Recitation 004

11/22/2024

GSI Info

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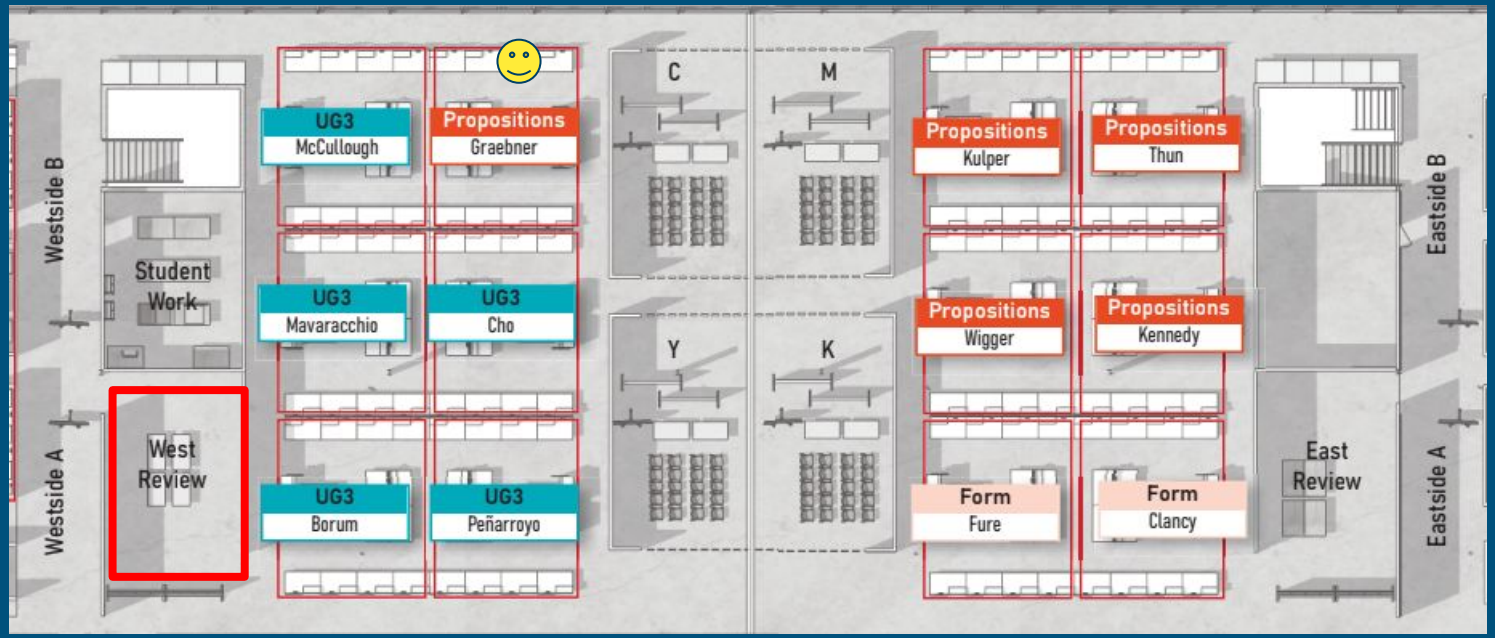


Questions

FINAL BRIDGE REPORT

- FINAL REPORT IS DUE NOVEMBER 25TH (150 Points)
  - Less than 4 days away
  - Reviews, deadlines, etc.
  - Don't ruin my Thanksgiving

