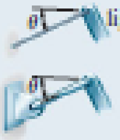
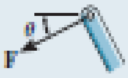
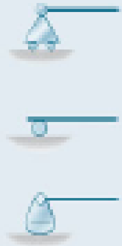
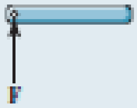
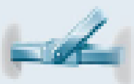
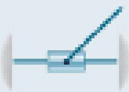
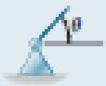
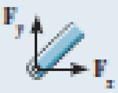
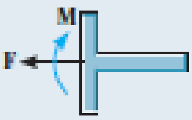
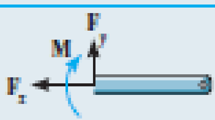
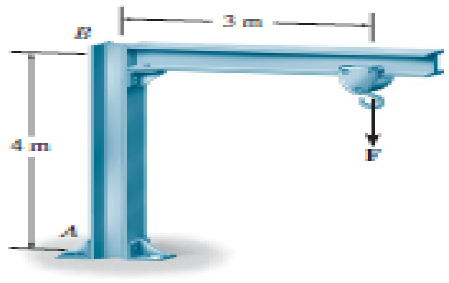
- **Support condtion**

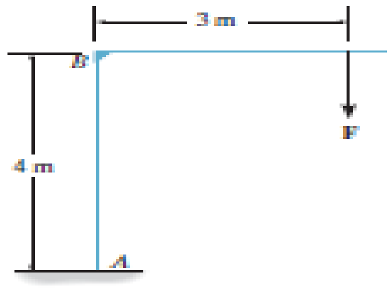
TABLE 2–1 Supports for Coplanar Structures

Type of Connection	Idealized Symbol	Reaction	Number of Unknowns
(1)  light cable, weightless link			One unknown. The reaction is a force that acts in the direction of the cable or link.
(2)  rollers, rocker			One unknown. The reaction is a force that acts perpendicular to the surface at the point of contact.
(3)  smooth contacting surface			One unknown. The reaction is a force that acts perpendicular to the surface at the point of contact.
(4)  smooth pin-connected collar			One unknown. The reaction is a force that acts perpendicular to the surface at the point of contact.
(5)  smooth pin or hinge			Two unknowns. The reactions are two force components.
(6)  slider, fixed-connected collar			Two unknowns. The reactions are a force and a moment.
(7)  fixed support			Three unknowns. The reactions are the moment and the two force components.

• idealized structure



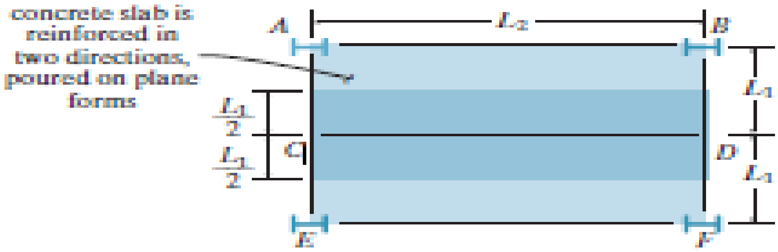
actual structure



idealized structure

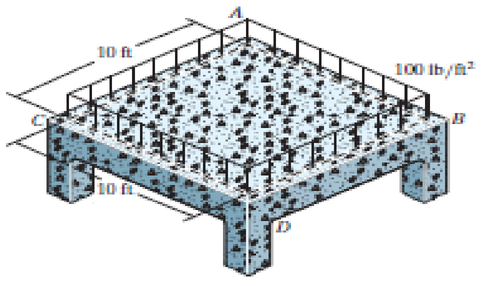
• Tributary Loadings

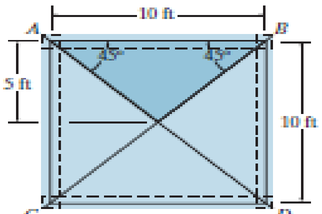
- One – way system
- $\frac{L1}{L2} > 2$



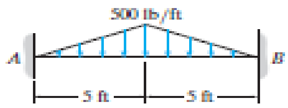
idealized framing plan for one-way slab action requires $L_2/L_1 > 2$

