

Arch314

STRUCTURES I

Fall 2024
Recitation

FACULTY: Prof. Peter von Bülow
Mohsen Vatandoost

Arch314: STRUCTURES I

Welcome to Recitation session 11/08

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Office: Room 3122

hours:

Wed: 11:30 – 14:30

Mon, Fri: 11:30 - 13:30

walk-ins welcome!

Please feel free to ask questions.

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Welcome to Recitation session 11/08

Outline:

- Quick **Recap** of the week
- Provide the solution for the assignment (**Homework 11**)
- Answering student's questions
- Lab: **Moment of Inertia**
- **Bridge** project (How to prepare the Final Report)

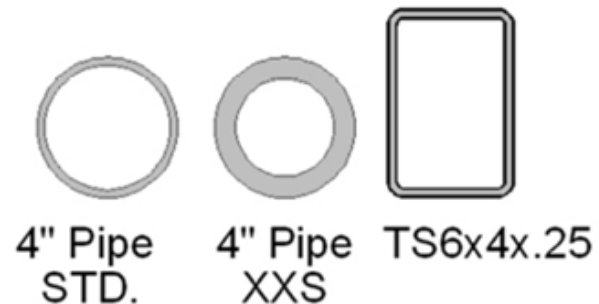
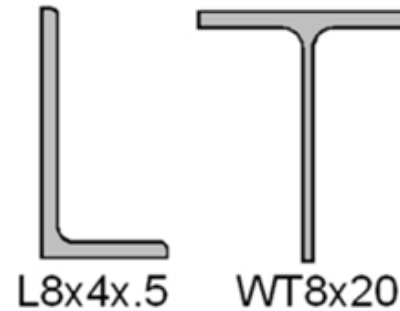
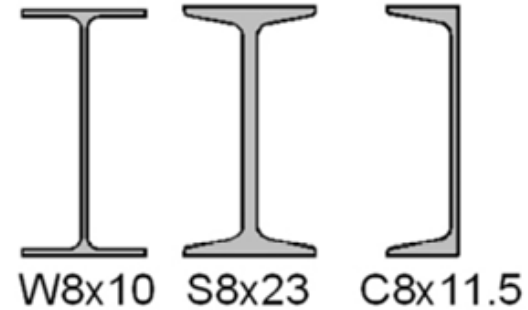
Please feel free to ask questions.

Recap of the week

ARCHITECTURE 314
STRUCTURES I

Cross-Sectional Properties of Structural Members

Resultant of Parallel Forces
Center of Gravity
Centroid of Area
First Moment of Area
Second Moment of Area
(Moment of Inertia)
Radius of Gyration



Provide the solution for the assignment – HW11

- Problem:

13. Moment of Inertia

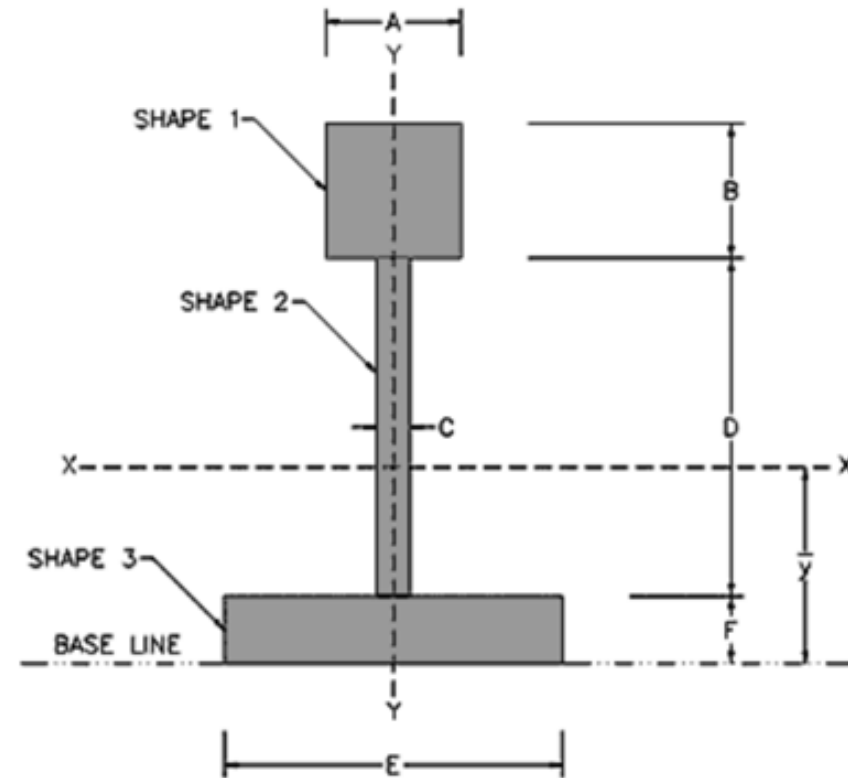
Use the Parallel Axis Theorem to find the moments of inertia about both the x-x and y-y axes of the compound section.

