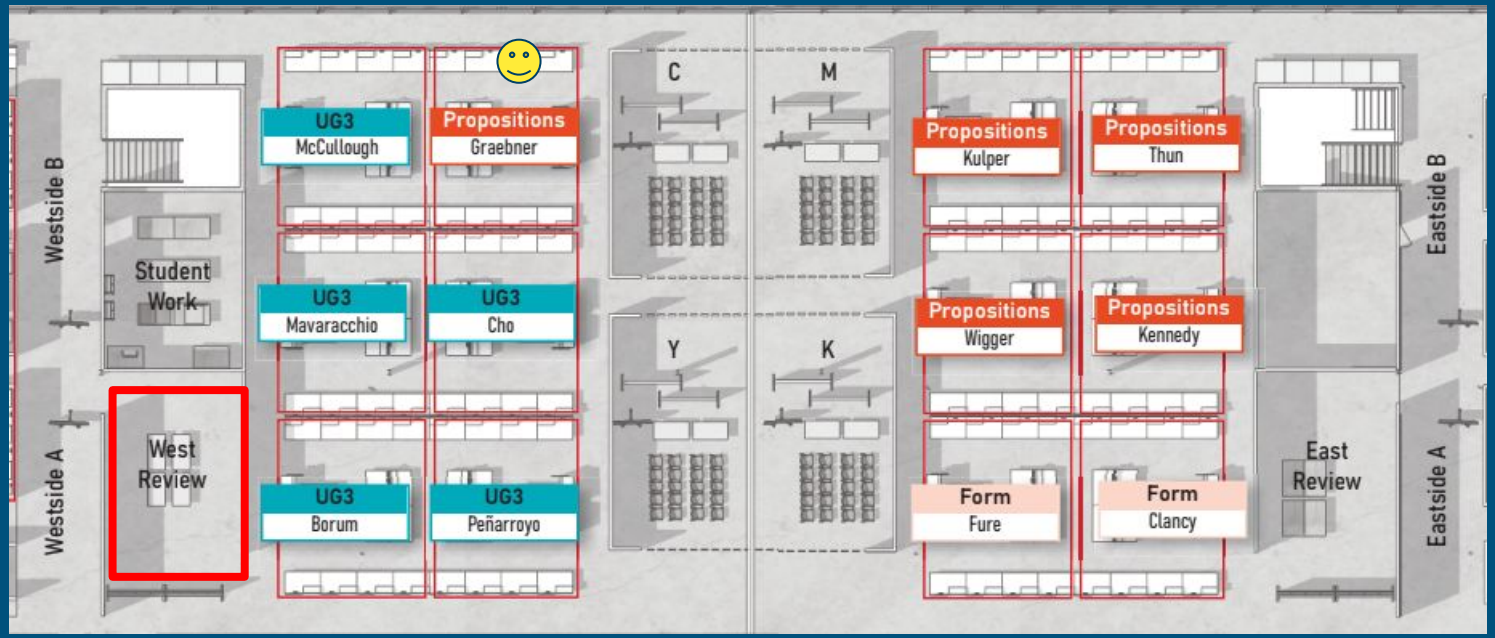
Recitation 004

11/08/2024

GSI Info

Aaron Comstock acom@umich.edu



Questions

BRIDGE SCORING

Class Rank:

- Your overall score is out of 100
- Lowest score is then put at a passing grade (62%) and the highest is at 100 %
- The rest are ranked in between them

TESTING	**60**	
Bridge < 4 oz is 8 pts and holds at least 50 lbs is 8 pts (else pts scaled down)	16	
Correct materials – wood and glue – solid deck (no holes)	14	
Points awarded (out of 30) based on class rank using formula: [(4/weight OZ)*50 + (load in LBS/50)*9]	30	

- FINAL REPORT IS DUE NOVEMBER 25TH (150 Points)

