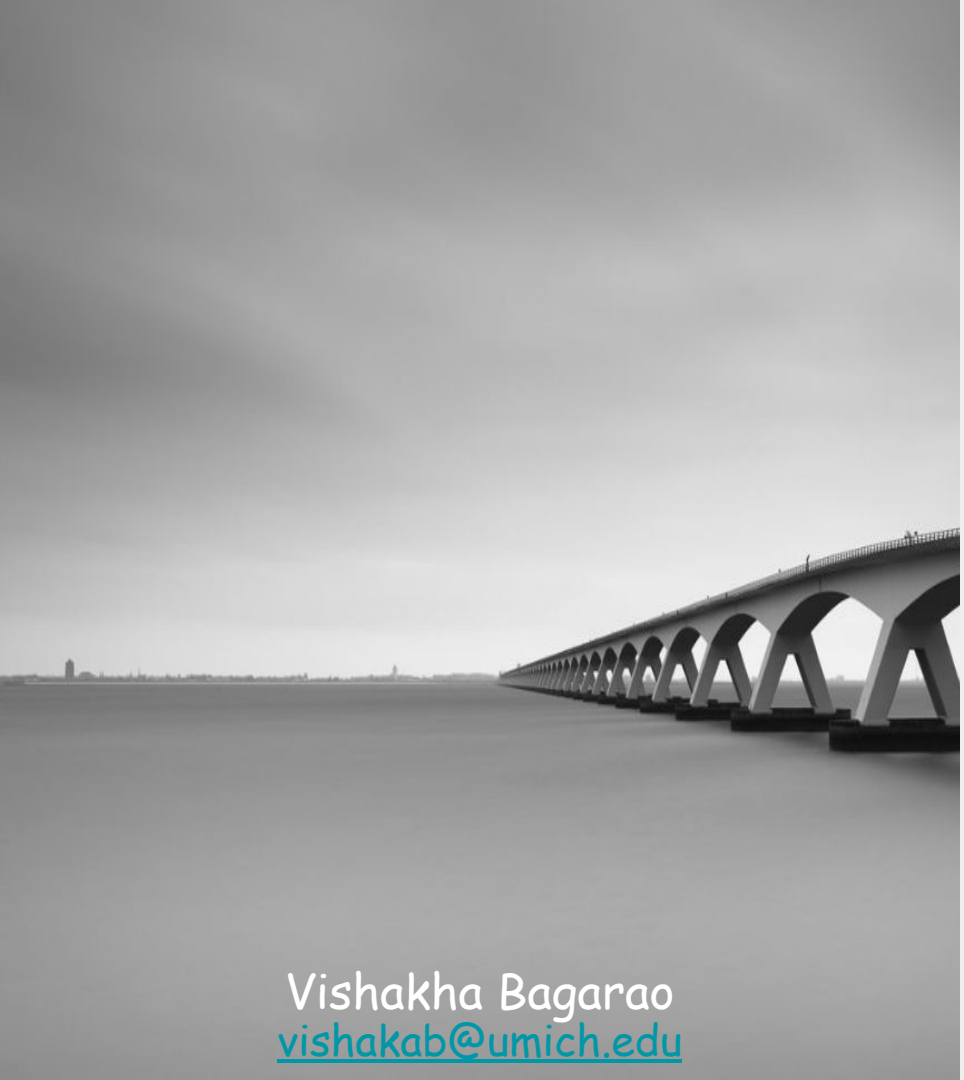
Arch 314- Structures I

Recitation 006

Vishakha Bagarao

25th Oct 2024



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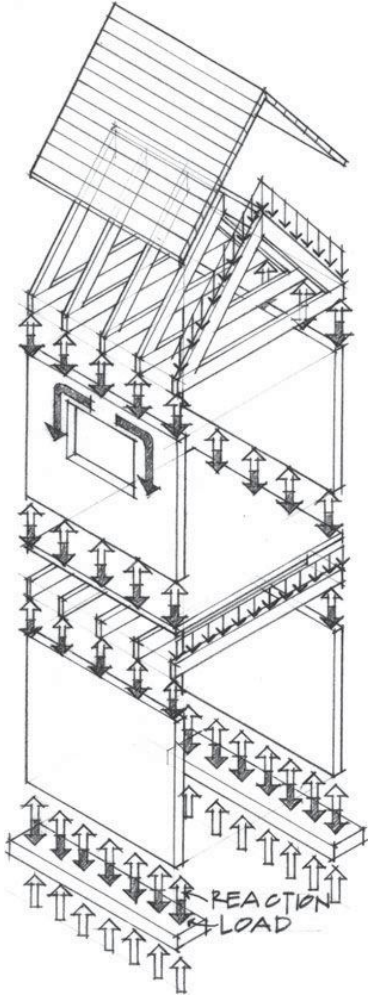
Contents

- Quick Recap
  - Load Tracing & Floor System
  - Lateral Stability
    - Problem Set 09 -Floor System
- Lab 07- Lateral Stability