- Two-way system
- $\frac{L1}{L2} < 2$
- special case :



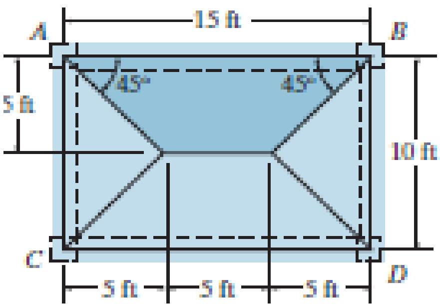


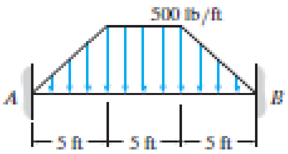
idealized framing plan



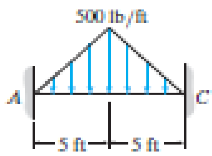
idealized beam

- general case :





idealized beam



idealized beam

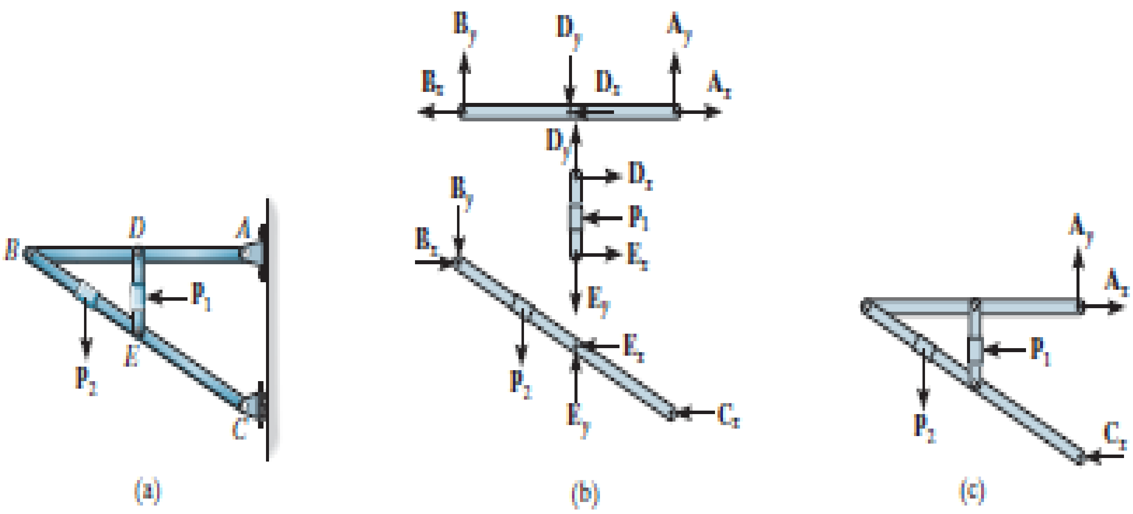
- **Equations of Equilibrium**

$$\Sigma F_x = 0$$
$$\Sigma F_y = 0$$
$$\Sigma M_O = 0$$

- **Determinacy and Stability**

$r = 3n$, statically determinate

$r > 3n$, statically indeterminate



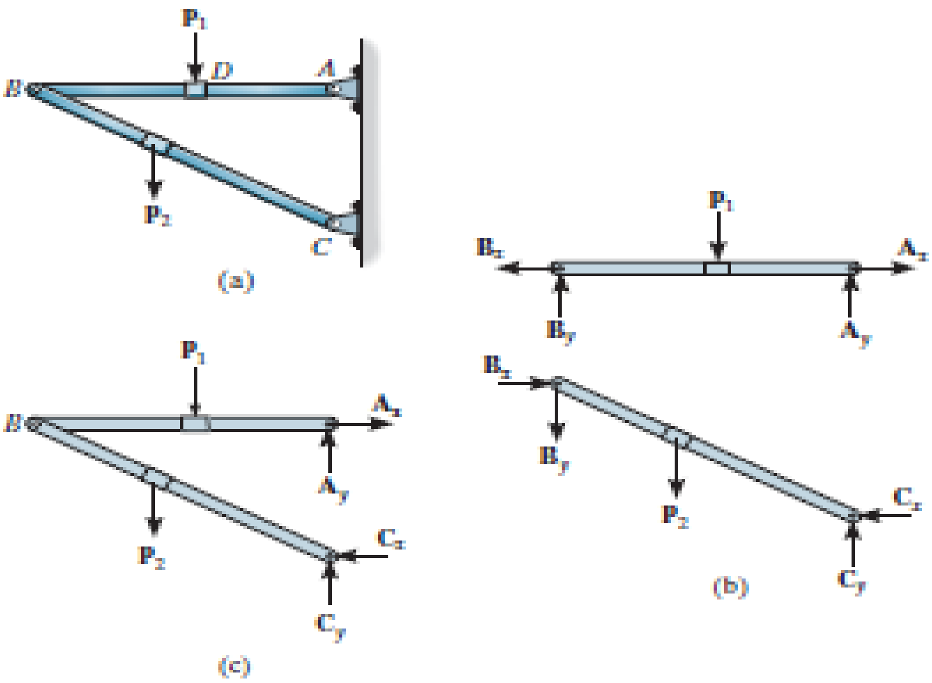
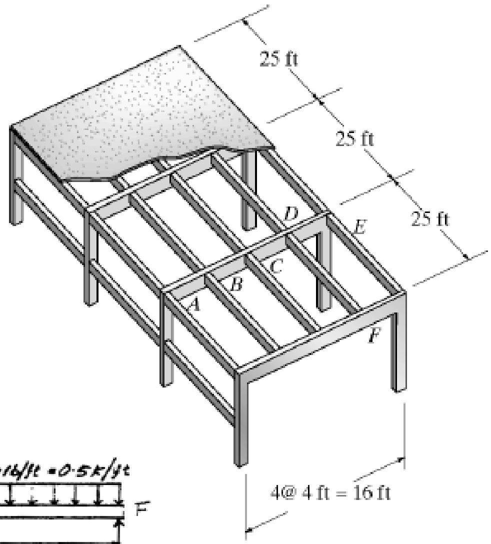


Fig. 2–27

