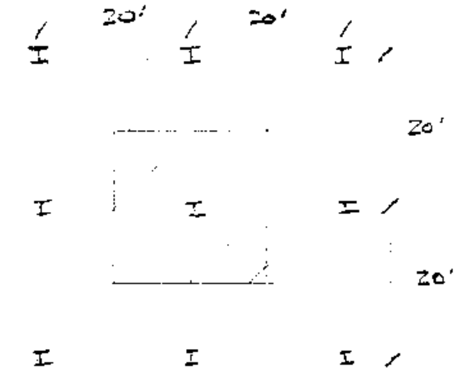
Assignment #1 | CE 461 |

8/28/06

1.11 A 3 story hotel has interior columns that are spaced 20' apart in two perpendicular directions. If the loading on the flat roof is estimated to be 30 lb/ft², determine the live load supported by a typical interior column at (a) the ground-floor level, & (b) the second-floor level.



Tributary Area

$A_T = 20' \times 20' = 400\ ft^2$

$L = L_o\left(.25 + \frac{15}{\sqrt{K_{LL} A_T}}\right)$

$L_o = 40$ - Table 1-4

$K_{LL} = 4$ for interior columns

Great job!

(Prob 12 graded separately)

a) $A_T = 400\ ft^2$

$F_G = (30\ lb/ft^2)(400\ ft^2) = 12000\ lb = 12\ kip$

$L = 40\left(.25 + \frac{15}{\sqrt{4(400)}}\right) = 25\ lb/ft^2$ $(1600\ ft^2 > 400\ ft^2)$

$F_1 = (25\ lb/ft^2)(400\ ft^2) = 10{,}000\ lb = 10\ kip$

$F_2 = (25\ lb/ft^2)(400\ ft^2) = 10{,}000\ lb = 10\ kip$

$F = F_G + F_1 + F_2 = 12 + 10 + 10$

$\boxed{F = 32.0\ kip}$

b) $A_T = 400\ ft^2$

$F_G = (30\ lb/ft^2)(400\ ft^2) = 12000\ lb = 12\ kip$

$L = 40\left(.25 + \frac{15}{\sqrt{4(400)}}\right) = 25\ lb/ft^2$

$F_1 = (25\ lb/ft^2)(400\ ft^2) = 10{,}000\ lb = 10\ kip$

$F = F_G + F_1 = 12 + 10$

$\boxed{F = 22.0\ kip}$

$\frac{8}{10}$

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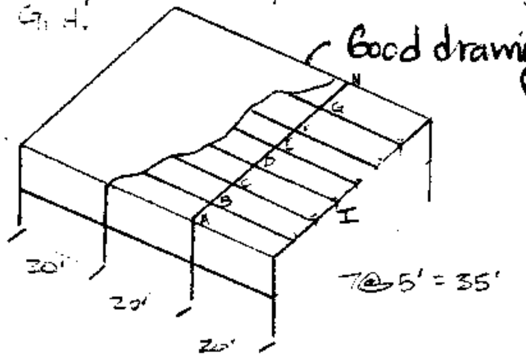
2.1 The roof deck of the single story building is subjected to a dead plus live load of 95 lb/ft². If the purlins are spaced 5' & the bents are spaced 20' apart, determine the distributed loading that acts along the purlin DI, & the loadings that act on the bent @ A, B, C, D, E, F, G, H.



Good drawing!

Tributary area for bents B - G: 5' x 20' = 100 ft²

$F = (95\ lb/ft^2)(100\ ft^2)$

$\boxed{F = \cancel{9500\ lb} = F_{B-G}}$ -1 4750 lb

You must divide by two because one-half of the load is on bent I and one-half is on bent II.