Revised Bridge Design Analysis	**50**	
Internal axial force calculations/modeling (with proper design loading indicated) (Dr. Frame acceptable)	10	
Derivation of member cross-sectional areas from axial forces	10	
Member size selection from available stock	4	
Est. weight calculation of bridge - including members, glue & fasteners	6	
Method of joints/sections calculation for at least 1 joint (@ reaction is usually easiest based on truss geometry, but could be done elsewhere)	10	
Member crushing calculations/check (show work) using $F'_c=P/A$	4	
Prediction of capacity of bridge and mode of failure	6	
Illustration of Tested (Revised from Preliminary) Design	**20**	
Cross-section of bridge	4	
Elevation(s) of bridge	4	
Dimensions and units labeled in elevation and cross-section	4	
Member sizes labeled (with dimensions)	4	
Member stresses labeled (with units)	4	
Testing Results	**30**	
Weight and height of bridge	5	
Capacity of bridge	5	
Observations of testing	6	
Description of mode of failure	5	
Images of failure	5	
Following the guidelines	4	
Post-Testing Analysis	**30**	
Comparison of testing with predicted capacity and modes of failure	10	
Discussion of discrepancies between results	10	
Suggested improvements for future designs with reasoning discussed	10	

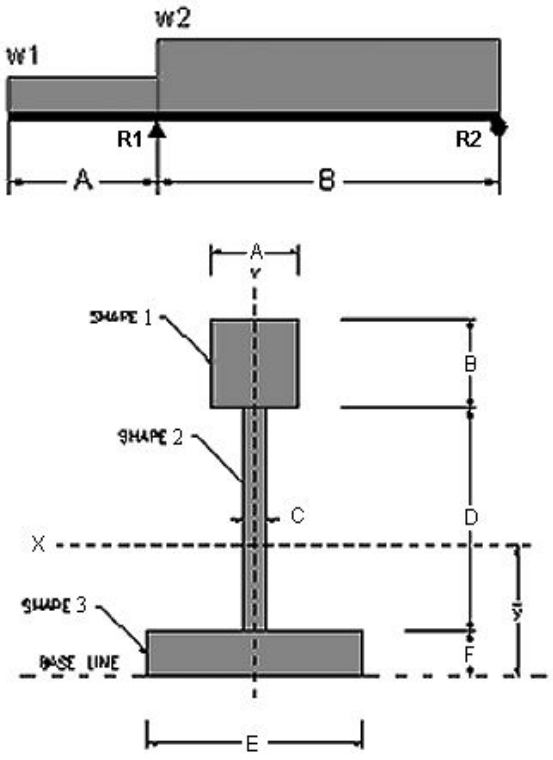
HW #13

13. Horizontal Shear

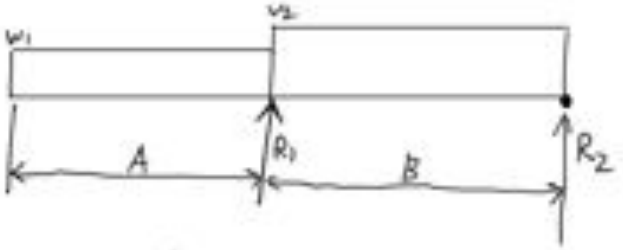
Determine the maximum overall shear force and the horizontal shear stress at that location. Then find the horizontal shear stress at each end of the center web (top and bottom).

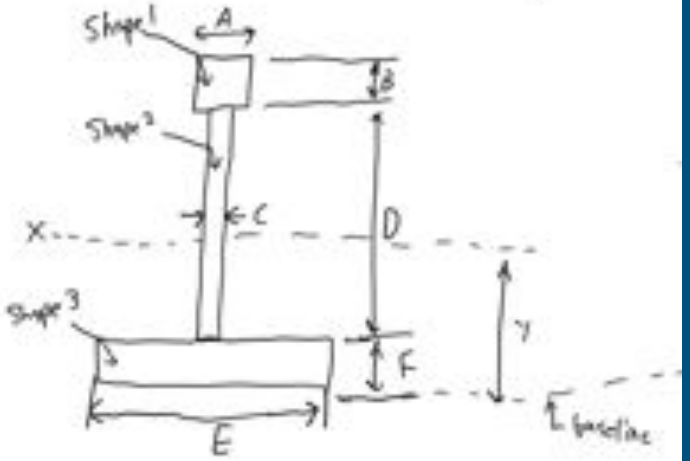
DATASET: 1 -2- -3-

Section dimension A	4 IN
Section dimension B	4 IN
Section dimension C	1 IN
Section dimension D	7 IN
Section dimension E	8 IN
Section dimension F	4 IN
Beam span A	8 FT
Beam span B	11 FT
Beam load w1	24 PLF
Beam load w2	19 PLF