2–2. The roof deck of the single story building is subjected to a dead plus live load of 125 lb/ft^2. If the purlins are spaced 4 ft and the bents are spaced 25 ft apart, determine the distributed loading that acts along the purlin DF, and the loadings that act on the bent at A, B, C, D, and E.



$$\frac{L_2}{L_1} = \frac{25}{4} = 6.25 > 2$$

One - way slab.

Tributary load along DF = (125 lb/ft^2)(4 ft) = 500 lb/ft **Ans**

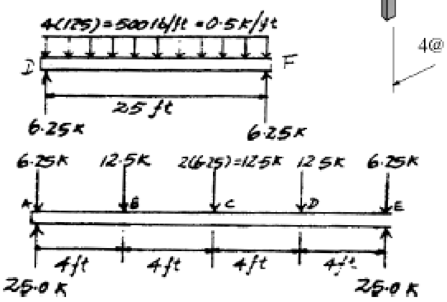
This load is also transferred to the bent from the other side of AE. Half the tributary loading acts at A and E.

At A and E:

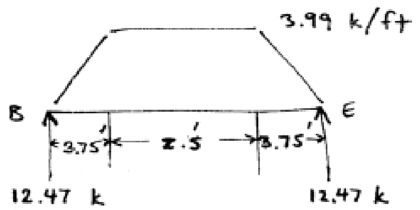
$F' = 6250 \text{ lb} = 6.25 \text{ k}$ **Ans**

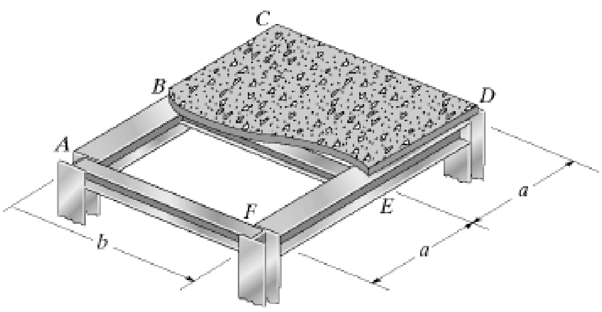
At B, C, D:

