

FUNDAMENTALS OF STRUCTURAL ANALYSIS

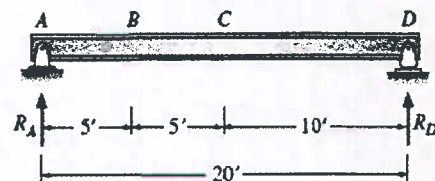
3rd Edition

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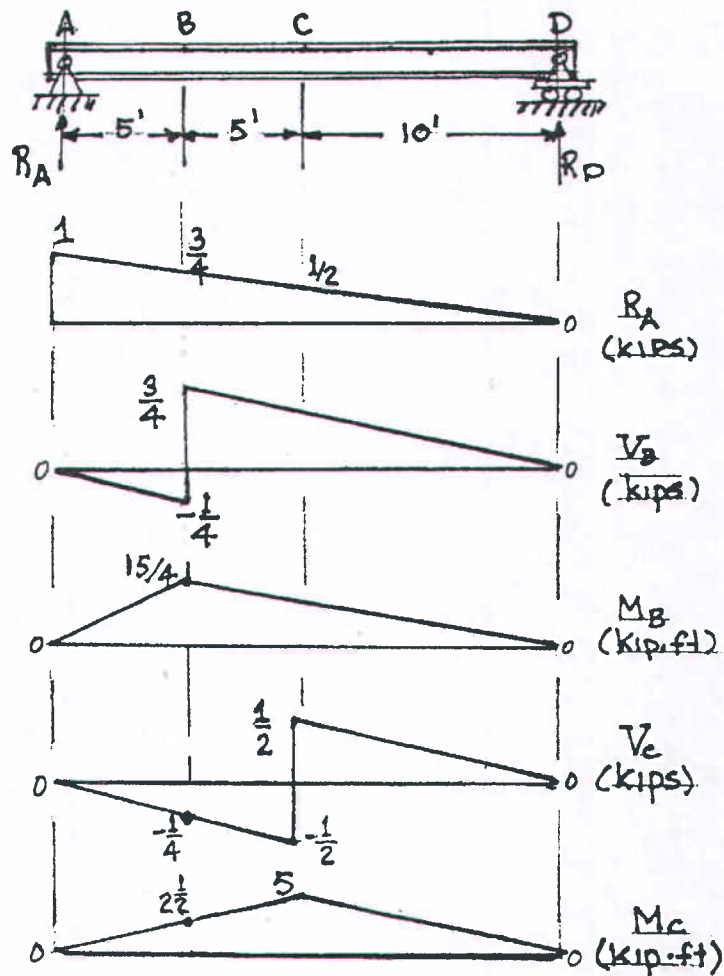
SOLUTIONS MANUAL

CHAPTER 8: LIVE LOAD FORCES: INFLUENCE LINES FOR DETERMINATE STRUCTURES

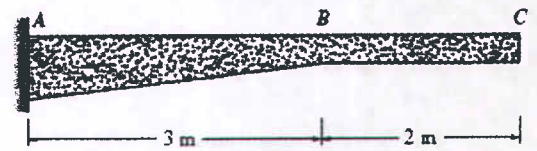
P8.1. Draw the influence lines for the reaction at A and for the shear and moment at points B and C . The rocker at D is equivalent to a roller.



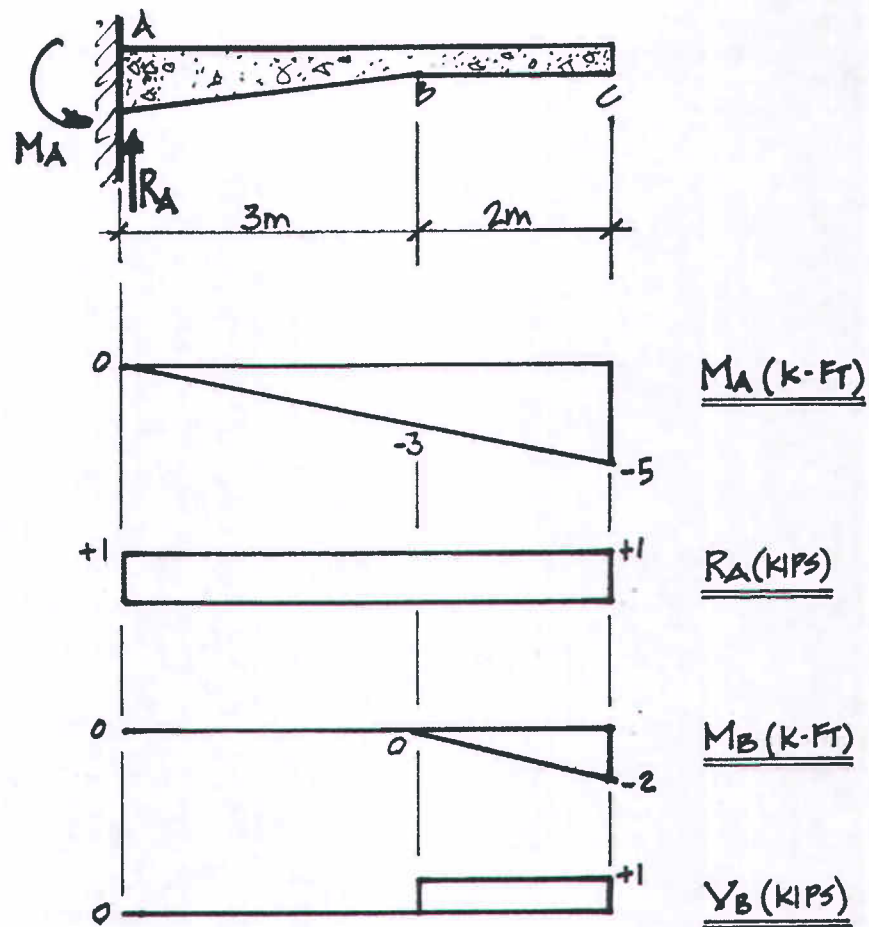
P8.1



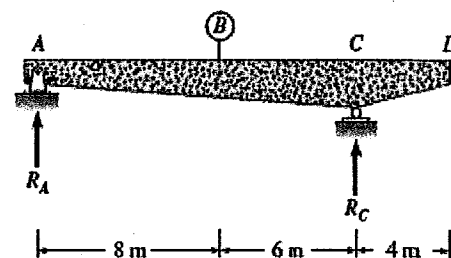
P8.2. For the beam shown in Figure P8.2, draw the influence lines for the reactions M_A and R_A and the shear and moment at point B .



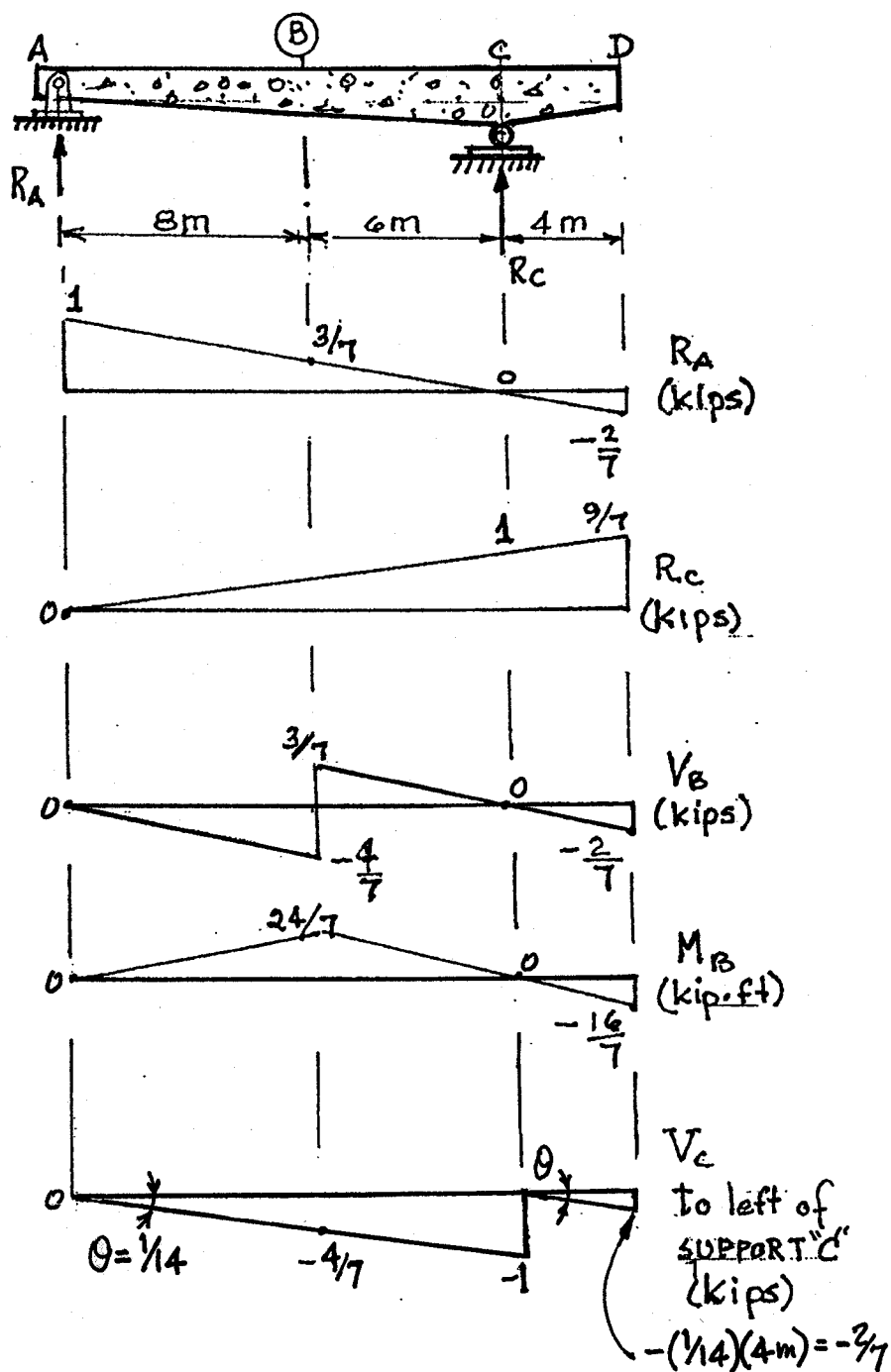
P8.2



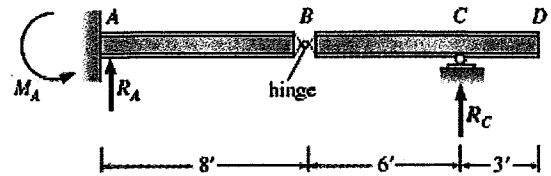
P8.3. Draw the influence lines for the reactions at supports A and C, the shear and moment at section B, and the shear just to the left of support C.



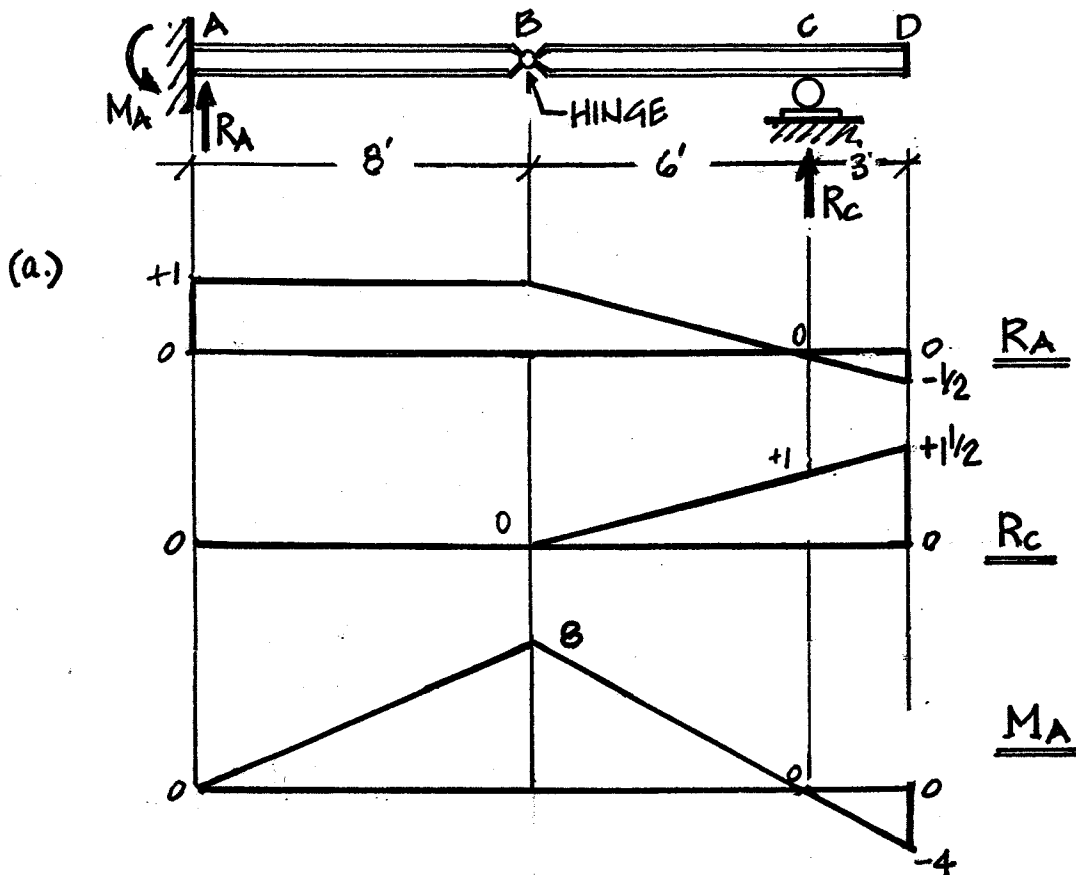
P8.3



P8.4. (a) Draw the influence lines for reactions M_A , R_A , and R_C of the beam in Figure P8.4. (b) Assuming that the span can be loaded with a 1.2 kips/ft uniform load of variable length, determine the maximum positive and negative values of the reactions.



P8.4

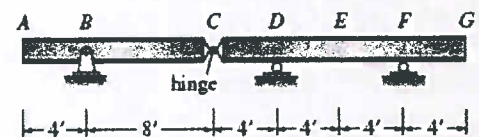


(b.)

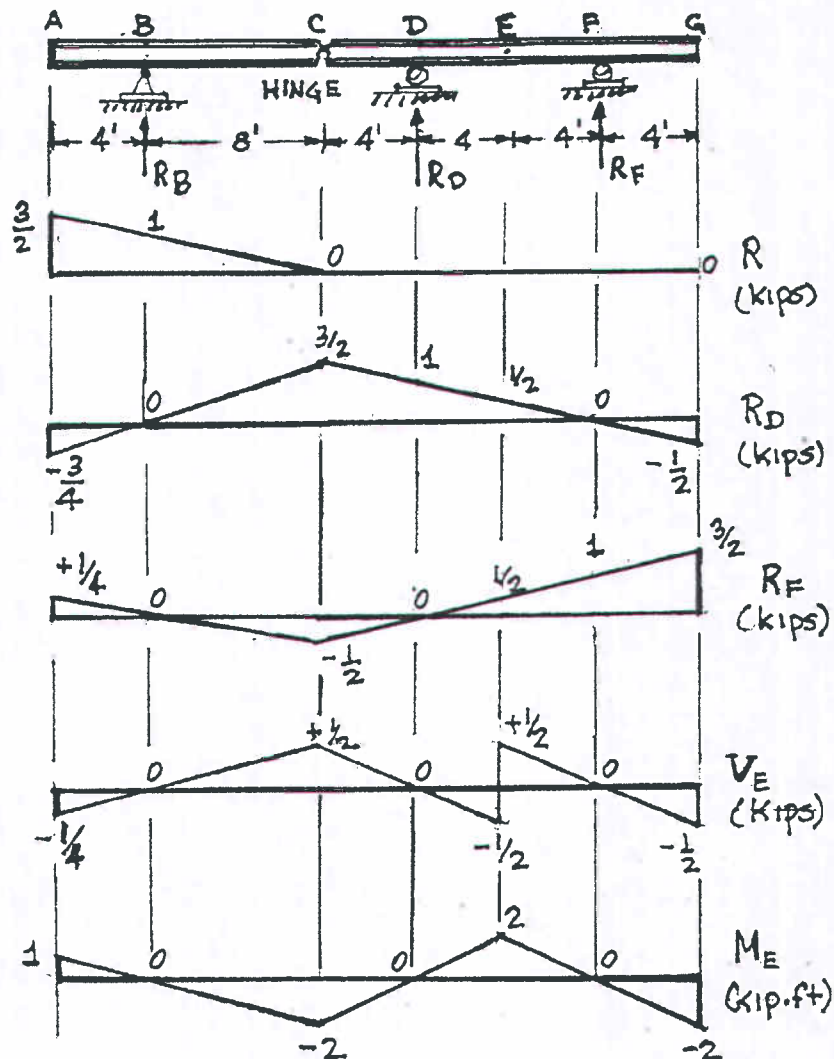
UNIFORM LOAD OF VARIABLE LENGTH 1.2 k/ft.

$$\begin{aligned}
 +R_A \text{ MAX.} &= [1(8) + \frac{1}{2}(1)(6)] 1.2 \text{ k/ft.} = +13.2 \text{ k} \\
 +R_C \text{ MAX.} &= \frac{1}{2}(1.5)(9) 1.2 \text{ k/ft.} = +8.1 \text{ k} \\
 +M_A \text{ MAX.} &= \frac{1}{2}(+3)(14) 1.2 \text{ k/ft.} = +67.2 \text{ ft-k} \\
 -R_A \text{ MAX.} &= (-\frac{1}{2})(\frac{1}{2})(3) 1.2 \text{ k/ft.} = -0.9 \text{ k} \\
 -R_C \text{ MAX.} &= 0 \\
 -M_A \text{ MAX.} &= \frac{1}{2}(-4)(3) 1.2 \text{ k/ft.} = -7.2 \text{ ft-k}
 \end{aligned}$$

P8.5. (a) Draw the influence lines for reactions R_B , R_D , and R_F of the beam in Figure P8.5 and the shear and moment at E . (b) Assuming that the span can be loaded with a 1.2 kips/ft uniform load of variable length, determine the maximum positive and negative values of the reactions.