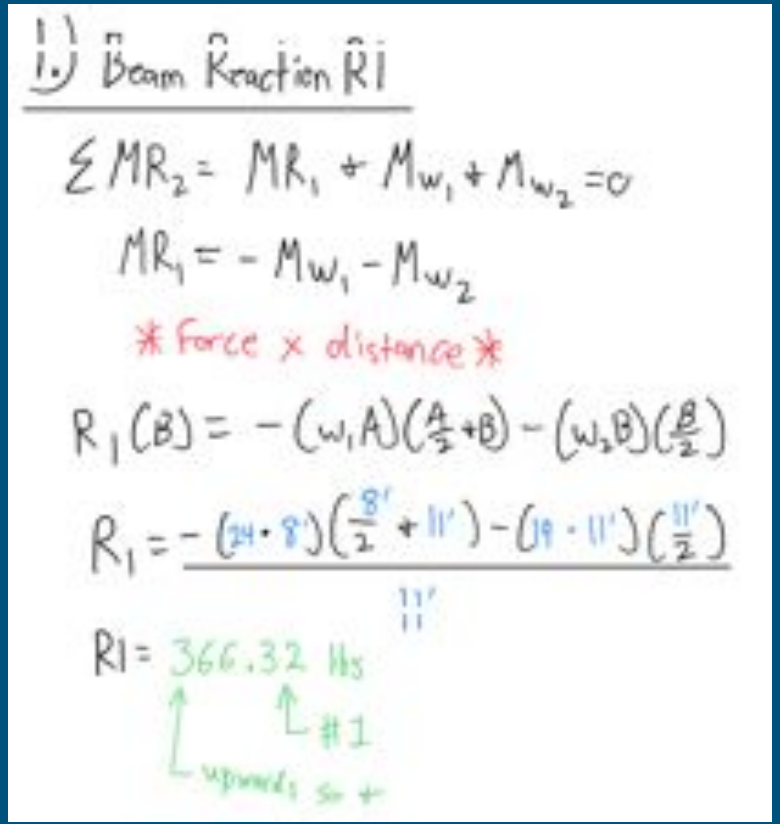
#	Question
1	Beam reaction R1 (upward is +)
2	Beam reaction R2 (upward is +)
3	Negative shear at R1 (use - sign)
4	Positive shear at R1
5	Shear at R2 (use - or + sign)
6	Maximum shear force (absolute value)
7	Static Moment (Q) at top of shape 2
8	Static Moment (Q) at bottom of shape 2
9	Static Moment (Q) at the neutral axis
10	Moment of Inertia about the neutral axis
11	Section width at the neutral axis
12	Horizontal shear stress at the top of shape 2 for Vmax
13	Horizontal shear stress at the bottom of shape 2 for Vmax
14	Horizontal shear stress at the neutral axis for Vmax

