Arch 314
Structures I

Fall 2025 Recitation 004

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Amely Wackerbauer

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Recitation 004

Welcome to session 11! (Last one!)

- Teaching Evaluations
- Quick Recap of this week's lecture
- Homework Review (#14 Beam Deflection)
- Lab: Beam Deflection

Feel free to ask questions anytime

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Please complete teaching evaluations! :)

Send me a screenshot of the email confirmation
and you will get 20 bonus points!!

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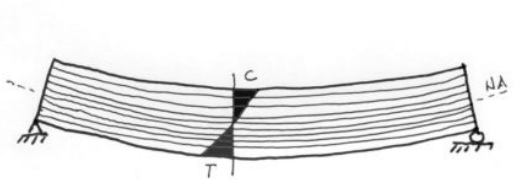
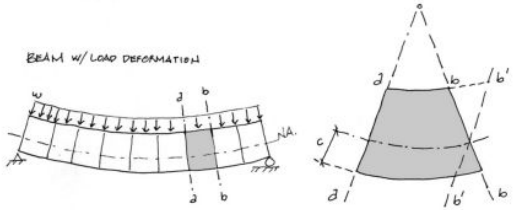
Lecture: Beam Deflection Pt 1 & Pt 2 (Mon + Wed)

Deflection

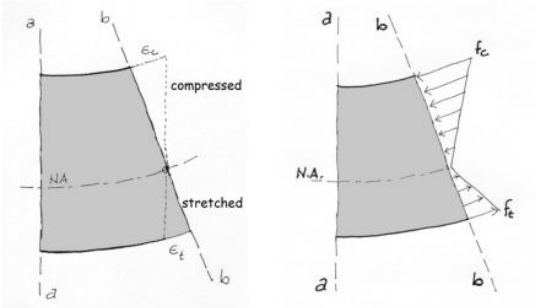
Axial fiber deformation in flexure results in normal (vertical) deflection.



The change in lengths, top and bottom, results in the material straining. For a simple span with downward loading, the top is compressed and the bottom stretched.



The material strains result in corresponding stresses. By Hooke's Law, these stresses are proportional to the strains which are proportional to the change in length of the radial arcs of the beam "fibers".



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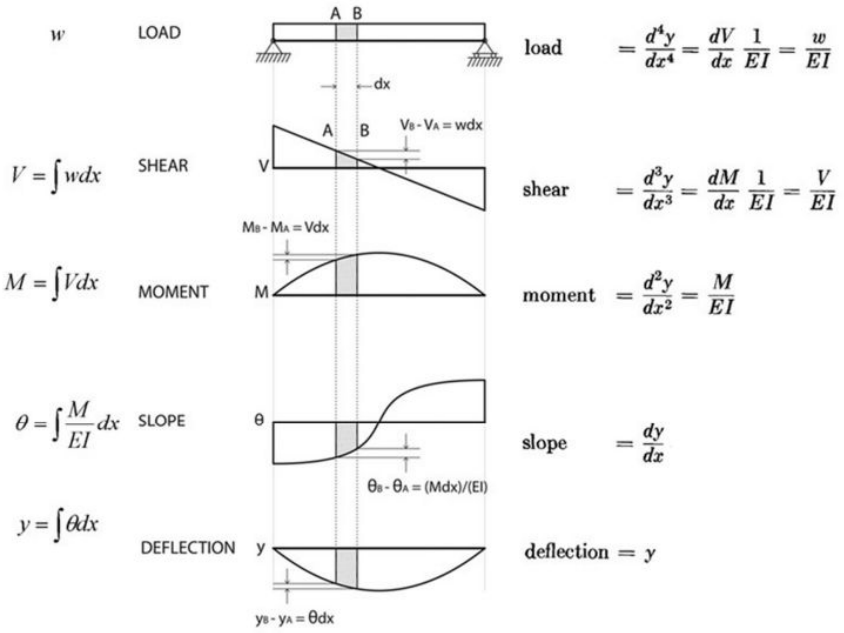
Lecture: Beam Deflection Pt 1 & Pt 2 (Mon + Wed)

Relationships of Forces and Deformations

There is a series of relationships involving forces and deformations along a beam, which can be useful in analysis. Using either the deflection or load as a starting point, the following characteristics can be discovered by taking successive derivatives or integrals of the beam equations.