P8.5



REACTIONS PRODUCED BY $W = 1.2 \text{ kips/ft}$

$$R_B = WA = 1.2 \text{ kips/ft} \left(\frac{1}{2} \times 12' \times \frac{3}{2} \right) = \underline{10.8 \text{ kips} \uparrow}$$

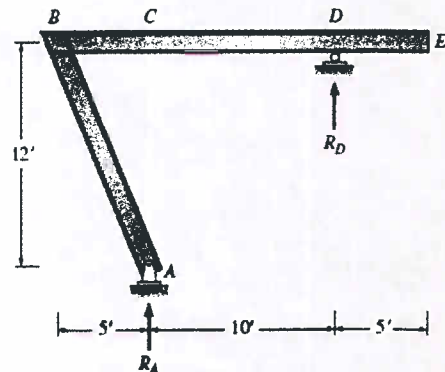
$$R_D = 1.2 \left[\frac{1}{2} \left(-\frac{3}{4} \right) 4 \right] + 1.2 \left[\frac{1}{2} \times 4 \left(-\frac{1}{2} \right) \right] = \underline{-3 \text{ kips} \downarrow}$$

$$- 1.2 \left[\frac{1}{2} \left(\frac{3}{2} \right) 20 \right] = \underline{18 \text{ kips} \uparrow}$$

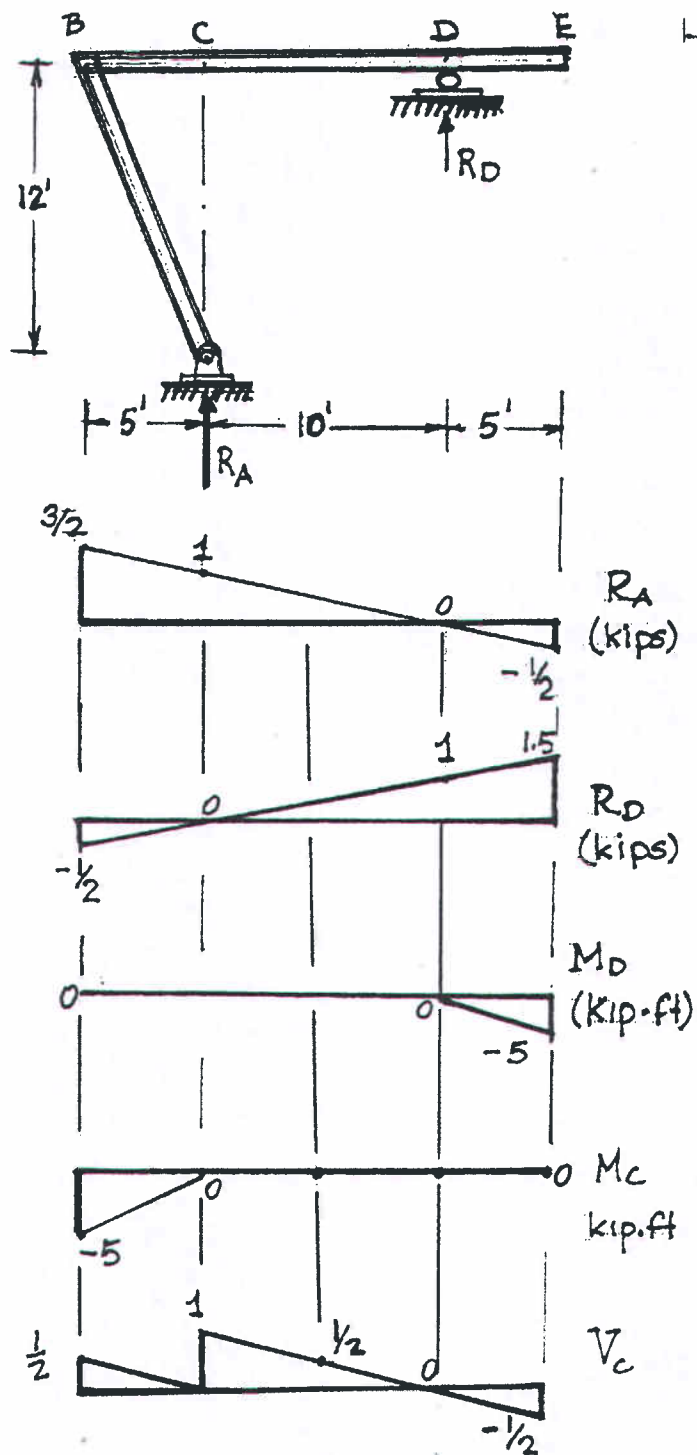
$$R_F = 1.2 \left(\frac{1}{2} \times 12 \times \left(-\frac{1}{2} \right) \right) = \underline{-3.6 \text{ kips} \downarrow}$$

$$1.2 \left(\frac{1}{4} \times \frac{1}{2} \times 4 \right) + 1.2 \left(12 \times \frac{3}{2} \times \frac{1}{2} \right) = \underline{11.4 \text{ kips} \uparrow}$$

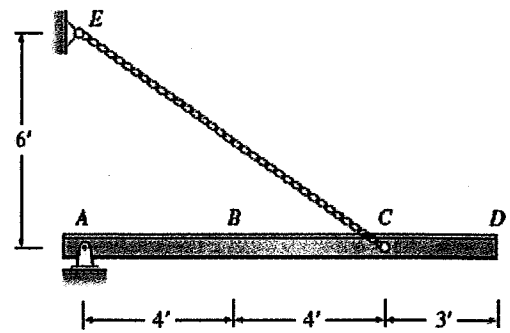
P8.6. Load moves along girder $BCDE$. Draw the influence lines for the reactions at supports A and D , the shear and moment at section C , and the moment at D . Point C is located directly above support A .



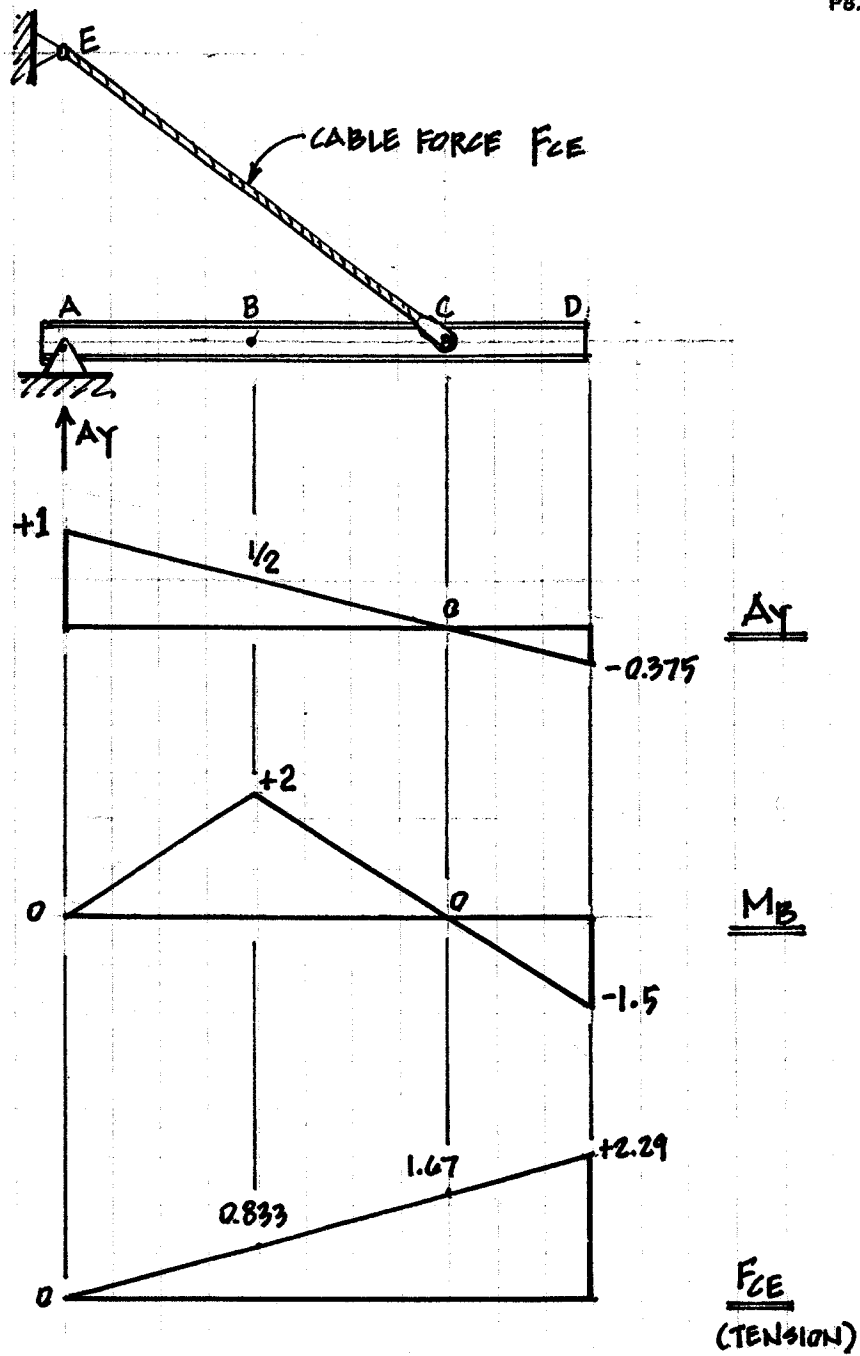
P8.6



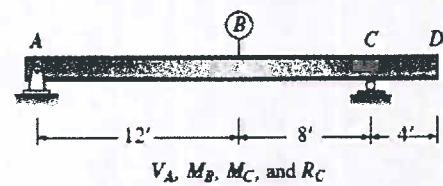
P8.7. Beam AD is connected to a cable at C . Draw the influence lines for the force in cable CE , the vertical reaction at support A , and the moment at B .



P8.7

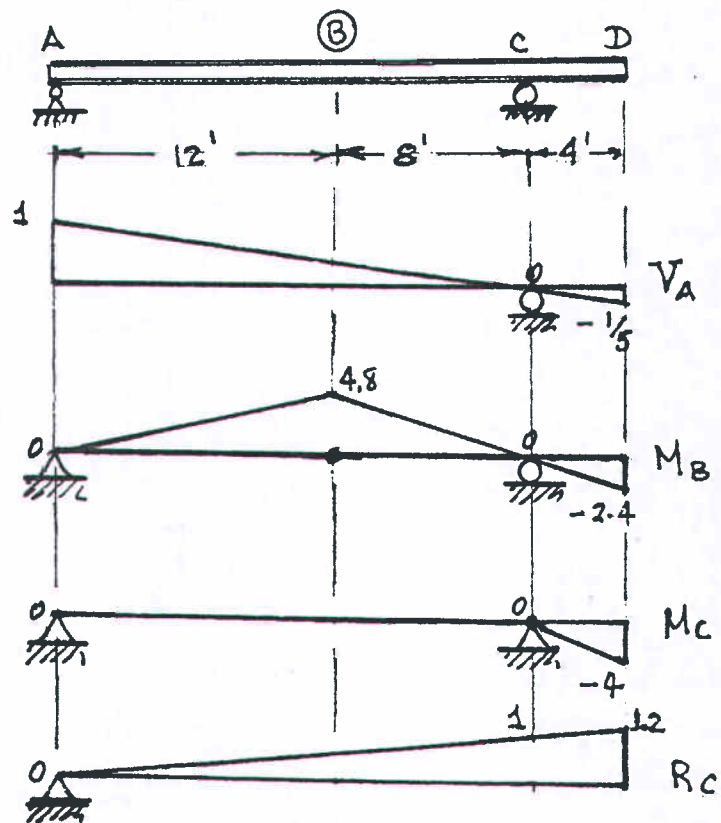


P8.8. Using the Müller-Breslau principle, sketch the shape of the influence lines for the reactions and internal forces noted below each structure.

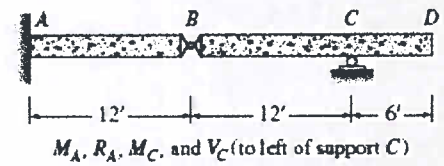


P8.8

MÜLLER-BRESLAU

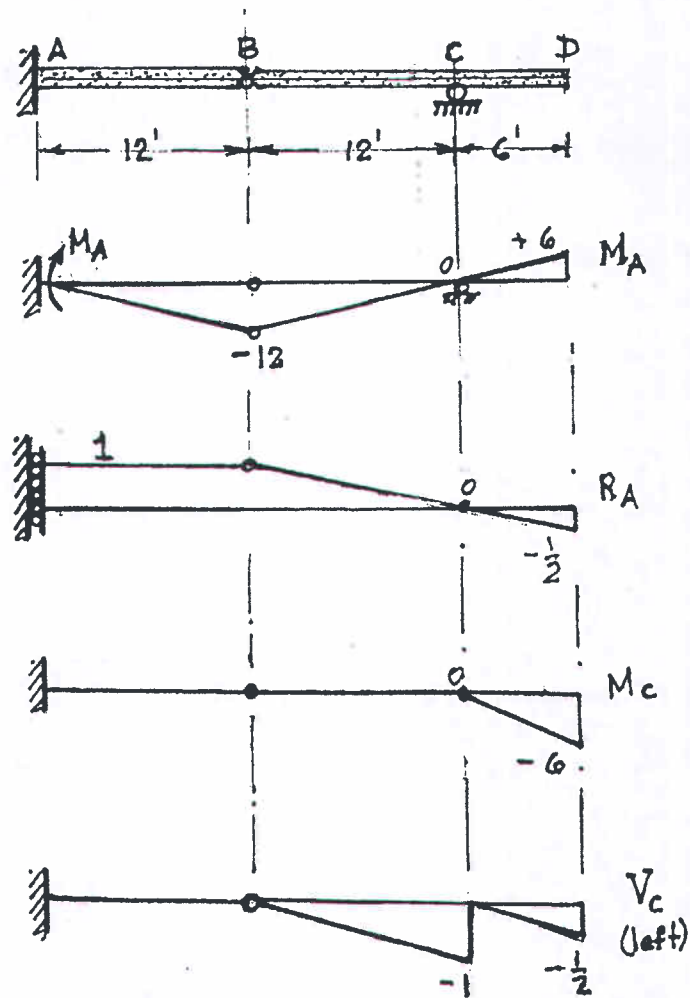


P8.9. Using the Müller-Breslau principle, sketch the shape of the influence lines for the reactions and internal forces noted below each structure.

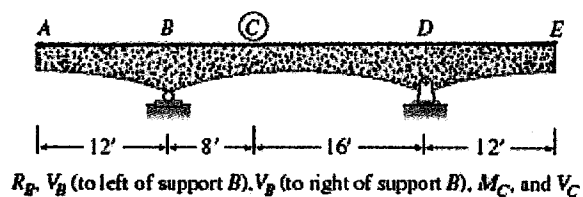


P8.9

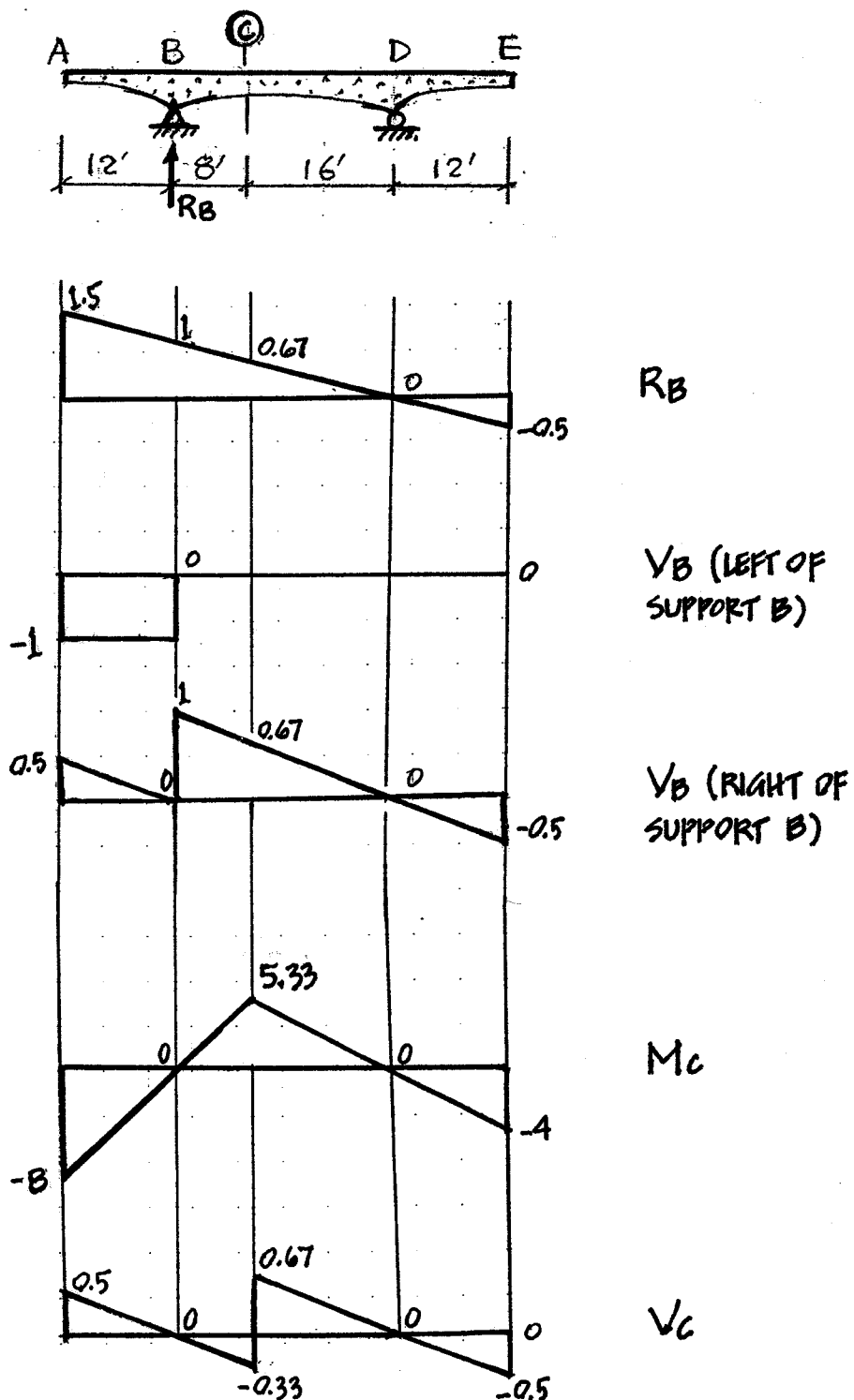
MÜLLER-BRESLAU



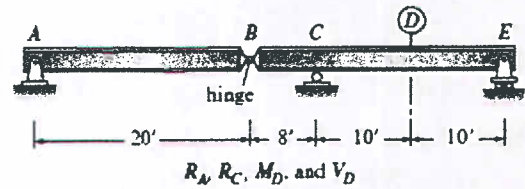
P8.10. Using the Müller-Breslau principle, sketch the shape of the influence lines for the reactions and internal forces noted below each structure.



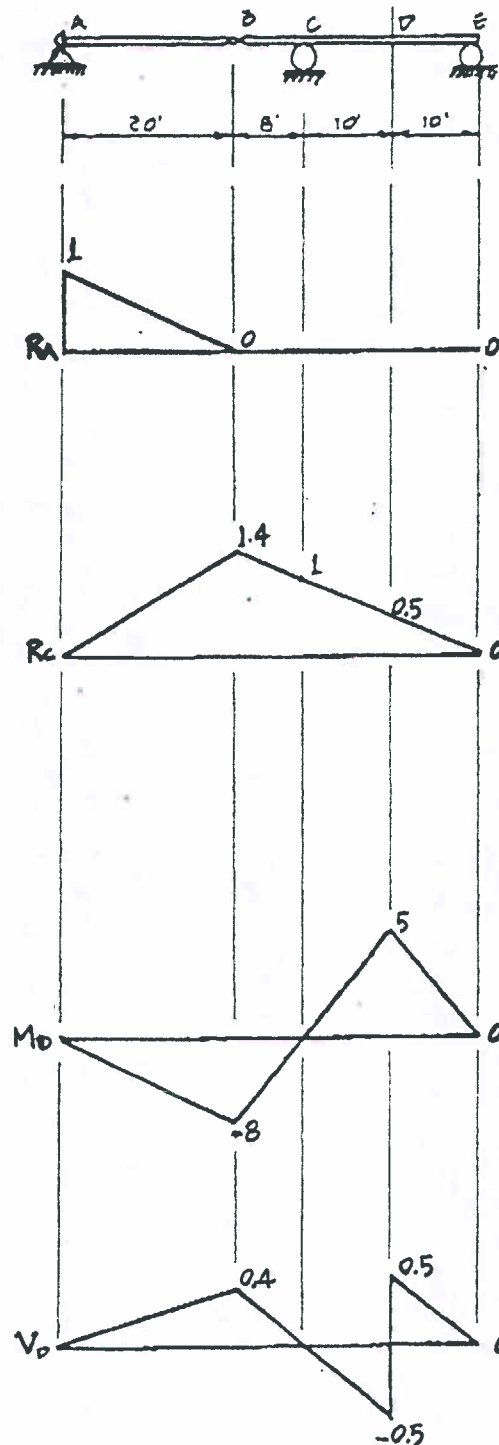
P8.10



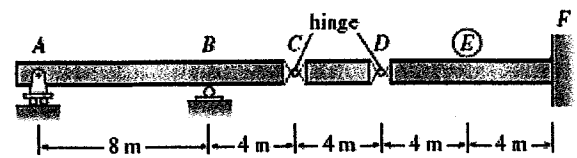
P8.11. Using the Müller-Breslau principle, sketch the shape of the influence lines for the reactions and internal forces noted below each structure.