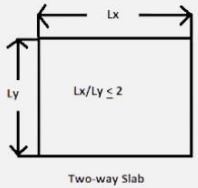
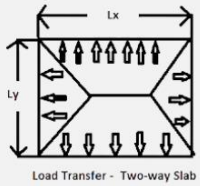
Load Tracing & Floor System

- Load path- The manner in which loads travel throughout the structure.
- The **shorter the load path** to its foundation and **the fewer elements** involved in doing so, the greater the **economy and efficiency** of the structure.
- To maximize structural efficiency:
  - tension in steel
  - compression in concrete
- Gravity loads (Perpendicular to the roof or floor systems) trace from top down to their resolution at the foundation.
- Floor slabs (concrete) span in the direction of the steel reinforcement.
  - One way slab
  - Two way slab



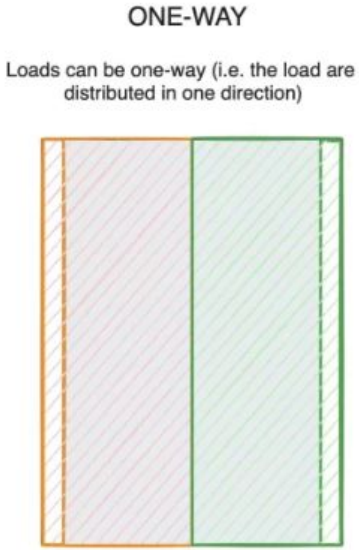
Load Paths

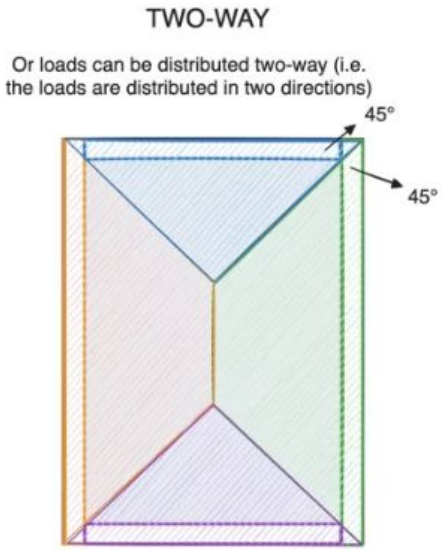
Floor slabs

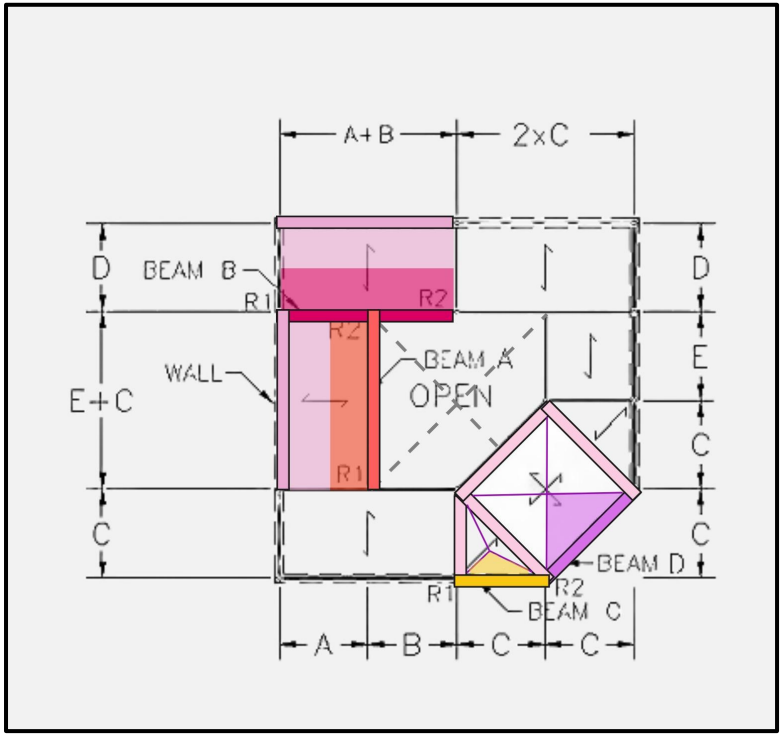
	One Way Slab	Two Way Slab
	 One-way Slab Load Transfer - One-way Slab	 Two-way Slab  Load Transfer - Two-way Slab
Ratio	Ratio of the longer span to the shorter span is greater than two. **(lx/ly>=2)**	Ratio of the longer span to the shorter span is lesser than equal to two. **(lx/ly<= 2)**
Support	Supported by beams on two opposite sides	Supported by beams on all four sides
Load Transfer	Transfers load to the two supporting beams in one direction	Transfers load to the columns/walls below
Reinforcement	Requires less steel reinforcement.	Requires More steel reinforcement.
Thickness	Comparatively thicker	Comparatively thinner
Span Length	Suitable for short spans	Suitable for longer spans

Tributary Area

- Tributary area- the area that a member must support as being halfway between the adjacent similar members.







