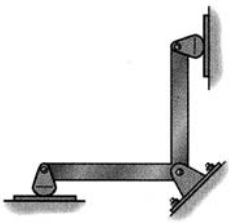
CE 371- Structural Analysis I
Homework #3 Solutions

9.

Classify each structure shown below a stable or unstable. If stable, determine whether they are statically determinate or statically indeterminate. Explain your reasoning. If statically indeterminate, specify the degree of statical indeterminacy. All structures are planar and movements in the out-of-plane direction are prevented.

a)



r = 4, n = 1

r > 3n

4 > 3(1)

Stable, Statically Indeterminate 1° (Points 2.5)

b)

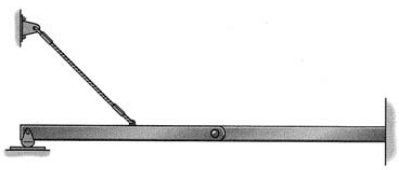
r = 10, n = 3

r > 3n

10 > 9

Stable, Statically Indeterminate 1° (Points 2.5)

c)



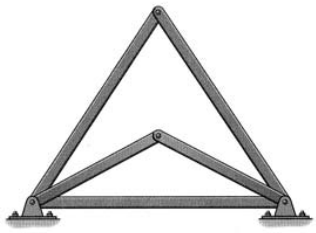
r = 7, n = 2

r > 3n

7 > 3(2)

Stable, Statically Indeterminate 1° (Points 2.5)

d)



b= 5, j= 4, r=4

b + r > 2j

5 + 4 > 2(4)

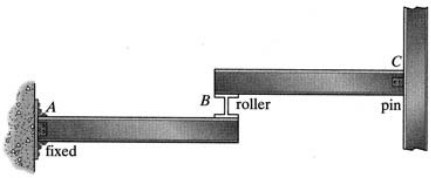
9 > 8

Stable, Statically Indeterminate 1° (Points 2.5)

10.

Classify each structure shown below as stable or unstable. If stable, determine whether they are statically determinate or statically indeterminate. Explain your reasoning. If statically indeterminate, specify the degree of statical indeterminacy. All structures are planar and movements in out-of-plane direction are prevented.

a)



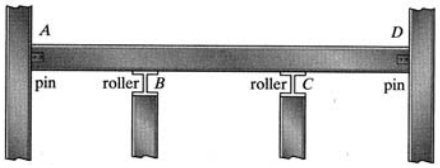
r = 6, n = 2

r = 3n

6 = 3(2)

Statically determinate (Points 5)

b)



r = 6, n = 1

r > 3n

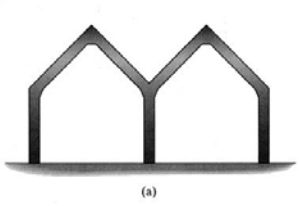
6 > 3(1)

Statically Indeterminate 3° (Points 5)

11.

Classify each of the structures shown below as stable or unstable. If stable, determine whether statically determinate or statically indeterminate. Explain your reasoning. If indeterminate, specify the degree of statical indeterminacy. All structures are planar and movements out-of-plane direction are prevented. All internal joints are fixed-connected (a.k.a rigidly connected).

a)



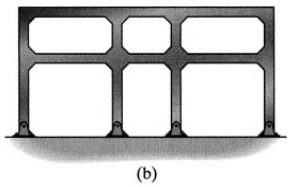
r = 15, n = 3

r > 3n

15 > 9

Stable, Statically Indeterminate 6° (Points 2.5)

b)



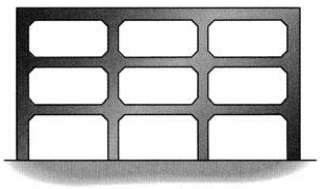
r = 26, n = 4

r > 3n

26 > 3(4)

Stable, Statically Indeterminate 14° (Points 2.5)

c)



(c)

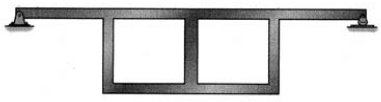
r = 39, n = 4

r > 3n

39 > 3(4)

Stable, Statically Indeterminate 27° (Points 2.5)

d)



(d)

r = 15, n = 3

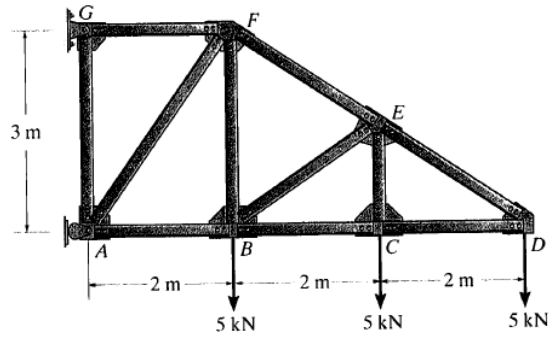
r > 3n

15 > 3(3)

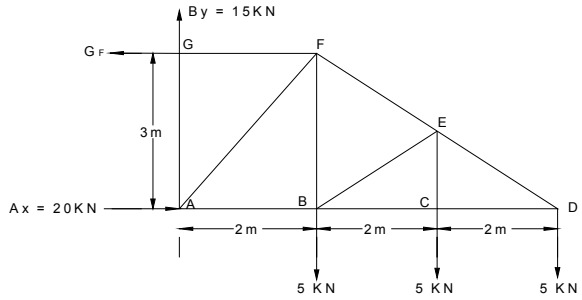
Stable, Statically Indeterminate 6° (Points 2.5)

12.

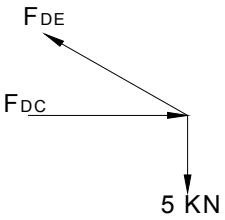
Determine the force in each member of the truss. State if the members are in tension or compression. Assume all members are pin connected.