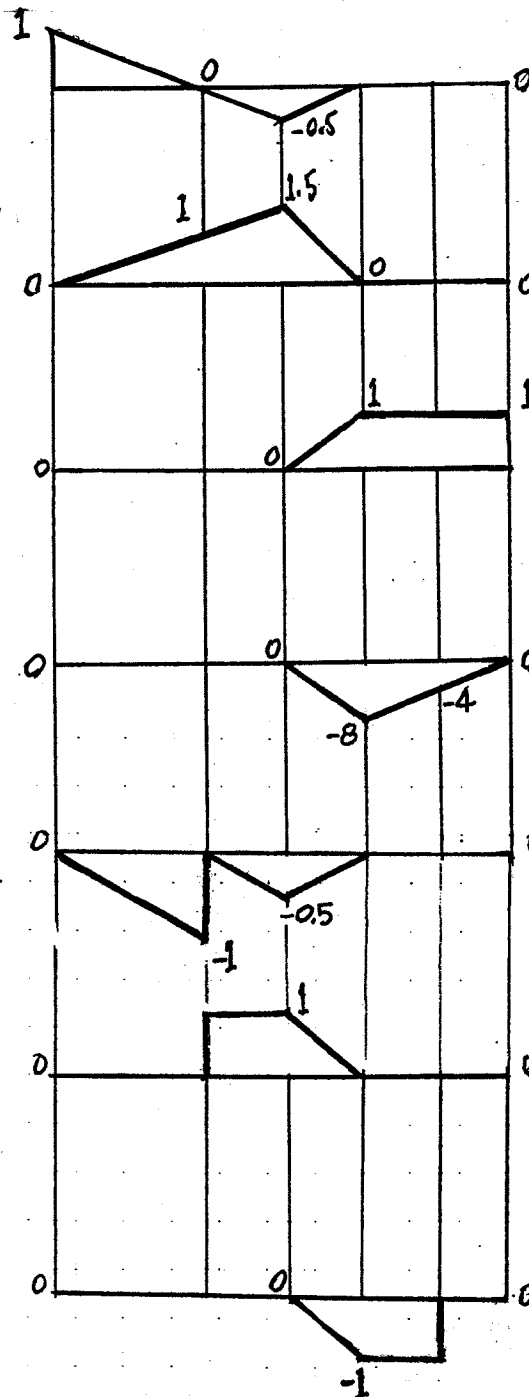
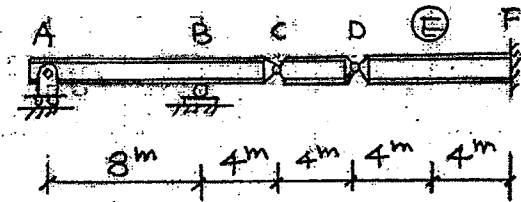
P8.11



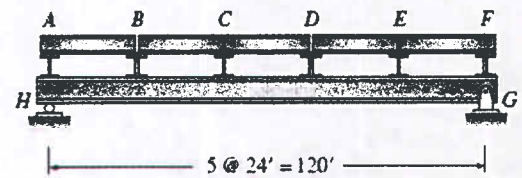
P8.12. For the beam shown in Figure P8.12, draw the influence lines for the reactions at A , B , and F , the end moment at F , shears to the left and right of support B , and shear at E .



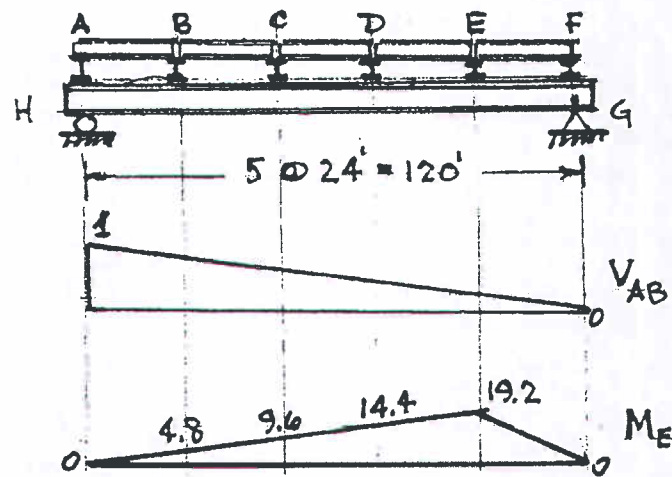
P8.12



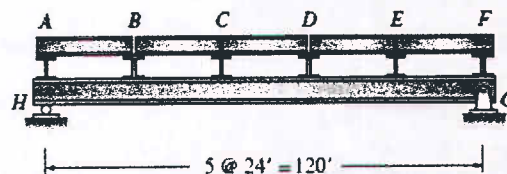
P8.13. Draw the influence lines for the shear between points *A* and *B* and for moment at point *E* in the girder *GH* shown in Figure P8.13.



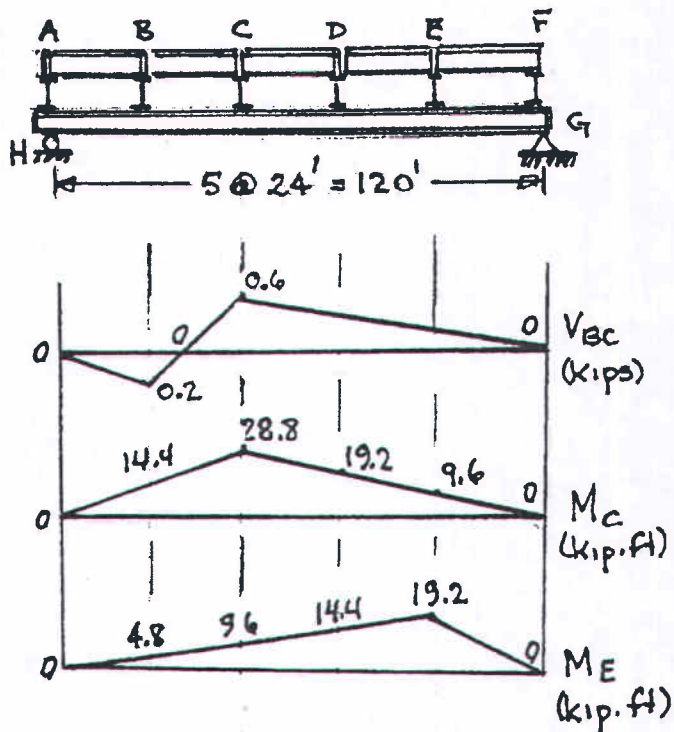
P8.13



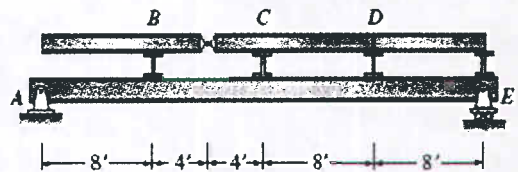
P8.14. For the floor system shown in Figure P8.13, draw the influence lines for shear between points *B* and *C* and for the moment at points *C* and *E* in the girder.



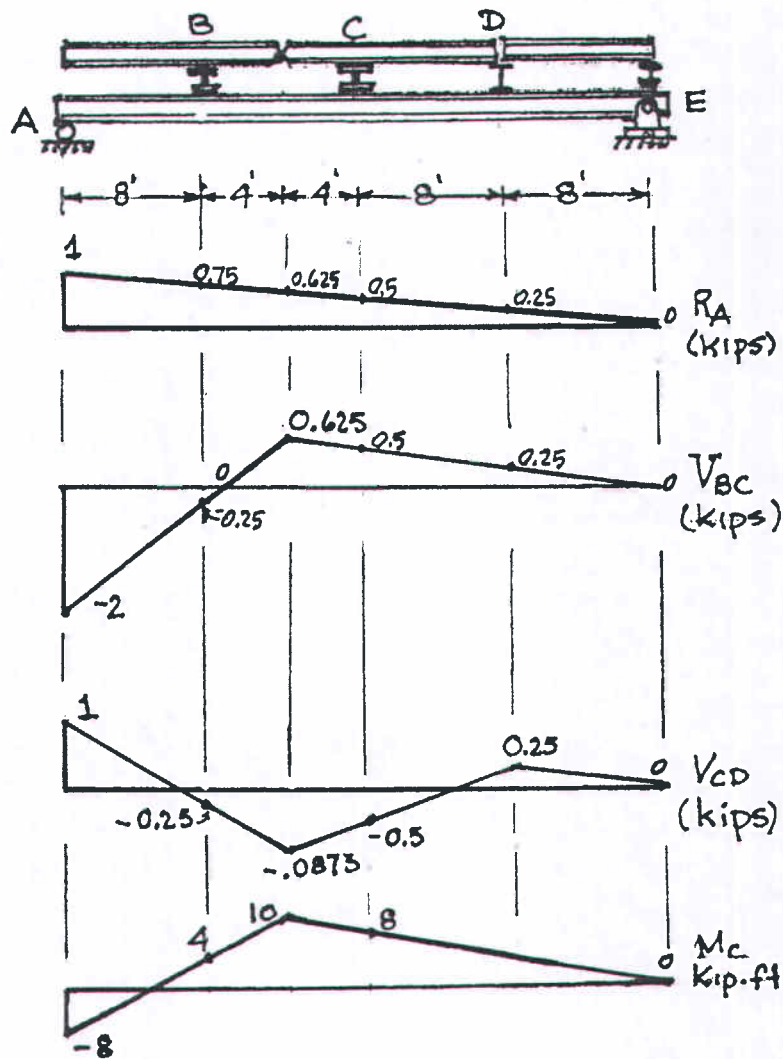
P8.13



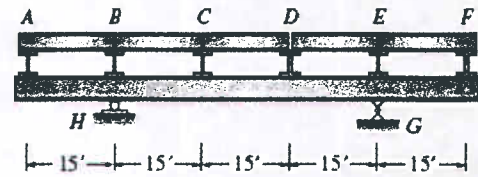
P8.15. For the girder in Figure P8.15, draw the influence lines for the reaction at A , the moment at point C , and the shear between points B and C in girder AE .



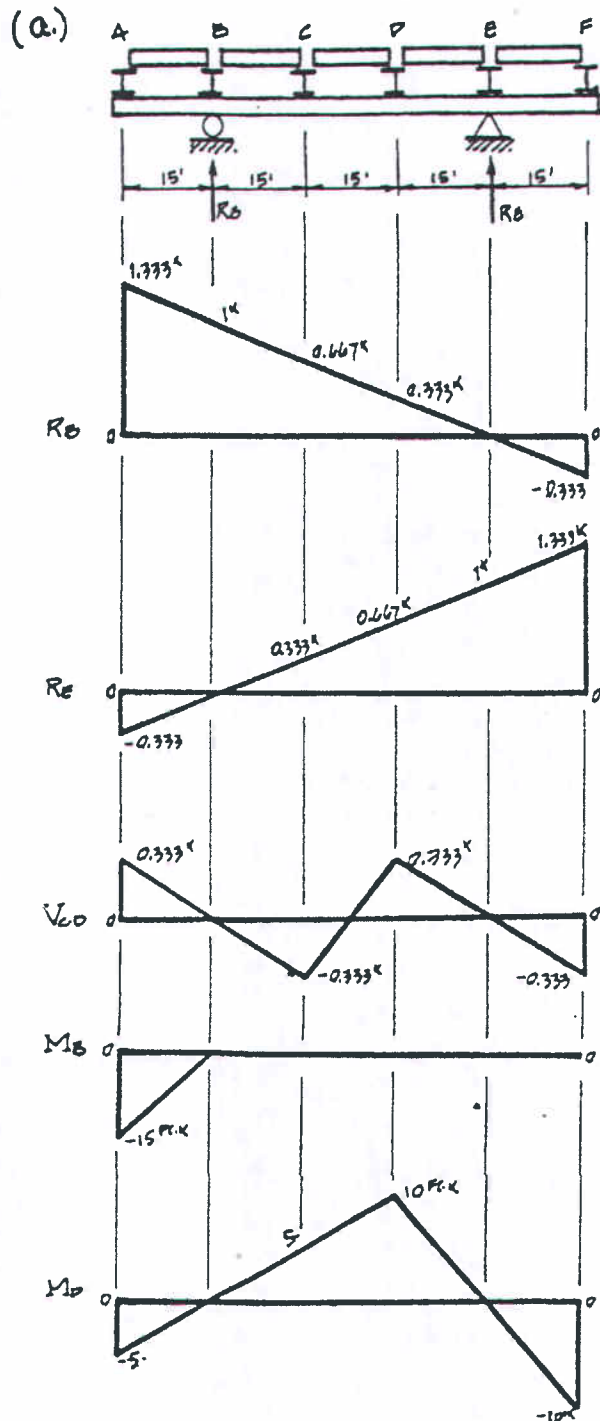
P8.15



P8.16. (a) Draw the influence lines for the reactions at B and E, the shear between CD, the moment at B and D for the girder in Figure P8.16. (b) If the dead load of the floor system (stringers and slab) is approximated by a uniformly distributed load of 3 kip/ft, the reaction of the floor beam's dead load to each panel point equals 1.5 kips, and the deadweight of the girder is 2.4 kips/ft, determine the moment in the girder at D and the shear just to the right of C. Assume the floor system is supported by two outside girders (see Figure 8.16, for example).



P8.16



(b) EXCEPT FOR DEAD WEIGHT OF GIRDER ALL LOADS APPLIED TO GIRDER BY FLOOR BEAMS.

TYPICAL INTERIOR FLOOR BEAM REACTION = FLR. SLAB + STRINGERS

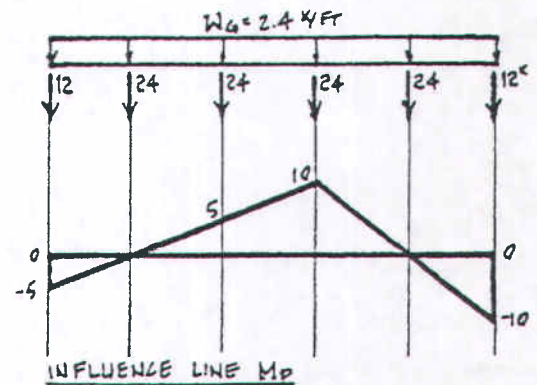
$$R = (3 \text{ k/ft}) \times (5/2) + 1.5 = 24 \text{ k}$$

END FLOOR BEAM REACTION

$$R_s = R/2 = 12 \text{ k}$$

LOAD INFLUENCE LINE FOR M_D (SEE 7.5 2.)

LOADS

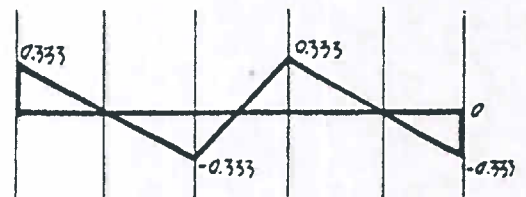


$$M_D = \sum F(\text{ORDINATES}) + W(\text{AREA UNDER INFLUENCE LINE})$$

$$= 12(-5) + 24(5) + 24(10) - 12(10) + 2.4[-5(15/2) + 10(45/2) - 15(10/2)]$$

$$M_D = 450 \text{ FT-K}$$

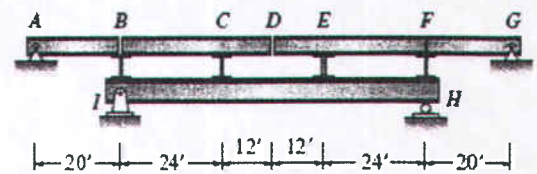
LOAD INFLUENCE LINE FOR V_{CD} (SEE 7.5 2.)



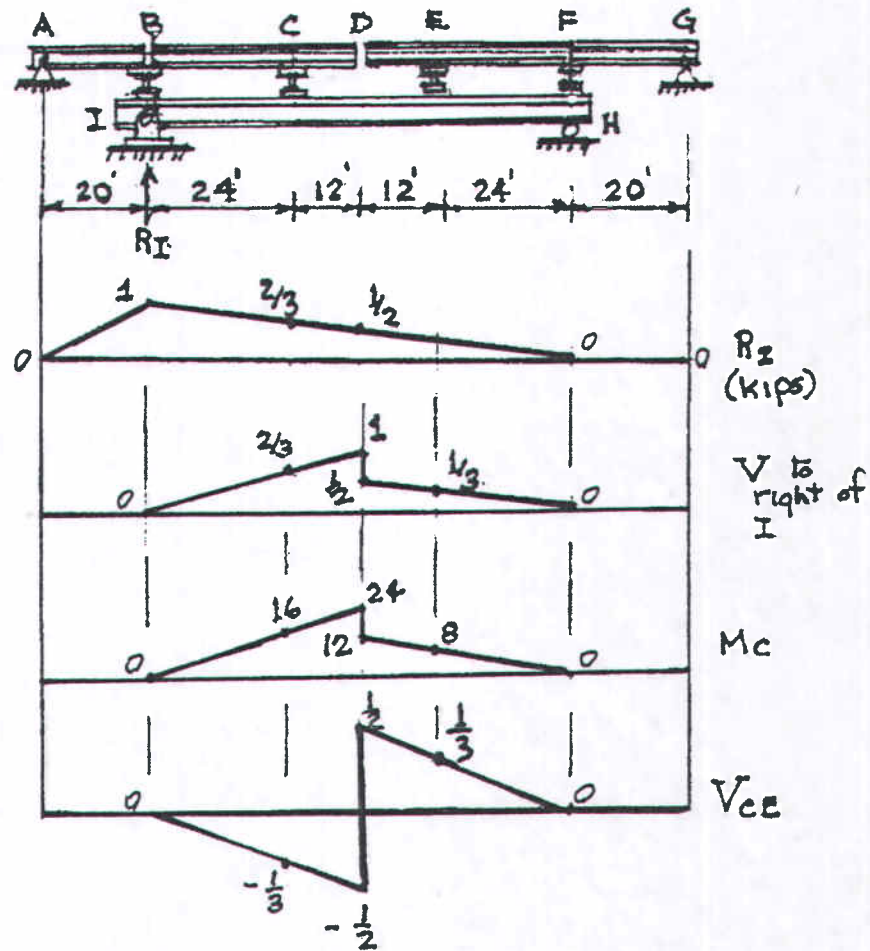
$$V_{CD} = 12(0.333) + 24(-0.333) + 24(0.333) - 12(0.333) + 2.4(0)$$

$$V_{CD} = 0$$

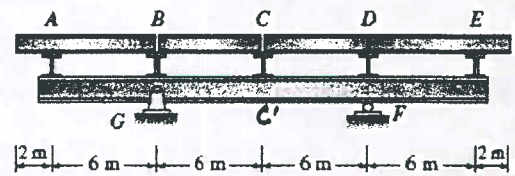
P8.17. For the girder in Figure P8.17, draw the influence lines for the reaction at I , the shear to the right of support I , the moment at C , and the shear between CE .



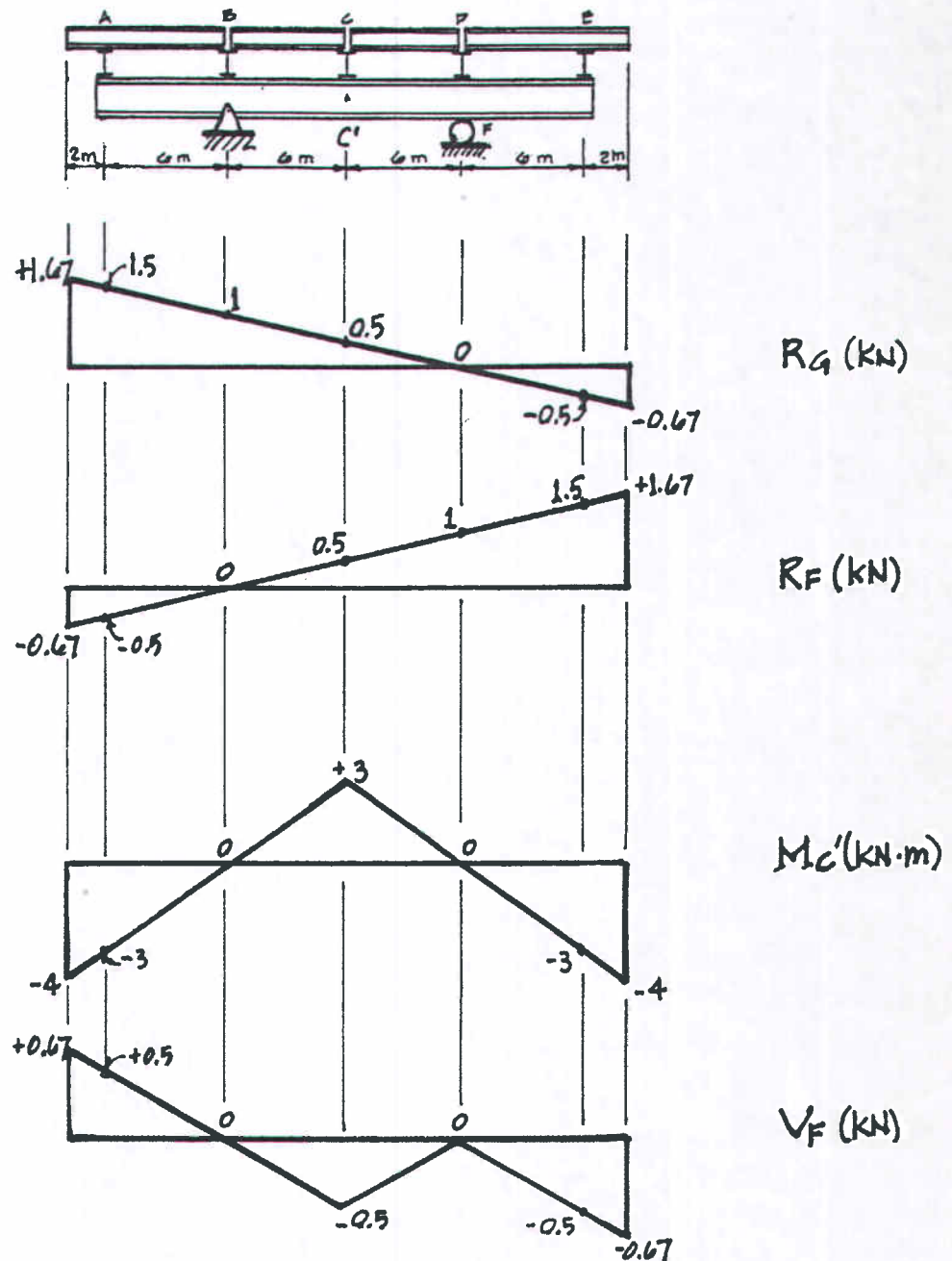
P8.17



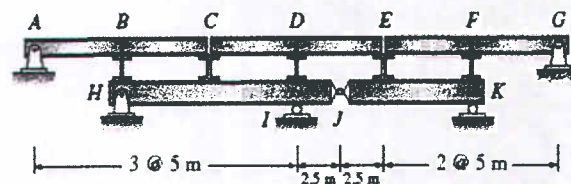
P8.18. For the girder in Figure P8.18, draw the influence lines for the support reactions at G and F , the moment at C , and the shear to the left of support F .