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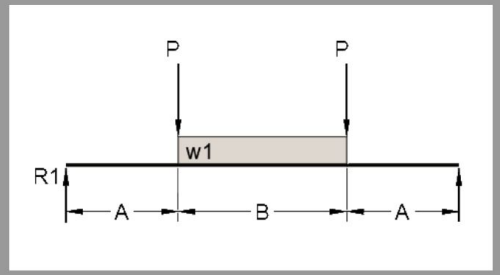
HW #14: Beam Deflection

14. Beam Deflection

For the given simple span beam, use shear, moment, slope and deflection diagrams to determine the slope at each end, the deflection at points A and B distance from left, and the maximum deflection at the centerline. Remember to divide out EI to get deflection in inches. Be sure to correct errors at each step to maintain accuracy.



DATASET: 1 -2- -3-

Length A	11 FT
Length B	10 FT
Point Load P	13 KIPS
Uniform Load w	1 KLF
Modulus of Elasticity	29000 KSI
Moment of Inertia	820 IN^4

#	Question	Your Response	Correct Answer	Score
1	R1 (+ = upward)	18 KIPS	18 KIPS	5
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6	Area under moment diagram (MA1)	1089 KIP-FT^2	1089 KIP-FT^2	5
7	Area under moment diagram (MA2)	41.67 KIP-FT^2	41.6667 KIP-FT^2	5
8	Area under moment diagram (MA3)	990 KIP-FT^2	990 KIP-FT^2	5
9	Slope(EI) at reaction (S1). Give absolute value.	2120.67 KIP-FT^2	2120.67 KIP-FT^2	5
10	Slope(EI) at point load (S1). Give absolute value.	1037.67 KIP-FT^2	1031.67 KIP-FT^2	5
11	Area under slope(EI) diagram (SA1)	11348.4 KIP-FT^3	11348.3 KIP-FT^3	5
12	Area under slope(EI) diagram (SA2)	7986 KIP-FT^3	7986 KIP-FT^3	5
13	Area under slope(EI) diagram (SA3)	2579.2 KIP-FT^3	2579.17 KIP-FT^3	5
14	Centerline deflection. Give absolute value in INCHES.	1.59 INCHES	1.59237 INCHES	5

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HW #14: Beam Deflection

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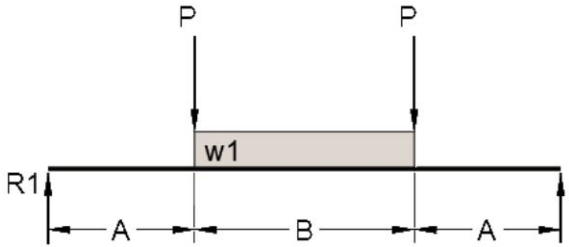

