GNG 1105E – Engineering Mechanics

CHAPTER S4 – STRUCTURES
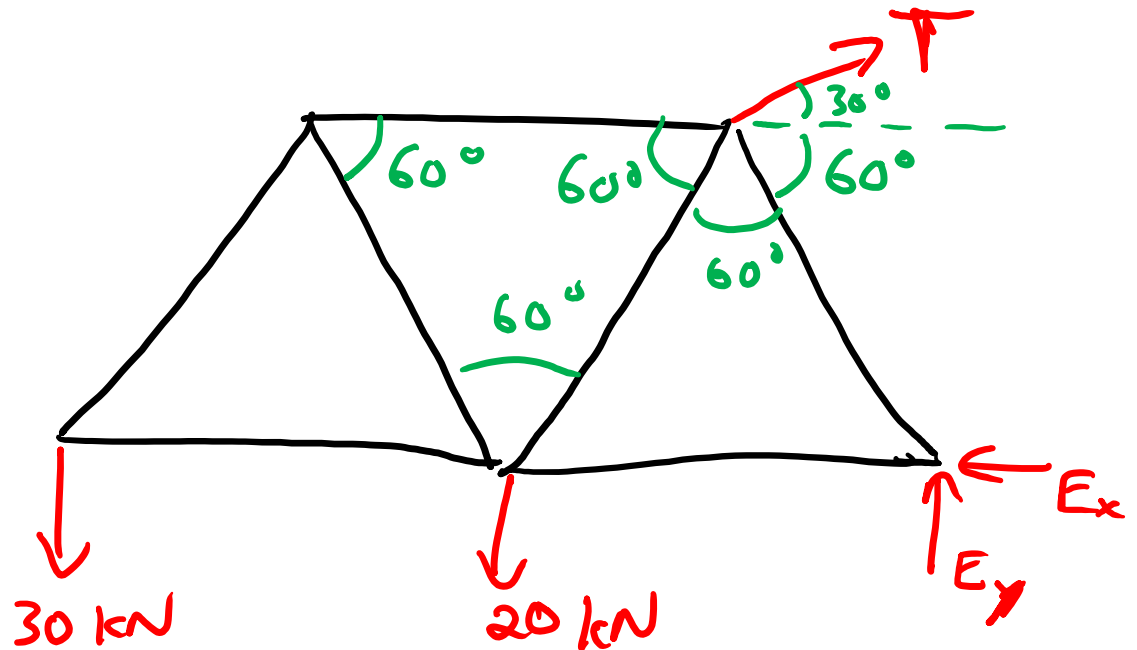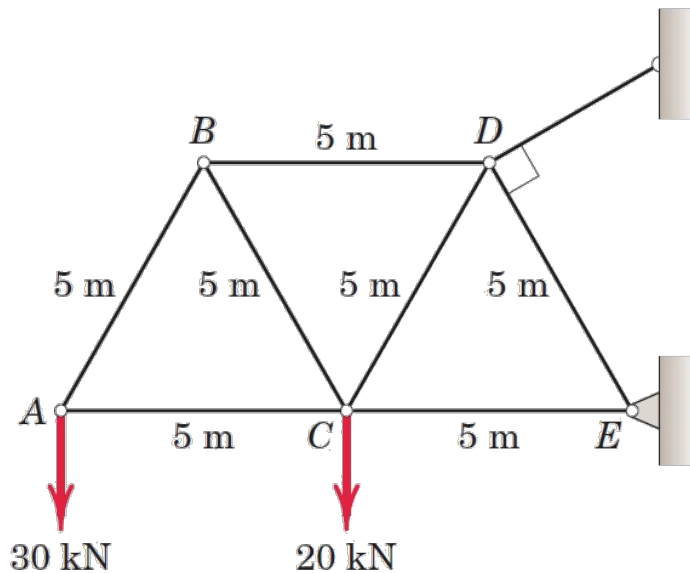
Assigned readings

4/4 Method of sections
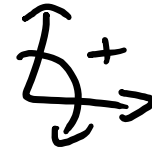
Sample problem 4/1

Compute the force in each member of the loaded cantilever truss by the method of joints.