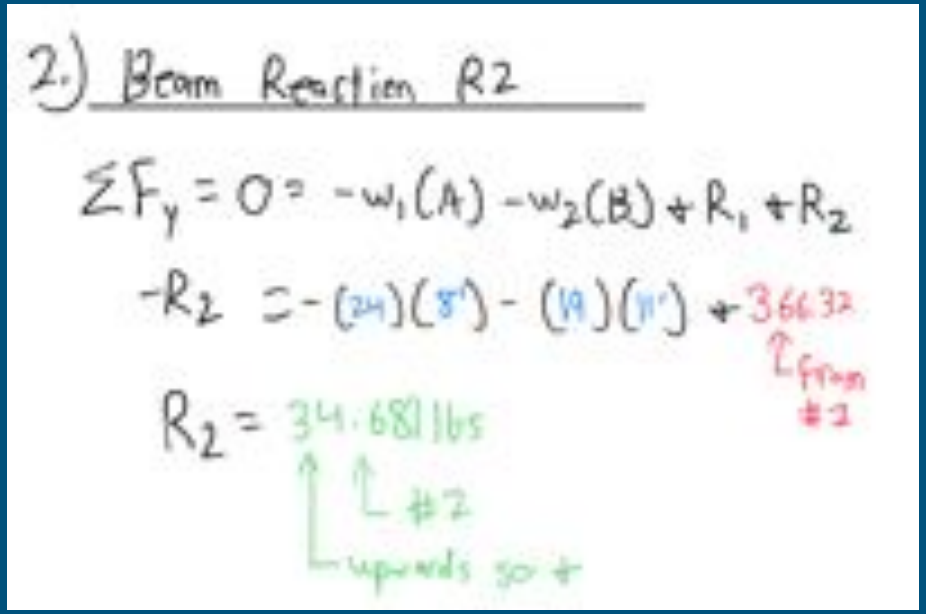




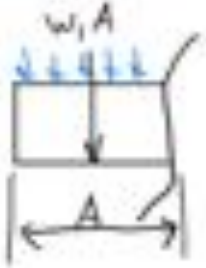
A = 4"
B = 4"
C = 1"
D = 7"
E = 8"
F = 4"

Beam Span A = 8'
Beam Span B = 11'
Beam load W_1 = 24 PLF
Beam load W_2 = 19 PLF


1.) Beam Reaction R1
$\Sigma MR_2 = MR_1 + Mw_1 + Mw_2 = 0$
$MR_1 = -Mw_1 - Mw_2$
* Force x distance *
$R_1(B) = -(w_1 A)(\frac{A}{2}+B) - (w_2 B)(\frac{B}{2})$
$R_1 = \frac{-(24 \cdot 8')(\frac{8'}{2}+11') - (9 \cdot 11')(\frac{11'}{2})}{11'}$
R1 = 366.32 lbs
#1
upward so +


2.) Beam Reaction R2
$\Sigma F_y = 0 = -w_1(A) - w_2(B) + R_1 + R_2$
$-R_2 = -(24)(8') - (19)(11') + 366.32$
from #1
$R_2 = 34.68$ lbs
#2
upwards so +

