Problem Set 8

Problem 8.1. Method of Joints for Truss Analysis

Determine the force in each member of the truss, and state if the members are in tension or compression.

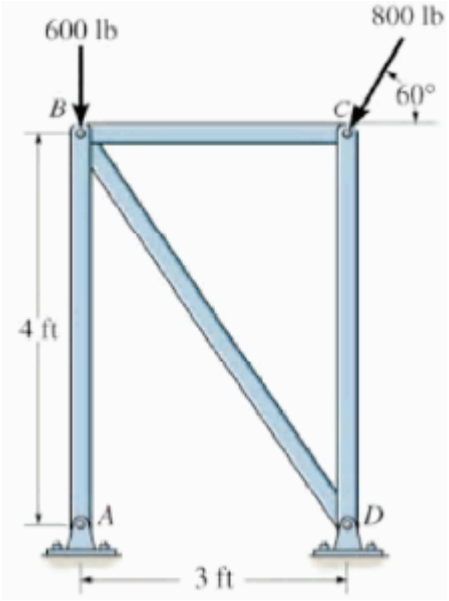


Figure P8.1: Problem 8.1

Problem 8.2. Method of Sections for Truss Analysis

The roof truss supports the loading shown. Determine the force in the members BC, CK, and KJ and state if these members are in tension or compression.

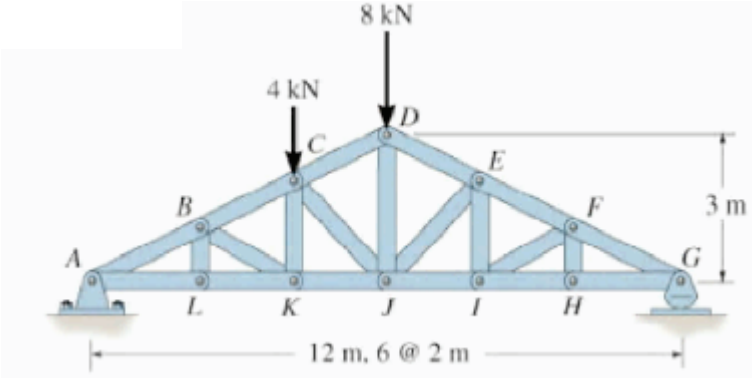
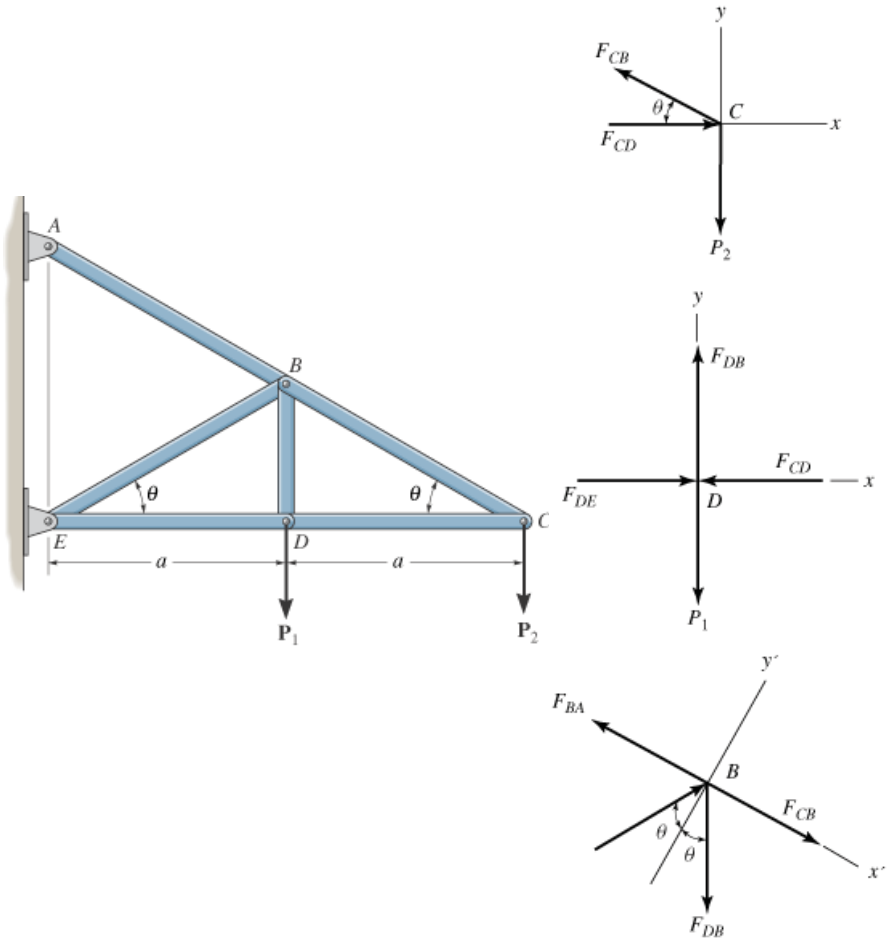


Figure P8.2: Problem 8.2

Problem 8.3

Determine the force in each member of the truss and state if the members are in tension or compression.