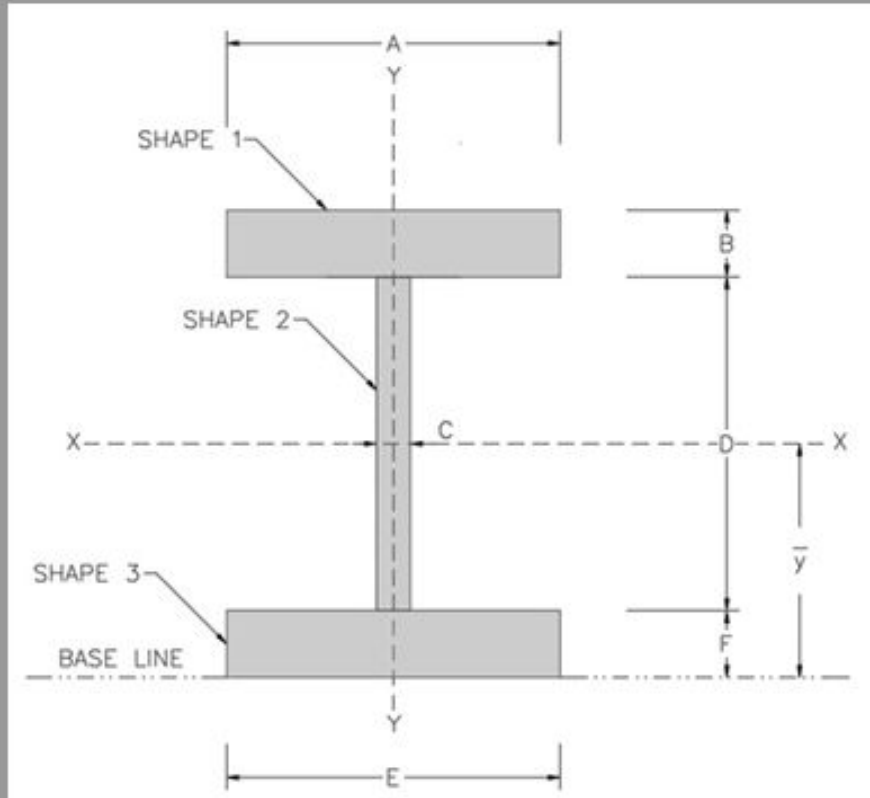
HW #11

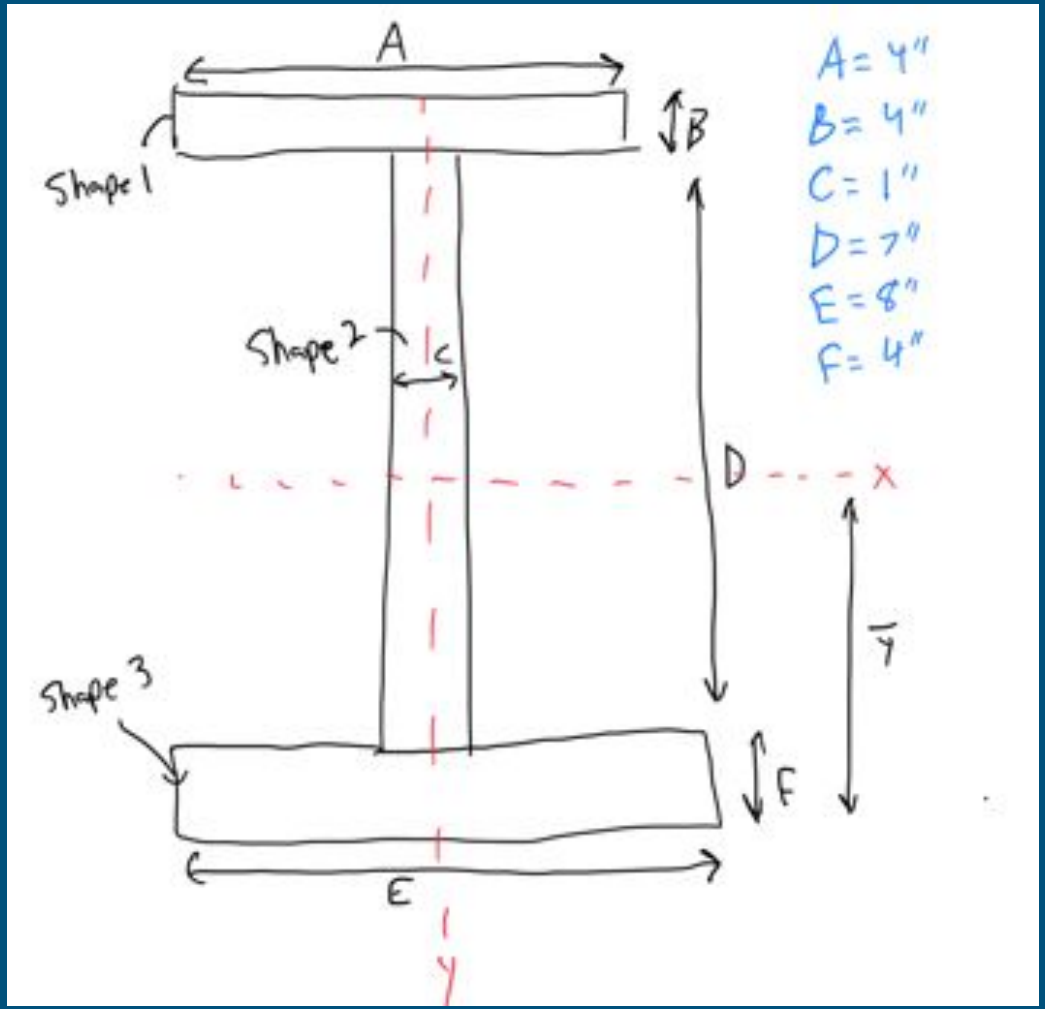
11. Moment of Inertia

Use the Parallel Axis Theorem to find the moments of inertia about both the x-x and y-y axes of the compound section.