3.) Negative Shear @ R1



$\Sigma F_y = -V - w_1 A = 0$

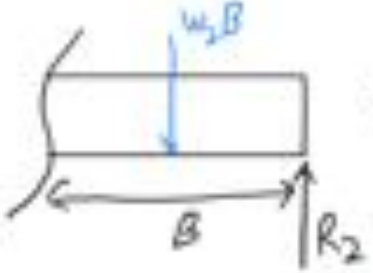
$V = -w_1 A$

$V = -(24)(8')$

$V = -192 \text{ lbs}$

↑ #3

4.) Positive shear @ R1



$\Sigma F_y = V + R_2 - w_2B$

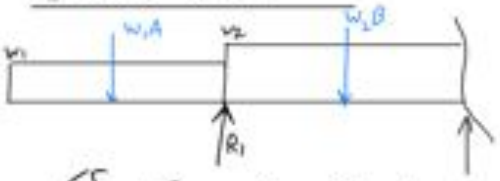
$V = -34.68 + (19)(11)$

from #2

$V = 174.319$ lbs

#4

5.) Shear @ R2



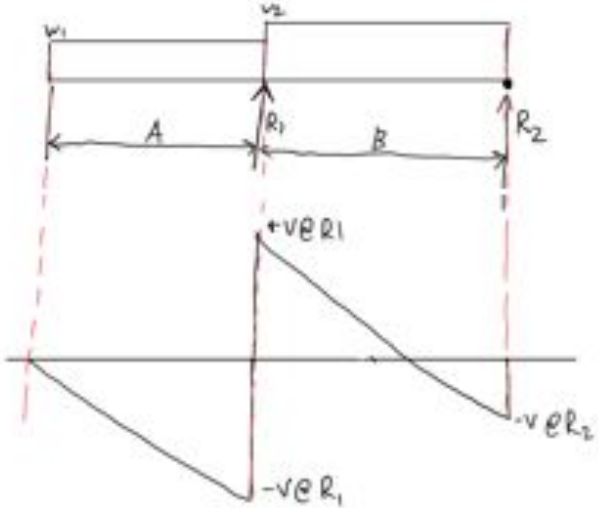
$$\Sigma F_y = R_1 - w_1 A - w_2 B - V = 0$$

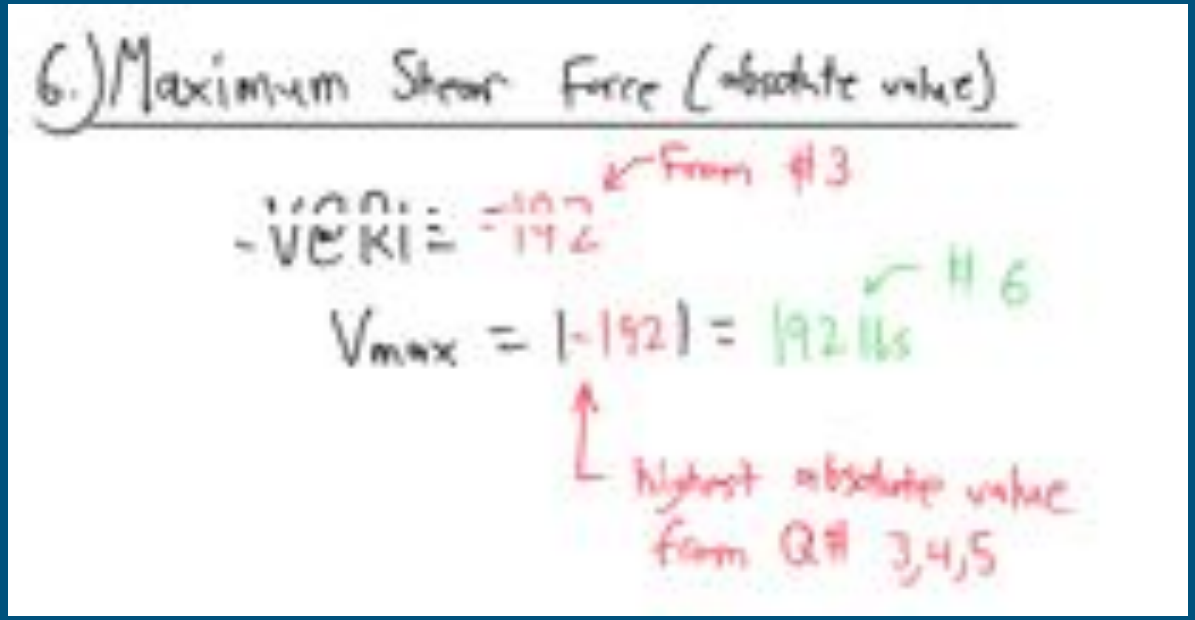
$$V = 366.32 - (24)(8') - (19)(11')$$

↑ From #1 ← #5

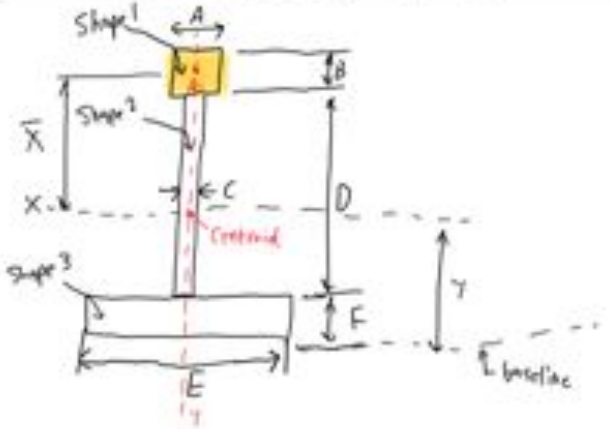
$$V = -34.68 \text{ lbs}$$

Shear Diagram




6.) Maximum Shear Force (absolute value)
From #3
-V@K1 = -192
#6
Vmax = |-192| = 192 lbs
Highest absolute value from Q# 3,4,5

