Arch 314
Structures I

Fall 2025 Recitation 004

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Recitation 004

Welcome to session 6!

- Bridge!!
- Quick Recap of this week's lecture (+ part of last week's)
- Homework Review (#9 Floor Systems)
- Lab: Load Tracing

Feel free to ask questions anytime

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Bridge

Due Dates:

- Bridge Testing - **11.03!!**
  - Sign up for testing slot if not already
- Final Report - 11.25 (right before Thanksgiving break)

Key Rules:

- Must load bricks on the deck
- Wood + Glue only
- MUST BE UNDER 4OZ
  - Scales will be down in Peter's office - do NOT remove them & make sure they are in oz not Toz
  - Note: for data gathering purposes - please weigh bridge materials before/without glue + again after glue

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Bridge

Tips:

- See feedback on preliminary report
  - Don’t forget lateral bracing
- Make sure you have lip on both ends to combat sagging and so the bridge can properly fit on stand (test downstairs!!)
- Account for 10% weight = glue
- Make a test bridge if possible
- DO NOT WAIT UNTIL THE LAST MINUTE

- Loading strategy - place on the joints and load fast! Have a system of who is holding/passing what (assembly line!)
  - Load across entirety of bridge - distribute load / not allowed to only load on ends

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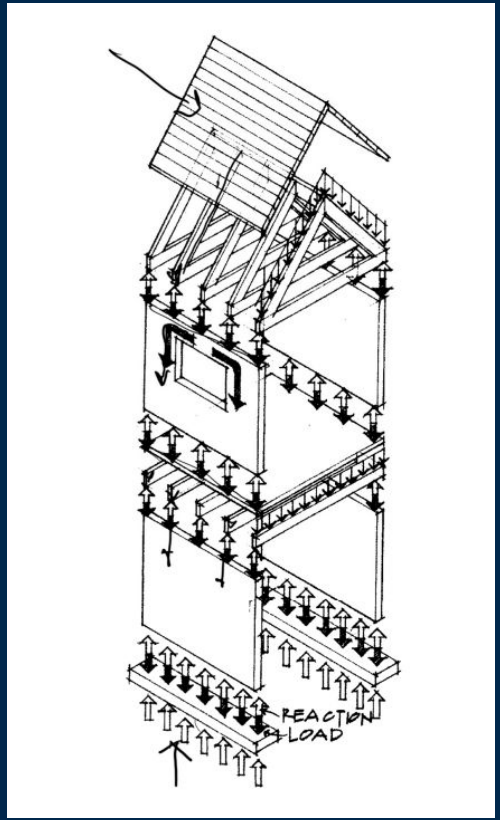
Lecture: Load Tracing & Floor Systems (10/15)



Load Paths

Floor Loads

Dead Load

weight of structure

Live Load

occupancy load

Member Hierarchy

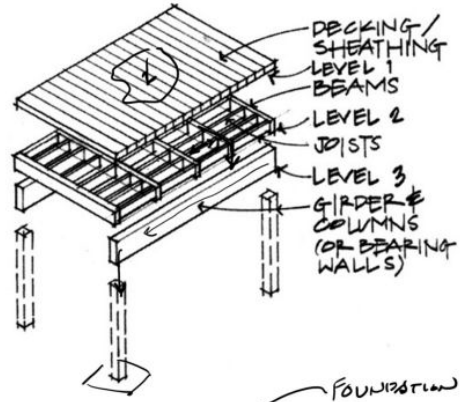
Flooring spans between joists

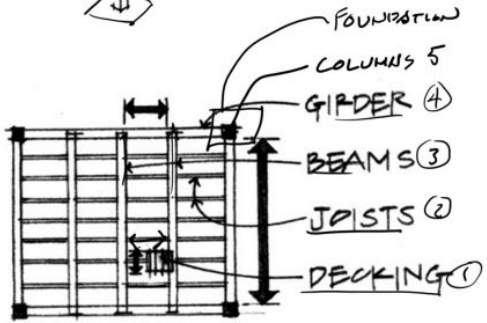
Joists span between beams

Beams span between girders

Girders span between columns

Columns carry load to ground





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Lecture: Load Tracing & Floor Systems (10/15)