Floor Systems:

Step 01: Determine total uniform load of floor: w

- Total uniform load of floor = Dead load of floor + Live load of floor

Step 02: Full uniform load on beam:

- Full uniform load on beam= Total uniform load x tributary length

Step 03: Determine the Point load on beam:

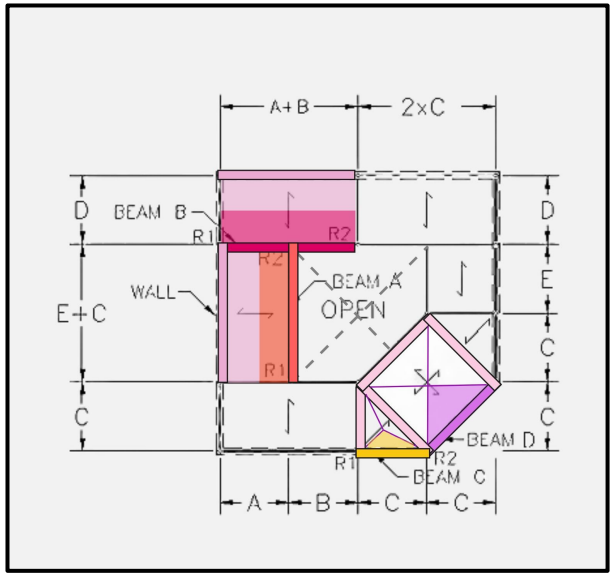
Step 04: Determine the Peak value of triangular load

For triangular slab: wp = w x h

For two way slab: wp = w x tributary length

Step 05: End Reactions on beams:

- $\Sigma M = 0$
- $\Sigma Fx = 0$



Problem Set 09

MICHIGAN Architecture — Structures Problems

Contact | Schedule | Lectures | Recitation | Bridges1 | Bridges2 | Problems

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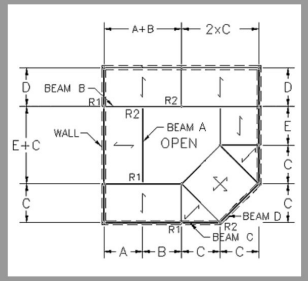
9. Floor Systems

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: 2 -1- -3-

Span A	18 FT
Span B	10 FT
Span C	17 FT
Span D	12 FT
Span E	10 FT
Dead load of wall	870 PLF
Dead load of floor	29 PSF
Live load on floor	39 PSF

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
7	End reaction R2 on Beam B	11023.3 LBS	11023.3 LBS	5
8	Full uniform load on Beam C	870 PLF	870 PLF	5
9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
11	End reaction R2 on Beam C	8213.83 LBS	8213.83 LBS	5
12	Full uniform load on Beam D	870 PLF	870 PLF	5
13	Peak value of triangular load on Beam D	817.36 PLF	817.415 PLF	5
14	End reaction R1 on Beam D	15371.1 LBS	15371.1 LBS	5
15	End reaction R2 on Beam D	15371.1 LBS	15371.1 LBS	5

Current Score: 75 / 75

Problem Menu

Logout

BEAM A

Floor Systems:

Total Uniform load of = Dead load of + Live load of
Floor Floor Floor

$\omega = 29\ PSF + 39\ PSF$

$\therefore \omega = 68\ PSF.$

BEAM A:

#1. Full Uniform load on beam A: ω_A

$\omega_A = \omega \times A/2$

$= 68 \times \frac{18}{2}$ $\left[\frac{LBS}{ft^2} \times ft = \frac{LBS}{ft}\right]$

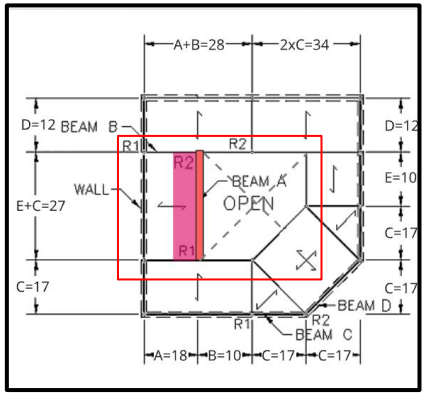
$\therefore \omega_A = 612\ PLF$

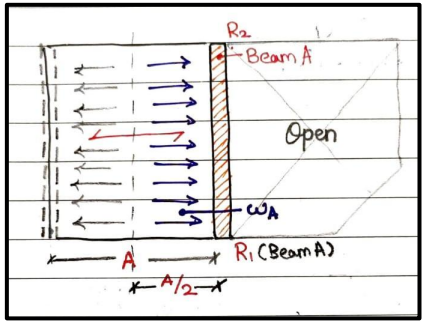
#2, 3. End reactions R_1, R_2 on beam A:

$W_A = \omega_A \times (E+C)$ $\left[\frac{LBS}{FT} \times FT = LBS\right]$

$= 612 \times 27$

$\therefore W_A = 16524\ LBS.$





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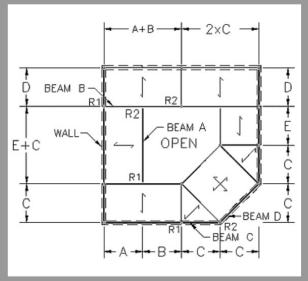