DATASET: 1

-2-

-3-

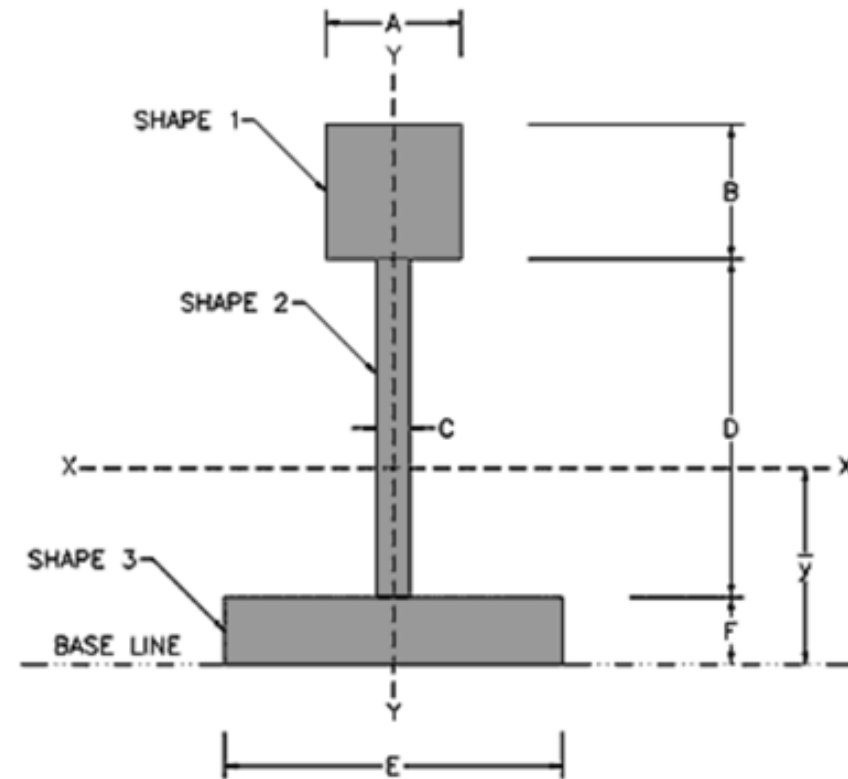
Dimension A	5 IN
Dimension B	2 IN
Dimension C	2 IN
Dimension D	7 IN
Dimension E	10 IN
Dimension F	2 IN



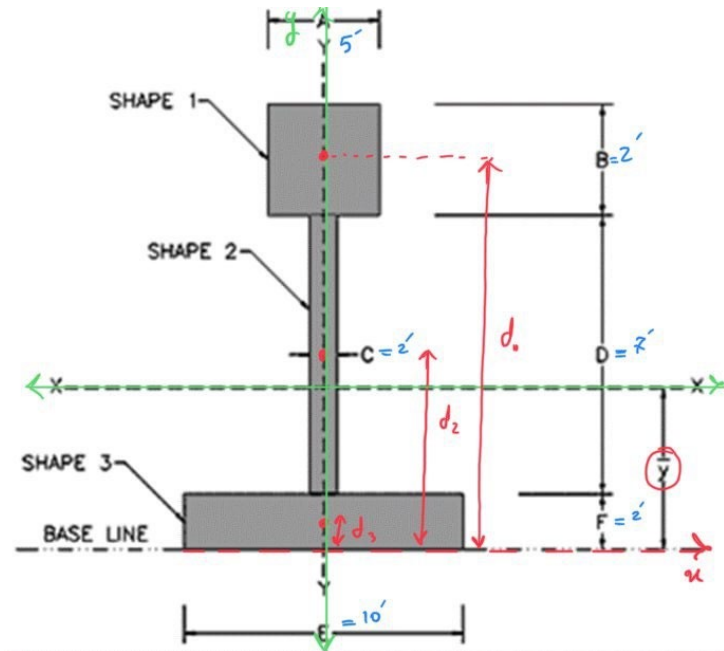
Provide the solution for the assignment – HW11