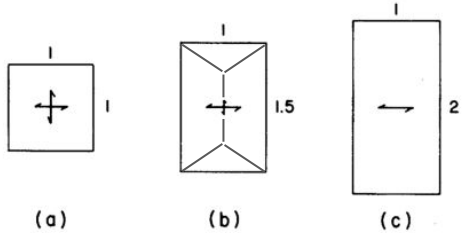
Load Paths

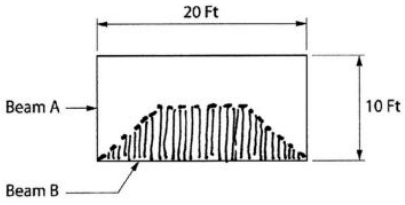
Floor Slabs

Concrete slabs span in the direction of the steel reinforcement.

One-way slabs should span the shortest direction.

Two-way slabs span in both directions. Aspect ratios should be square or less than 2:1. The load path divides at 45° from corner.





two-way slab tributary area of beam B

two-way waffle slab

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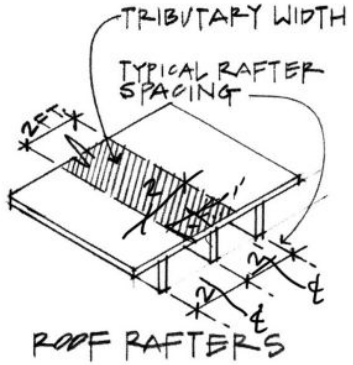
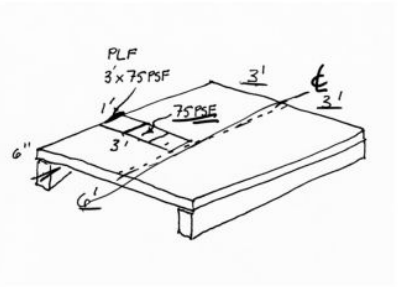
Lecture: Load Tracing & Floor Systems (10/15)

Tributary Area

The **tributary area** is an area used to determine the load on a member.



Each member has a tributary area that can be used to find the total load on that member.



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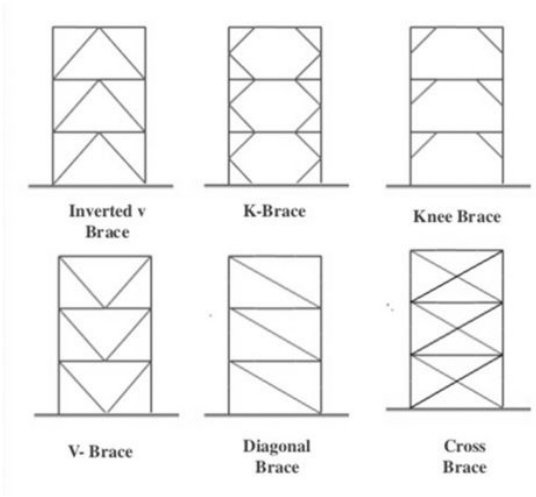
Lecture: Lateral Stability (10/20)

Frame Bracing

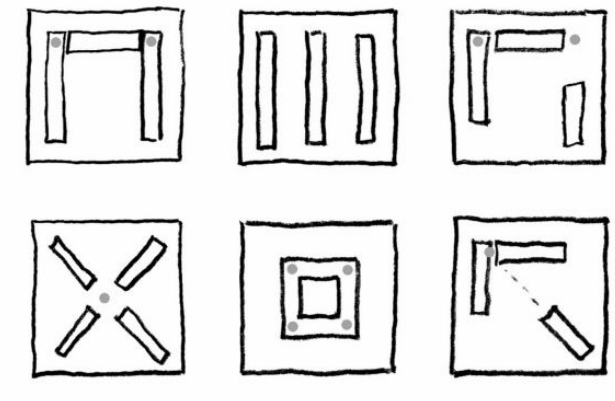
types of bracing



Lateral Force Resistance

Stability requires at least 2 points of intersection.