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1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
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8	Full uniform load on Beam C	870 PLF	870 PLF	5
9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
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Problem Menu

Logout

BEAM A

$\Sigma V_A = 0 = R_1 + R_2 - W_A.$

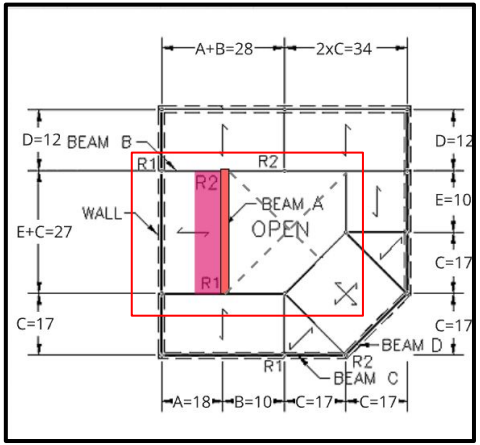
$\therefore$ Symmetry with loads.

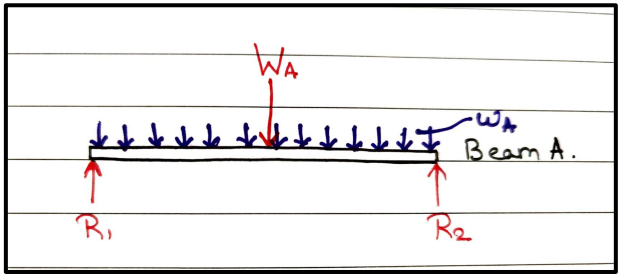
$R_1 = R_2$

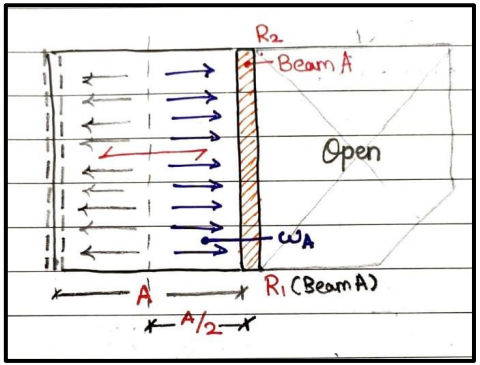
$\therefore R_1 = R_2 = \frac{W_A}{2} = \frac{16524}{2} = 8262 \text{ LBS}$

$\therefore R_1 = 8262 \text{ LBS}$

$\therefore R_2 = 8262 \text{ LBS}.$







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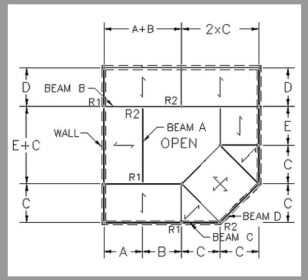

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Span C	17 FT
Span D	12 FT
Span E	10 FT
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Dead load of floor	29 PSF
Live load on floor	39 PSF

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
7	End reaction R2 on Beam B	11023.3 LBS	11023.3 LBS	5
8	Full uniform load on Beam C	870 PLF	870 PLF	5
9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
11	End reaction R2 on Beam C	8213.83 LBS	8213.83 LBS	5
12	Full uniform load on Beam D	870 PLF	870 PLF	5
13	Peak value of triangular load on Beam D	817.36 PLF	817.415 PLF	5
14	End reaction R1 on Beam D	15371.1 LBS	15371.1 LBS	5
15	End reaction R2 on Beam D	15371.1 LBS	15371.1 LBS	5

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Problem Menu

Logout

BEAM B

Beam B:

#4. Full Uniform load on Beam B : ω_B

$\omega_B = \omega \times D/2$

$= 68 \times 12/2$

$\therefore \omega_B = 408$ PLF

#5. Point load on Beam B: P_B

$\therefore R_2$ of Beam A is resting on Beam B.

$P_B = R_2 = 8262$ LBS.

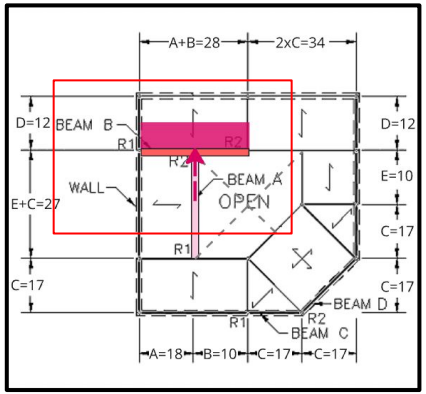
6.7.