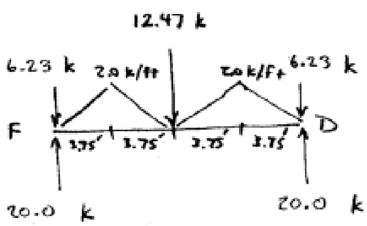
$F = 2(6250) = 12\,500 \text{ lb} = 12.5 \text{ k}$ **Ans**



2–3. The steel framework is used to support the 4-in. reinforced lightweight concrete slab that carries a uniform live loading of 500 lb/ft^2. Sketch the loading that acts along members BE and FD. Set b = 10 ft, a = 7.5 ft. *Hint:* See Table 1–3.



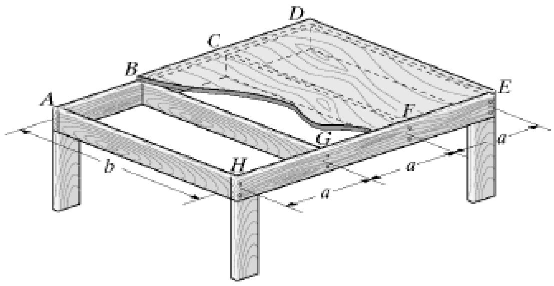




Reaction at B, 12.5 k;

Reaction at F, 20 k

2–5. The frame is used to support the wood deck in a residential dwelling. Sketch the loading that acts along members *BG* and *ABCD*. Set $b = 10$ ft, $a = 5$ ft. *Hint:* See Table 1–4.



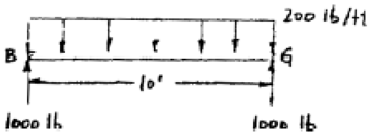
From Table 1-4

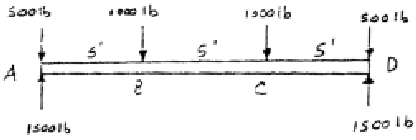
$LL = 40$ psf

$\frac{L_2}{L_1} = \frac{b}{a} = \frac{10}{5} = 2$

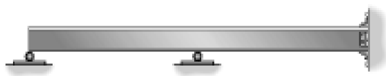
One-way slab

Reaction at *A*: 1500 lb **Ans**





***2–8.** Classify each of the structures as statically determinate, statically indeterminate, stable, or unstable. If indeterminate, specify the degree of indeterminacy.



(a)

(a)

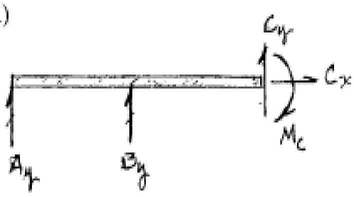
$r = 5, \quad n = 1$

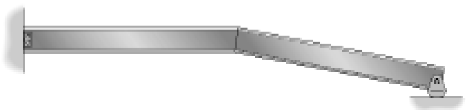
$r > 3n$

$5 > 3(1)$

Indeterminate to 2°, Stable

(a)





(b)

(b)

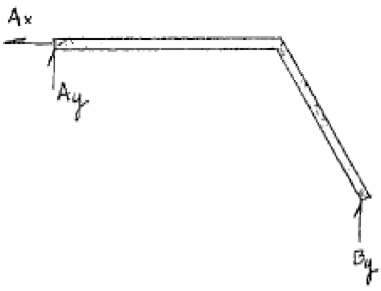
$r = 3, \quad n = 1$

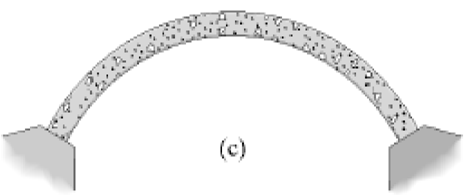
$r = 3n$

$3 = 3(1)$

Determinate, Stable

(b)





(c)

(c)