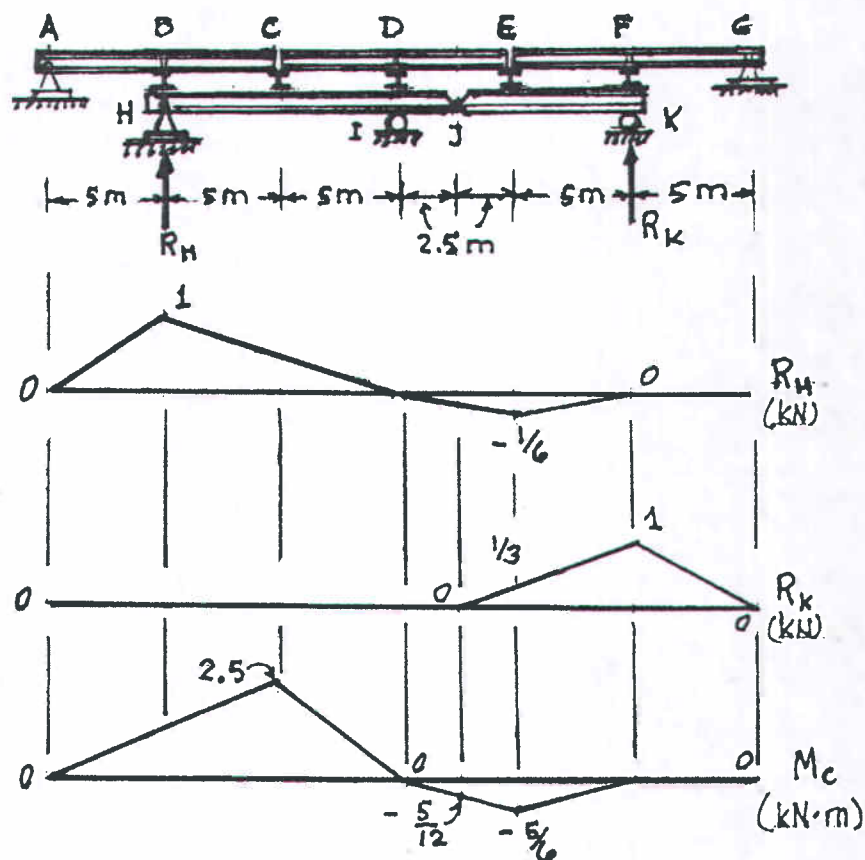
P8.18



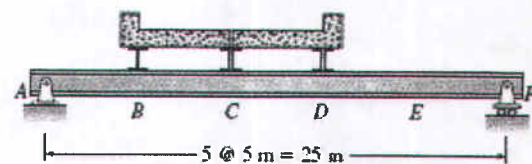
P8.19. (a) For the girder *HJJ* shown in Figure P8.19, draw the influence line for moment at *C*. (b) Draw the influence line for the reactions at support *H* and *K*.



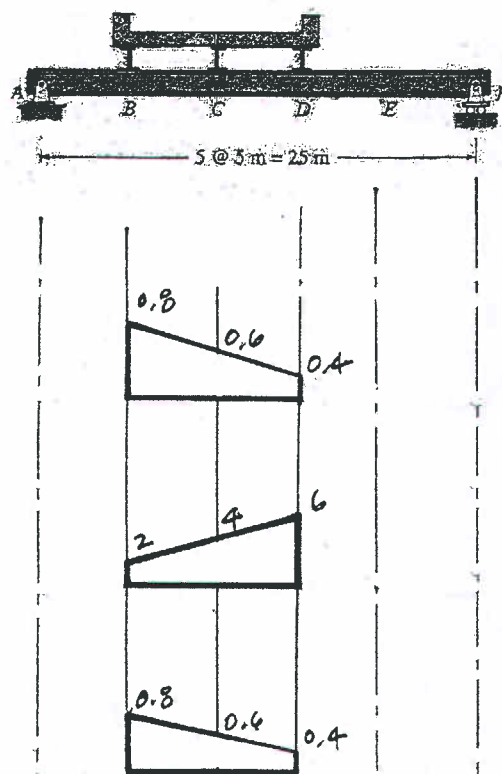
P8.19



P8.20. The load can only be applied between points *B* and *D* of the girder shown in Figure P8.20. Draw the influence lines for the reaction at *A*, the moment at *D*, and the shear to the right of support *A*.



P8.20

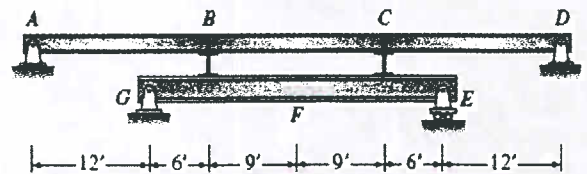


R_A

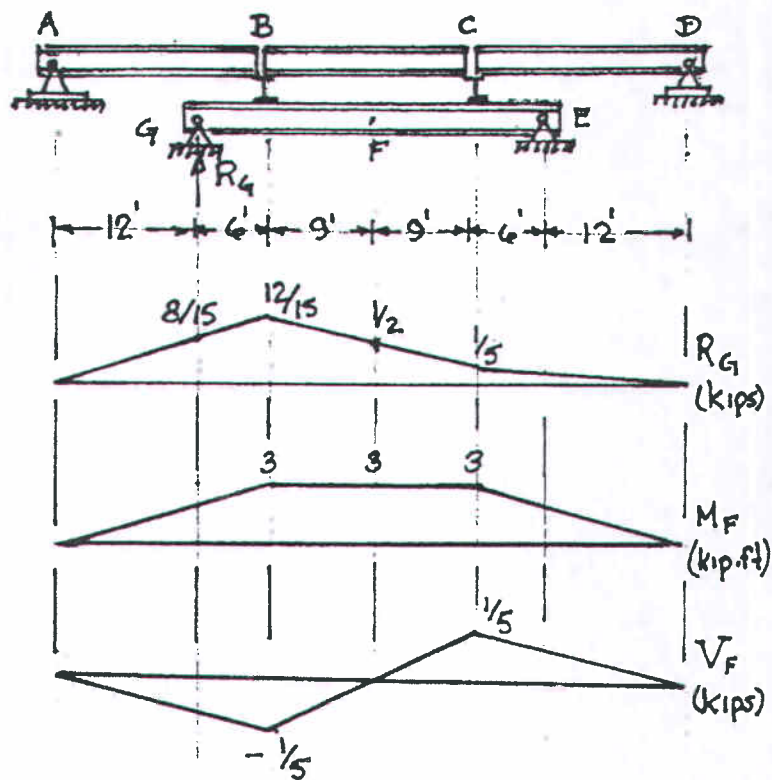
M_D

V_A

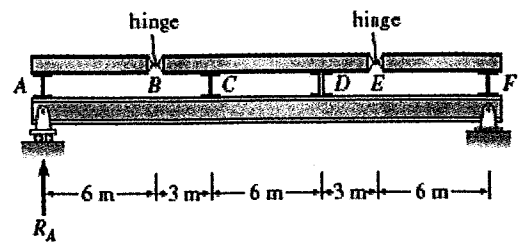
P8.21. For the girder EG shown in Figure P8.21, draw the influence lines for the reaction at G and the shear and moment at F , located at midspan of girder EG .



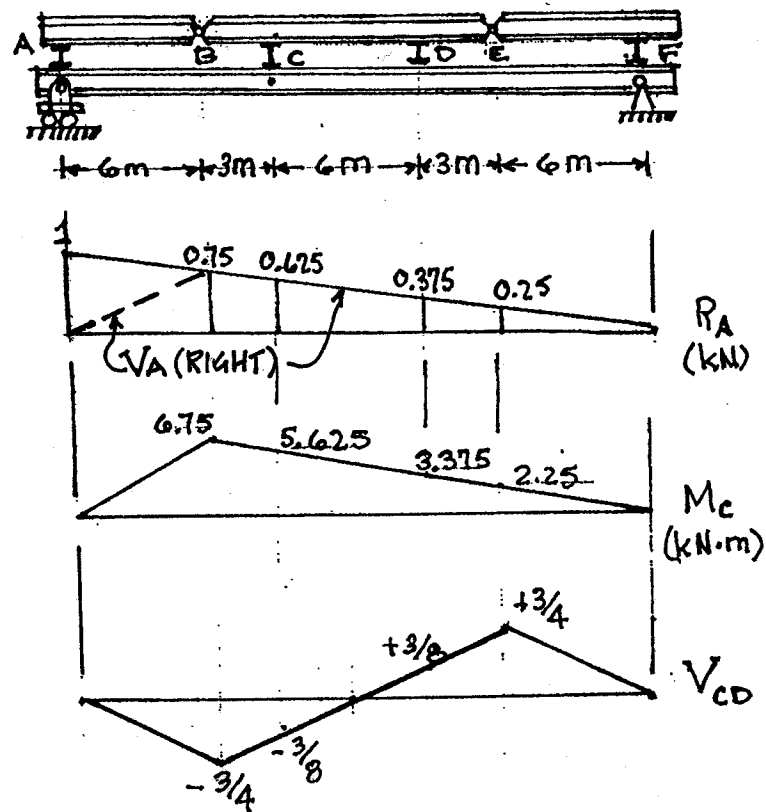
P8.21



P8.22. For girder AF shown in Figure P8.22, draw the influence lines for the reaction at A , the moment at C , the shear immediately to the right of support A , and the shear between C and D .

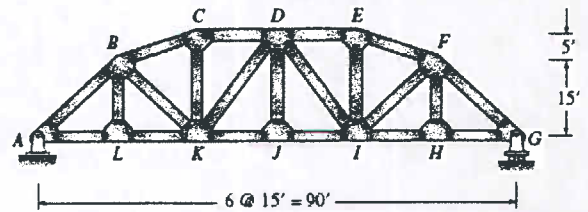


P8.22

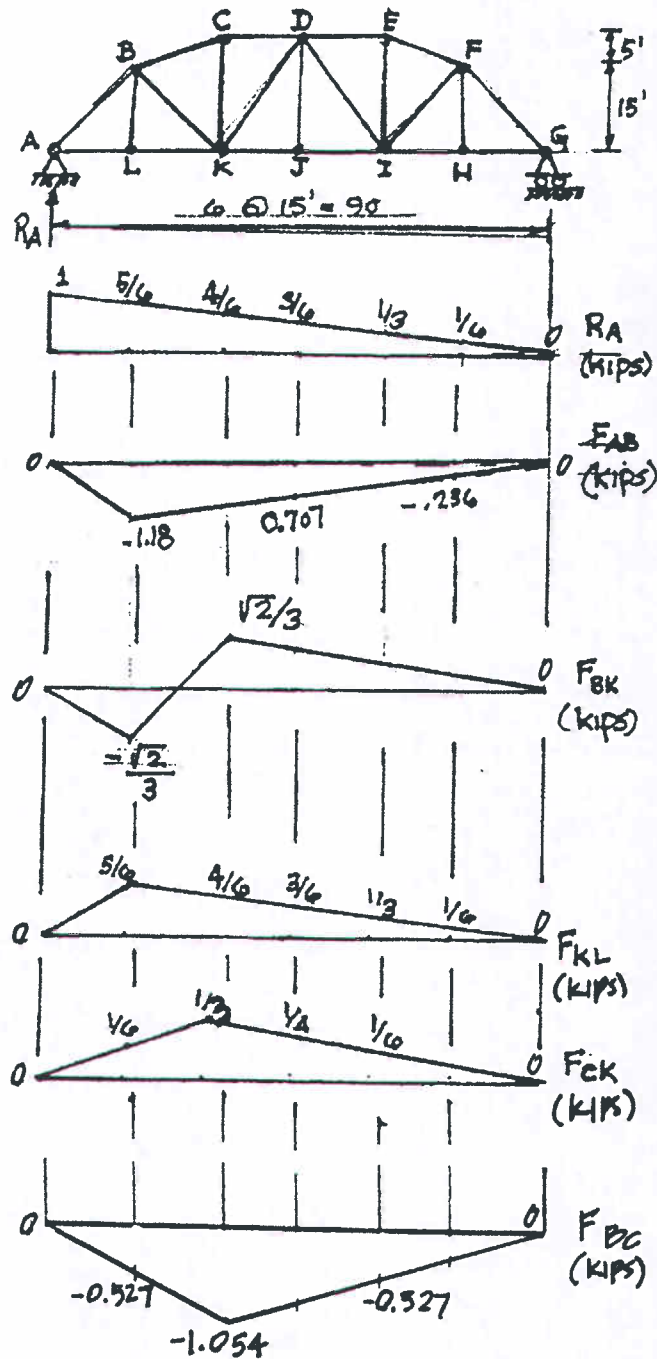


NOTE: INFLUENCE LINE FOR SHEAR FROM "A" TO "B" SHOWN DASHED ON INFLUENCE LINE FOR " R_A "; REMAINING INFLUENCE LINE (RIGHT OF B) IS THE SAME AS THAT FOR " R_A ".

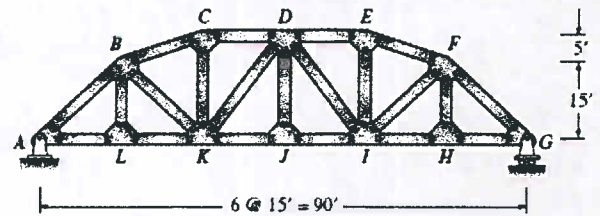
P8.23. Draw the influence lines for the bar forces in members AB , BK , BC , and LK if the live load is applied to the truss in Figure P8.23 through the lower chord.



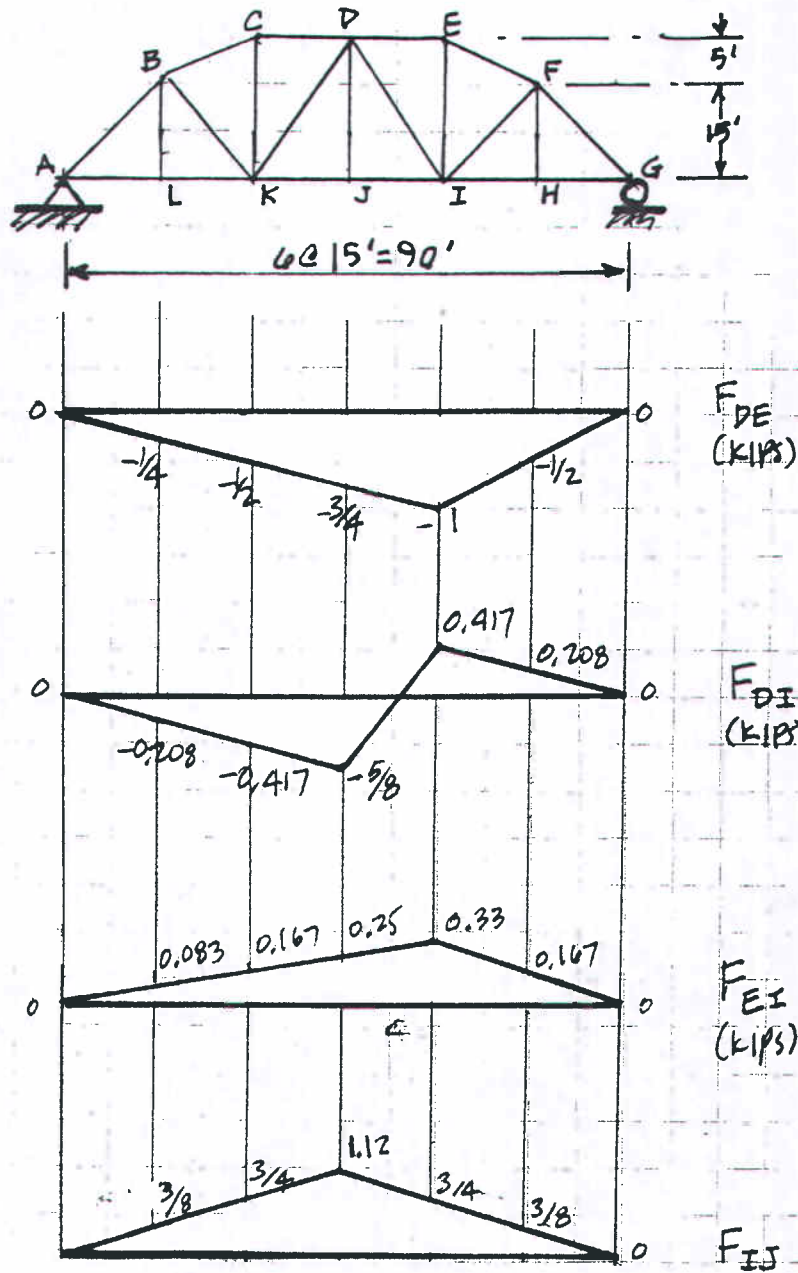
P8.23



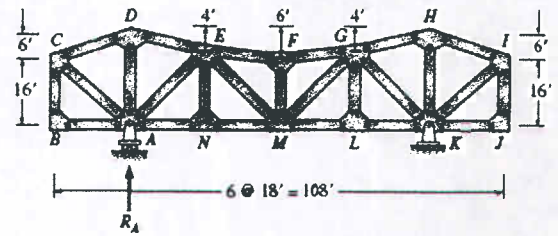
P8.24. Draw the influence lines for the bar forces in members DE , DI , EI , and IJ if the live load in Figure P8.23 is applied through the lower chord panel points.