FBD

Sample problem 4/1

$$\Sigma M_E = 0$$

$$5T - 20(5) - 30(10) = 0$$

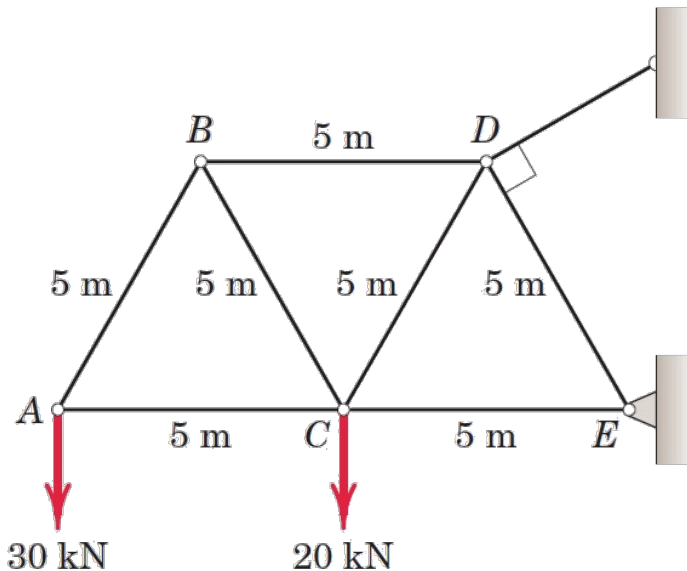$$T = 80 \text{ kN}$$

$$\Sigma F_x = 0$$

$$80 \cos 30° - E_x = 0$$
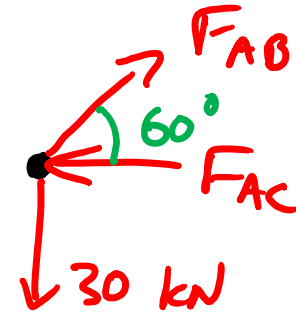
$$E_x = 69.3 \text{ kN}$$

$$\Sigma F_y = 0$$

$$80 \sin 30° + E_y - 20 - 30 = 0$$

$$E_y = 10 \text{ kN}$$

Sample problem 4/1

Joint A

F_{AB}

$60°$

F_{AC}

$30\ kN$

$\Sigma F_y = 0$

$F_{AB}\sin 60 - 30 = 0$

$F_{AB} = 34.6\ kN\ (T)$

$\Sigma F_x = 0$

$-F_{AC} + F_{AB}\cos 60° = 0$

$F_{AC} = 17.32\ kN\ (C)$

Joint B

$60°$ $60°$ F_{BD}

F_{BC}

F_{AB}
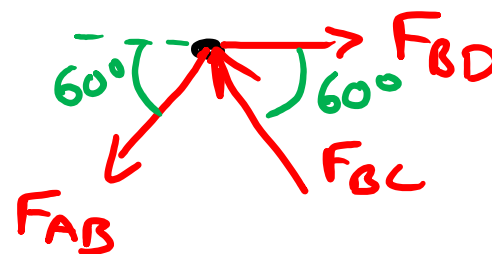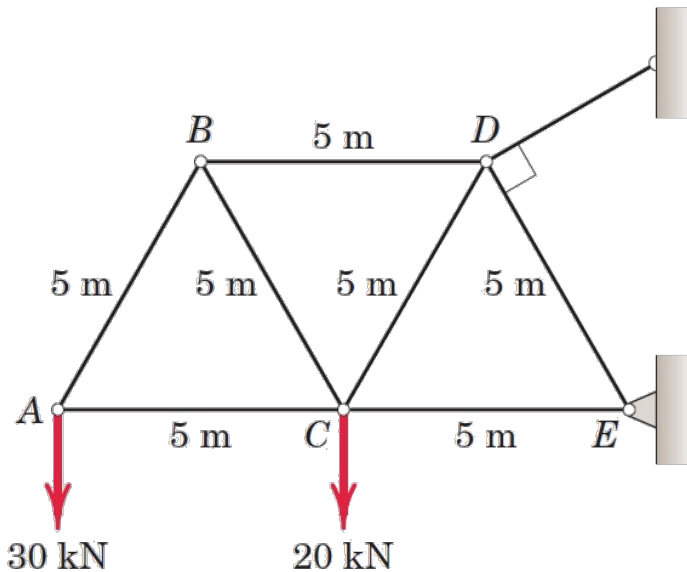
$\Sigma F_y = 0$