#	Question	Your Response
1	x-x Moment of Inertia of shape 1 about its own centroid (I_{xx})	<input type="text"/> IN^4
2	x-x Moment of Inertia of shape 2 about its own centroid (I_{xx})	<input type="text"/> IN^4
3	x-x Moment of Inertia of shape 3 about its own centroid (I_{xx})	<input type="text"/> IN^4
4	Summation of x-x Moments of Inertia of all shapes (SUM I_{xx})	<input type="text"/> IN^4
5	Distance from the centroid of shape 1 to the centroid of the whole shape	<input type="text"/> IN
6	Distance from the centroid of shape 2 to the centroid of the whole shape	<input type="text"/> IN
7	Distance from the centroid of shape 3 to the centroid of the whole shape	<input type="text"/> IN
8	2nd Moment of area 1 about centroid of whole shape x dist. to centroid (Ad^2)	<input type="text"/> IN^4
9	2nd Moment of area 2 about centroid of whole shape x dist. to centroid (Ad^2)	<input type="text"/> IN^4
10	2nd Moment of area 3 about centroid of whole shape x dist. to centroid (Ad^2)	<input type="text"/> IN^4
11	Summation of moments of areas times distances to centroid (SUM Ad^2)	<input type="text"/> IN^4
12	Moment of Inertia about the x-x axis for the whole shape (I_x)	<input type="text"/> IN^4
13	y-y Moment of Inertia of shape 1 about its own centroid (I_{yy})	<input type="text"/> IN^4
14	y-y Moment of Inertia of shape 2 about its own centroid (I_{yy})	<input type="text"/> IN^4
15	y-y Moment of Inertia of shape 3 about its own centroid (I_{yy})	<input type="text"/> IN^4
16	Summation of y-y Moments of Inertia of all shapes (SUM I_{yy})	<input type="text"/> IN^4
17	Moment of Inertia about the y-y axis for the whole shape (I_y)	<input type="text"/> IN^4

• Problem:



Provide the solution for the assignment – HW11

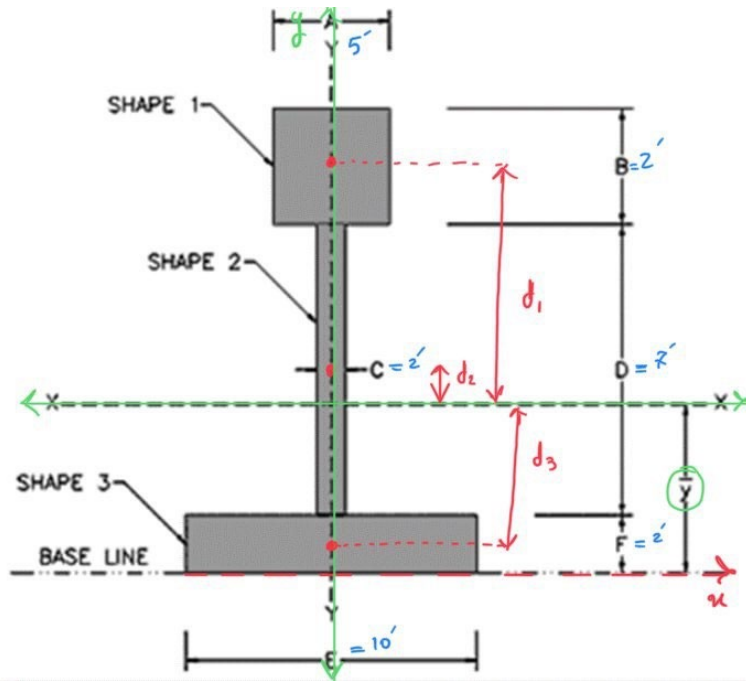


Step 1 - Calculate the Centroid of the Area

	Area	distance from base	First moment of Area
	A (ft^2)	d (ft)	$A \times d$ (ft^3)
Shape 1	$5 \times 2 = 10$	$2 + 7 + \frac{2}{2} = 10$	100
Shape 2	$2 \times 7 = 14$	$2 + \frac{7}{2} = 5.5$	77
Shape 3	$10 \times 2 = 20$	$\frac{2}{2} = 1$	20
Sum	44 ft^2	—	197

$$\bar{y} = \frac{\sum A \times d}{\sum A} \rightarrow \bar{y} = \frac{197}{44} = \underline{4.477} \text{ ft}$$