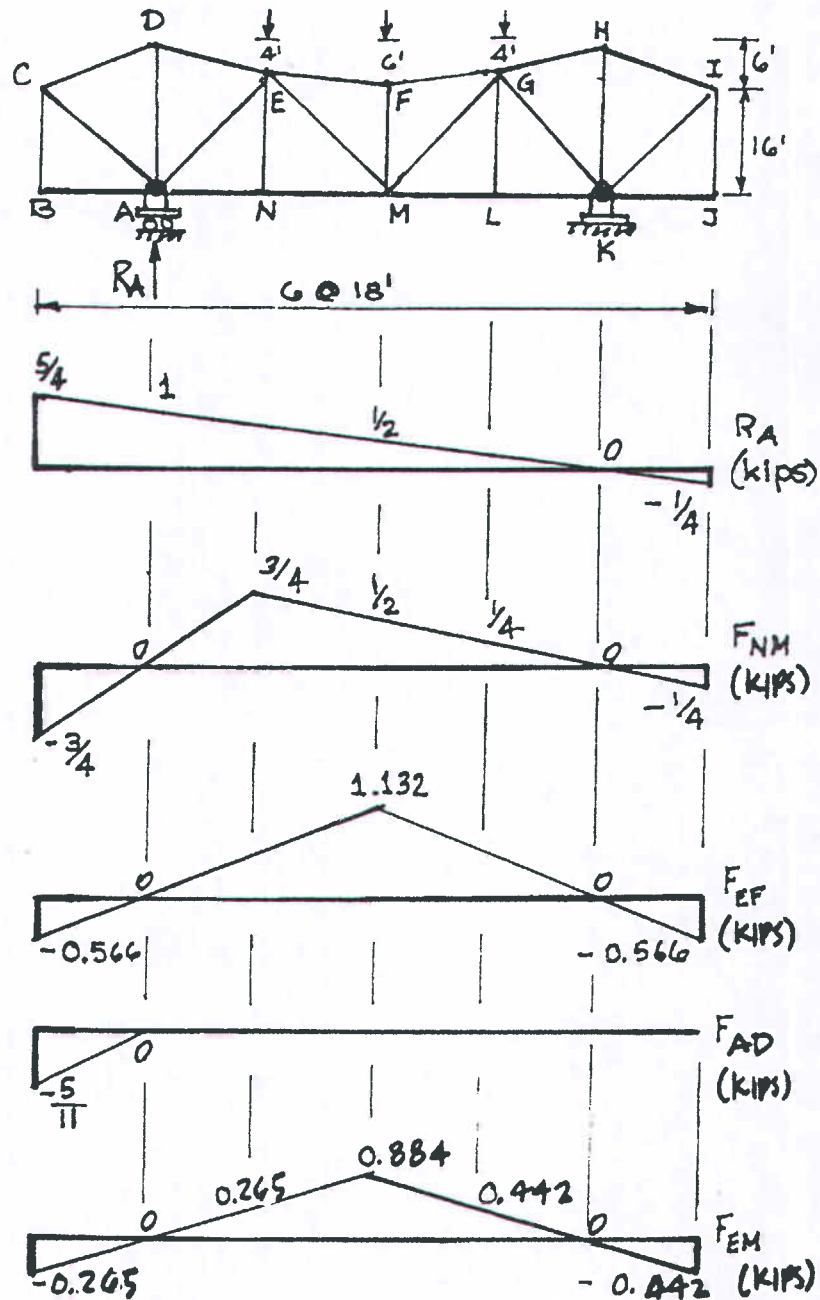
P8.23



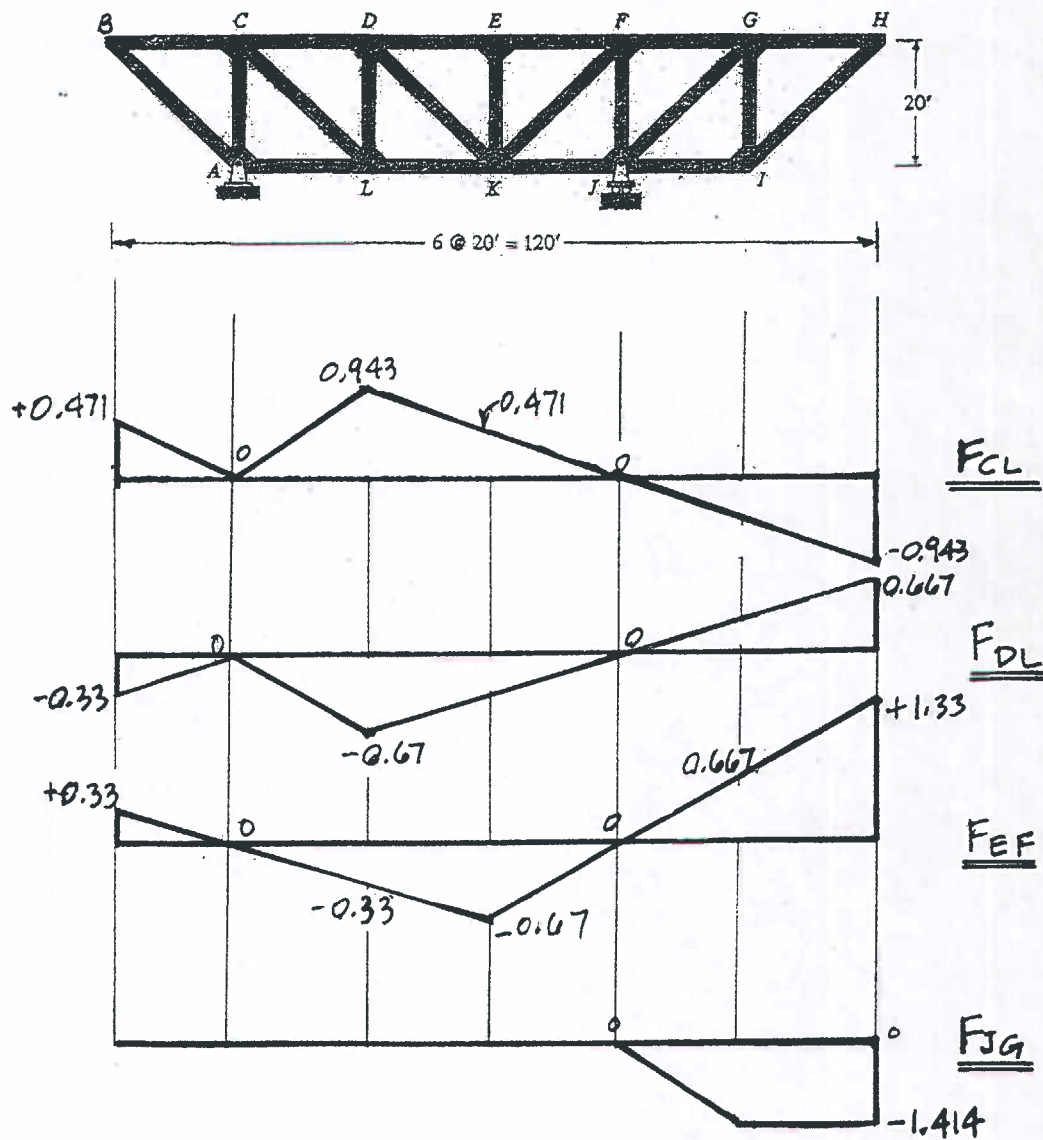
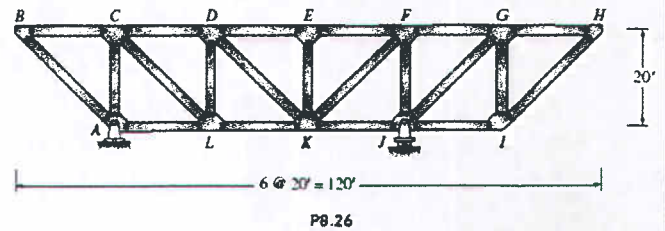
P8.25. Draw the influence lines for R_A and the bar forces in members AD , EF , EM , and NM . Loads are transmitted into the truss through the lower chord panel points. Vertical members EN and GL are 18 ft long, FM is 16 ft.



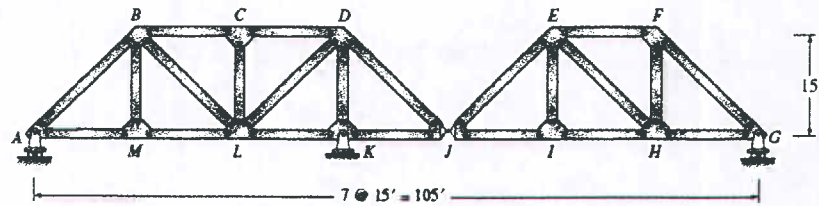
P8.25



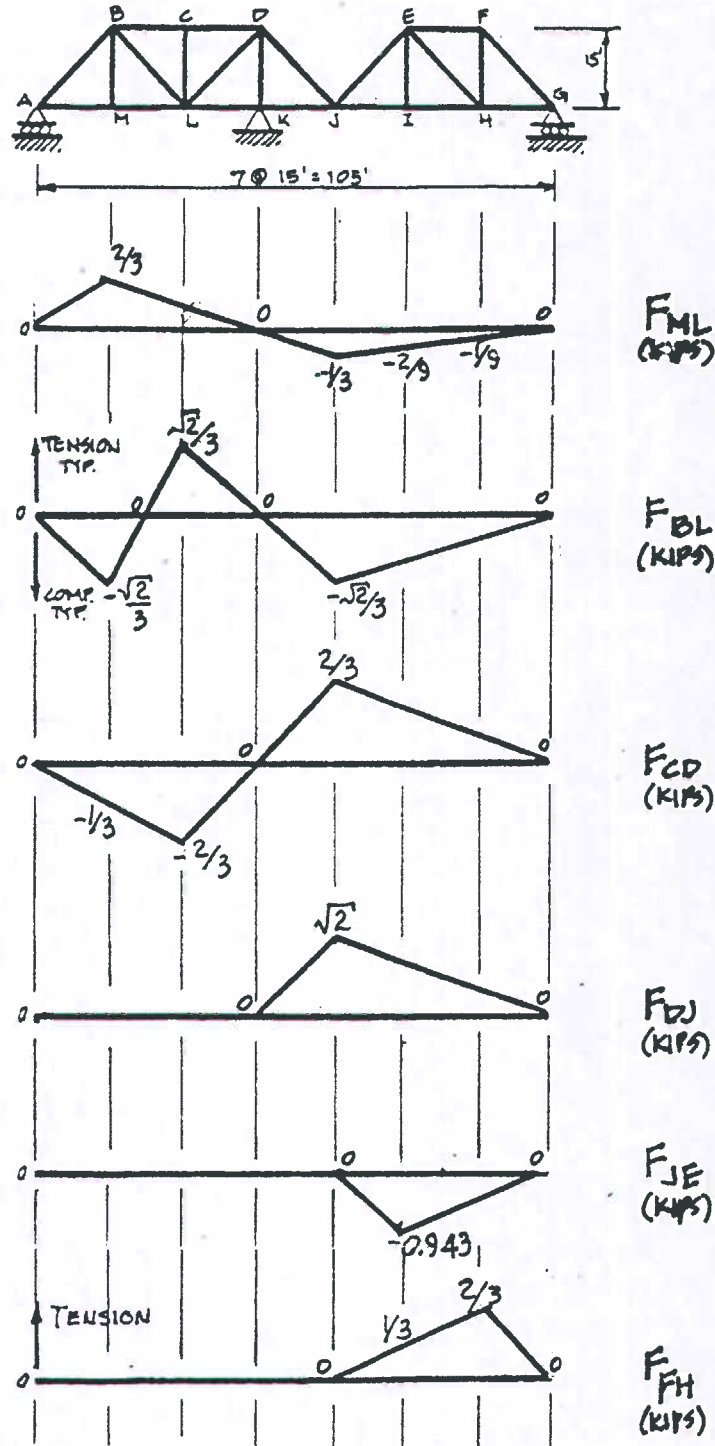
P8.26. Draw the influence lines for the bar forces in members CL , DL , EF , and JG if the live load is applied to the truss in Figure P8.26 through the upper chord panel points.



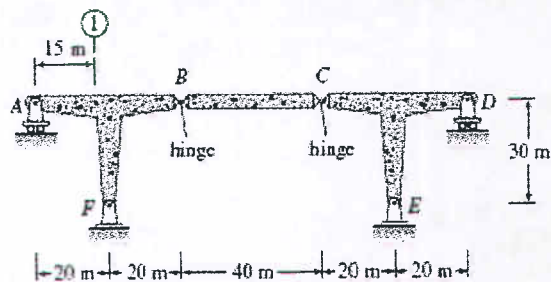
P8.27. Draw the influence lines for bar forces in members ML , BL , CD , EJ , DJ , and FH of the cantilever truss in Figure P8.27 if the live load is applied through the lower chord panel points.



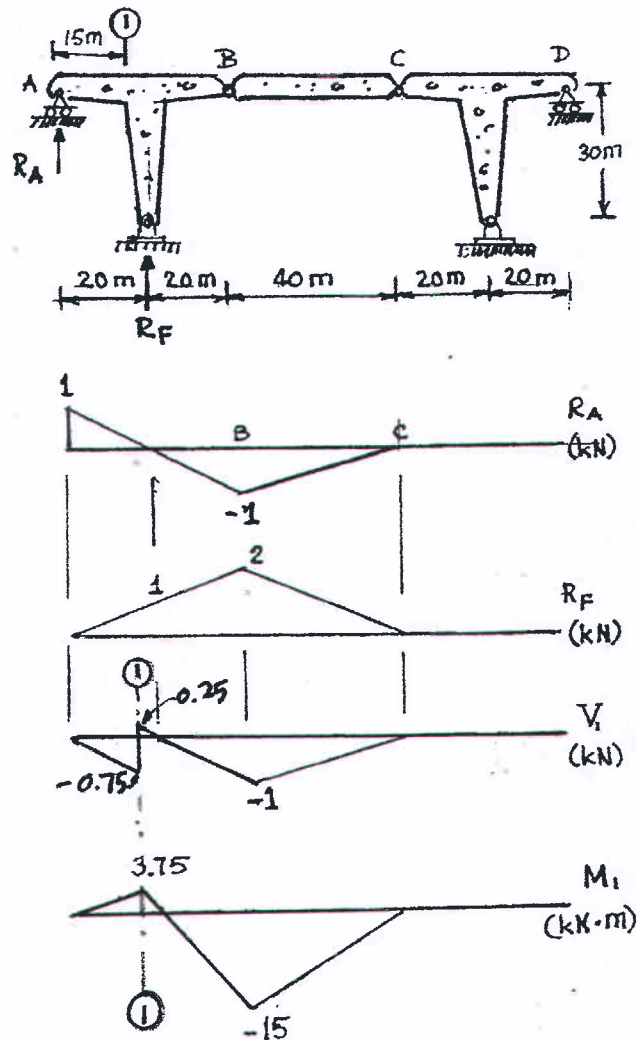
P8.27



P8.28. Draw the influence lines for the reactions at A and F and for the shear and moment at section 1. Using the influence lines, determine the reactions at supports A and F if the dead load of the floor system can be approximated by a uniform load of 10 kN/m . See Figure P8.28.



P8.28



REACTION AT SUPPORT A: $DL = 10 \text{ k/ft}$

$$R_A = 10 \text{ kips/ft} \left[\frac{1 \times 20}{2} - \frac{1 \times 60}{2} \right]$$

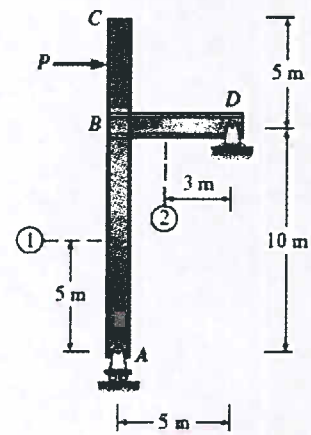
$$R_A = -200 \text{ kN} \downarrow$$

REACTION AT SUPPORT F: $DL = 10 \text{ k/ft}$

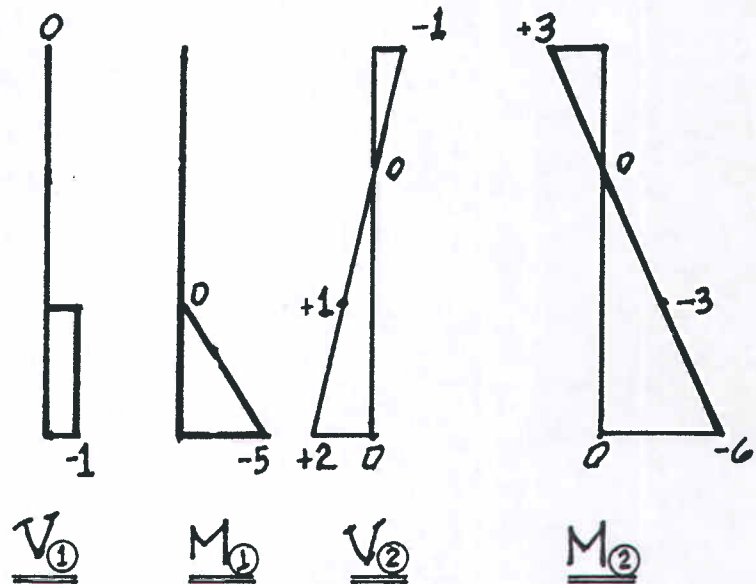
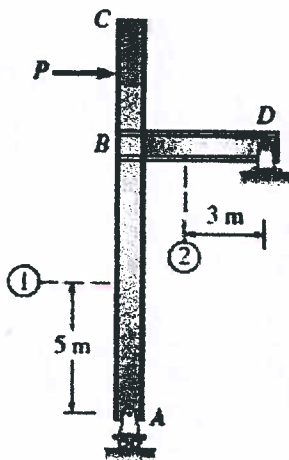
$$R_F = 10 \text{ kips/ft} \left[\frac{2 \times 80}{2} \right]$$

$$R_F = 800 \text{ kN} \uparrow$$

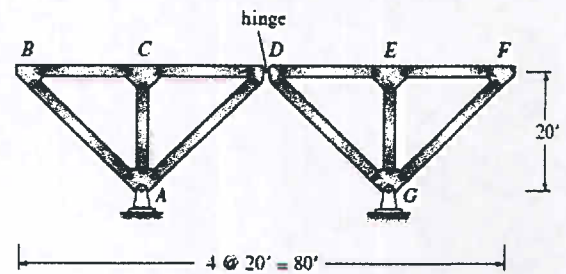
P8.29. The horizontal load P can act at any location along the length of member AC shown in Figure P8.29. Draw the influence lines for the moment and shear at section 1, and the moment at section 2.



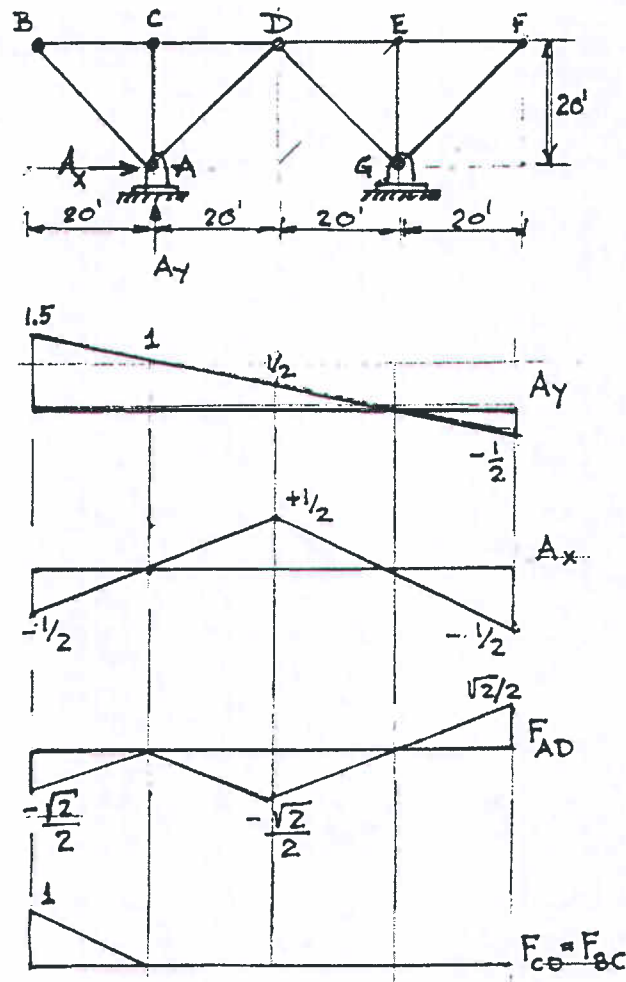
P8.29



P8.30. Draw the influence lines for the vertical and horizontal reactions, A_x and A_y , at support A and the bar forces in members AD , CD , and BC . If the truss is loaded by a uniform dead load of 4 kips/ft over the entire length of the top chord, determine the magnitude of the bar forces in members AD and CD .