Tributary area for bents A & H:

$A_T = 2.5' \times 20' = 50\ ft^2$

$F_{A,H} = (95\ lb/ft^2)(50\ ft^2) = 4750\ lb$

$\boxed{F_{A,H} = \cancel{4750}\ lb}$ 2375 lb

-1

Tributary area for DI:

$A_T = 5' \times 20' = 100\ ft^2$

$F_{DI} = (95\ lb/ft^2)(100\ ft^2) = 9500\ lb$

$F_{along\ DI} = 9500\ lb/(20\ ft)$

$\boxed{F_{along\ DI} = 475\ lb/ft}$ ✓

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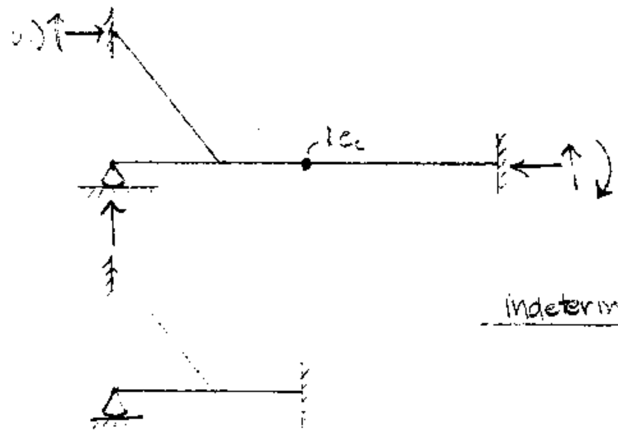
2-9 Classify each of the structures as statically determinate, statically indeterminate, or unstable. If indeterminate, specify the degree of indeterminacy.

a.)

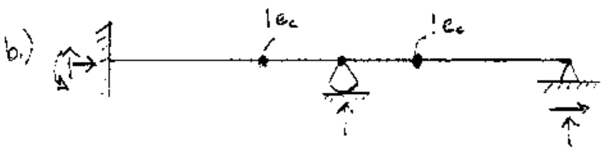


6 unknowns > 3 equil + 1 ec = 4 equations

indeterminate ⟹ unstable

Indeterminate to 2°

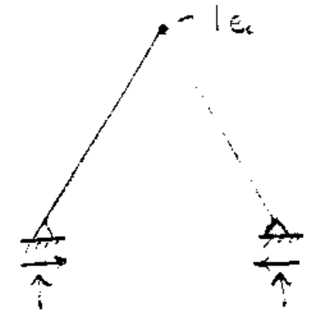
b.)



6 unknowns > 3 equil + 2 ec = 5 equations

Indeterminate to 1°

c.)



4 unknowns = 4 equations

Stable ∴ statically determinate

d.)

2 unknowns < 4 equations

∴ unstable

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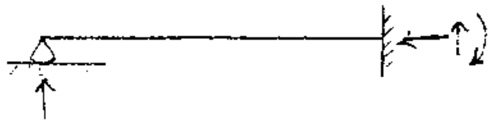
2.11 Classify each of the structures as statically determinate, indeterminate, or unstable. If indeterminate specify the degree of indeterminacy. The supports & connections are to be assumed as stated.

a) 

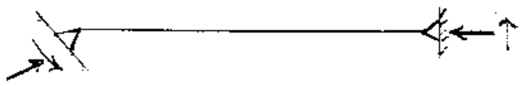
6 unknowns > 3 equations

∴ indeterminate to 3° ✓

b) 

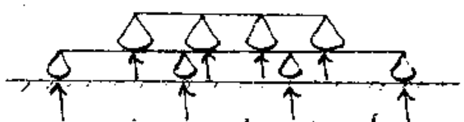
4 unknowns > 3 equations

∴ indeterminate to 1° ✓

c) 

4 unknowns > 3 equations

∴ indeterminate to 1° ✓

d.) 