Force is more evenly resisted with centroid of walls in the kern of slab



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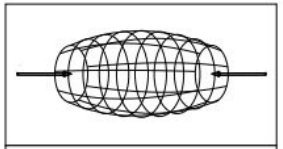
Lecture: Stress and Strain (10/22)

Stress and Strain

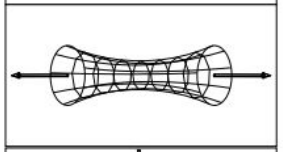
- Stress
- Strain
- Analysis – ASD vs. LRFD
- Modes of Failure

Types of Stress

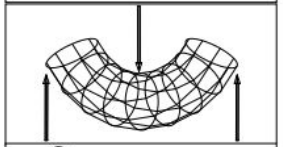
- Compression $\sigma = \frac{P}{A}$



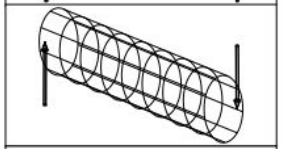
- Tension $\sigma = \frac{P}{A}$



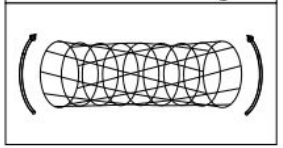
- Flexure $\sigma = \frac{M\ c}{I}$



- Shear $\tau = \frac{P}{A} or \frac{VQ}{Ib}$



- Torsion $\tau = \frac{T\ r}{J}$



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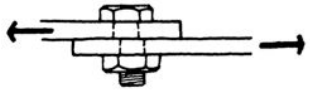
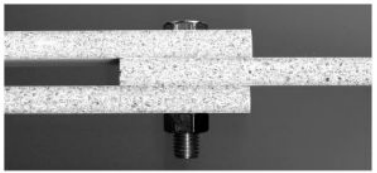
Lecture: Stress and Strain (10/22)

Stress

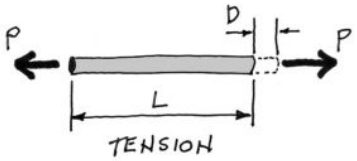
Stress is the result of some force being applied to an area of some material.

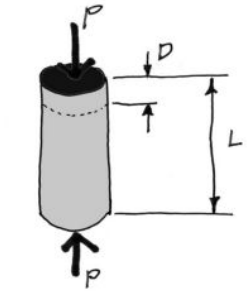
$$\sigma = \frac{P}{A}$$





Shear Stress





COMPRESSION

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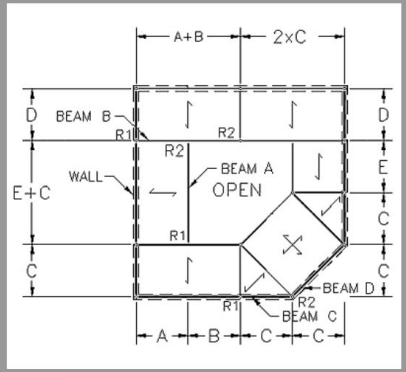
HW #9: Floor Systems

9. Floor Systems

For each beam, A through G, determine the loading from the floor, the wall and from other beam reactions. Then, calculate the end reactions for each beam.

DATASET: 1 -2- -3-

Span A	9 FT
Span B	11 FT
Span C	10 FT
Span D	14 FT
Span E	9 FT
Dead load of wall	255 PLF
Dead load of floor	21 PSF
Live load on floor	28 PSF



Your answer was correct.
You scored 5 points.