P8.30

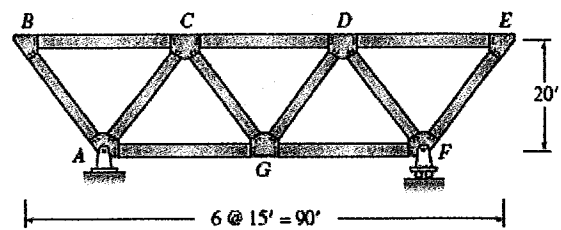


$$F_{BC} = F_{CD} = W \cdot A = 4 \text{ kips/ft} \left(\frac{1}{2} \right) (1) 20 = \underline{\underline{40 \text{ kips}}}$$

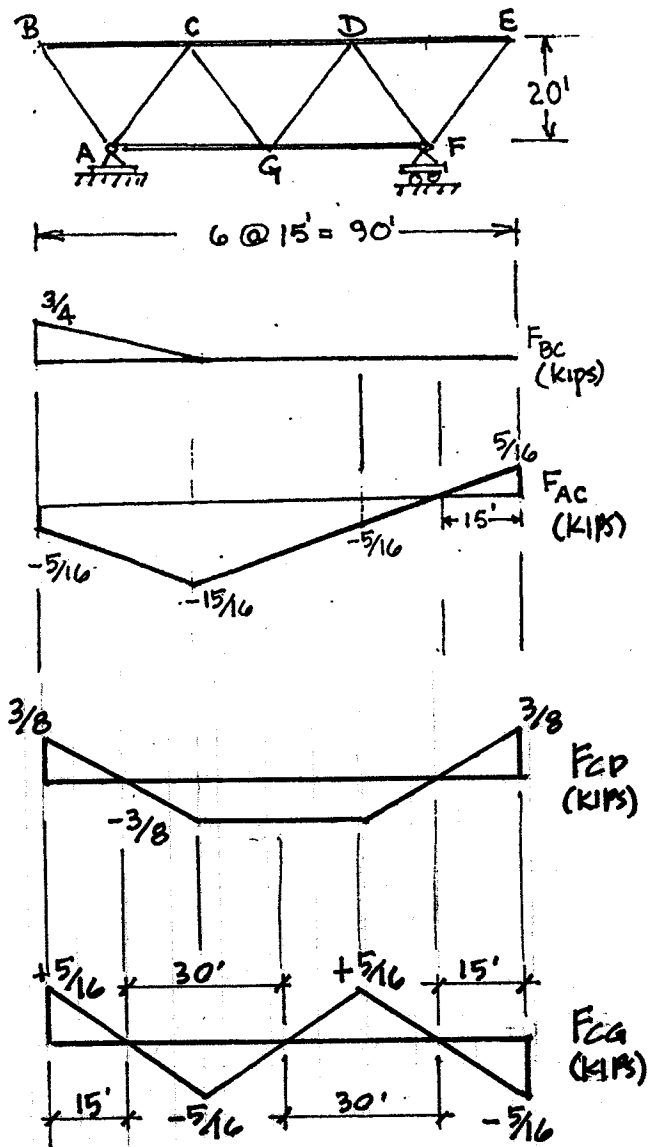
$$F_{AD}^* = \frac{1}{2} (40) \left(-\frac{\sqrt{2}}{2} \right) 4 \text{ kips/ft} = \underline{\underline{-40\sqrt{2} \text{ kips}}}$$

NOTE* POSITIVE AND NEGATIVE AREAS ON ENDS CANCEL OUT.

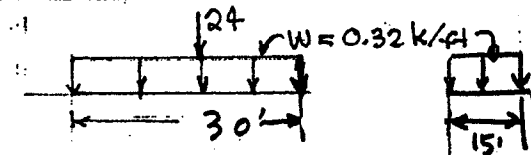
P8.31. Draw the influence lines for the forces in members BC, AC, CD, and CG. Load is transferred from the roadway to the upper panel points by a system of stringers and floor beams (not shown). If the truss is to be designed for a uniform live load of 0.32 kip/ft that can be placed anywhere on the span in addition to a concentrated live load of 24 kips that can be positioned where it will produce the largest force in bar CG, determine the maximum value of live load force (tension, compression, or both) created in bar CG.



P8.31



MAX. COMPR IN BAR CG.



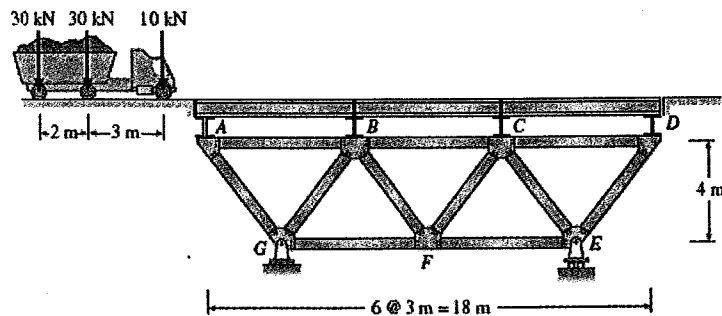
$$\begin{aligned}
 F_{CG} &= w(\text{negative area}) + 24\left(-\frac{5}{16}\right) \\
 &= 0.32\left(\frac{1}{2}(30+15)\left(-\frac{5}{16}\right)\right) + (-7.5) \\
 &= -9.75 \text{ kips COMPRESSION.}
 \end{aligned}$$

MAX. TENSION IN BAR CG.

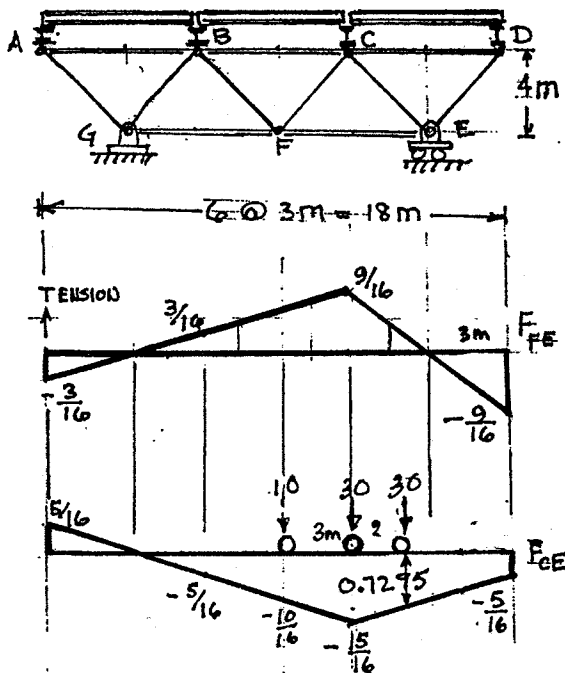
F_{CG} = SAME AREA AS MAX. COMPRESSION, BUT IN TENSION.

$$F_{CG} = +9.75 \text{ kips TENSION}$$

P8.32. A bridge is composed of two trusses whose configuration is shown in Figure P8.32. The trusses are loaded at their top chord panel points by the reactions from a stringer and floor beam system that supports a roadway slab. Draw the influence lines for forces in bars FE and CE . Assume that vehicles move along the center of the roadway so one-half the load is carried by each truss. If a fully loaded motorized ore carrier with a total weight of 70 kN crosses the bridge, determine the maximum live load forces in bars FE and CE . Assume the truck can move in either direction. Consider the possibility of both tension and compression force in each bar.



P8.32



MAX TENSION IN F_{FE}

$$T_{max} = 10 \text{ kN}(0.25) + 30 \text{ kN}(0.4375) + 30(9/16)$$

$$= \underline{\underline{32.5 \text{ kN}/2}} = \underline{\underline{16.25 \text{ kN}}}$$

PER TRUSS

MAX COMPRESSION IN F_{FE}

$$C_{max} = \left[-\frac{9}{16}(30) - \frac{3}{16}(30) \right] \frac{1}{2}$$

$$= \left[-16.875 - 5.625 \right] \frac{1}{2}$$

$$= \underline{\underline{11.25 \text{ kN PER TRUSS}}}$$

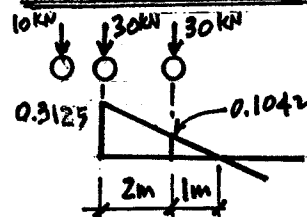
MAX COMPRESSION IN F_{CE} / PER TRUSS

$$C_{max} = \left[10\left(-\frac{10}{16}\right) + 30\left(-\frac{15}{16}\right) + 30(0.7295) \right] \frac{1}{2}$$

$$= \left[6.25 + 28.125 + 21.885 \right] \frac{1}{2}$$

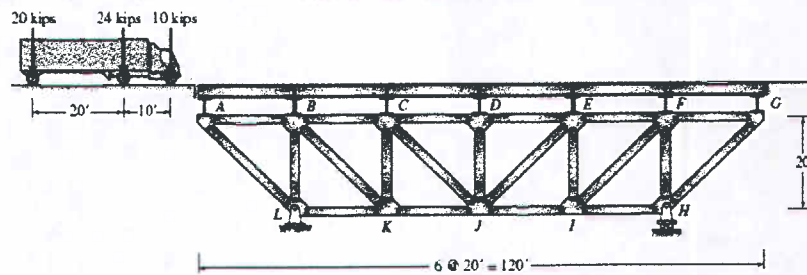
$$= \underline{\underline{28.13 \text{ kN / PER TRUSS}}}$$

MAX TENSION IN F_{CE}

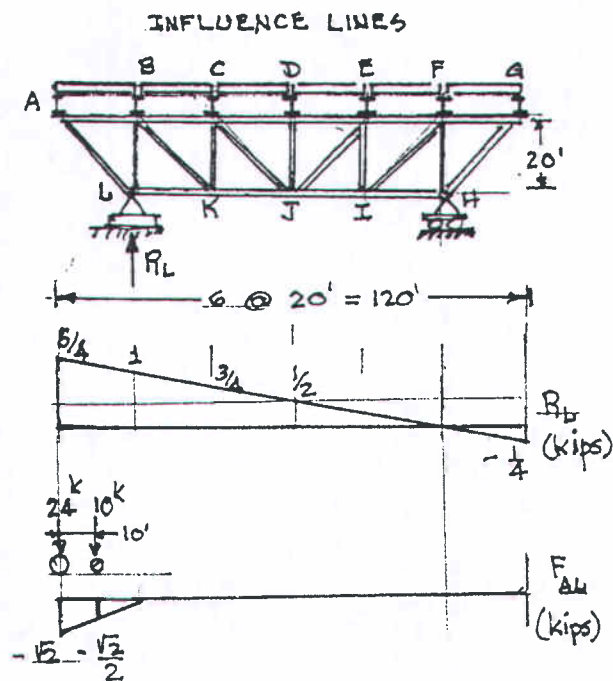


$$T_{max} = (0.3125 + 0.1042)(30 \text{ kN}) = \underline{\underline{6.25 \text{ kN}}}$$

P8.33. Draw the influence lines for forces in bars AL and KJ in Figure P8.33. Using the influence lines, determine the **maximum** live load force (consider both tension and compression) **produced** by the 54-kip truck as it transverse the bridge, which consists of two trusses. Assume the truck moves along the center of the roadway so that one-half of the truck load is carried by each truss. Assume the truck can travel in either direction.



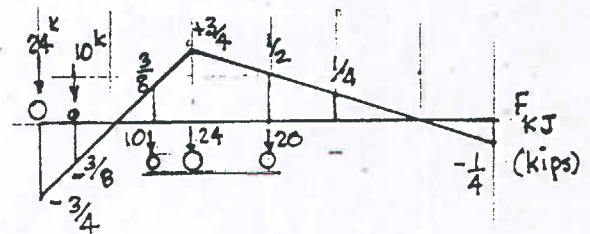
P8.33



MAX. L.L. COMPR. IN BAR F_{AL} (2 TRUSSES)

$$F_{AL} = 24^k \cdot \frac{\sqrt{2}}{2} + 10^k \cdot \frac{\sqrt{2}}{2} = 41.01 \text{ kips}$$

$$\text{EACH TRUSS} = 41.01/2 = \underline{\underline{20.51 \text{ kips}}}$$



MAX. L.L. COMPR. IN BAR KJ (2 TRUSSES)

$$F_{KJ} = -\frac{3}{4}(24) - \frac{3}{8}(10) = -21.75 \text{ kips}$$

$$\text{LOAD EACH TRUSS} = \underline{\underline{10.88 \text{ kips}}}$$

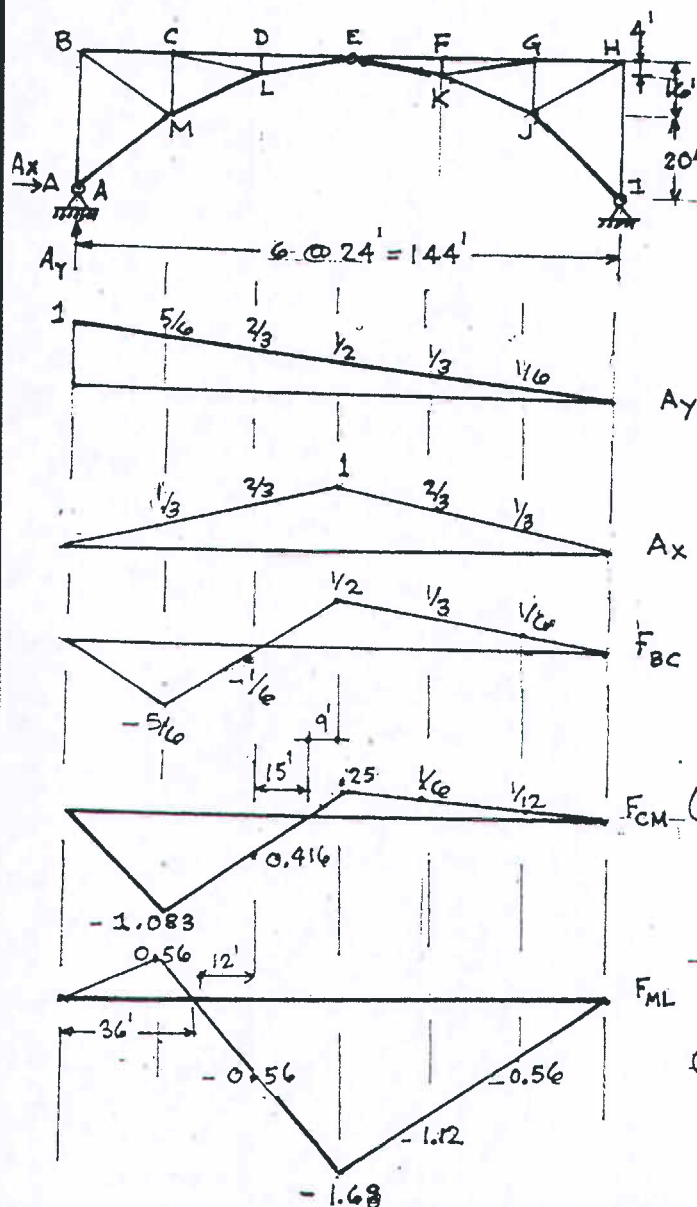
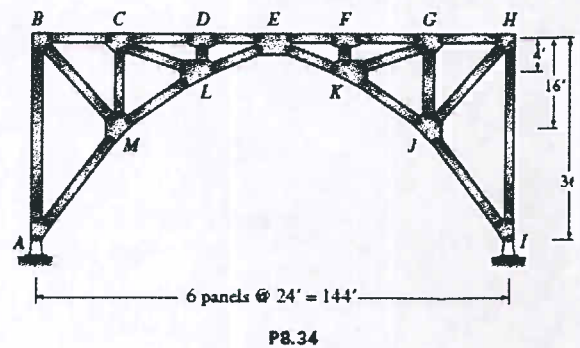
MAX. L.L. TENSION BAR KJ (2 TRUSSES)

$$F_{KJ} = 10^k \times \frac{3}{8} + 24^k \times \frac{3}{4} + 20^k \times \frac{1}{2}$$

$$= 3.75 + 18 + 10 = 31.75 \text{ kips}$$

$$F_{KJ}/\text{TRUSS} = 31.75/2 = \underline{\underline{15.875 \text{ kips}}}$$

P8.34. (a) Load is applied to the three-hinged trussed arch in Figure P8.34 through the upper chord panel points by a floor beam and stringer floor system. Draw the influence lines for the horizontal and vertical reactions at support A and the forces or components of force in members BC, CM, and ML. (b) Assuming that the dead load of the arch and floor system can be represented by a uniform load of 4.8 kip/ft, determine the forces in bars CM and ML produced by the dead load. (c) If the live load is represented by a uniformly distributed load of 0.8 kip/ft of variable length and a concentrated load of 20 kips, determine the maximum force in bar CM produced by the live load. Consider both tension and compression. Joint E acts as a hinge.



(b) DEAD LOAD FORCES IN BARS CM AND ML

$$F_{CM} = 4.8 \text{ k/ft} \left[\frac{1}{2} (63)(-1.083) + \frac{1}{2} (81)(0.25) \right]$$

$$= 115.1 \text{ kips COMPRESSION}$$

$$F_{ML} = 4.8 \text{ k/ft} \left[\frac{1}{2} (108)(-1.68) + \frac{1}{2} (36)(0.56) \right]$$

$$= 387.07 \text{ kips COMPRESSION}$$

(c) LIVE LOAD FORCES IN BAR CM

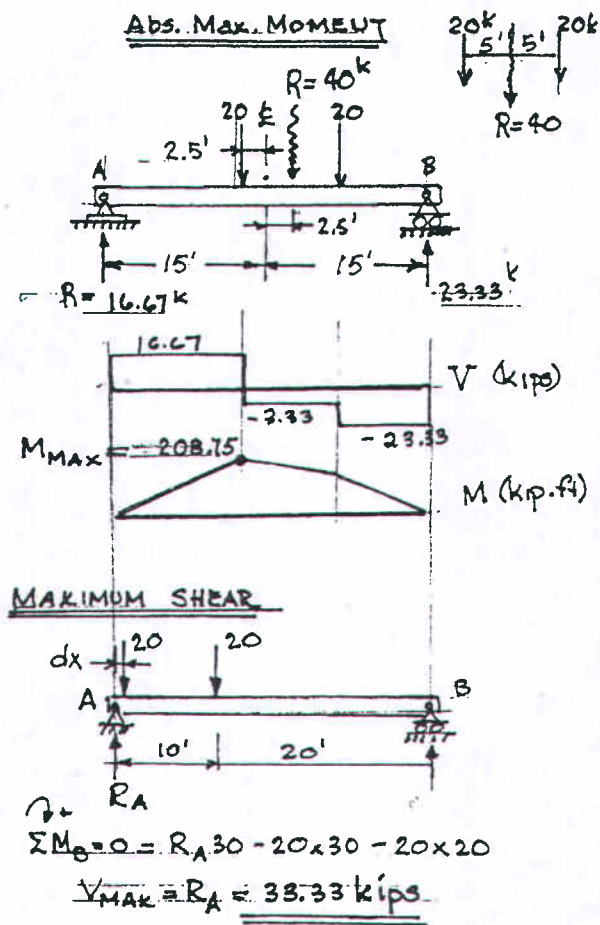
$$\text{MAX. COMPR.} = \frac{1}{2} (63)(-1.083) \frac{0.8 \text{ kips}}{\text{ft}} + 20(-1.083)$$

$$= 48.95 \text{ kips}$$

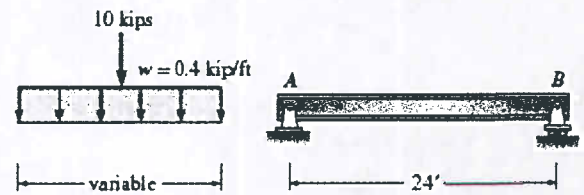
$$\text{MAX. TENSION} = \frac{1}{2} (81)(0.25) \frac{0.8 \text{ kips}}{\text{ft}} + 0.25(20)$$

$$= 13.1 \text{ kips}$$

P8.35. Compute the absolute maximum shear and moment produced in a simply supported beam by two concentrated live loads of 20 kips spaced 10 ft apart. The beam span is 30 ft.



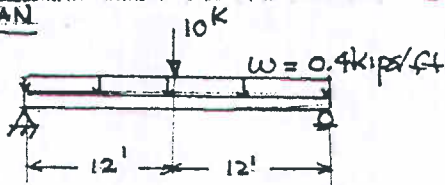
P8.36. Draw the envelopes for maximum shear and moment in a 24-ft-long simply supported beam produced by a live load that consists of both a uniformly distributed load of 0.4 kip/ft of variable length and a concentrated load of 10 kips (Figure P8.36). The 10 kip load can act at any point. Compute values of the envelope at the supports, quarter points, and midspan.