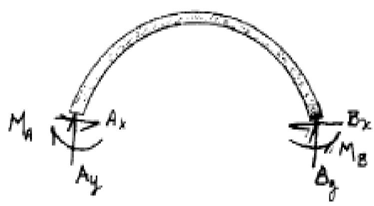
$r = 6, \quad n = 1$

$r > 3n$

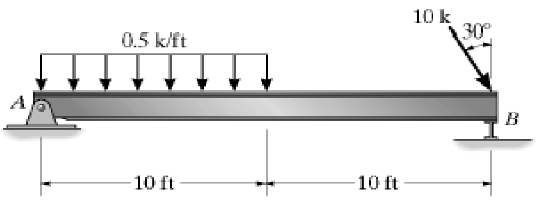
$6 > 3(1)$

Indeterminate to 3°, Stable

(c)



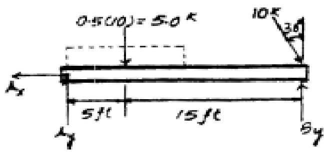
2–17. Determine the reactions on the beam. The support at B can be assumed to be a roller. Neglect the thickness of the beam.



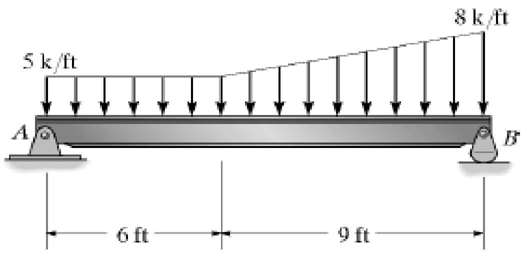
$$\circlearrowleft + \Sigma M_A = 0;\quad B_y(20) - 10\cos 30^\circ(20) - 5(5) = 0$$
$$B_y = 9.91\text{ k} \qquad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = 0;\quad A_y + 9.910 - 5 - 10\cos 30^\circ = 0$$
$$A_y = 3.75\text{ k} \qquad \textbf{Ans}$$

$$\xrightarrow{+} \Sigma F_x = 0;\quad -A_x + 10\sin 30^\circ = 0$$
$$A_x = 5.00\text{ k} \qquad \textbf{Ans}$$



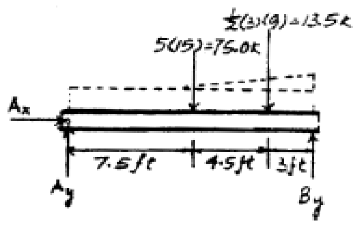
2–19. Determine the reactions on the beam.



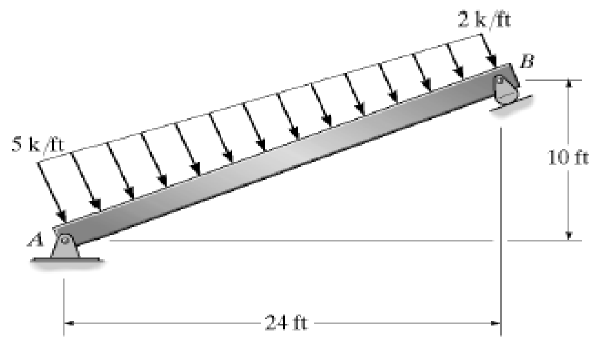
$$\circlearrowleft + \Sigma M_A = 0;\quad B_y(15) - 75(7.5) - 13.5(12) = 0$$
$$B_y = 48.3\text{ k} \qquad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = 0;\quad A_y + 48.3 - 75 - 13.5 = 0$$
$$A_y = 40.2\text{ k} \qquad \textbf{Ans}$$

$$\xrightarrow{+} \Sigma F_x = 0;$$
$$A_x = 0 \qquad \textbf{Ans}$$



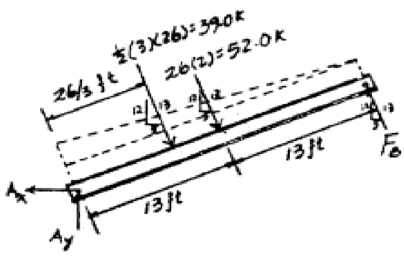
2–21. Determine the reactions on the beam.