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	220.5 PLF	220.5 PLF	5
2	End reaction R1 on Beam A	2094.75 LBS	2094.75 LBS	5
3	End reaction R2 on Beam A	2094.75 LBS	2094.75 LBS	5
4	Full uniform load on Beam B	343 PLF	343 PLF	5
5	Point load on Beam B	2094.75 LBS	2094.75 LBS	5
6	End reaction R1 on Beam B	4582.11 LBS	4582.11 LBS	5
7	End reaction R2 on Beam B	4372.64 LBS	4372.64 LBS	5
8	Full uniform load on Beam C	255 PLF	255 PLF	5
9	Peak value of triangular load on Beam C	122.5 PLF	122.5 PLF	5
10	End reaction R1 on Beam C	1683.35 LBS	1683.33 LBS	5
11	End reaction R2 on Beam C	1479.14 LBS	1479.17 LBS	5
12	Full uniform load on Beam D	255 PLF	255 PLF	5
13	Peak value of triangular load on Beam D	346.98 PLF	346.482 PLF	5
14	End reaction R1 on Beam D	3028.12 LBS	3028.12 LBS	5
15	End reaction R2 on Beam D	3028.12 LBS	3028.12 LBS	5

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HW #9: Floor Systems

DATASET: 1	-2-	-3-
Span A		9 FT
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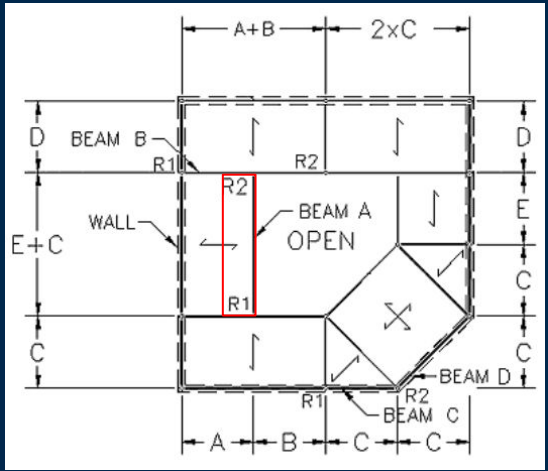
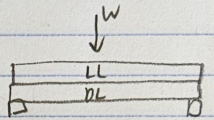


Total uniform load of floor = dead load + live load

$w = 21PSF + 28PSF$

$w = 49PSF$



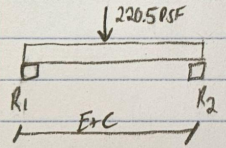
1. Full uniform load on Beam A

$W_A = w \times \frac{A}{2}$

$= 49 \times \frac{9}{2}$

$W_A = 220.5PLF$

2. End reactions on beam A



#1

W_A = uniform load × (E+C)

$= 220.5(9' + 10') = 4189.5lbs$

$\Sigma F_y = R_1 + R_2 - W_A$

reactions are symmetrical

$\Sigma F_y = 0 = 2R - 4189.5lbs$

$-2R = -4189.5lbs$

$R = 2094.75lbs$ ← Answer to #2+#3

$C = R_1$ and R_2

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HW #9: Floor Systems

DATASET: 1	-2-	-3-
Span A		9 FT
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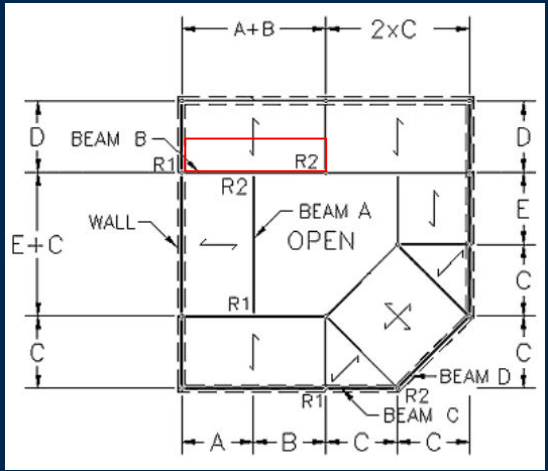


4. Full uniform load on Beam B

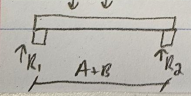
$w_B = w \times \frac{D}{2}$

$= 49 \times \frac{14'}{2} = 343$ PLF

5. Point load on Beam B

point load = R_2 of Beam A = 2094.75 lbs (#2)

6. End reactions on Beam B



W_B = uniform load × (A+B) (#4)