Straight edge!

unstable - all reactions are parallel ✓

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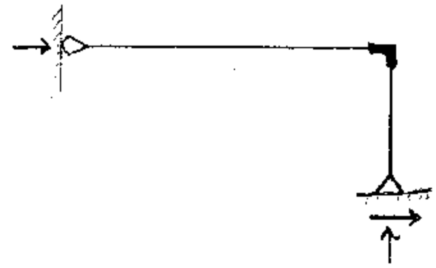
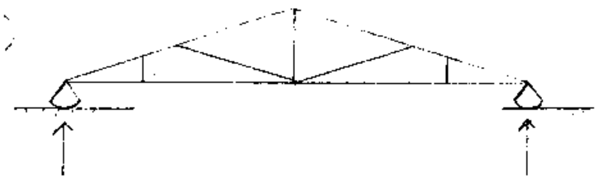
2.15 Classify each of the structures as statically determinate, indeterminate, or unstable. If indeterminate, specify the degree of indeterminacy. The supports or connections are to be assumed as stated.

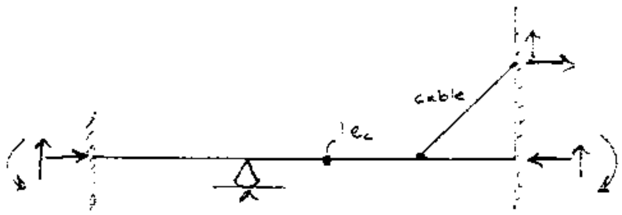
a.) 

3 unknowns = 3 equations

Stable ∴ determinate ✓

b.) 

parallel reaction ∴ unstable ✓

c.) 

9
5 unknowns > 3+1 = 4 equations

stable ∴ indeterminate to ~~1~~ 5°

-1

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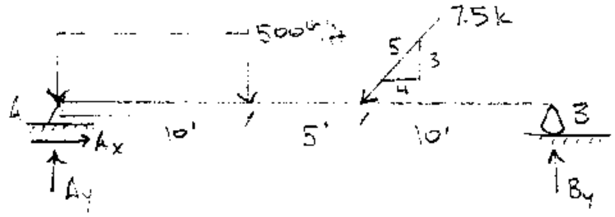
2.18 Determine the reactions on the beam. The support at B can be assumed as a roller.



3 unknowns = 3 equations

stable ∴ determinate

$\Sigma M_A = 0 = -500\,\text{lb/ft}\,(10\,\text{ft})(10/2) - \frac{3}{5}(7.5)(15') + B_y(25')$

$0 = -25{,}000\,\text{lb} - 67{,}500\,\text{lb} + 25'\,B_y$

$\boxed{B_y = 3700\text{ lb} = 3.7\text{ kip}}$ ✓

$\Sigma F_y = 0 = -500(10) - \frac{3}{5}(7.5) + B_y + A_y$

$\boxed{A_y = 5800\text{ lb} = 5.8\text{ kip}}$ ✓

$\Sigma F_x = 0 = A_x - \frac{4}{5}(7.5)$

$\boxed{A_x = 6\text{ kip}}$ ✓

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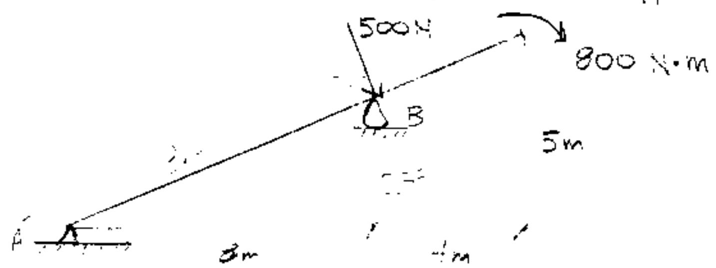
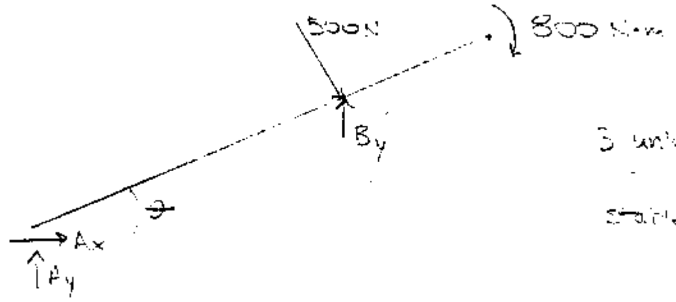
$\frac{10}{10}$