$F_{BC}\sin 60 - F_{AB}\sin 60 = 0$

$F_{BC} = F_{AB} = 34.6\ kN\ (C)$

$\Sigma F_x = 0 \rightarrow F_{BD} - 2(34.6)\cos 60° = 0,\ F_{BD} = 34.6\ kN$

(T)

B   5 m   D

5 m   5 m   5 m   5 m

A   5 m   C   5 m   E

30 kN   20 kN

Sample problem 4/1

Joint C
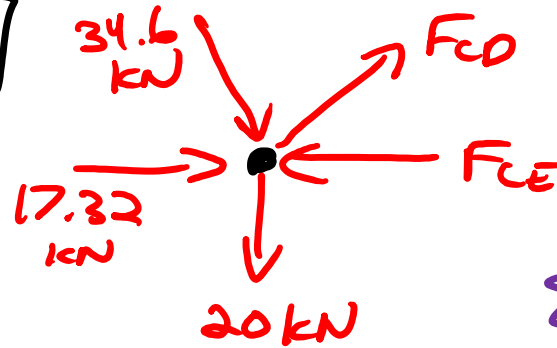
$\Sigma F_y = 0$
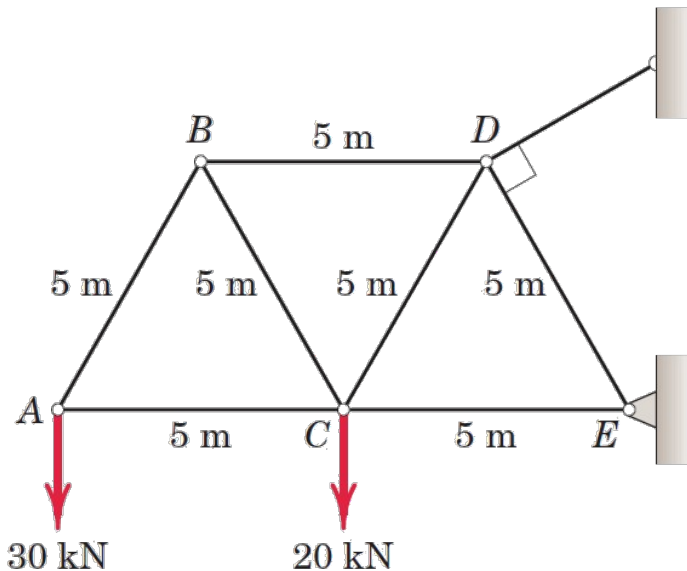
$F_{CD} \sin 60° - 34.6 \sin 60° - 20 = 0$
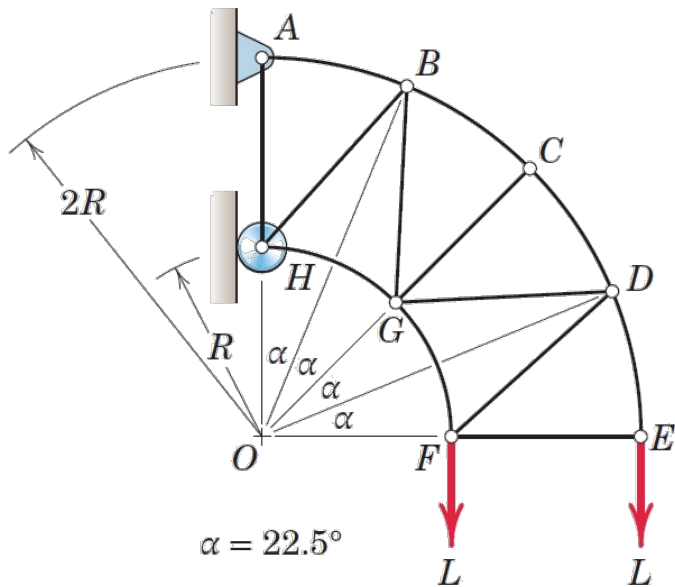
$F_{CD} = 57.7 \text{ kN (T)}$