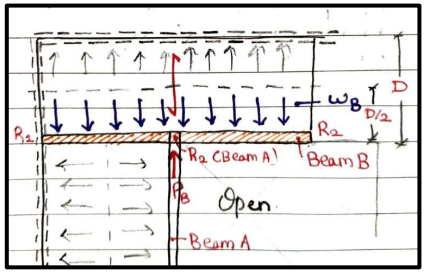
End reaction R_1, R_2 on Beam B:

$W_B = \omega_B \times (A+B)$

$= 408 \times (28)$

$\therefore W_B = 11424$ LBS //





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Contact | Schedule | Lectures | Recitation | Bridges1 | Bridges2 | Problems

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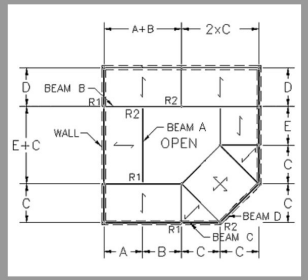

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Span B	10 FT
Span C	17 FT
Span D	12 FT
Span E	10 FT
Dead load of wall	870 PLF
Dead load of floor	29 PSF
Live load on floor	39 PSF

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
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8	Full uniform load on Beam C	870 PLF	870 PLF	5
9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
11	End reaction R2 on Beam C	8213.83 LBS	8213.83 LBS	5
12	Full uniform load on Beam D	870 PLF	870 PLF	5
13	Peak value of triangular load on Beam D	817.36 PLF	817.415 PLF	5
14	End reaction R1 on Beam D	15371.1 LBS	15371.1 LBS	5
15	End reaction R2 on Beam D	15371.1 LBS	15371.1 LBS	5

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Problem Menu

Logout

BEAM B

$\Sigma M_{R_2\,(Beam\,B)} = 0$

$0 = (R_1 \times 28) - (W_B \times 14) - (P_B \times 10)$

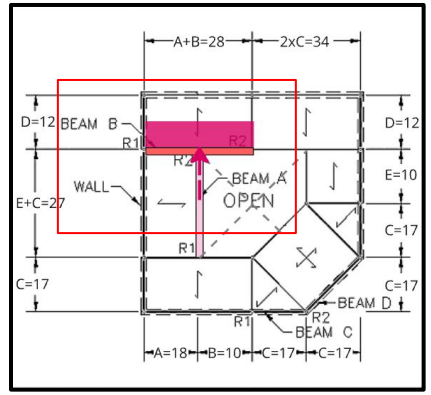
$R_1 \times 28 = (11424 \times 14) + (8262 \times 10)$

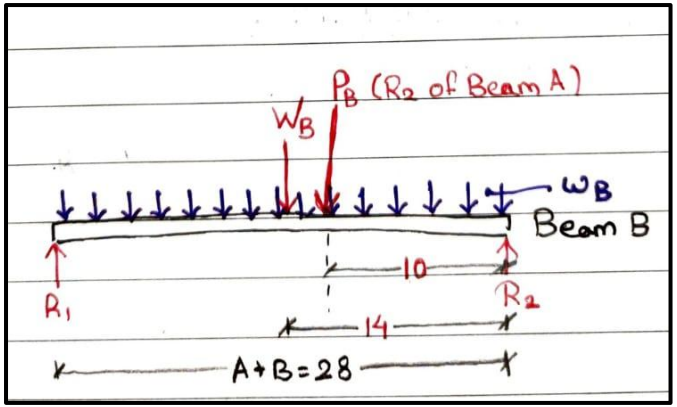
$\therefore R_1 = 8662.71$ LBS.

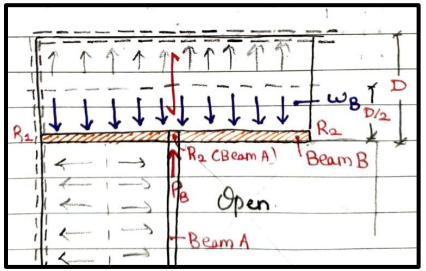
$\Sigma V_B = 0 = R_1 - W_B - P_B + R_2$

$0 = 8662.71 - 11424 - 8262 + R_2$

$\therefore R_2 = 11023.3$ LBS.







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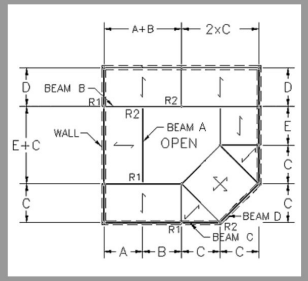

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Span E	10 FT
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Dead load of floor	29 PSF
Live load on floor	39 PSF

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
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9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
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Problem Menu

Logout

BEAM C

BEAM C:

#8. Full Uniform load on Beam C: w_c

There is only one uniform load on Beam C i-e dead load of wall.

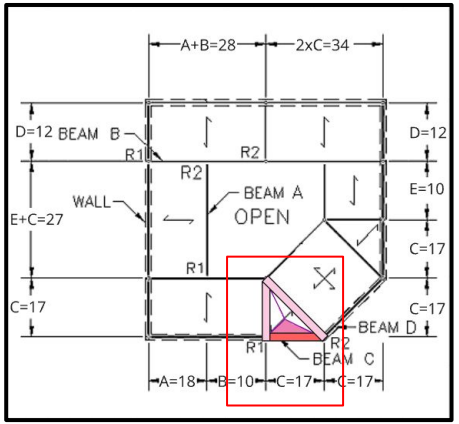
$\therefore w_c = 870$ PLF.