Sol:



Joint D:



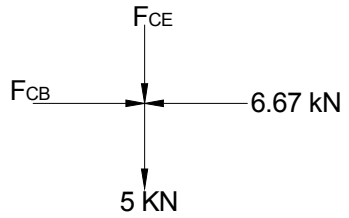
$+\uparrow \Sigma F_Y = 0;$ $F_{ED}(3/5) - 5 = 0;$ $F_{ED} = 8.33$ kN (T) **Ans**

$+\rightarrow \Sigma F_X = 0;$ $F_{CD} - 4/5(8.33) = 0;$

$F_{CD} = 6.67$ kN (C) **Ans**

(Points 2)

Joint C:



$\rightarrow + \Sigma F_X = 0;$ $F_{BC} - 6.67 = 0;$

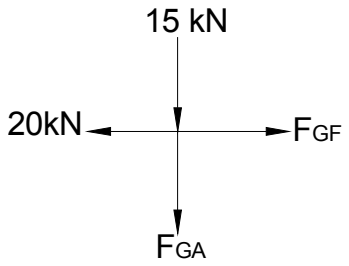
$F_{BC} = 6.67$ kN (C) **Ans**

$+\uparrow \Sigma F_Y = 0;$ $F_{CE} - 5 = 0$

$F_{CE} = 5$ kN (T) **Ans**

(Points 2)

Joint G:

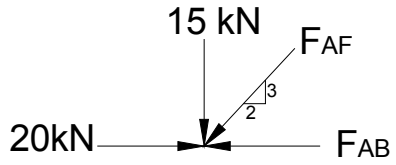


$\rightarrow + \Sigma F_X = 0;$ $F_{GF} - 20 = 0;$ $F_{GF} = 20$kN (T) **Ans**

$+\uparrow \Sigma F_Y = 0;$ $15 - F_{GA} = 0;$ $F_{GA} = 15$kN (T) **Ans**

(Point 1)

Joint A:



$+\uparrow \Sigma F_Y = 0;$ $15 - F_{AF} (\sin 56.3°) = 0;$

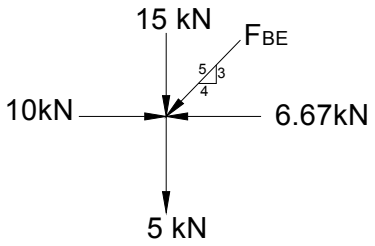
$F_{AF} = 18.0$kN (C) **Ans**

$\rightarrow +\ \Sigma F_X = 0;$ $\quad - F_{AB} - 18.0\ (\cos 56.3°) + 20 = 0$

$F_{AB} = 10.0$ kN (C) **Ans**

(Points 2)

Joint B:



$\rightarrow +\ \Sigma F_X = 0;$ $\quad - F_{BE}\ (4/5) + 10.0 - 6.67 = 0$

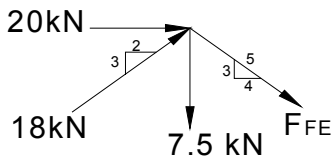
$F_{BE} = 41.7$kN (C) **Ans**

$+\uparrow \Sigma F_Y = 0;$ $\quad F_{FB} - 5 - 4.17(3/5) = 0;$

$F_{FB} = 7.50$kN (T) **Ans**

(Points 2)

Joint F:



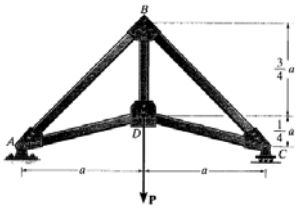
$+\uparrow \Sigma F_Y = 0;$ $\quad 18\ (\sin 56.3°) - 7.5 - F_{FE}\ (3/5) = 0;$

$F_{FE} = 12.5$kN (T) **Ans**

(Point 1.0)

13.

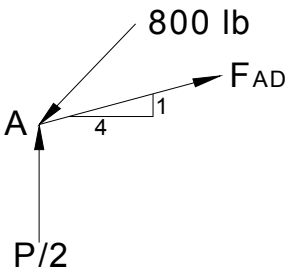
Members AB and BC can each support a maximum compressive force of 800 lb, and members AD, DC, and BD can support a maximum tensile force of 2000 lb. If a= 6ft, determine the greatest load P the truss can support.



Sol:

Assume F_{AB} = 800lb (C)

Joint A:



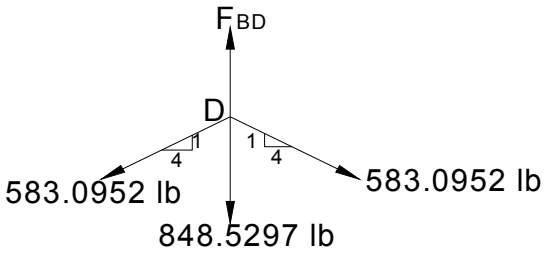
+ → $\Sigma F_X = 0$; $\quad -800\,(1/\sqrt{2}) + F_{AD}\,(4/\sqrt{17}) = 0$

F_{AD} = 583.0952lb < 1500 lb OK

+↑ $\Sigma F_Y = 0$; $\quad P/2 - 1/\sqrt{2}\,(800) + 1/\sqrt{17}\,(583.0952) = 0$

P = 848.5297 lb (Points 5)

Joint D:



+↑ $\Sigma F_Y = 0$; $\quad -848.5297 - 583.0952\,(2)\,(1/\sqrt{17}) + F_{DB} = 0$

$F_{BD} = 1131.3724$ lb < 1500 lb OK

Thus, $P_{max} = 849$ lb **Ans**

(Points 5)