$= 343\ (9'+11') = 6860$ lbs

$\Sigma M_{R2A} = 0 = R_{2A}(A) + W_B\left(\frac{A+B}{2}\right) - R_2(A+B)$ (#3)

$0 = 2094.75(9') + 6860\left(\frac{9'+11'}{2}\right) - R_2(9'+11')$

$\frac{20R_2}{20} = \frac{18,852.75 + 68,600}{20}$

$R_2 = 4372.64$ lbs ← Answer to #7

$\Sigma F_y = 0 = -R_{2A} - W_B + R_2 + R_1$ (#3)

$0 = -2094.75 - 6860 + 4372.64 + R_1$

$R_1 = 4582.11$ lbs ← Answer to #6

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HW #9: Floor Systems

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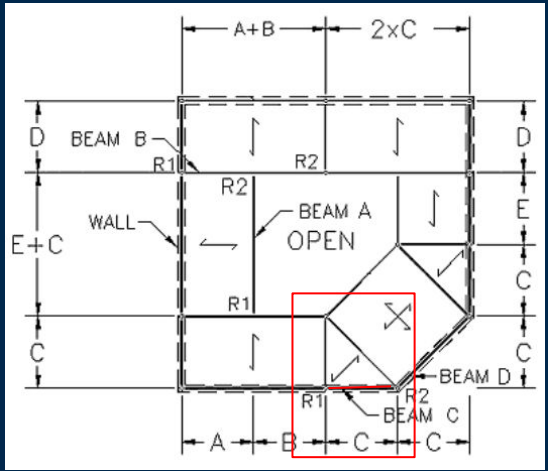

8. Full uniform load on Beam C
= only one uniform load on Beam C
= dead load of wall — given
= 255 PLF

9. Peak value of triangular load on Beam C

$l = \sqrt{c^2+c^2} = c\sqrt{2}$

$x = \frac{l}{2} = \frac{c\sqrt{2}}{4}$

$\sqrt{y^2+y^2} = \frac{x}{2}$

$\sqrt{y^2+y^2} = \frac{c\sqrt{2}}{4}$

$\left(\sqrt{y^2+y^2}\right)^2 = \left(\frac{c\sqrt{2}}{4}\right)^2$

$2y^2 = \frac{2c^2}{16}$

$y^2 = \frac{c^2}{16}$

$y = \frac{c}{4}$

Peak floor load
= Floor load × $\frac{c}{4}$
= 49 × $\frac{10}{4}$
= 122.5 PLF
Answer to #9

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HW #9: Floor Systems

DATASET: 1	-2-	-3-
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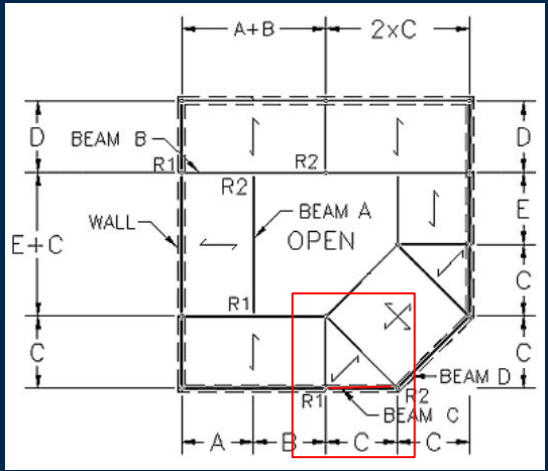
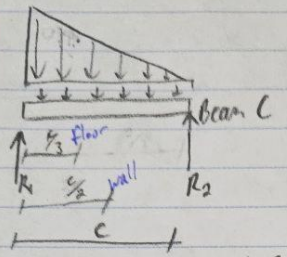


10. End reactions



#9

Floor load = peak Floor load × $\frac{c}{2}$

= 122.5 × $\frac{10}{2}$

= 612.5 lbs

wall load = uniform Beam C load × C'

= 255 × 10'

= 2550 lbs

$\Sigma M_{R1} = 0 = \text{floor}\left(\frac{c}{3}\right) + \text{wall}\left(\frac{c}{2}\right) - R_2(c)$

