1}{2}$

$$A_n = 3.96 \text{ in}^2$$

"Symmetry"



Design of Tension Members

$$\sum \gamma Q \leq \phi R_n = f(\phi, F, A)$$

Tension Member design dictated by area.

A_g → yielding

A_n, A_e → fracture

1. Required Area, Yielding

$$\phi R_n = 0.9 F_y A_g \geq P_u$$

$$A_g \geq \frac{P_u}{0.9 F_y}$$

2. Required Area, Fracture

$$\phi R_n = 0.75 F_u A_e \geq P_u$$

$$0.75 F_u U A_n \geq P_u$$

↓ estimate for initial design

$$0.75 F_u U (A_g - A_{bh}) \geq P_u$$

$$A_g \geq \frac{P_u}{0.75 U F_u} + A_{bh}$$

estimate