$\Sigma F_x = 0$

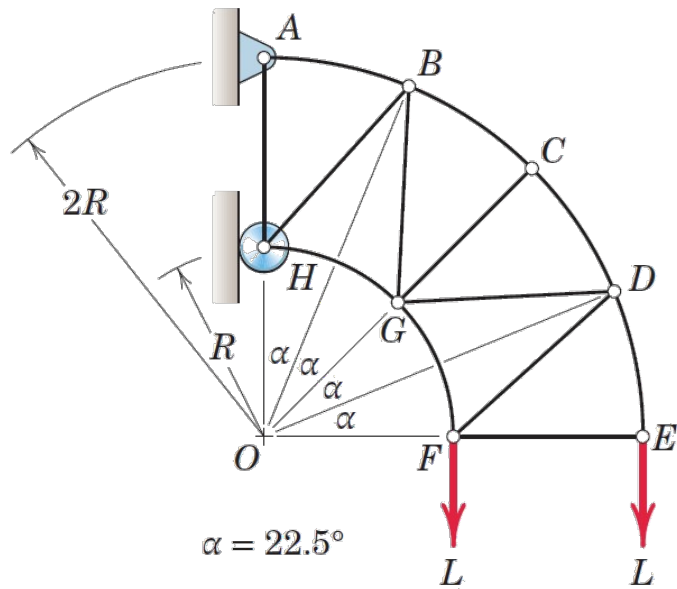$17.32 + 34.6 \cos 60 + 57.7 \cos 60 - F_{CE} = 0$