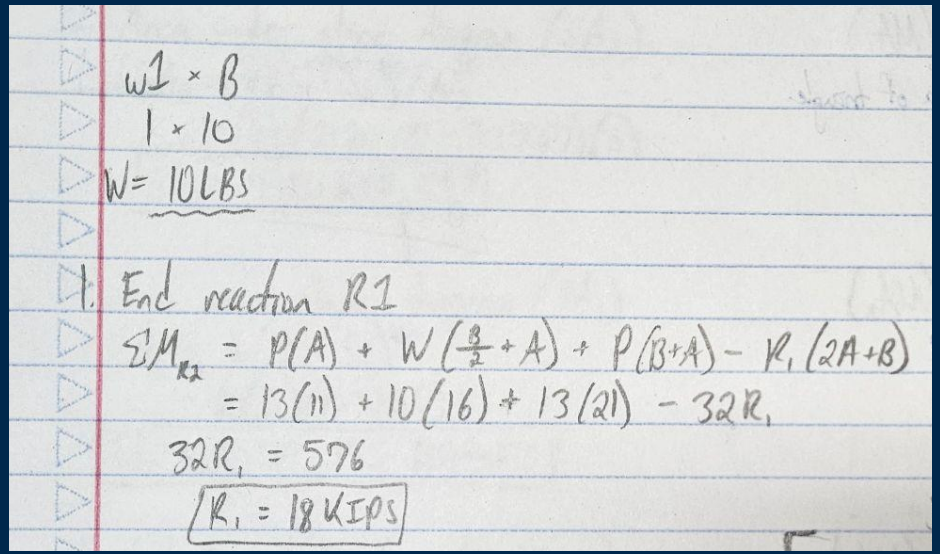

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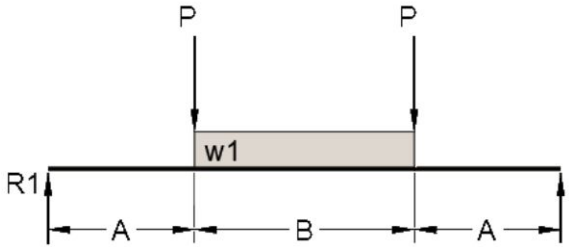


2. Shear at reaction (V1)

* R1 pushes beam upwards at reaction *

$V_1 = R_1 \overset{\#1}{=}$ 18 KIPS

3. Shear at point load (V2)

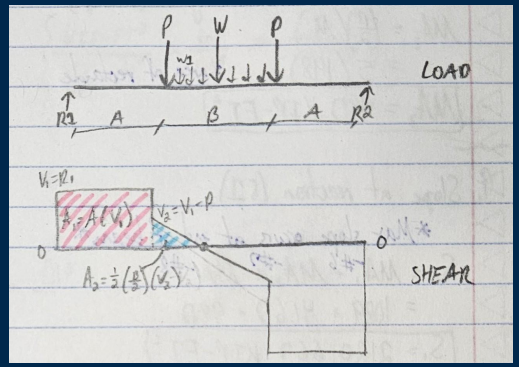
* P pushes beam downwards *

$V_2 = V_1 - P$

$= R_1 \overset{\#1}{=} P$ - given

$= 18 - 13$

$V_2 = 5$ KIPS



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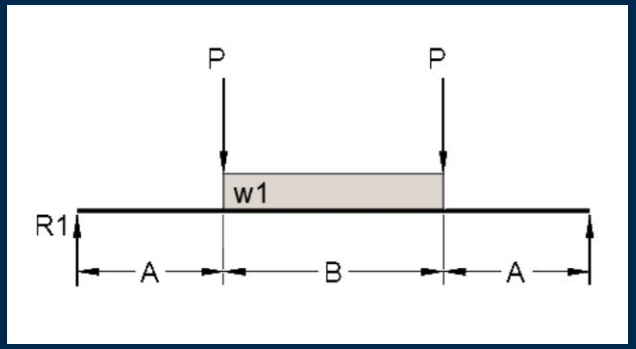