DATASET: 1 -2- -3-

Dimension A	4 IN
Dimension B	4 IN
Dimension C	1 IN
Dimension D	7 IN
Dimension E	8 IN
Dimension F	4 IN




A
B
Shape 1
Shape 2
C
D
x
Shape 3
F
E
y
A = 4"
B = 4"
C = 1"
D = 7"
E = 8"
F = 4"

1.) Moment of Inertia of Shape 1

$$I = \frac{bh^3}{12} = \frac{AB^3}{12} = \frac{4''\,(4'')^3}{12} = 21.33\ in^4$$

↑ I

2.) Moment of Inertia of Shape 2

$$I = \frac{bh^3}{12} = \frac{CD^3}{12} = \frac{1''(7'')^3}{12} = 28.583\ in^4$$

#2

3.) Moment of Inertia of Shape 3

$$I = \frac{bh^3}{12} = \frac{EF^3}{12} = \frac{8'' (4'')^3}{12} = 42.667\ in^4$$

#3

4.) Summation of x-x moments of inertia

$$\sum I_{xx} = I_{xx_1} + I_{xx_2} + I_{xx_3} =$$

$$\sum I_{xx} = 21.33 + 28.583 + 42.67 = 92.5803 \text{ in}^4$$

↑ from #1 ↑ from #2 ↑ from #3 ← #4

5.) Find the Centroid of total area

	Area $A = B \times h$	distance from Centroid to baseline d	Moment of Area $Q = A\bar{x}$
Shape 1	$16\ in^2$	$13\ in.$ $4" + 7" + 2"$	$208\ in^3$ $16\ in^2 \times 13"$
Shape 2	$7\ in^2$	$7.5\ in$ $3.5" + 4"$	$52.5\ in^3$ $7\ in^2 \times 7.5"$
Shape 3	$32\ in^2$	$2\ in$	$64\ in^3$ $32\ in^2 \times 2"$
Sum	$55\ in^2$	X	$324.5\ in^3$

$$C_T = \Sigma Q / \Sigma A$$

$$\frac{324.5\ in^3}{55\ in^2} = 5.9"$$

G.) Distance from the centroid of Shape 1

$$X_1 = |C_1 - C_T| = |13'' - 5.9''| = 7.1''$$

13" — From Strip #5

7.1" — #5

7.) Distance from the centroid of Shape 2

$$X_2 = |C_2 - C_T| = |7.5'' - 5.9''| = 1.6''$$

From Step #5

6

8.) Distance from the centroid of Shape 3

$$X_3 = |C_3 - C_T| = |2'' - 5.9''| = 3.9''$$

From Step #5

↑ #7

9.) 2nd moment of area | about centroid

$A_1 \times (X_1)^2 = 16 \times (7.1")^2 = 806.56\ in^4$

↑ From step 5 ↑ From #5 ↑ #8

10.) 2nd moment of area 2 about centroid

$$A_2 \times (X_2)^2 = 7\,in^2 \times (1.6'')^2 = 17.92\,in^4$$

↑ from step 5 ↑ from #6 ↑ #9

11.) 2nd moment of area 3 about centroid

$$A_3 \times (X_3)^2 = 32\,in^2 \times (3.9'')^2 = 486.72\,in^4$$

↑ from step 5

↑ from #7

↑ mult

12.) Summation of moments of areas times distance

$\Sigma Ad^2 = 806.56\ in^4 + 17.92\ in^4 + 486.72\ in^4 = 1311.2\ in^4$

From #8 From #9 From #10 #11

13.) Moment of Inertia about x-x axis for whole shape

$$I_x = \sum I_{xx} + \sum A x^2 =$$

#12

$92.5803\ in^4 + 1311.2\ in^4 = 1403.78\ in^4$

I_{xx} from #12 $\quad$ I_{xx} from #11

14.) y-y Moment of Inertia of Shape 1

$$I_{yy_1} = \frac{bh^3}{12} = \frac{BA^3}{12} = \frac{4"(4")^3}{12} = 21.33\ in^4$$

↑ A13

15.) y-y Moment of Inertia of Shape 2

$$I_{yy_2} = \frac{bh^3}{12} = \frac{Dc^3}{12} = \frac{7"(1")^3}{12} = 0.583\ in^4$$

↑ #14

16.) y-y Moment of Inertia of Shape 3

$$I_{yy_3} = \frac{bh^3}{12} = \frac{FE^3}{12} = \frac{4"(8")^3}{12} = 170.67\ in^4$$

↑ #15

17.) Summation of y-y moments of Inertia

$$\Sigma I_{yy} = I_{yy_1} + I_{yy_2} + I_{yy_3} =$$

$$\Sigma I_{yy} = 21.33\ in^4 + 0.583\ in^4 + 170.67\ in^4 = 192.58\ in^4$$

↑ from #13 ↑ from #14 ↑ from #15 ↑ #16

18.) Moment of inertia about the y-axis

$$I_y = \Sigma I_{yy} + \Sigma A_y^2 =$$

0

Total shape is symmetrical about y-axis so the distance of the shape and the centroid is 0, making the second moment area 0

$$I_y = 192.58 in^4 + 0 = 192.58 in^4$$

192.58 in⁴ ← From #16

192.58 in⁴ ← #17

LAB