2.22 Determine the reactions at the supports.





3 unknowns = 3 equations

stable ∴ determinate

$\tan\theta = 5/12$

$\theta = 22.62°$

$\Sigma M_A = 0 = -500(8.67) + \frac{8}{8.67} B_y (8.67) - 800$

$\boxed{B_y = 641.9 \text{ N}}$ ✓

$\Sigma F_y = 0 = -500(8/8.67) + 642 + A_y$

$\boxed{A_y = 180 \text{ N}}$ ✓

$\Sigma F_x = 0 = A_x + 500 \sin 22.62$

$\boxed{A_x = -192 \text{ N} \quad \text{or} \quad 192 \text{ N} \leftarrow}$ ✓

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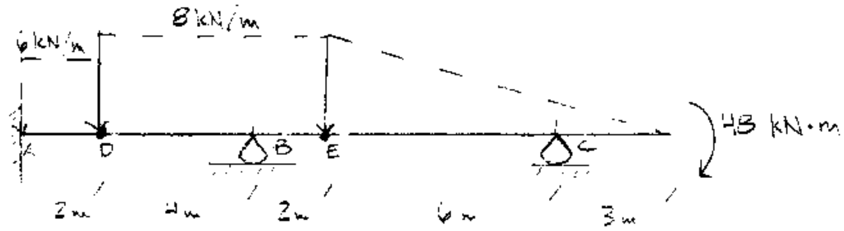
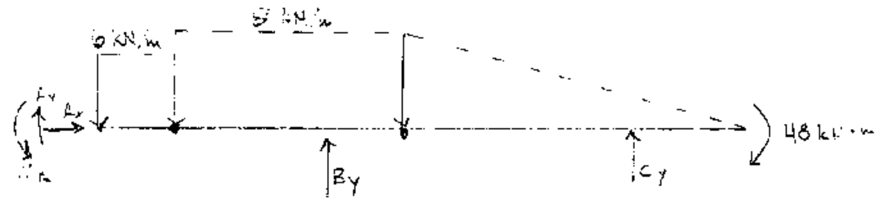
2-16 The compound beam is fix supported at A & supported by rockers at B & C. If there are hinges @ D & E determine the reactions at the supports A, B, & C.



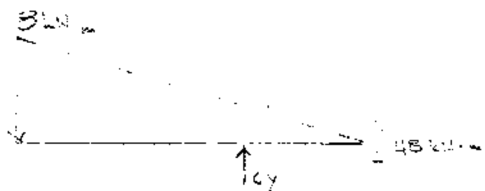


Sum unknowns = 3+2 equations

Statically determinate

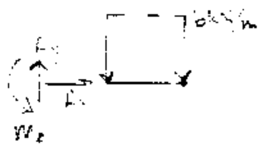
$\Sigma F_x = 0 = A_x$

$\boxed{A_x = 0\text{ kN}}$



$\Sigma M_E = 0 = -\frac{1}{2}\cdot 8(9)(\frac{1}{3}\cdot 9) - 48 + 6C_y$

$\boxed{C_y = 26\text{ kN}}$



$\Sigma M_D = 0 = M_A + 6(2)(\frac{2}{2}) - 2A_y$

$A_y = \frac{M_A + 12}{2}$ (1)

$\Sigma F_y = 0 = -6(2) - 8(6) - \frac{1}{2}(8)(9) + A_y + B_y + C_y$

$A_y = 70 - B_y$ (2)