Provide the solution for the assignment – HW11



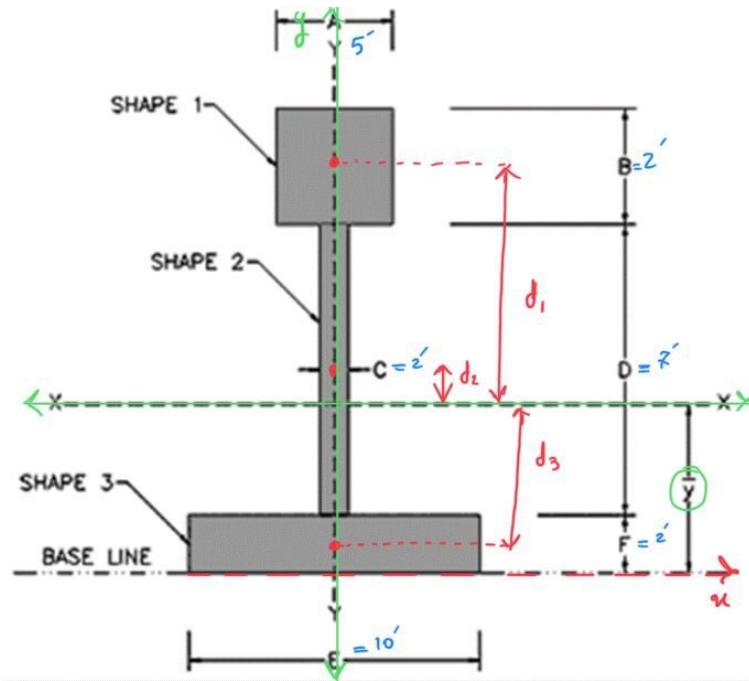
Step 2: Second moment of Area (I_x)
[Moment of Inertia]

$$I_x = \frac{bh^3}{12}$$

Centroid of shape to the centroid of whole shape

	I_x (in^4)	A (in^2)	d (in)	$A \times d^2$ (in^3)	$I_x + Ad^2$ (in^4)
Shape 1	$\frac{5 \times 2^3}{12} = 3.33$	$5 \times 2 = 10$	$10 - 4.47 = 5.53$	305.80	309.13
Shape 2	$\frac{2 \times 7^3}{12} = 57.16$	$2 \times 7 = 14$	$5.5 - 4.47 = 1.03$	14.85	72.01
Shape 3	$\frac{10 \times 2^3}{12} = 6.67$	$10 \times 2 = 20$	$1 - 4.47 = -3.47$	240.82	247.49
Sum	67.16	44 in^2	—	561.47 (in^3)	628.63 (in^4)