Solution

1. Mechanical System: truss.
2. Free-Body Diagram: joints C, D, and B.
3. Equations of equilibrium: Method of Joints $\sum F_x = 0$ & $\sum F_y = 0$.

```
P1 = 4; P2 = 4 kN;  a = 3  m; theta = 30  deg
% joint C
%  Fy = 0 => FCB*sind(theta) - P2 = 0
FCB = P2/sind(theta) % FCB = 8 [kN] (T)
% Fx = 0 => FCD - FCB*cosd(theta) = 0
FCD = FCB*cosd(theta) % FCD = 6.9282 [kN] (C)
% joint D
% Fx = 0 => FDE - FCD = 0
FDE = FCD % FDE = 6.9282 [kN] (C)
%  Fy = 0 => FDB - P1 = 0
FDB = P1 % FDB = 4 [kN] (T)
% joint B
% Fy' = 0 => FBE*cosd(theta) - PDB*cosd(theta) = 0
FBE = FDB % FBE = 4 [kN] (C)
% Fx' = 0 => (FDB+FBE)*sind(theta) + FCB - FBA = 0
FBA = (FDB+FBE)*sind(theta) + FCB % FBA = 12 [kN] (T)
```

Problem 8.4

The Howe bridge truss is subjected to the loading shown. Determine the force in members HI, HB, and BC, and state if the members are in tension or compression.