$F_{CE} = 63.5 \text{ kN (C)}$

34.6 kN

17.32 kN

20 kN

F_{CD}

F_{CE}

B   5 m   D

5 m   5 m   5 m   5 m

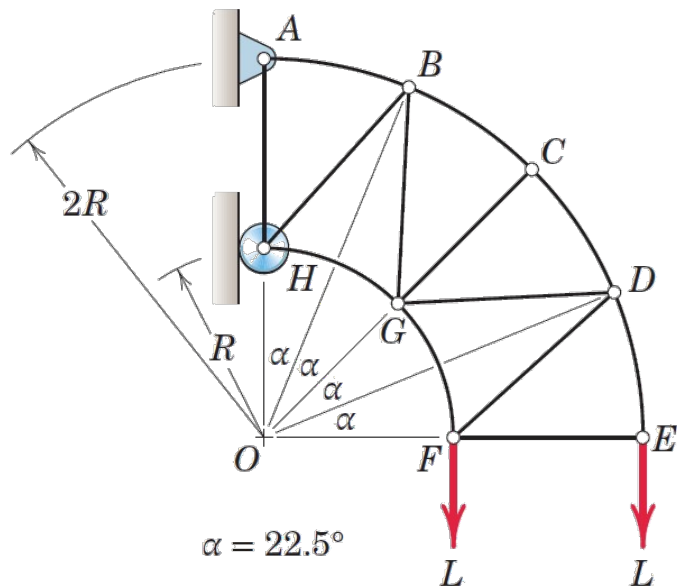A   5 m   C   5 m   E

30 kN   20 kN

Sample problem 4/2

The simple truss shown supports the two loads, each of magnitude *L*. Determine the forces in members *DE*, *DF*, *DG*, and *CD*.
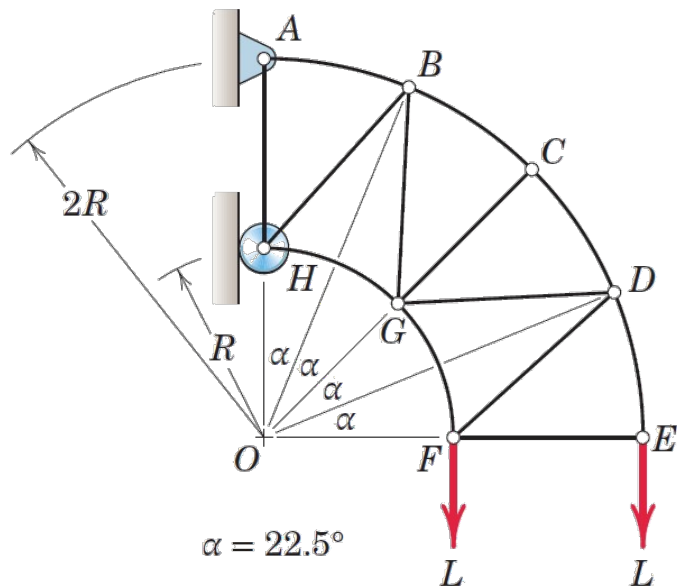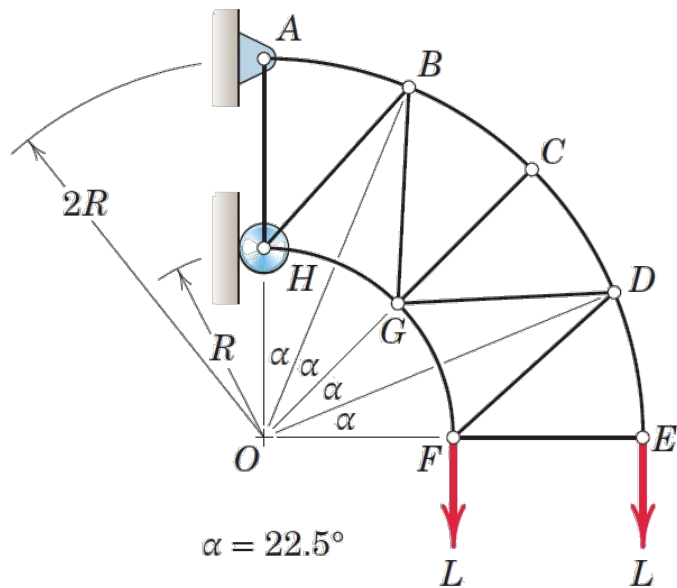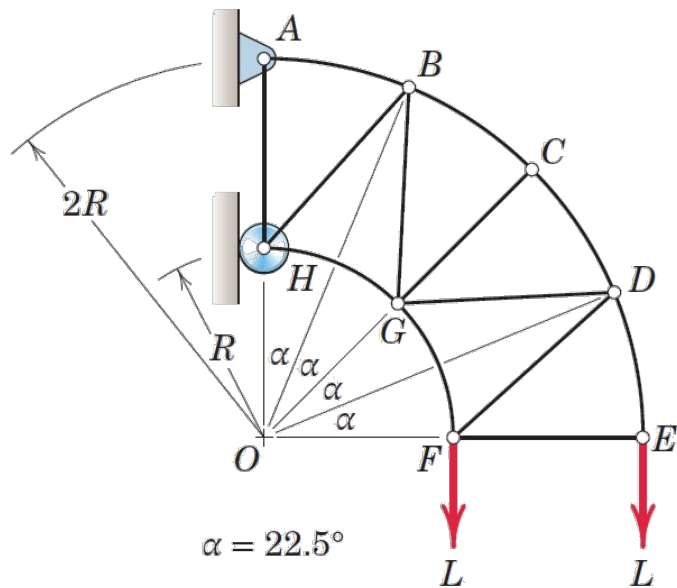
Sample problem 4/2

Sample problem 4/2

Sample problem 4/2

2R

R

A

B

C

D

E

F

G

H

O

α

α

α

α

$\alpha = 22.5°$

L

L

Sample problem 4/2

Sample problem 4/2

2R

R

α α
  α
    α

O   F   E
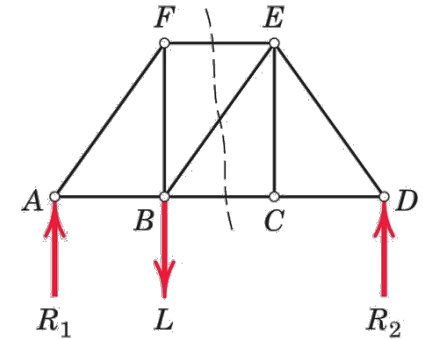
α = 22.5°

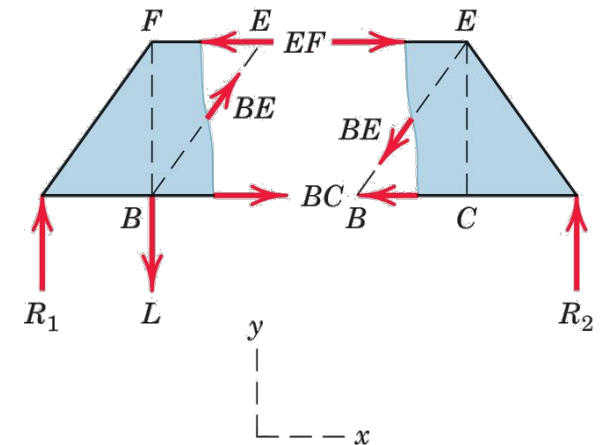L   L

A
B
C
D
H
G

4/4 Method of Sections

Used to determine the force in almost any member of the truss directly without going joint by joint