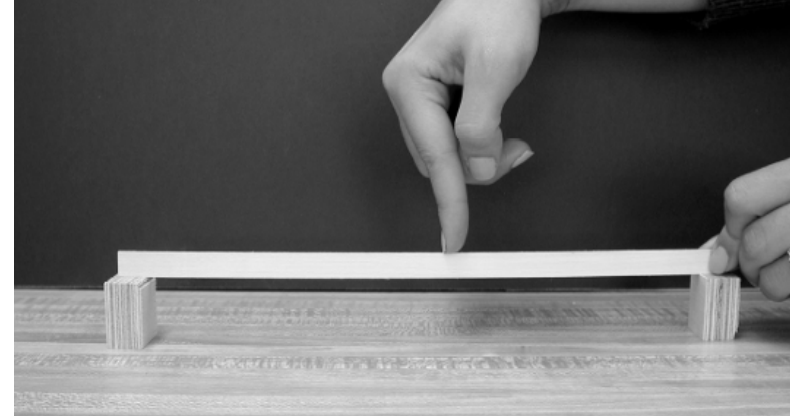
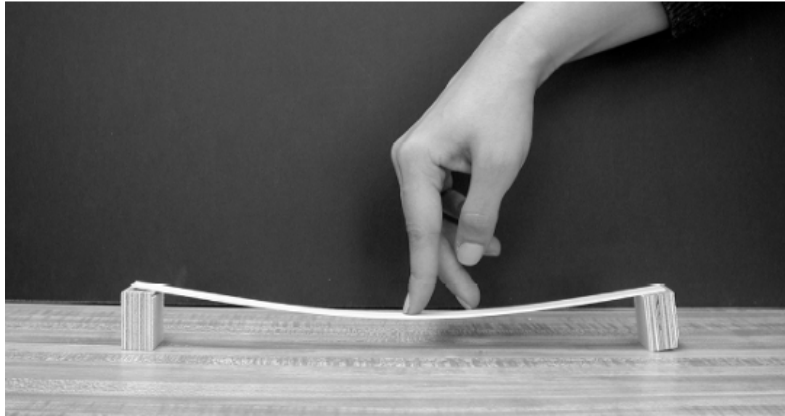
Provide the solution for the assignment – HW11



Step 3: Moment of Inertia (I_y)

	I_y (in ⁴)	A (in ²)	d (in)	$A \times d^2$ (in ⁴)	$I_u + Ad^2$
Shape 1	$\frac{2 \times 5^3}{12} = 20.84$	$5 \times 2 = 10$	0	0	20.84
Shape 2	$\frac{2 \times 2^3}{12} = 4.67$	$2 \times 7 = 14$	0	0	4.67
Shape 3	$\frac{2 \times 10^3}{12} = 166.67$	$10 \times 2 = 20$	0	0	166.67
Sum	192.18	44 in ²	—	—	192.18 (in ⁴)

Lab: Moment of Inertia



Moment of Inertia

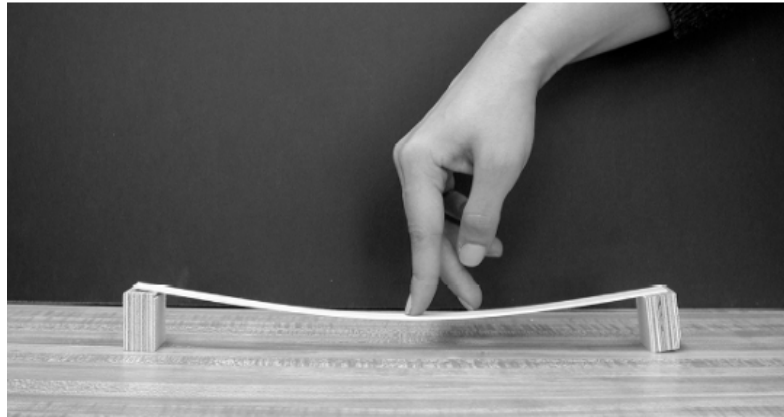
Description

This project uses observation and calculation to investigate the moment of inertia.

Goals

- To observe the strong and weak axis moment of inertia through physical testing.
- To calculate the strong and weak axis moment of inertia for a given section.
- To compare the physical sense with the calculated values.

Lab: Moment of Inertia



Moment of Inertia
of a rectangle

$$I = \frac{bd^3}{12}$$

Procedure

1. Span the given 1/16" x 1/2" basswood stick flatwise between two supports.
2. Load the 'beam' at mid span with your finger to cause about 1/2" deflection.
3. Now rotate the stick 90° so that it is on the narrow edge, and hold it in place.
4. Again with your finger apply about the same load as before, and notice how much stiffer the beam has become.
5. Now calculate the moment of inertia for both orientations – flatwise and on edge.
6. Compare the two numbers and observe how they relate to the actual stiffness you felt with your finger.

Bridge Project_ Final Report

- Pay Particular attention to the Tally sheet and requirements. (We Don't want you to lose points!)
- Look at the examples provided in the course website.
- **It is not finished yet!** Prepare your report Properly.

PRELIMINARY REPORT (re-submit original)	40
TESTING	60
FINAL REPORT REQUIREMENTS	150

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Thank you.

Any question?

Please feel free to ask questions.