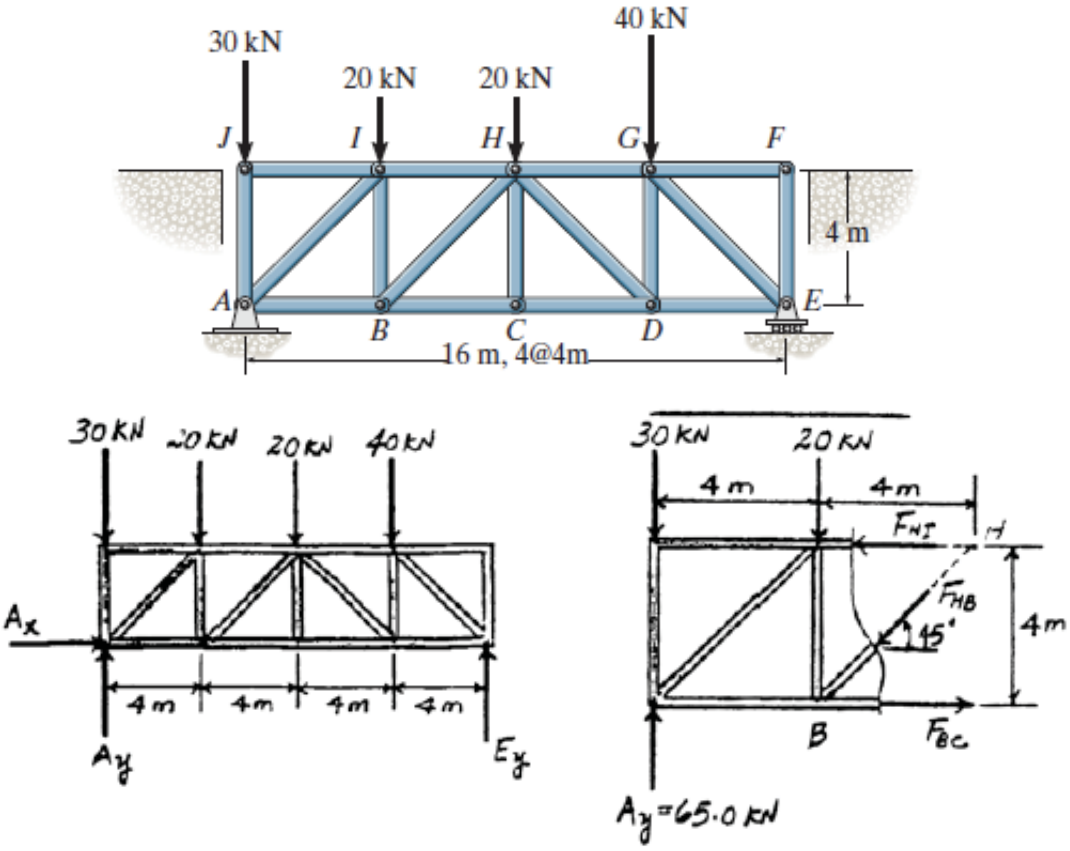


Figure P8.4: Problem 8.4

Solution

1. Mechanical System: bridge.
2. Free-Body Diagram: left-hand side of the bridge.
3. Equations of equilibrium: Method of Sections $\sum F_x = 0$ & $\sum F_y = 0$ & $\sum M_P = 0,\ \forall P$.

```
% support reactions
% sum M_E = 0 => 30*16+20*12+20*8+40*4-Ay*16 = 0
Ay = (30*16+20*12+20*8+40*4)/16 % Ay = 65 [kN]
% Fx = 0 =>
Ax = 0
% Method of Sections
% sum M_H = 0 => FBC*4+20*4+30*8-Ay*8 = 0
FBC = -(20*4+30*8-Ay*8)/4 % FBC = 50 [kN] (T)
% sum M_B = 0 => FHI*4+30*4-Ay*4 = 0
FHI = -(30*4-Ay*4)/4 % FHI = 35 [kN] (C)
% Fy = 0 => Ay-30-20-FHB*sind(45) = 0
FHB = (Ay-30-20)/sind(45) % FHB = 21.2 [kN] (C)
```

Problem 8.5

Determine the force in each member of the space truss and state if the members are in tension or compression. The truss is supported by a ball-and-socket joints at A, B, and E.

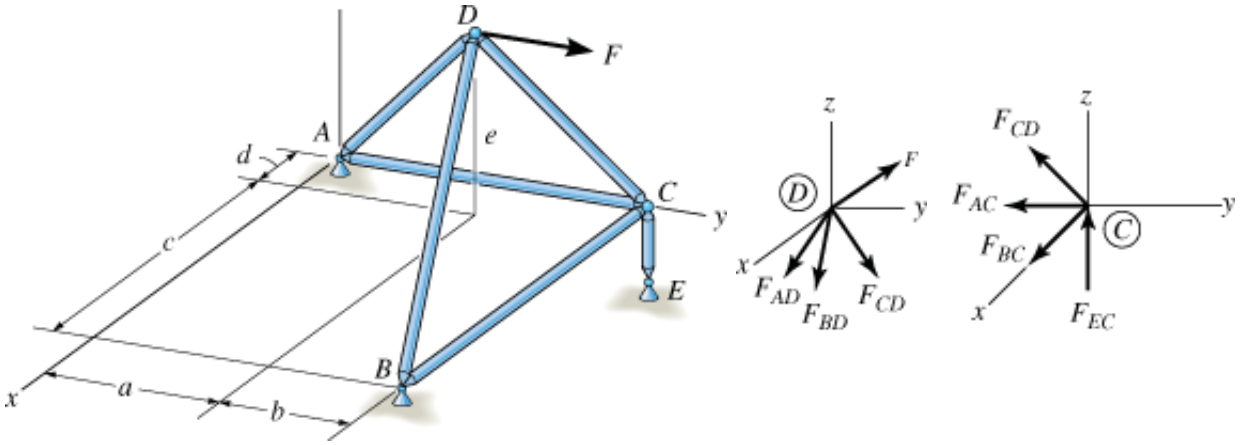


Figure P 8.5: Problem 8.5

Solution

1. Mechanical System: space truss
2. Free-Body Diagram: nodes D and C.
3. Equations of equilibrium: Method of Joints $\sum F_x = 0$ & $\sum F_y = 0$ & $\sum F_z = 0$.

```
Fx = -200; Fy = 400; % N
a = 2; b = 1.5; c = 5; d = 1; e = 2; % m
F = [Fx, Fy, 0];
rA = [0, 0, 0]; rB = [c+d, a+b, 0]; rC = [0, a+b, 0]; rD = [d, a, e];
uDA = -rD/norm(rD); % uDA = [ -0.333, -0.667, -0.667]
uDB = (rB-rD)/norm(rB-rD); % uDB = [ 0.894, 0.268, -0.358]
uDC = (rC-rD)/norm(rC-rD); % uDC = [ -0.371, 0.557, -0.743]
F_DA = FAD*uDA; F_DB = FBD*uDB; F_DC = FCD*uDC;
% sum F at node D
FD = F+F_DA+F_DB+F_DC;
solD = solve(FD(1),FD(2),FD(3));
% FAD = 343 [N] (T)
% FBD = 186 [N] (T)
% FCD = -397 [N] (C)
% node C
F_CD = -fCD*uDC
uCA = -rC/norm(rC); % uCA = [ 0, -1.0, 0]
uCB = (rB-rC)/norm(rB-rC); % uCB = [ 1.0, 0, 0]
uEC = [0, 0, 1];
F_AC = FAC*uCA; F_BC = FBC*uCB; F_EC = FEC*uEC;
FC = F_AC+F_BC+F_EC+F_CD;
solC = solve(FC(1),FC(2),FC(3));
% FAC = 221 [N] (T)
% FBC = 148 [N] (T)
% FEC = 295 [N] (C)
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