7.) Static moment (Q) @ top of Shape #2



$Q_1 = A_1(\bar{X}_1)$

$Q_1 = (B)(A)\left(\frac{B}{2} + D + F - \bar{Y}\right)$

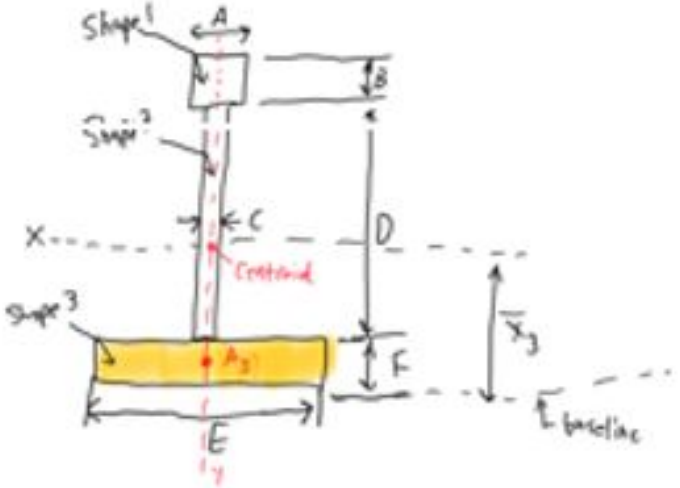
Centroid of Area — from Hw #11 Step 5

$= (4")(4")\left(\frac{4"}{2} + 7" + 4" - 5.9"\right)$

$= 113.6\ in^3$

↳ #7

8) Static moment (Q) @ bottom of Shape #2



$$Q_3 = A_3(\bar{x}_3)$$

$$= (F(E))\left(C_1 - \frac{F}{2}\right)$$

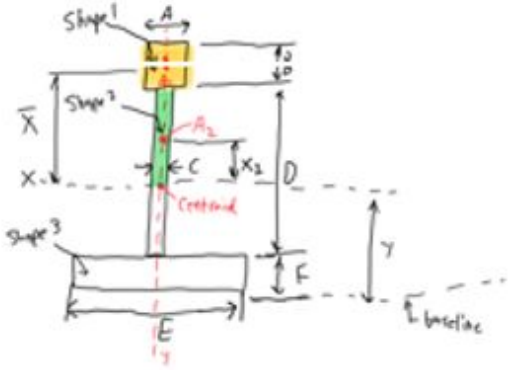
Centroid of Area from HW #11 Step 5

$$= \left(4''(8'')\right)\left(5.9'' - \frac{4''}{2}\right)$$

$$= 124.8\ in^3$$

↑ #8

9.) Static Moment Q @ Neutral axis



$$Q_{NA} = Q_1 + Q_2$$

$$Q_2 = A_2(\bar{X}_2)$$

$$Q_{NA} = Q_1 + \left(C(D+F-C_A)\right)\left(\frac{(D+F-C_A)}{2}\right)$$

$$= Q_1 + \frac{C(D+F-C_A)^2}{2}$$

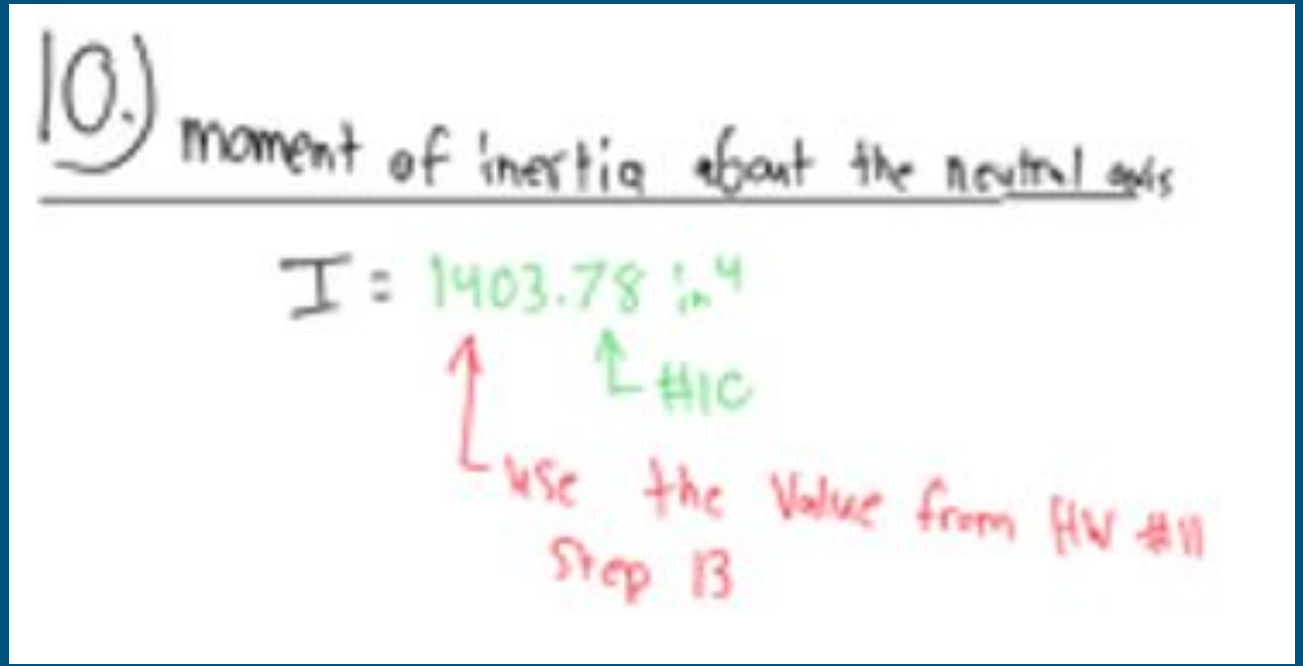
From #7

Centroid of Area From line #11 Step 5

$$= 113.6\,in^3 + \frac{1"(7"+4"-5.9")^2}{2}$$

$$= 126.605\,in^3$$

↑ #9


10.) moment of inertia about the neutral axis