$= 612.5\left(\frac{10}{3}\right) + 2550\left(\frac{10}{2}\right) - 10R_2$

$\frac{10R_2}{10} = \frac{14,791.14}{10}$

$R_2 = 1,4791.14$ lbs ← Answer to #11

$\Sigma F_y = -\text{floor}_w - \text{wall}_w + R_1 + R_2$

$= -612.5 - 2550 + R_1 + 14791.14$

$R_1 =$ 1683.35 lbs ← Answer to #10

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HW #9: Floor Systems

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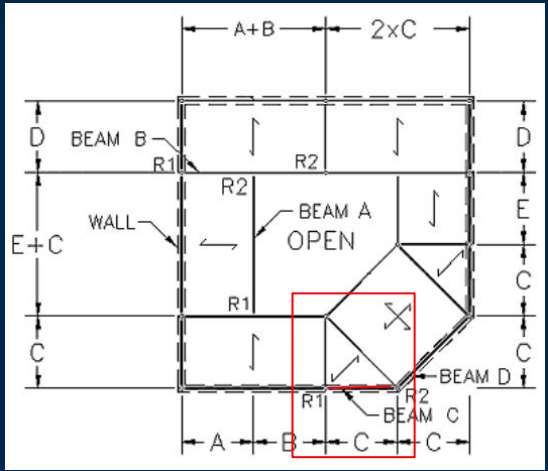

12. Full uniform load on Beam D
= only one uniform load on Beam D
= dead load of wall - given
= 255 PLF

13. Peak value of triangular load on Beam D

$\ell = c\sqrt{2}$ (from Beam C calcs)
$= 10\sqrt{2} = 14.14'$

$h = \frac{1}{2}\ell = \frac{c\sqrt{2}}{2} = \frac{10\sqrt{2}}{2} = 7.07'$

Peak value = height × floor load
$= 7.07' \times 49 =$ 346.98 PLF ← Answer to #13

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HW #9: Floor Systems

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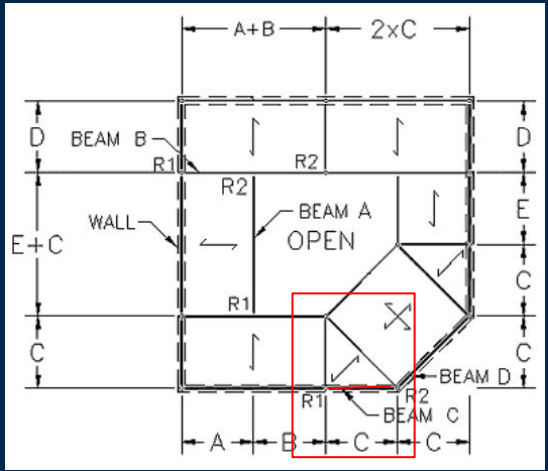

14. End reactions on Beam D

$\Sigma F_y = 0 = R_1 + R_2 - W_{wall} - peak$

* reactions are symmetrical *

$\Sigma F_y = 0 = 2R - W_{wall} - peak\ floor$

$= 2R - 3606.24 - 2450$

$2R = 6,056.24$

$R = \boxed{3028.12\ lbs}$ ← Answer to #14+15

$= R_1$ and R_2

#12

$W_{wall} = w * c\sqrt{2} = 255 * 10\sqrt{2}$

$= 3606.24$

#10

$Peak\ Floor = peak\ value * \frac{c\sqrt{2}}{2}$

$= 2450$

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HW #9: Floor Systems

9. Floor Systems

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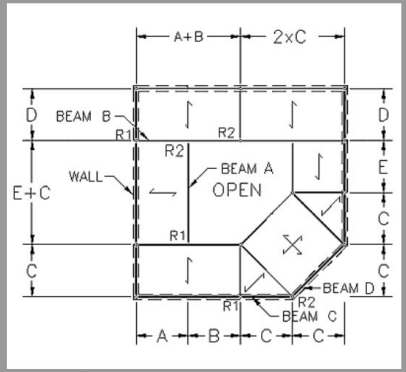

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LAB!

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