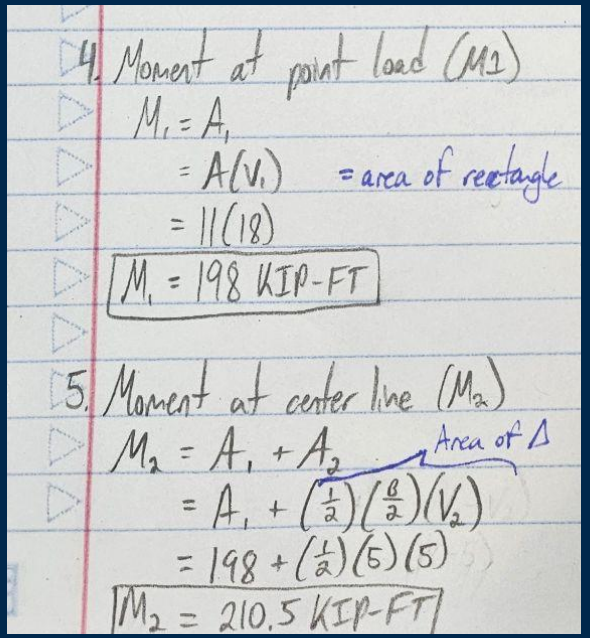

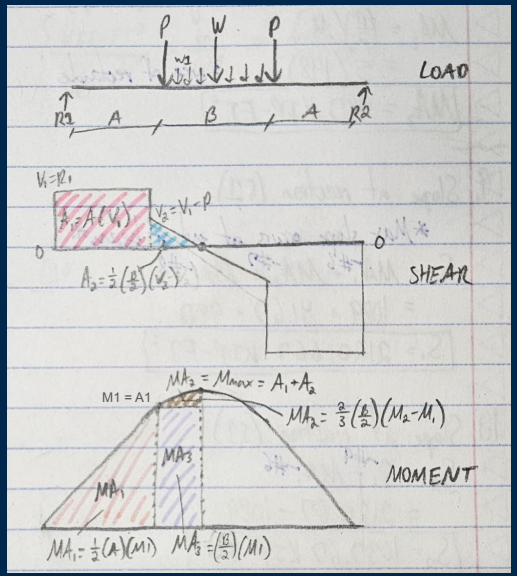

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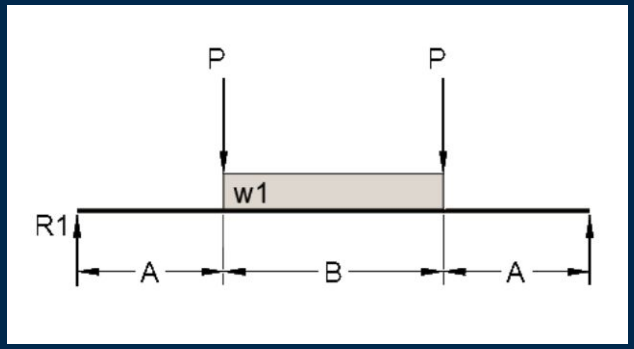