I = 1403.78 in^4
#10
use the Value from HW #11 Step 13

11.) Section width @ neutral axis

$C = 1''$ ← #11

1 given

12.) Horizontal Shear Stress @ top of stage 2

$$f_v = \frac{V_{max}(Q_1)}{I(C)}$$ ← actually b in equation but you need to use the value for C

From #6: 192 — From #7: (113.62^1)

$$f_v = \frac{192\ (113.62^1)}{1409.78\ (1'')} = 15.537\ PSI$$

1409.78: From #10

15.537 PSI: #12

13.) Horizontal Shear Stress @ bottom of stage 2

$$f_v = \frac{V_{max}(Q_2)}{I(C)}$$

← actually b in equation but you need to use the value for c

From #6 — From #8

$$f_v = \frac{192 \quad (124.852)}{1409.78 \left(\ 1''\ \right)} = 17.0693 \text{ PSI}$$

From #10 — #13

14.) Horizontal Shear Stress @ Neutral axis of shape 2

$$f_v = \frac{V_{max}(Q_{NA})}{I(c)}$$

← actually b in equation but you need to use the value for c

$$f_v = \frac{192 \quad (126.605\ in^3)}{1403.78\ (1")} = 17.3162\ PSI$$

192: From #6

126.605 in³: From #9

1403.78: From #10

17.3162 PSI: #14

LAB