An entire section of a truss is analyzed as a rigid body in equilibrium

Usually limited to cutting at most three members at one time


(a)

(b)

4/4 Method of Sections

In general, start by solving for external reaction forces

Pass a section through the member of interest and up to 2 other members to isolate a portion of the truss
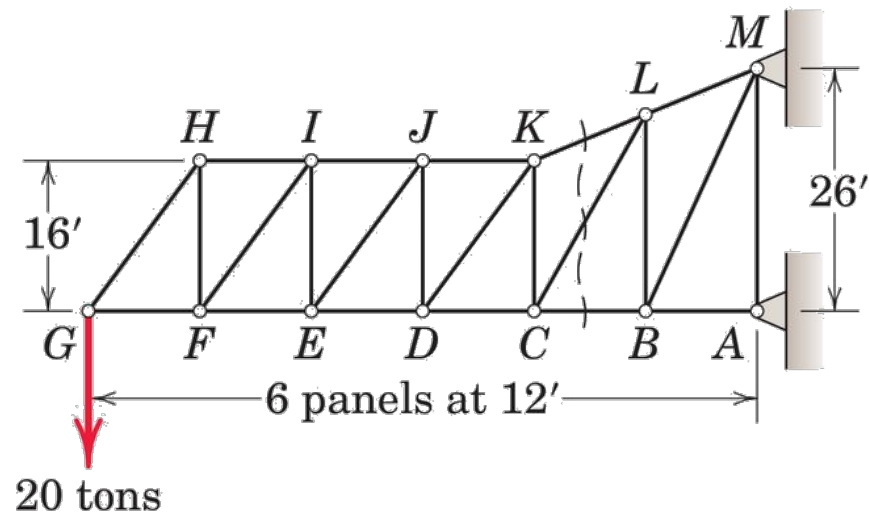
Choose either side of the truss and apply equations of equilibrium to solve for unknown internal forces
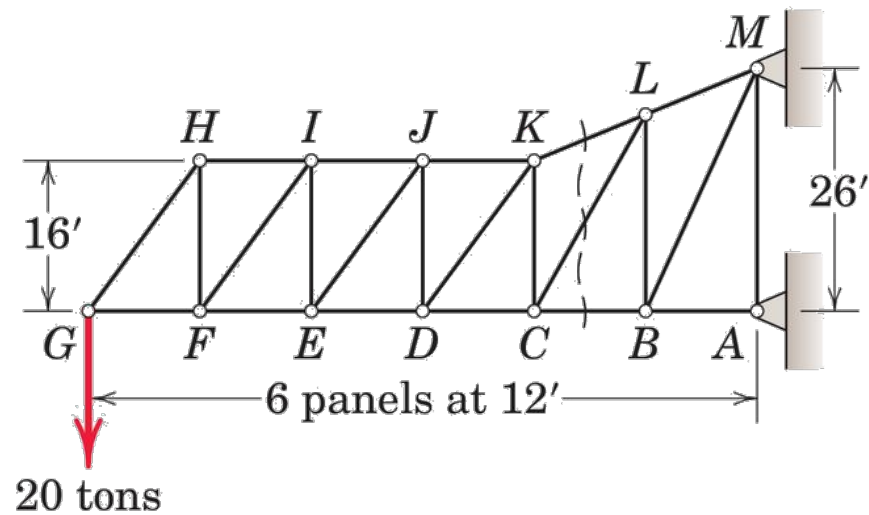
Sample problem 4/3