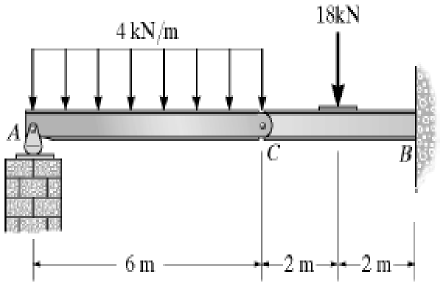
$$\circlearrowleft + \Sigma M_A = 0;\quad F_B(26) - 52(13) - 39\left(\frac{1}{3}\right)(26) = 0$$
$$F_B = 39.0\text{ k} \qquad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = 0;\quad A_y - \frac{12}{13}(39) - \left(\frac{12}{13}\right)52 + \left(\frac{12}{13}\right)(39.0) = 0$$
$$A_y = 48.0\text{ k} \qquad \textbf{Ans}$$

$$\xrightarrow{+} \Sigma F_x = 0;\quad -A_x + \left(\frac{5}{13}\right)39 + \left(\frac{5}{13}\right)52 - \left(\frac{5}{13}\right)39.0 = 0$$
$$A_x = 20.0\text{ k} \qquad \textbf{Ans}$$



2–23. Determine the reactions at the supports A and B of the compound beam. There is a pin at C.



Section AC

$\circlearrowleft + \Sigma M_C = 0;\quad 24\text{ kN}(3\text{ m}) - A_y(6\text{ m}) = 0$

$A_y = 12\text{ kN}$

$+\uparrow \Sigma F_y = 0;\quad 12\text{ kN} - 24\text{ kN} + C_y = 0$

$C_y = 12\text{ kN}$

$\underset{\rightarrow}{+}\Sigma F_x = 0\quad C_x = 0$

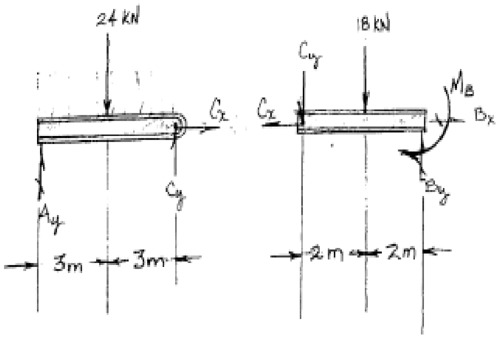
Section CB

$\circlearrowleft + \Sigma M_B = 0\quad -M_B + 18\text{ kN}(2\text{ m}) + 12\text{ kN}(4\text{ m}) = 0$

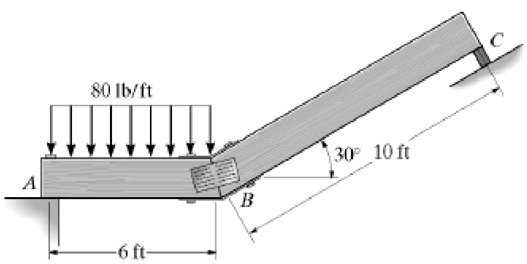
$M_B = 84\text{ kN}\cdot\text{m}$

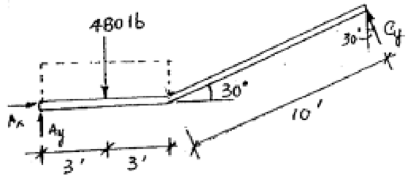
$+\uparrow \Sigma F_y = 0;\quad -12\text{ kN} - 18\text{ kN} + B_y = 0$

$B_y = 30\text{ kN}$



2–26. Determine the reactions at the smooth support C and pinned support A. Assume the connection at B is fixed connected.





$+\Sigma M_A = 0;\quad C_y(10 + 6\sin 60^\circ) - 480(3) = 0$

$C_y = 94.76\text{ lb} = 94.8\text{ lb}$ **Ans.**

$+\rightarrow \Sigma F_x = 0;\quad A_x - 94.76\sin 30^\circ = 0$

$A_x = 47.4\text{ lb}$ **Ans.**

$+\uparrow \Sigma F_y = 0;\quad A_y + 94.76\cos 30^\circ - 480 = 0$

$A_y = 398\text{ lb}$ **Ans.**