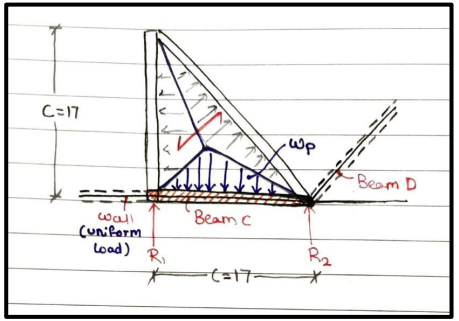
$W_c = w_c \times C$

$= 870 \times 17$

$\therefore W_c = 14790$ LBS. //

MATRIKAS





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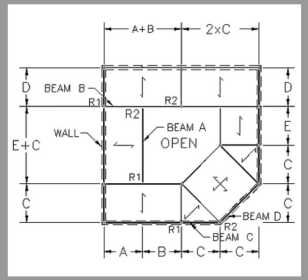

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Dead load of floor	29 PSF
Live load on floor	39 PSF

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2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
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Logout

BEAM C

#9. Peak value of triangular load on Beam C

$w_p = w \times h$

For h,

$AC = \sqrt{17^2+17^2} = 24.04$

$BD = AD = DC = AC/2 = 12.02$

$BO = BD/2 = 6.01$

$\sin 45 = \frac{1}{\sqrt{2}} = \frac{opp}{hyp.} = \frac{h}{BO.}$

$\therefore h = \frac{6.01}{\sqrt{2}} = 4.25.$ //

$\therefore w_p = 68 \times 4.25$

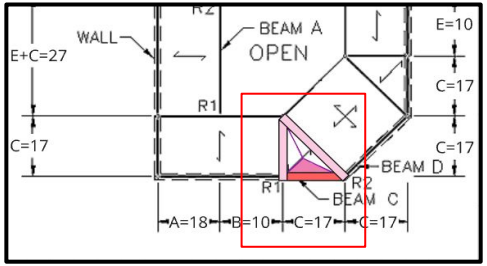
$\therefore w_p = 289$ PLF

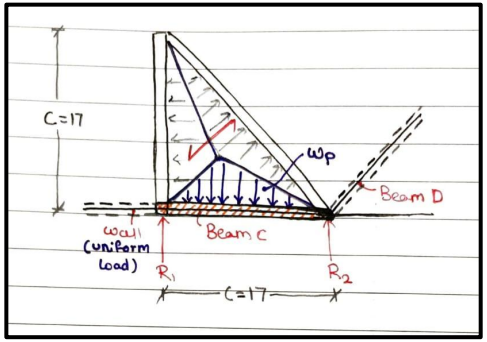
#10, 11. End reactions R_1, R_2 on Beam C:

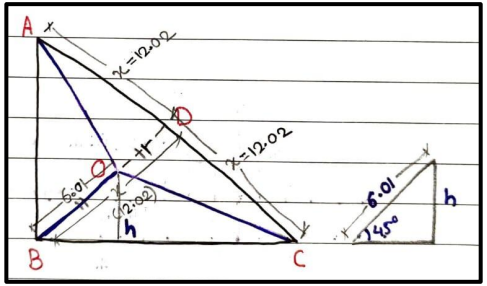
$W_p = w_p \times C/2$

$= 289 \times 17/2$

$\therefore W_p = 2456.5$ LBS. //







Problem Set 09

MICHIGAN Architecture — Structures Problems

Contact | Schedule | Lectures | Recitation | Bridges1 | Bridges2 | Problems

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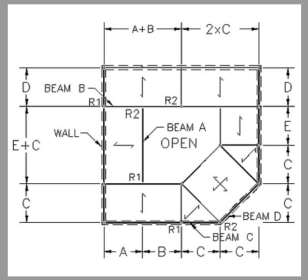
9. Floor Systems

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: 2 -1- -3-

Span A	18 FT
Span B	10 FT
Span C	17 FT
Span D	12 FT
Span E	10 FT
Dead load of wall	870 PLF
Dead load of floor	29 PSF
Live load on floor	39 PSF

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
7	End reaction R2 on Beam B	11023.3 LBS	11023.3 LBS	5
8	Full uniform load on Beam C	870 PLF	870 PLF	5
9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
11	End reaction R2 on Beam C	8213.83 LBS	8213.83 LBS	5
12	Full uniform load on Beam D	870 PLF	870 PLF	5
13	Peak value of triangular load on Beam D	817.36 PLF	817.415 PLF	5
14	End reaction R1 on Beam D	15371.1 LBS	15371.1 LBS	5
15	End reaction R2 on Beam D	15371.1 LBS	15371.1 LBS	5

Current Score: 75 / 75

Problem Menu

Logout

BEAM C

$\Sigma M_{R_2\,(Beam\,C)} = 0$

$0 = (R_1 \times 17) - \left(W_p \times 17 \times \frac{2}{3}\right) - \left(W_c \times \frac{17}{2}\right)$