Calculate the forces induced in members *KL*, *CL*, and *CB* by the 20-ton load on the cantilever truss.
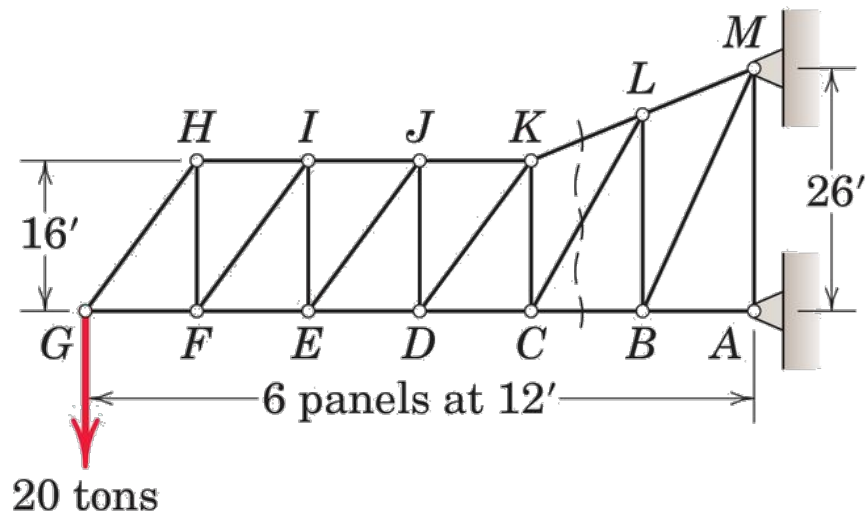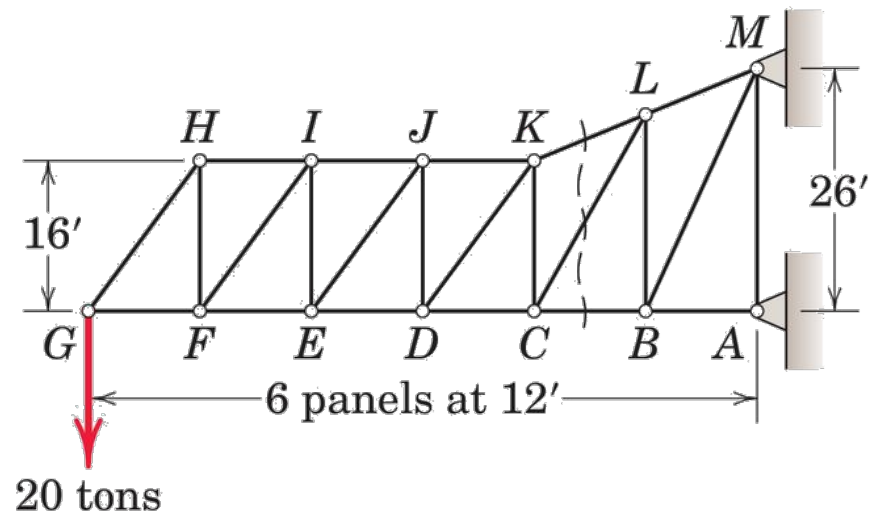
Sample problem 4/3
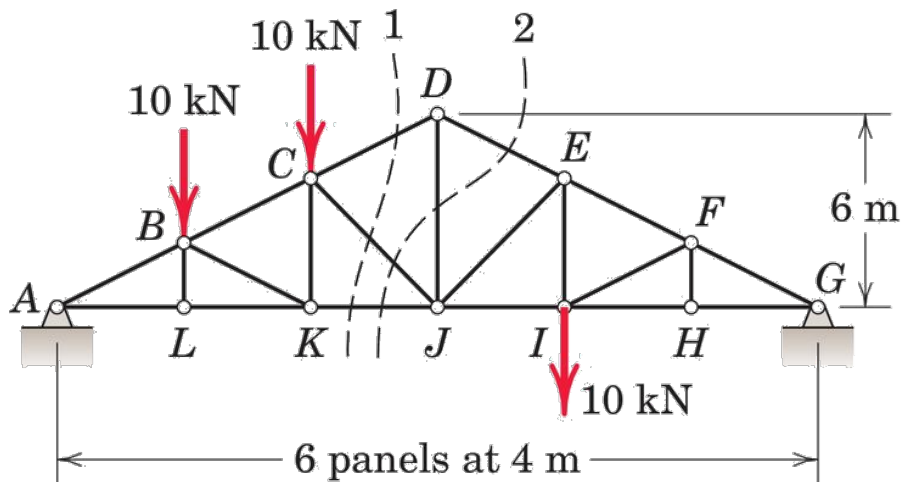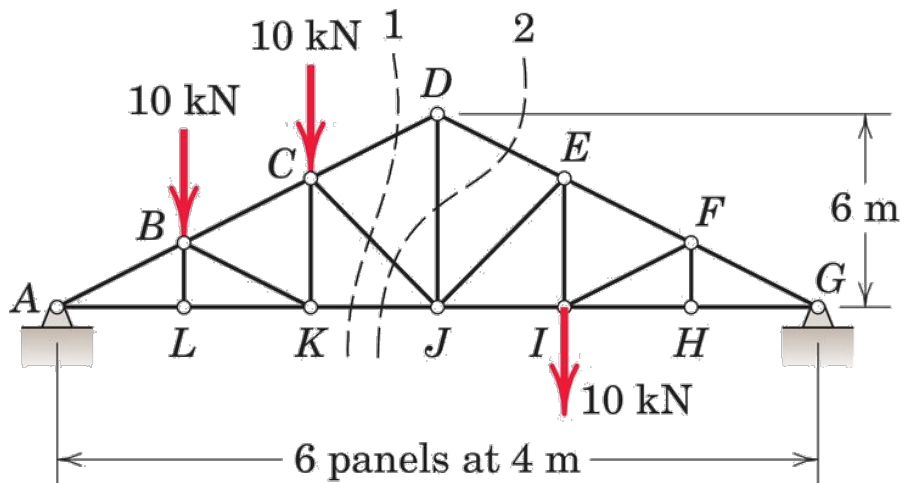
Sample problem 4/3