6. Area under moment diagram (MA_1)

$MA_1 = \left(\frac{1}{2}\right)(A)(M_1)$ = area of triangle

$= \left(\frac{1}{2}\right)(11)(198)$ #4

$MA_1 = 1089$ KIP-FT^2

7. Area under moment diagram (MA_2)

$MA_2 = \left(\frac{2}{3}\right)\left(\frac{B}{2}\right)(M_2 - M_1)$ #5 #4

$= \left(\frac{2}{3}\right)(5)(210.5 - 198)$

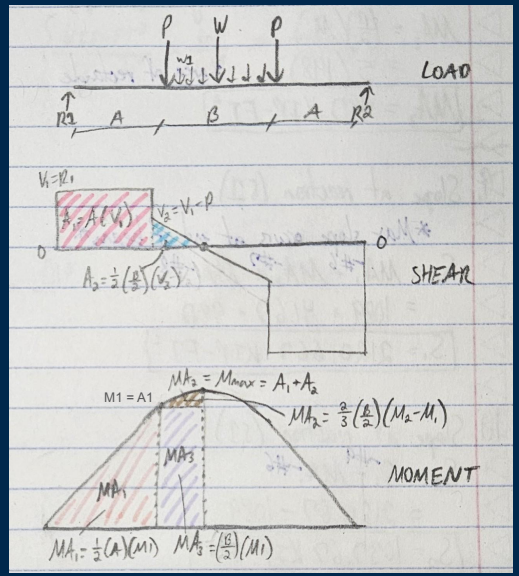
$MA_2 = 41.67$ KIP-FT^2

8. Area under moment diagram (MA_3)

$MA_3 = \left(\frac{B}{2}\right)(M_1)$

$= 5(198)$ = area of rectangle

$MA_3 = 990$ KIP-FT^2



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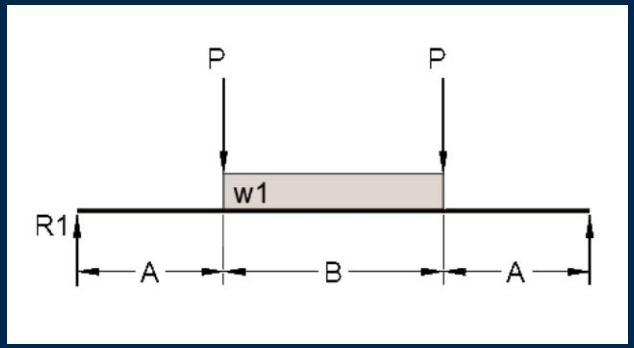


9. Slope at reaction (S1)

Max slope occurs at end of beam

$S_1 = MA_1 (\#6) + MA_2 (\#7) + MA_3 (\#8)$

$= 1089 + 41.67 + 990$

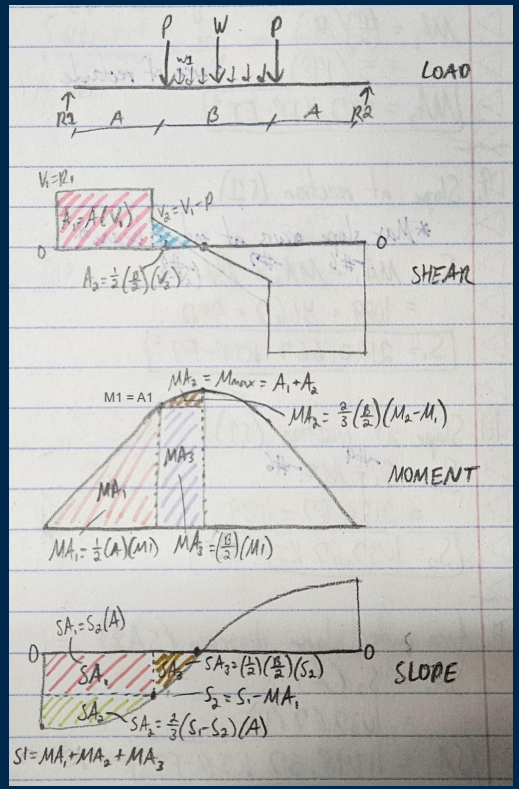
$S_1 = 2120.667\ KIP\text{-}FT^2$

10. Slope at point load (S2)

$S_2 = S_1 (\#9) - MA_1 (\#6)$

$= 2120.67 - 1089$

$S_2 = 1037.67\ KIP\text{-}FT^2$



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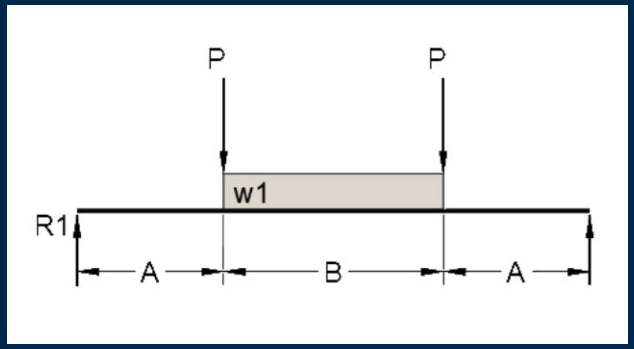


11. Area under slope diagram (SA1)

$SA_1 = S_2(A)$

$= 1037.67(11)$

$SA_1 = 11348.37\ KIP\text{-}FT^3$

12. Area under slope diagram (SA_2)

$SA_2 = \left(\frac{2}{3}\right)(S_1 - S_2)(A)$ (#9, #10)