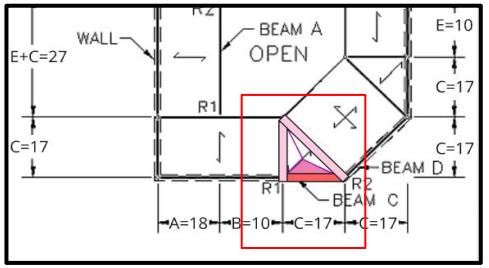
$\therefore R_1 = \frac{(2456.5 \times 17 \times 2/3) - (14790 \times 17/2)}{17}$

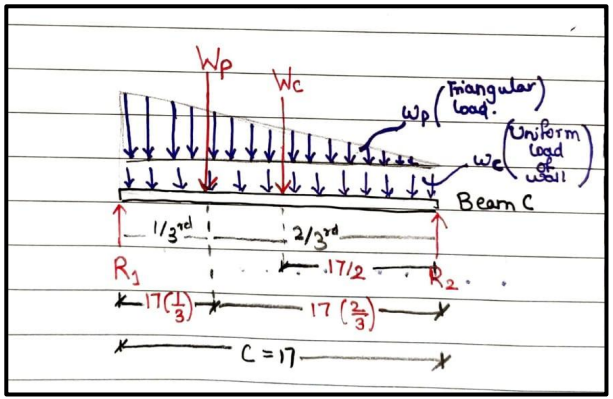
$\therefore R_1 = 9032.667$ LBS.

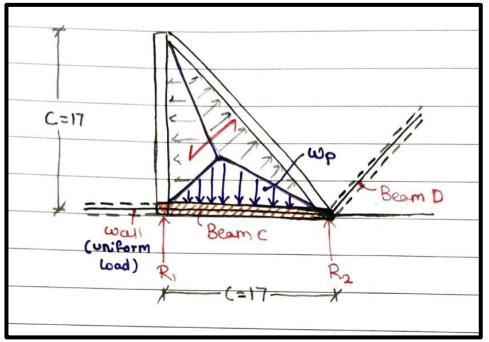
$\Sigma V_c = 0 = R_1 - W_p - W_c + R_2$

$\therefore R_2 = -9032.667 + 2456.5 + 14790$

$\therefore R_2 = 8213.833.$







Problem Set 09

MICHIGAN Architecture — Structures Problems

Contact | Schedule | Lectures | Recitation | Bridges1 | Bridges2 | Problems

Logged in as: Vishakha Bagarao

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: 2 -1- -3-

Span A	18 FT
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Dead load of wall	870 PLF
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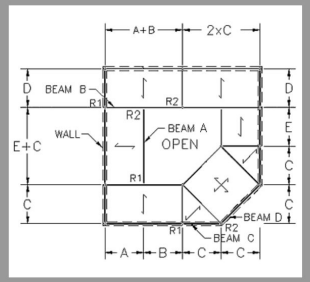

#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
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9	Peak value of triangular load on Beam C	289 PLF	289 PLF	5
10	End reaction R1 on Beam C	9032.67 LBS	9032.67 LBS	5
11	End reaction R2 on Beam C	8213.83 LBS	8213.83 LBS	5
12	Full uniform load on Beam D	870 PLF	870 PLF	5
13	Peak value of triangular load on Beam D	817.36 PLF	817.415 PLF	5
14	End reaction R1 on Beam D	15371.1 LBS	15371.1 LBS	5
15	End reaction R2 on Beam D	15371.1 LBS	15371.1 LBS	5

Current Score: 75 / 75

Problem Menu

Logout

BEAM D

Beam D

#12. Full uniform load on beam D: w_D

There is only one uniform load on Beam D similar to Beam C i.e dead load of wall.

$\therefore w_D = 870$ PLF.

#13. Peak value of triangular load on beam D.

$w_p = w \times a$

$= 68 \times 12.02$

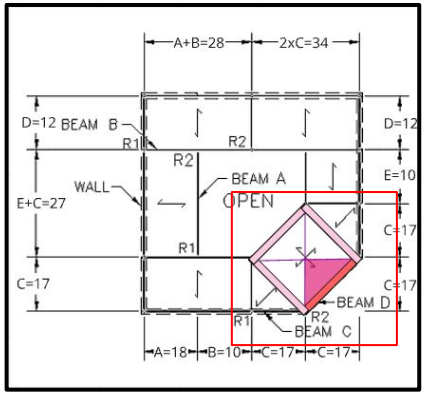
$\therefore w_p = 817.36$ PLF.

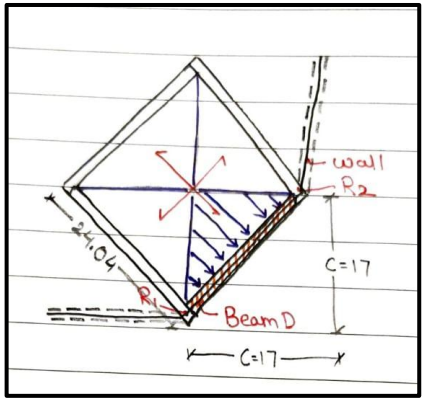
#14, 15. End reactions R_1, R_2 on beam D.