P8.36

ENVELOPE FOR MAX. MOMENT

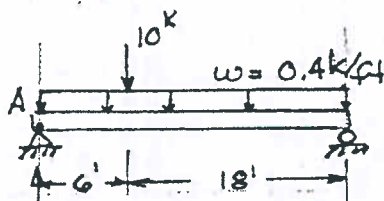
MIDSPAN



$$M = \frac{wL^2}{8} + \frac{PL}{4} = \frac{0.4(24)^2}{8} + \frac{10(24)}{4}$$

$$M = 28.8 + 60 = 88.8 \text{ kip}\cdot\text{ft}$$

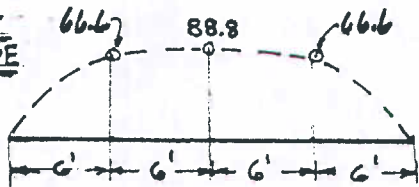
AT 1/4 POINT



$$R_A = 4.8 + 7.5 = 12.3 \text{ k}$$

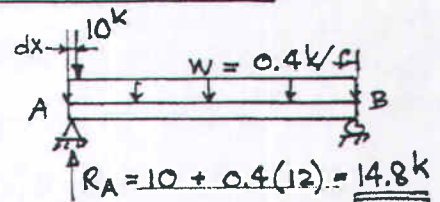
$$M = 12.3 \times 6 - 2.4 \times 3 = 66.6 \text{ kip}\cdot\text{ft}$$

MOMENT ENVELOPE (kip·ft)

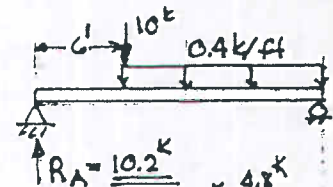


ENVELOPE FOR MAX SHEAR

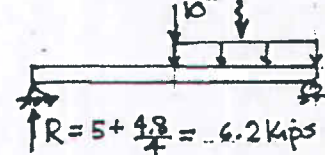
AT SUPPORT



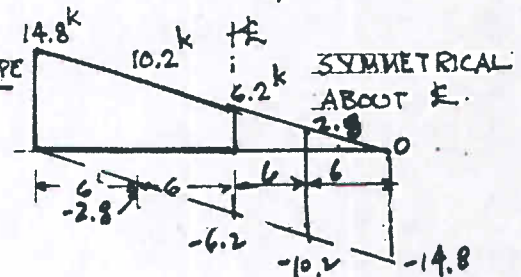
AT 1/4 POINT



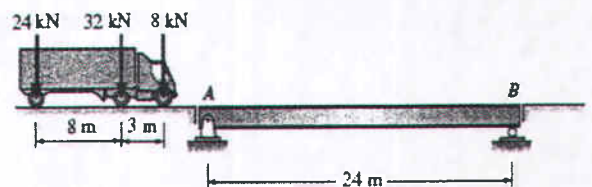
AT MIDSPAN



SHEAR ENVELOPE

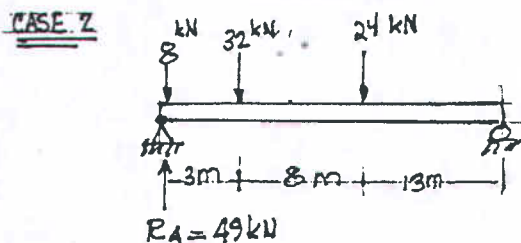
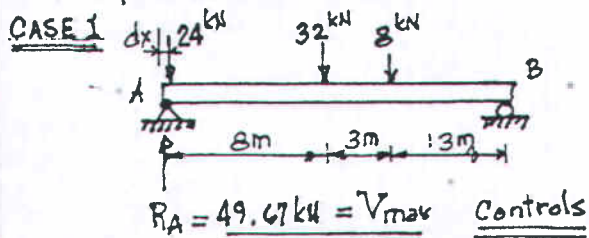


P8.37. Determine (a) the absolute maximum values of shear and moment in the beam produced by the wheel loads and (b) the maximum value of moment when the middle wheel is positioned at the center of the beam in Figure P8.37.

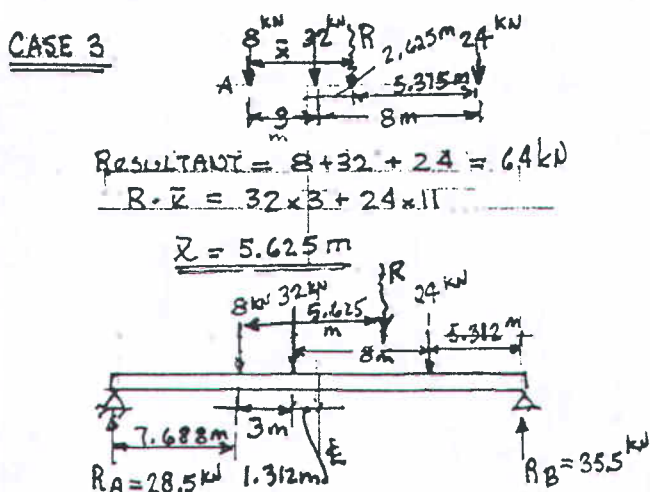


P8.37

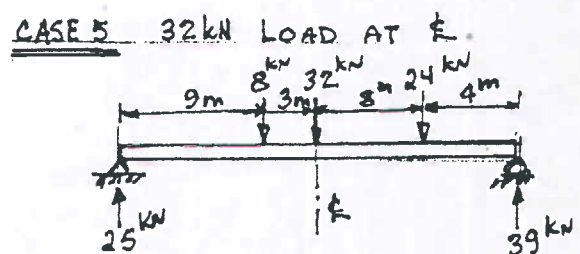
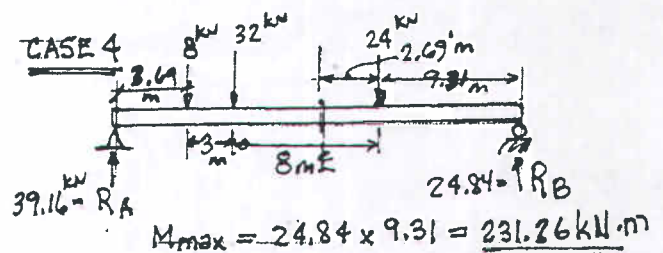
Compute max shear.



Compute Abs. max moment



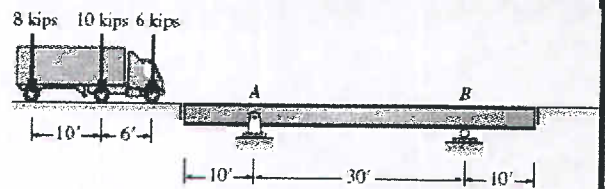
$M_{\max} = 28.5 \times 10.688 - 8 \times 3$
 $= 280.6 \text{ kN}\cdot\text{m}$ Controls



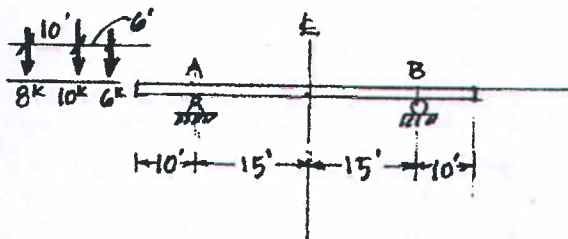
Moment at midspan

$M_{\bar{x}} = 39 \times 12 - 24 \times 8$
 $= 276 \text{ kN}\cdot\text{m}$

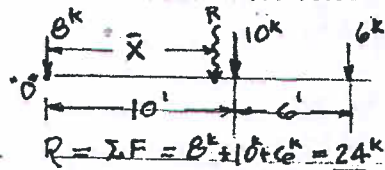
P8.38. Determine (a) the absolute maximum value of live load moment and shear produced in the 50-ft girder and (b) the maximum value of moment at midspan (Figure P8.38). *Hint:* For part (b) use the influence line for moment.



P8.38



(a) Absolute Max. Moment

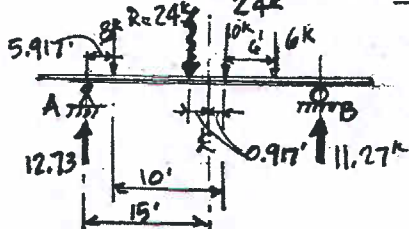


$$R = \sum F = 8^k + 10^k + 6^k = 24^k$$

LOCATE "R" $\sum M$ about "O"

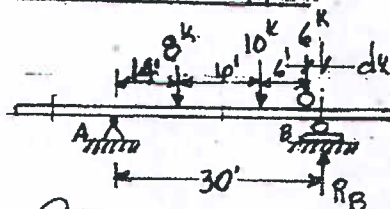
$$R \cdot \bar{x} = \sum F \cdot k$$

$$\bar{x} = \frac{10^k \times 10' + 16^k \times 6'}{24^k} = 8.17 \text{ ft.}$$



$$M_{\max} = (12.73^k)(15.917') - 8^k(10') = 122.6 \text{ kip} \cdot \text{ft}$$

MAX SHEAR AT SUPPORT

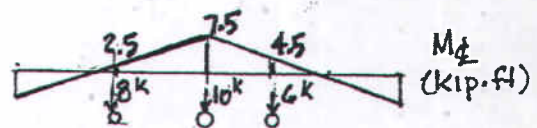


$\sum M_A = 0$

$$0 = 8^k(14') + 10^k(24') + 6^k(30') - R_B(30')$$

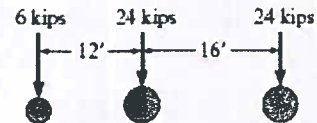
$$V_B = R_B = 17.73 \text{ kips}$$

(b) INFLU. LINE FOR MOMENT AT MID-SPAN



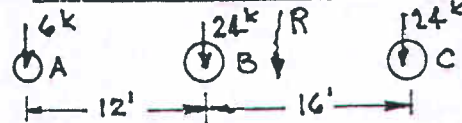
$$M_{\frac{L}{2}} = 8^k(2.5) + 10^k(7.5) + 6^k(4.5) = 122 \text{ kip} \cdot \text{ft}$$

P8.39. Determine the absolute maximum value of live load shear and moment produced in a simply supported beam spanning 40 ft by the wheel loads shown in Figure P8.39.



P8.39

COMPUTE ABSOLUTE MAX MOMENT



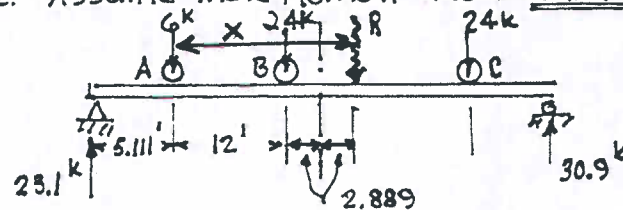
1. RESULTANT $R = 6 + 24 + 24 = \underline{54 \text{ kips}}$

LOCATION: $\sum M_A : \sum F \cdot \bar{x} = R \bar{x}$

$$24 \times 12 + 24 \times 28 = 54 \bar{x}$$

$$\bar{x} = \underline{17.778'}$$

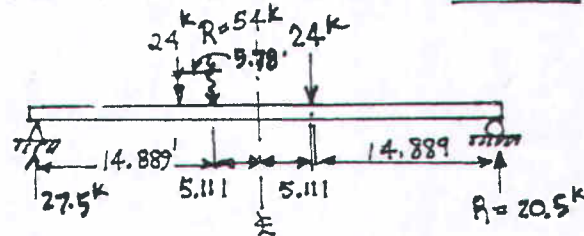
2. Assume max Moment under wheel B



$$M_{MAX} = \sum M_B = 23.1(17.778) - 6 \times 12$$

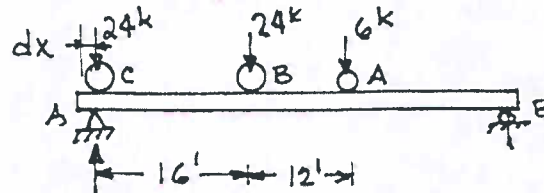
$$M_{MAX} = \underline{323.26 \text{ kip} \cdot \text{ft}} \quad \underline{\text{CONTROLS}}$$

3. Assume max moment under wheel C



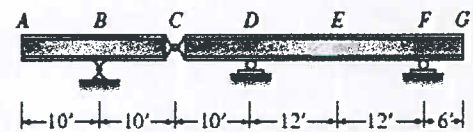
$$M_{MAX} = 20.5 \times 14.889 = \underline{305.3 \text{ kip} \cdot \text{ft}}$$

4. ABSOLUTE MAX SHEAR



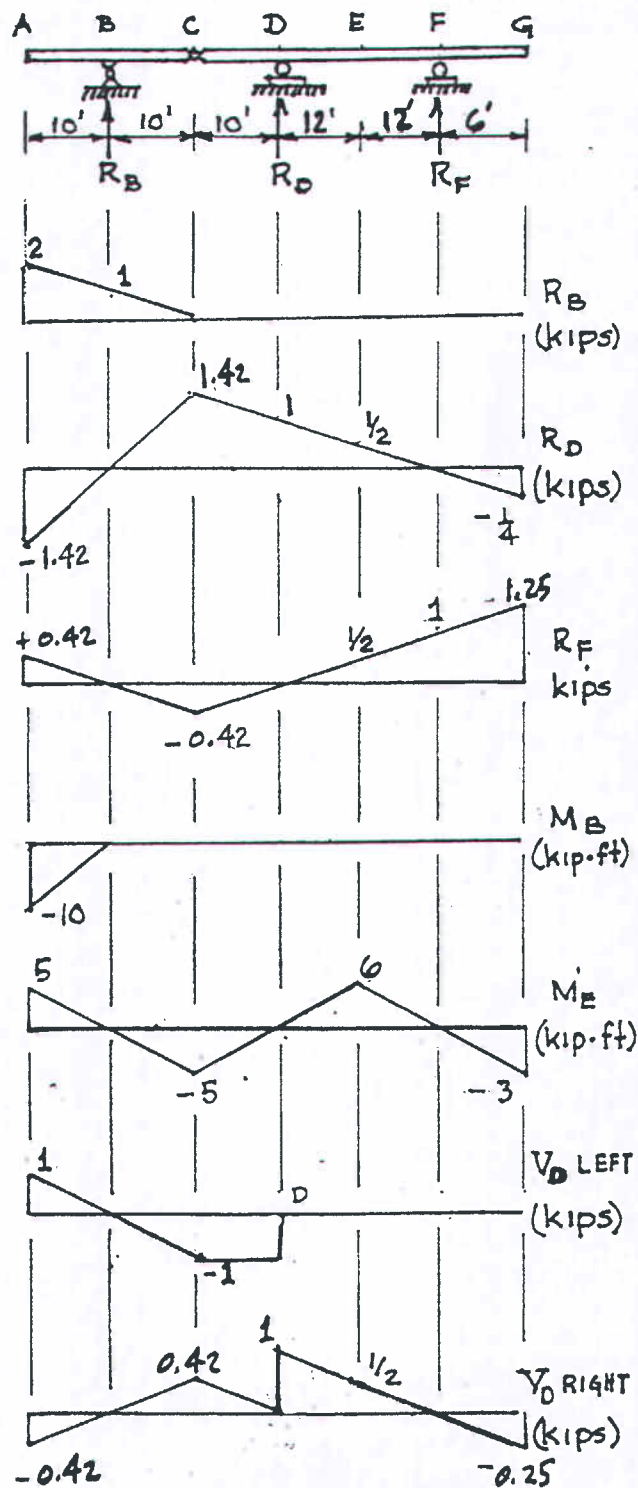
$$R_A = \underline{40.2 \text{ kips}} = \underline{V_{max}}$$

P8.40. For the beam shown in Figure P8.40, draw the influence lines for the reactions at B , D , and F ; the moment at B and E ; and the shear to the left and right at D .

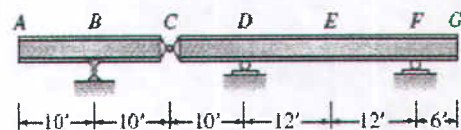


P8.40

INFLUENCE LINES



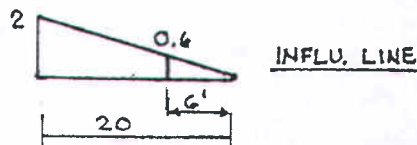
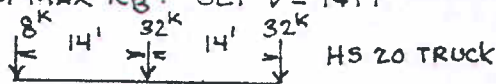
P8.41. (a) Consider the beam shown in Figure P8.40. Position the HS 20-44 truck (see Figure 8.25a in the text) to produce the maximum reaction at B. (b) Position the HS 20-44 lane loading (see Figure 8.25b) that produces the maximum positive moment at E. Reposition the loading to produce the maximum negative moment at E. (c) Compute the moment at E produced by a uniformly distributed dead load of 3 kips/ft over the entire span.



P8.40

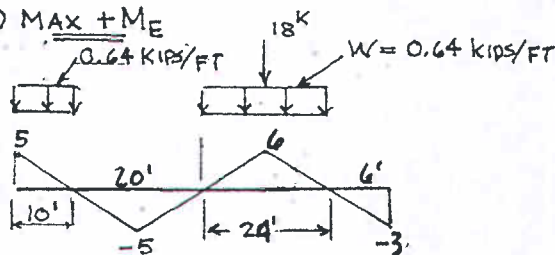
SEE 8.40 FOR INFLUENCE LINES

(a) MAX R_B . SET $V = 14$ FT

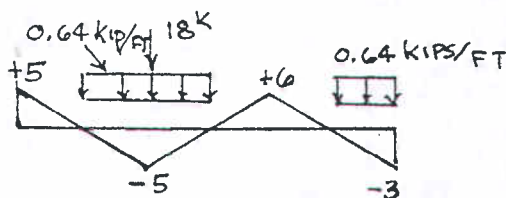


$$\text{MAX } R_B = 32^k(2) + 32^k(.6) = \underline{\underline{83.2 \text{ kips}}}$$

(b) MAX $+M_E$



$$\begin{aligned} \text{MAX. } +M_E &= 0.64 \left(\frac{5 \times 10}{2} + \frac{6 \times 24}{2} \right) + 18 \times 6 \\ +M_E &= \underline{\underline{170 \text{ kip.ft.}}} \end{aligned}$$



$$\begin{aligned} \text{MAX. } -M_E &= 0.64 \left(\frac{-5 \times 20}{2} + \frac{-3 \times 6}{2} \right) + (-5 \times 18) \\ -M_E &= \underline{\underline{-127.8 \text{ ft.k}}} \end{aligned}$$

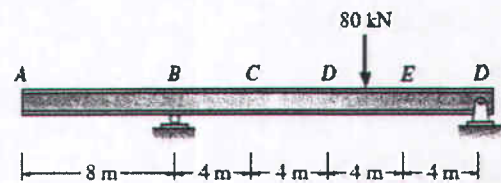
(c) M_E PRODUCED BY A UNIFORM D.L. = 3 KIPS/FT OVER ENTIRE 60 FT SPAN

$$M_E = A_{\text{NET}} \times 3 \text{ KIPS/FT}$$

$$\begin{aligned} M_E &= 3^k \left[\left(\frac{5 \times 10}{2} \right) - \frac{5(20)}{2} + \frac{6(24)}{2} - \frac{3(6)}{2} \right] \\ &= \underline{\underline{114 \text{ ft.k}}} \end{aligned}$$

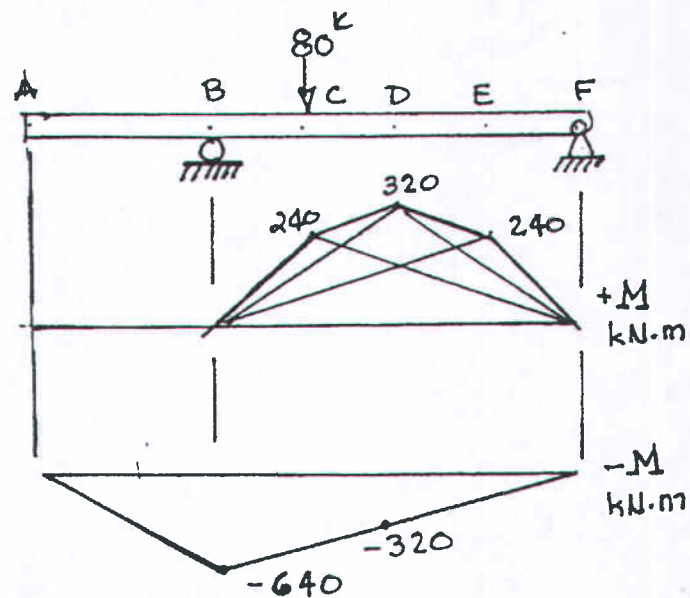
(NOTE: IMPACT FACTORS WERE NOT INCLUDED.)

P8.42. The beam shown in Figure P8.42 is subjected to a moving concentrated load of 80 kN. Construct the envelope of both maximum positive and negative moments for the beam.

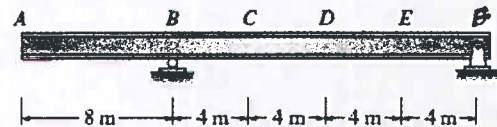


P8.42

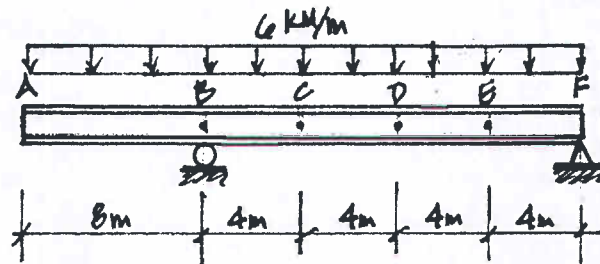
CONSTRUCT MOMENT ENVELOPES.
BETWEEN B AND D EVALUATE
MOMENTS AT 4m INTERVALS



P8.43. Consider the beam shown in Figure P8.42. Construct the envelope of maximum positive shear assuming the beam supports a 6 kN/m uniformly distributed load of variable length.