$= \left(\frac{2}{3}\right)(2120.67 - 1037.67)(11)$

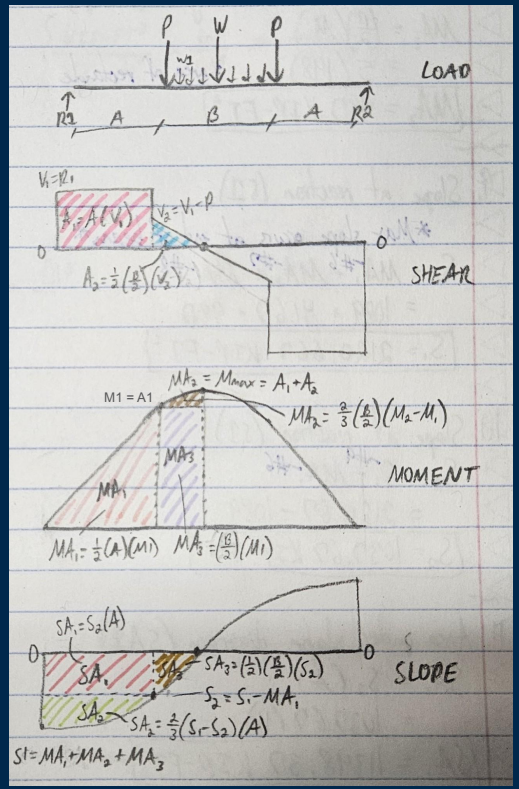
$SA_2 = 7986\ KIP\text{-}FT^3$

13. Area under slope diagram (SA_3)

$SA_3 = \frac{1}{2}\left(\frac{B}{2}\right)(S_2)$ (#10)

$= \frac{1}{2}(5)(1037.67)$

$SA_3 = 2579.175\ KIP\text{-}FT^3$



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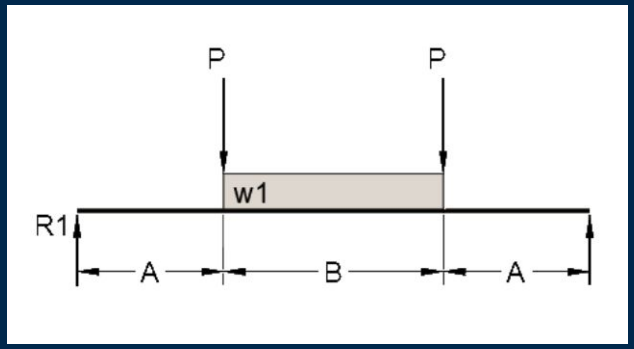

14. Centerline deflection (INCHES!)

$$\text{Deflection} = \frac{|D_{max}|}{E \times I} \times 12^3 \quad \text{— convert to inches}$$

$$\left\{ \frac{\text{KIP-FT}^3}{\frac{\text{KIP}}{\text{in}^2} \times \text{in}^4} \times \frac{\text{in}^3}{\text{ft}^3} = \text{inches} \right\}$$

$$|D_{max}| = SA_1 + SA_2 + SA_3|$$

$$\text{Deflection} = \frac{|SA_1^{\#11} + SA_2^{\#12} + SA_3^{\#13}|}{\text{given } 29000\,(820)} \times 12^3$$

$$= \frac{|1348.37 + 7986 + 2579.175|}{29000\,(820)} \times 12^3$$

$$= \boxed{1.5924 \text{ in}}$$

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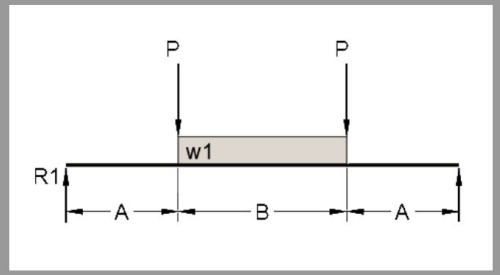

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LAB!

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