$W_p = 817.36 \times 12.02$

$\therefore W_p = 9824.6672$ LBS. //

$\therefore W_D = 870 \times 24.04 = 20916.2186$ LBS.





Problem Set 09

MICHIGAN Architecture — Structures Problems

Contact | Schedule | Lectures | Recitation | Bridges1 | Bridges2 | Problems

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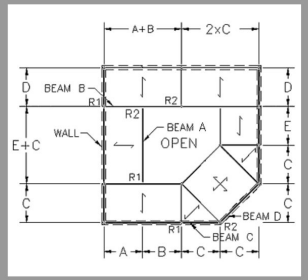

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#	Question	Your Response	Correct Answer	Score
1	Full uniform load on Beam A	612 PLF	612 PLF	5
2	End reaction R1 on Beam A	8262 LBS	8262 LBS	5
3	End reaction R2 on Beam A	8262 LBS	8262 LBS	5
4	Full uniform load on Beam B	408 PLF	408 PLF	5
5	Point load on Beam B	8262 LBS	8262 LBS	5
6	End reaction R1 on Beam B	8662.71 LBS	8662.71 LBS	5
7	End reaction R2 on Beam B	11023.3 LBS	11023.3 LBS	5
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Current Score: 75 / 75

Problem Menu

Logout

BEAM D

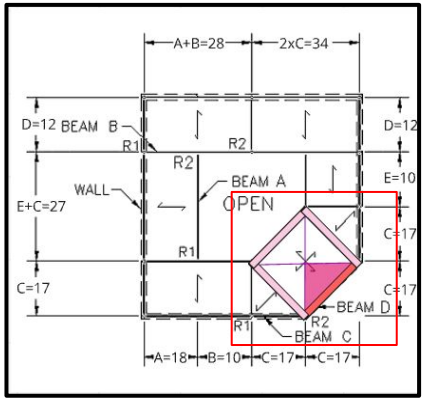
$\Sigma V_D = 0 = R_1 + R_2 - W_P - W_D$

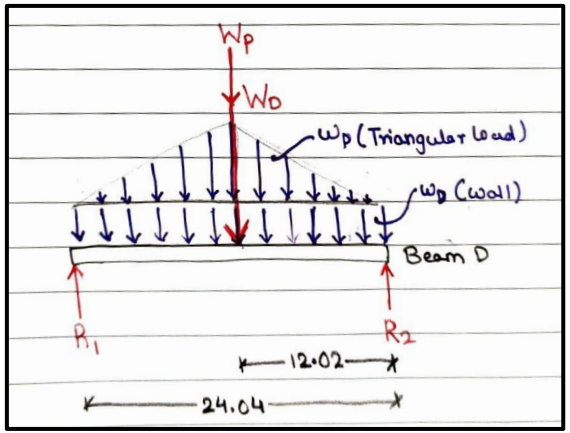
$\therefore$ Symmetry with loads ($R_1 = R_2$)

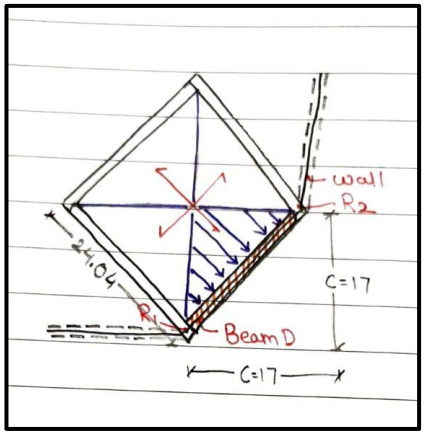
$\therefore R_1 = R_2 = \frac{W_P + W_D}{2}$

$= 30740.8858 / 2$

$\therefore R_1 = R_2 = 15371.1$ LBS.







Lab 07: Lateral Stability

Structures II
Arch 324

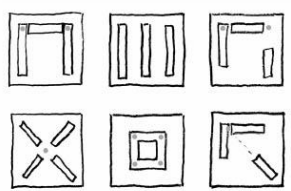
Name 1 _____
Name 2 _____
Name 3 _____

Lateral Stability

Description
This project investigates stable arrangements of structural walls against lateral loading.

Goals
To observe the effects of lateral loading
To investigate the criteria of stable wall patters
To develop stable arrangements of shear walls based on the 2 point rule

Procedure
1. Arrange the small wood walls on the foam core base to support the MDF slab.
2. Make each of the six arrangements.
3. Apply lateral and torsional accelerations to the base and note the effects on the assembly. Mark on the diagrams below which fail and which remain stable.
4. Make your own stable and unstable arrangement.
5. Sketch the arrangements below and mark the intersection points.



Stable	Unstable

Due
During Recitation