P8.42



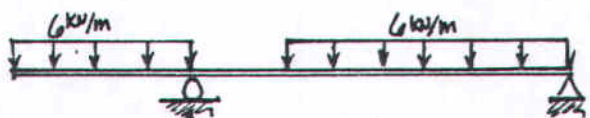
INFLUENCE LINE FOR
 V_B (RIGHT SIDE)



V DIAGRAM FOR BEAM



V_C INFLUENCE LINE



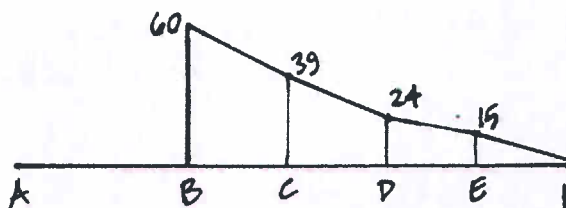
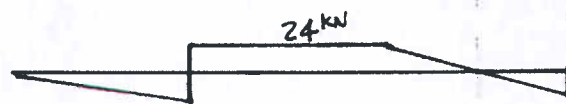
LOADING



V DIAGRAM (V_C MAX.)

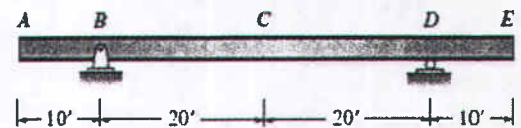


V_D

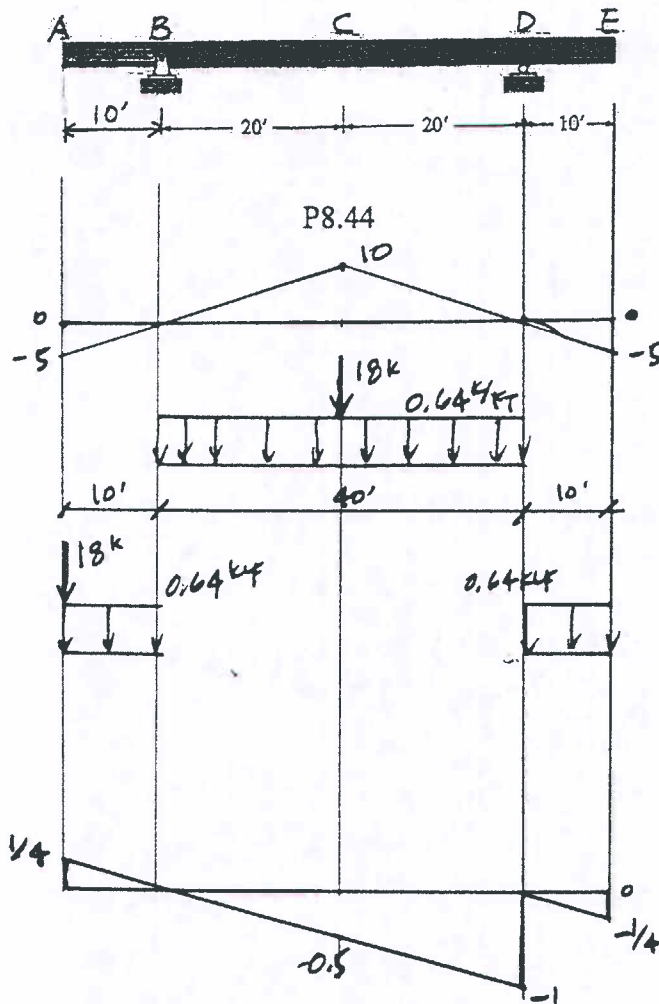


ENVELOPE FOR
 $+V_{MAX}$ (KN)

P8.44. Consider the beam shown in Figure P8.44. Position the HS 20-44 lane loading (see Figure 8.25b) to produce the maximum positive moment at C, the maximum negative moment at C, and the maximum shear to the left of support D.



P8.44



$$M_C \text{ (k-ft)}$$

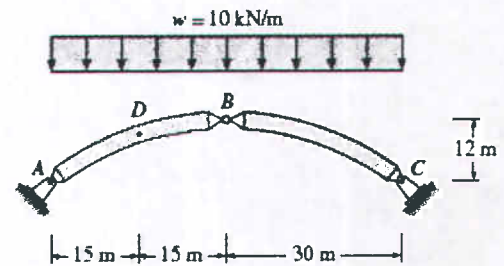
$$\begin{aligned} M_C^{+MAX} &= \\ \frac{1}{2}(10)(40)(0.64 \text{ k/ft}) + 10(18 \text{ k}) &= \\ = +308 \text{ ft-k} \end{aligned}$$

$$\begin{aligned} M_C^{-MAX} &= \\ \frac{1}{2}(-5)(10)(0.64 \text{ k/ft}) 2 + (-5)(18) &= \\ = -122 \text{ ft-k} \end{aligned}$$

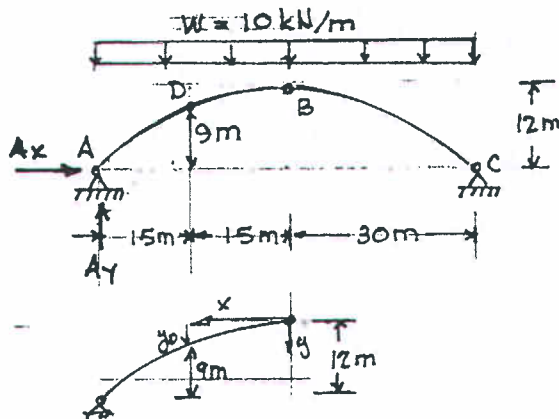
$$V_D \text{ (kips)}$$

$$\begin{aligned} V_D \text{ LEFT SIDE} &= \\ \left[\frac{1}{2}(-1)(40) + \frac{1}{2}(-1/4)(10) \right] 0.64 \text{ k/ft} - & \\ -1(26 \text{ k}) &= \underline{\underline{39.6 \text{ kips}}} \end{aligned}$$

P8.45. (a) The three-hinged arch shown in Figure P8.45 has a parabolic profile. Draw the influence lines for both the horizontal and vertical reactions at A and the moment at D. (b) Compute the horizontal and vertical reactions at support A if the arch is loaded by a uniform load of 10 kN/m. (c) Compute the maximum moment at point D.



P8.45



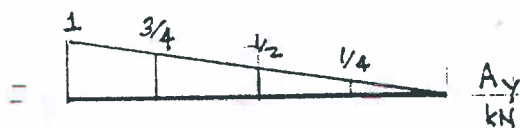
EQ. OF PARABOLA $y = kx^2$

at $x = 30, y = 12$: $12 = k(30)^2$
 $\frac{1}{75} = k$

POINT D

at $x = 15, y = \frac{1}{75}(15)^2 = 3m$

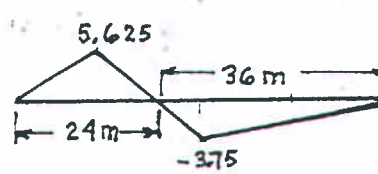
INFLUENCE LINES



A_y
kN



A_x
kN



M_D
kN·m

(b)

REACTIONS DUE TO 10 kN/m

$A_y = w(\text{AREA}) = 10(\frac{1}{2} \times 1 \times 60)$

$A_y = 300 \text{ kN}$

$A_x = (\frac{1}{2} \times 1.25 \times 60)10 = 375 \text{ kN}$

$M_{\text{max}} + M \text{ AT D} = (\frac{1}{2} \times 24 \times 5.625)10 \text{ kN/m}$
 (LOAD X AREA) = 675 kN·m

M AT D IF UNIFORM LOAD ACTS OVER

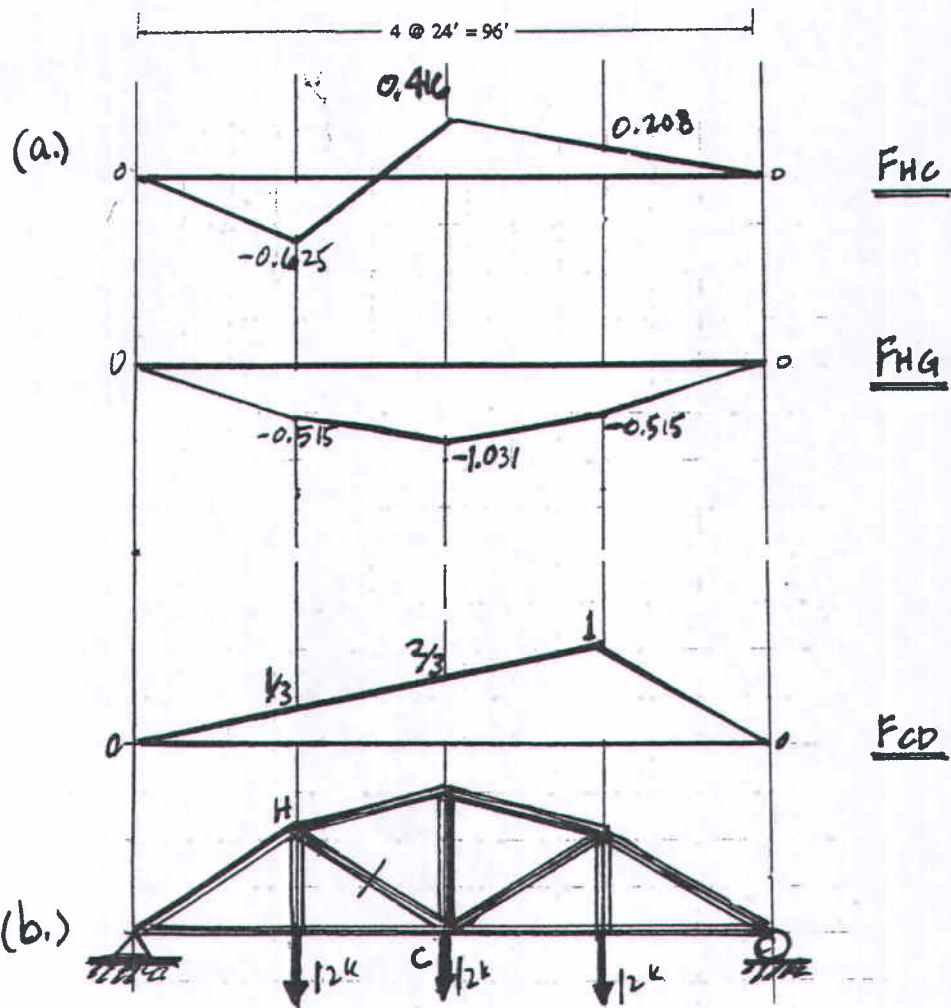
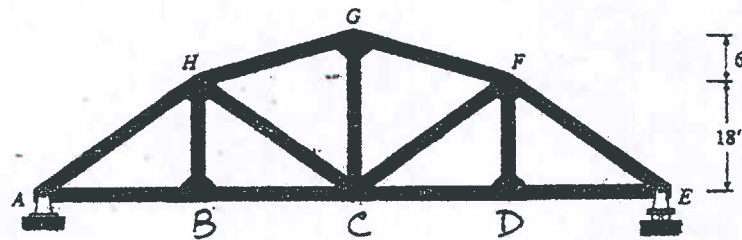
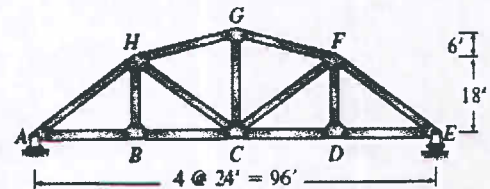
ENTIRE SPAN:

$M_D = wA = 10(\frac{1}{2} \times 1.25 \times 60) = 10(\frac{1}{2} \times 36 \times 3.75)$

$M^* = 0$

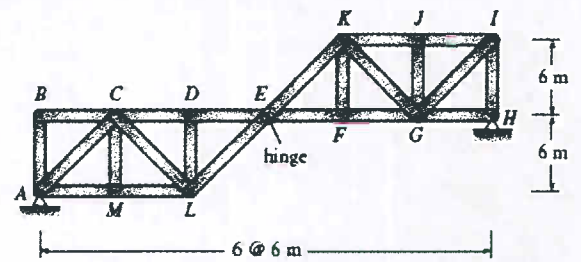
* UNIFORM LOAD ON A PARABOLIC ARCH PRODUCES AXIAL FORCE ON ALL SECTIONS BUT NO MOMENT OR SHEAR.

P8.46. (a) Draw the influence lines for the bar forces in members HC , HG , and CD of the truss shown in Figure P8.46. The load moves along the bottom chord of the truss. (b) Compute the force in member HC if panel points B , C , and D are each loaded by a concentrated vertical load of 12 kips.



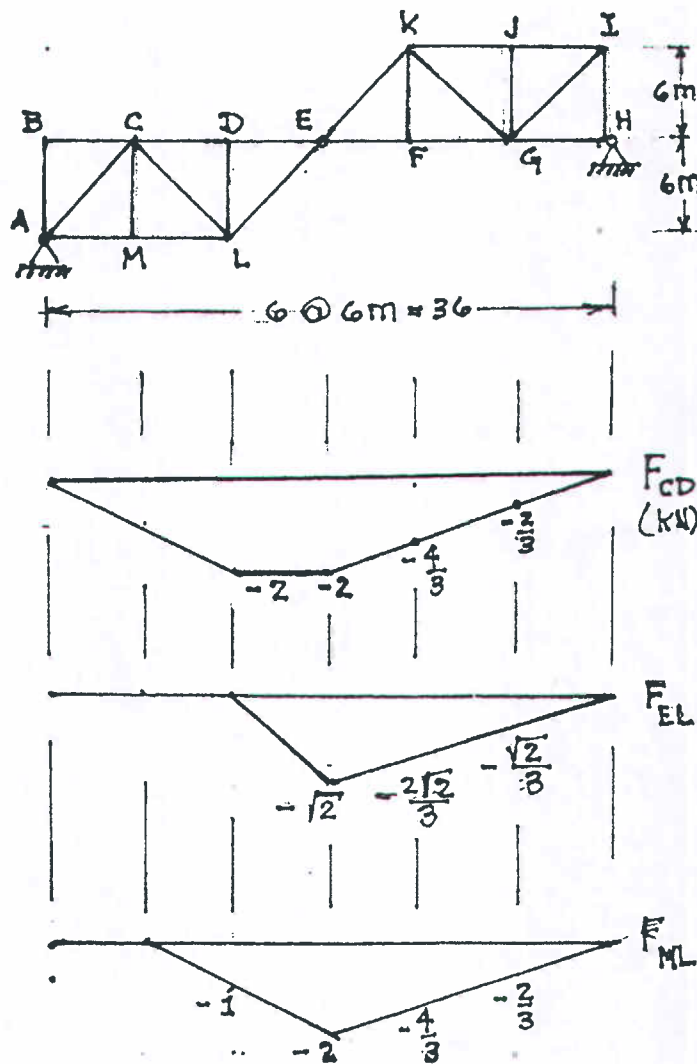
$$F_{HC} = -0.625(12k) + 0.416(12k) + 0.208(12k) = 0$$

P8.47. Draw the influence lines for bar forces in members CD , EL , and ML of the truss shown in Figure P8.47. The load moves along BH of the truss.

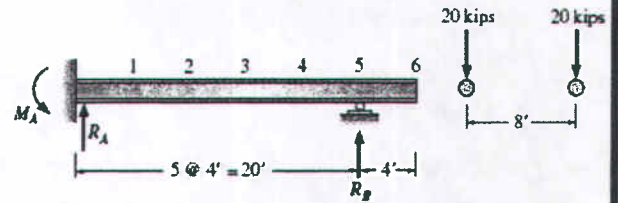


P8.47

INFLUENCE LINES

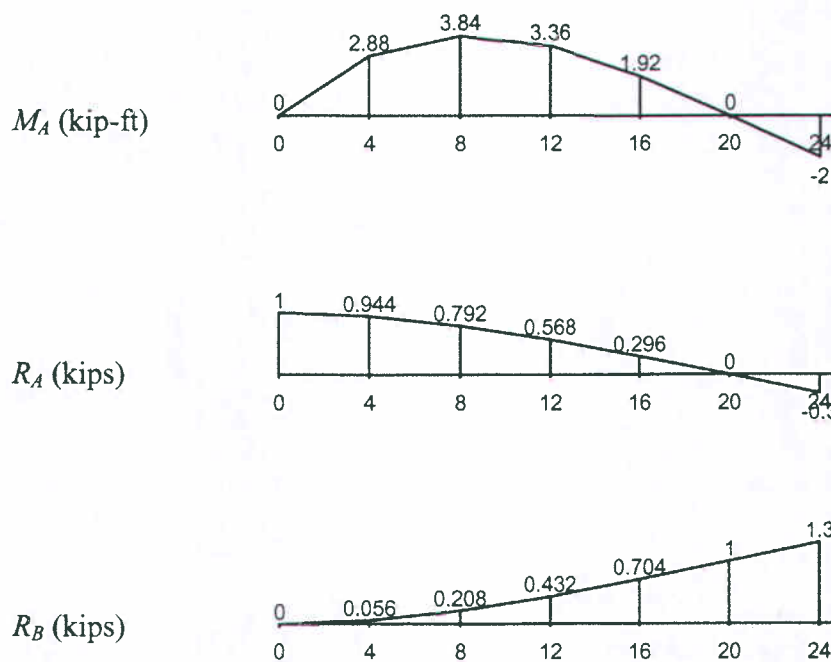


P8.48. *Computer application. Construction of an influence line for an indeterminate beam.* (a) For the indeterminate beam shown in Figure P8.48, construct the influence lines for M_A , R_A , and R_B by applying a unit load to the beam at 4-ft intervals to compute the corresponding magnitudes of the reactions. (b) Using the influence line in part (a), determine the maximum value of the reaction R_B produced by two concentrated 20-kip wheel loads spaced 8 ft apart.



P8.48

(a)

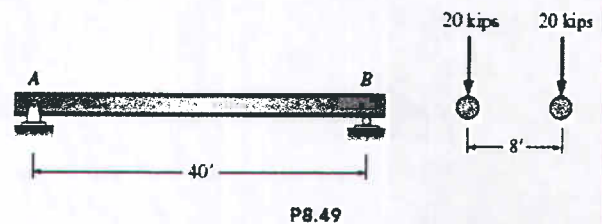


(b)

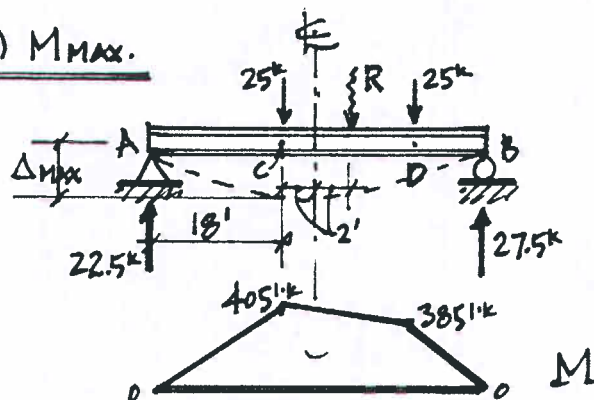
Positive wheel loads at locations 4 and 6:

$$R_B = 20(1.3) + 20(0.704) = 40.08 \text{ kips}$$

P8.49. A simply supported crane runway girder has to support a moving load shown in Figure P8.49. The moving load shown has to be increased by an impact factor listed in Table 2.3. (a) Position the moving load to compute the maximum moment. Also compute the maximum deflection produced by the load. (b) Re-position the moving load symmetrically on the span and compute the maximum moment and the maximum deflection. Which case produces a larger deflection?



(a.) M_{MAX} .

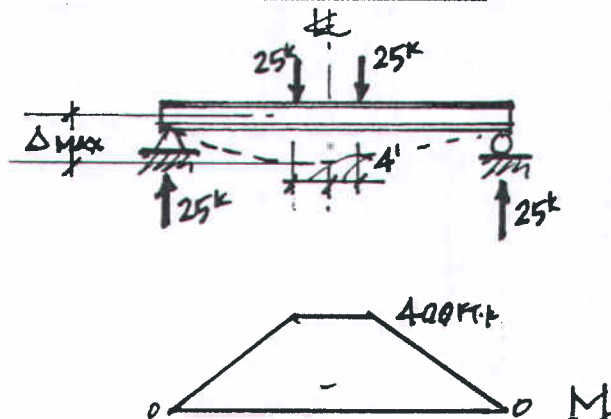


$$P = 1.25 (20k) = 25k$$

$$M_{MAX} = 405 \text{ FT.K}$$

$$\Delta_{MAX} = \frac{107,400,000}{EI} \text{ @ 2.4' RIGHT OF "C".}$$

(b.) LOADS CENTERED ON BEAM



$$\Delta_{MAX} = \frac{108,749,000}{EI} \text{ @ C}$$

MAX. DEFLECTION OCCURS WHEN LOADS ARE CENTERED SYMMETRICALLY ON THE BEAM SPAN.