$\Sigma M_A = 0 = -6(2)(1) - 8(6)(5) - \frac{1}{2}8(9)(11) - 48 + 26(14) + B_y(6) + M_A$

$308 = 6B_y + M_A$ (3)

(1) → (2): $\frac{M_A + 12}{2} = 70 - B_y$

$M_A = 2(70 - B_y) - 12$ (4)

(4) → (3): $308 = 6B_y + [2(70 - B_y) - 12]$

$308 = 6B_y + 140 - 2B_y - 12$

$\boxed{B_y = 45\text{ kN}}$ (5)

(5) → (2): $A_y = 70 - 45$

$\boxed{A_y = 25\text{ kN}}$ (6)

(6) → (1): $25 = \frac{M_A + 12}{2}$

$\boxed{M_A = 38\text{ kN·m}}$

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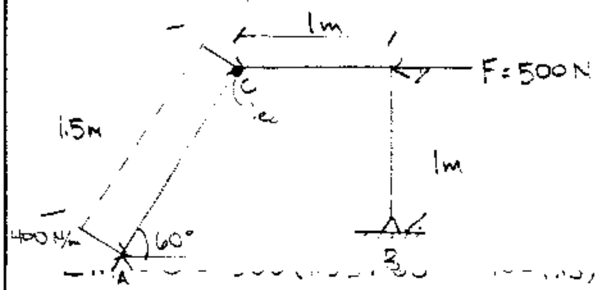
2.44 Determine the horizontal & vertical components of force that pins A & B exert on the two member frame. Set F = 500 N



(1) → (2): $0 = 629.5 - 450 + 0.799\,B_x + 1.75\,B_x$

$\boxed{B_x = -97.4\ \text{N or } 97.4\ \text{N} \rightarrow}$ (3)

(3) → (1): $\boxed{B_y = -97.4\ \text{N or } 97.4\ \text{N} \downarrow}$

$\Sigma F_x = 0 = A_x + 400(1.5)\sin 60^\circ - B_x - 500$

$0 = A_x + 520 - (-97.4) - 500$

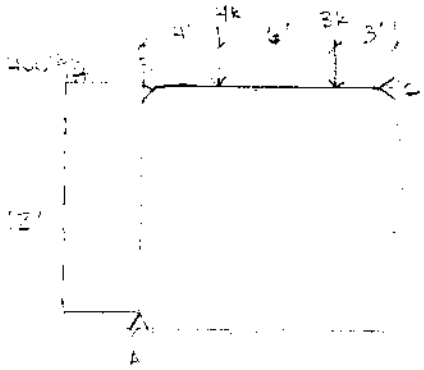
$\boxed{A_x = -117.4\ \text{N or } 117.4\ \text{N} \leftarrow}$

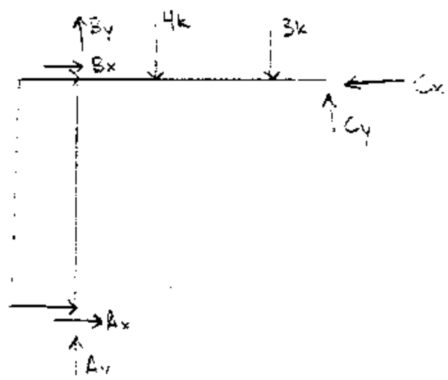
$\Sigma F_y = 0 = -400(1.5)\cos 60^\circ + A_y + B_y$

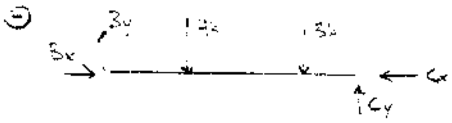
[illegible]

Assignment #1 | CE [illegible] | 8/28/06

2-5 Determine the horizontal & vertical reactions or force at the connections A, B, & C. Assume each of these connections is a pin.