Sample problem 4/3
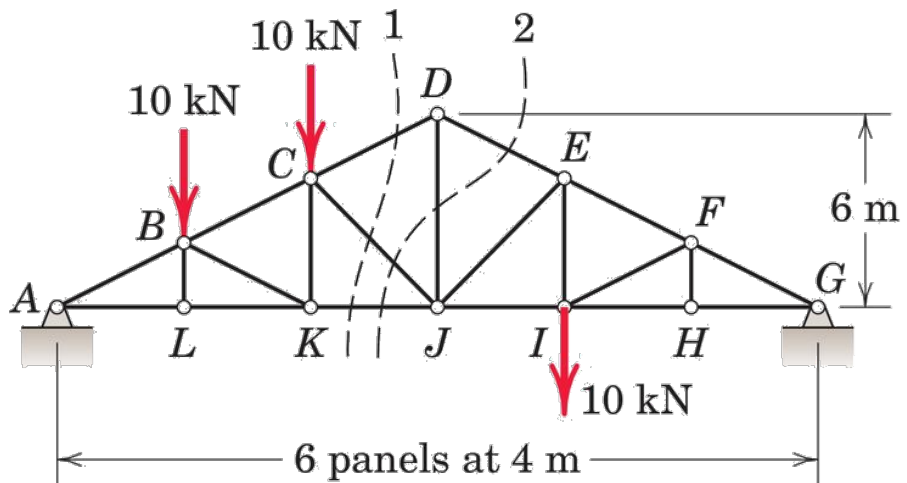
Sample problem 4/4

Calculate the force in member *DJ* of the Howe roof truss illustrated. Neglect any horizontal components of force at the supports.
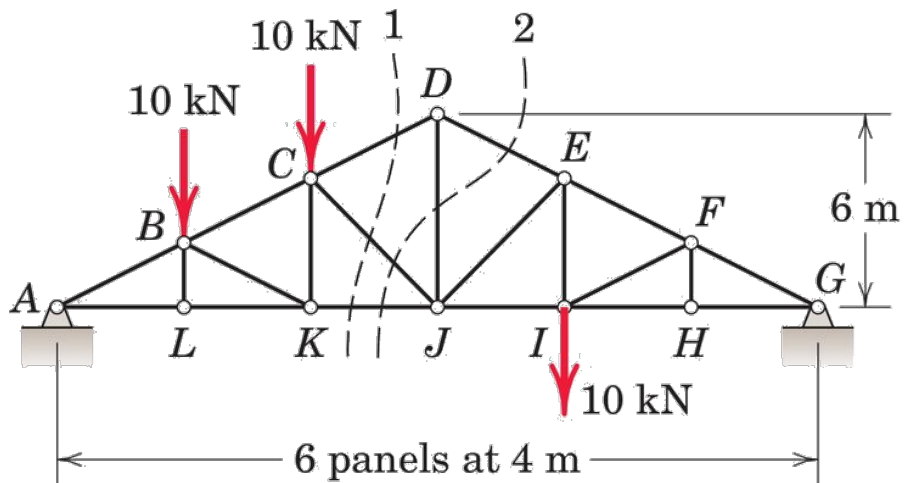
Sample problem 4/4

Sample problem 4/4

Sample problem 4/4

Sample problem 4/4