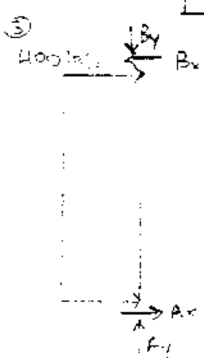


② $\Sigma M_B = 0 = -4000(4) - 3000(10) + C_y(13)$

$$\boxed{C_y = 3538.5 \text{ lb} = 3.54 \text{ kip} \uparrow}$$

② $\Sigma F_y = 0 = -4000 - 3000 + 3539 + B_y$

$$\boxed{B_y = 3461 \text{ lb} = 3.46 \text{ kip} \uparrow}$$



③ $\Sigma F_y = 0 = -B_y + A_y$

$0 = -3.46 + A_y$

$$\boxed{A_y = 3.46 \text{ kip}}$$

③ $\Sigma M_B = 0 = 400(12)(12/2) + A_x(12)$

$A_x = -2400$ lb or -2.40 kip ←

$$\boxed{A_x = 2.40 \text{ kip} \leftarrow}$$

③ $\Sigma F_x = 0 = -B_x + A_x$

$$\boxed{B_x = 2.40 \text{ kip} \leftarrow}$$

① $\Sigma M_A = 0 = 2.4(12) - 4(4) - 3(10) + 3.54(13) + C_x(12)$

$$\boxed{C_x = 2.40 \text{ kip}}$$

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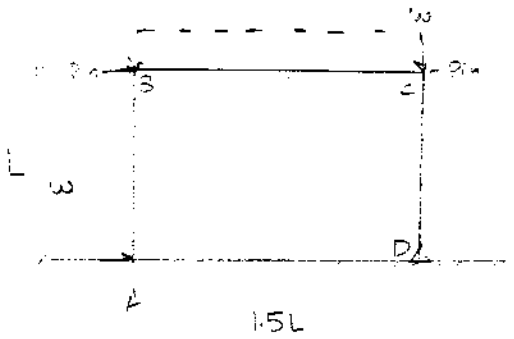
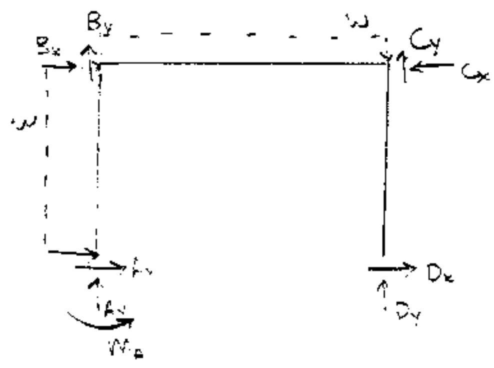
2.46 Determine the reactions at the supports A & D. Assume A is fixed, and B & C & D are pins.





Member CD

$\Sigma M_D = 0 = C_x(L)$

$C_x = 0$

$\Sigma F_x = 0 = -C_x + D_x$

$\boxed{D_x = 0}$

using (1)

$\Sigma F_y = 0 = -0.75wL + D_y$

$\boxed{D_y = 0.75wL}$

Member BC

$\Sigma F_x = 0 = -C_x + B_x$

$B_x = 0$

$\Sigma M_B = -1.5Lw(1.5L/2) + C_y(1.5L)$

$C_y = 0.75wL \quad (1)$

$\Sigma F_y = 0 = -1.5Lw + 0.75w + B_y$

$B_y = 1.5Lw - 0.75w$

Member AB

$\Sigma F_x = 0 = B_x + A_x + wL$

$-A_x = wL$

or

$\boxed{A_x = wL \leftarrow}$

$\Sigma M_A = 0 = -B_x(L) - wL(L/2) + M_A$

$\boxed{M_A = wL^2/2}$

Entire structure: $\Sigma F_y = 0 = A_y + D_y - 1.5Lw$

$0 = A_y + 0.75Lw - 1.5Lw$

$\boxed{A_y = 0.75\,Lw}$