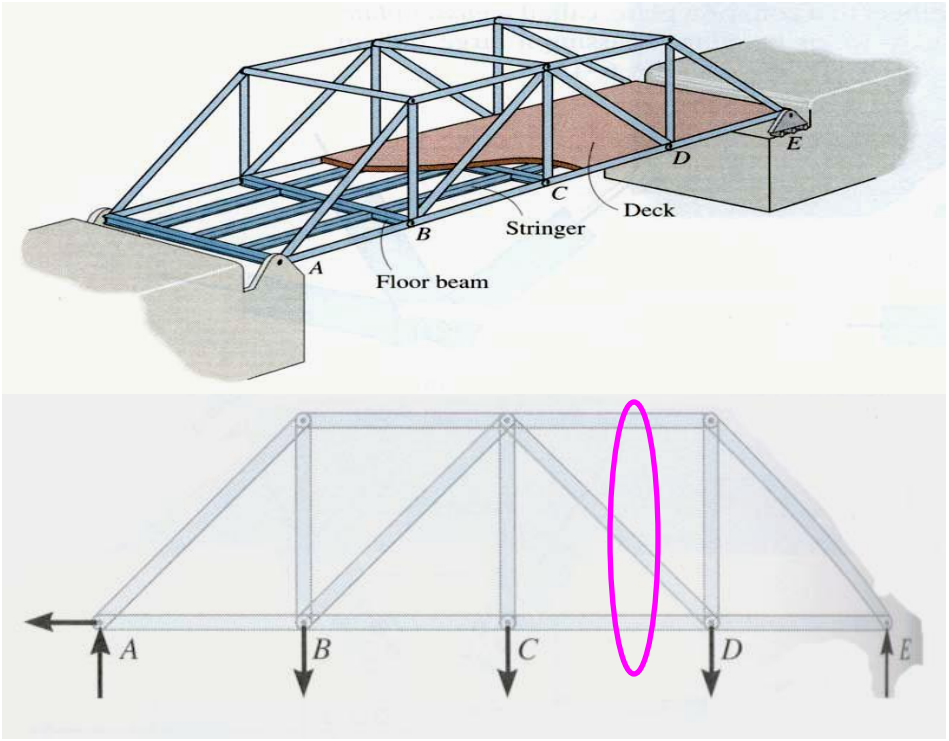
THE METHOD OF SECTIONS

Today's Objectives:

Students will be able to determine:

1. Forces in truss members using the method of sections.



In-Class Activities:

- Check Homework, if any
- Reading Quiz
- Applications
- Method of Sections
- Concept Quiz
- Group Problem Solving
- Attention Quiz

APPLICATIONS

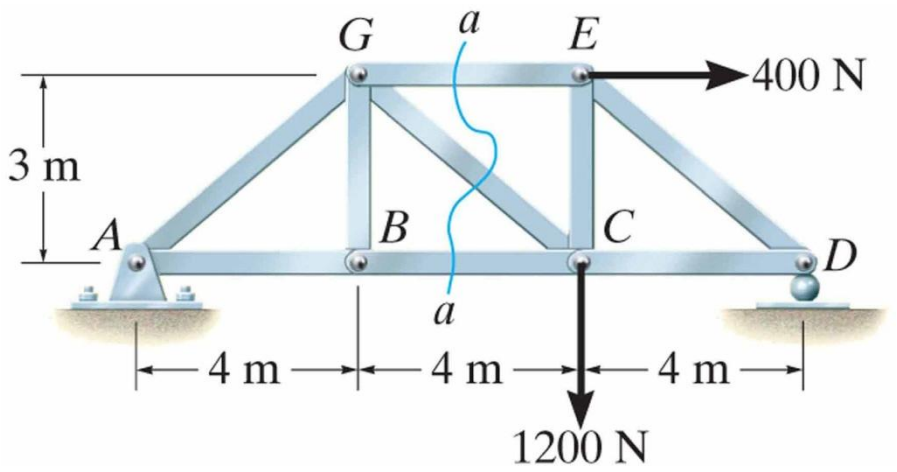
Long trusses are often used to construct bridges.

The method of joints requires that many joints be analyzed before we can determine the forces in the middle part of the truss.

Is there another method to determine these forces directly?

Method of Sections

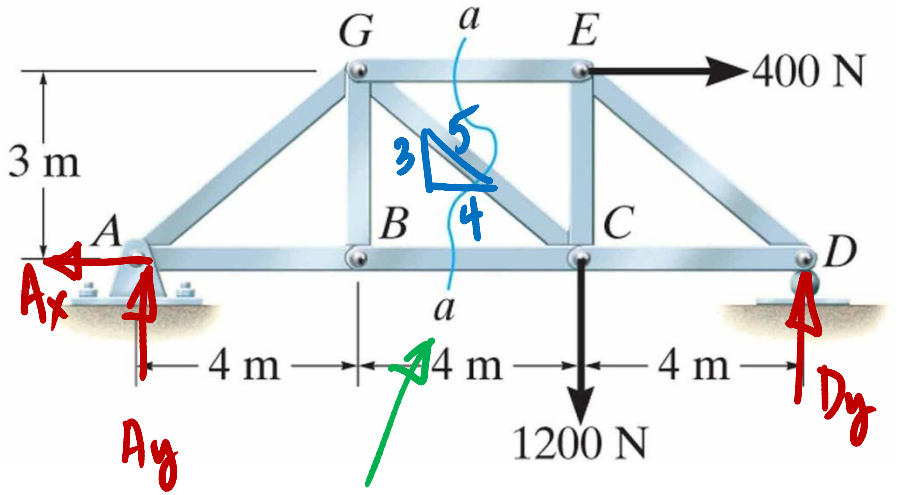
- To find forces in selected members
- Divide truss into 2 sections



Steps:

1. Find reactions at supports.
2. Select a cutting section (if possible cutting only 3 members) that divides truss into two parts.
3. FBD of one portion of truss.
4. 3 Equations of equilibrium (non-concurrent, non-parallel).

Example 1. Find forces in members EG, CG and BC.



② choose section

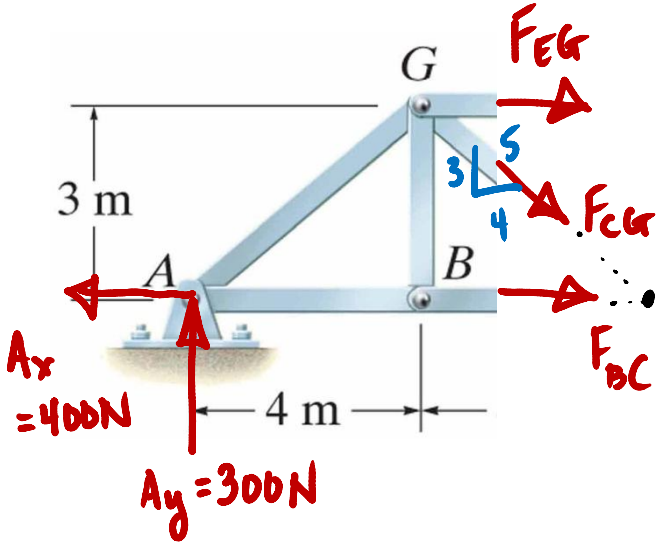
① Find reactions at supports

$\Sigma F_x = 0 = A_x + 400N \Rightarrow A_x = +400N$

$\Sigma F_y = 0 = A_y + D_y - 1200N \Rightarrow A_y = 300N$

$\Sigma M_A = 0 = -8(1200) - 3(400) + 12 D_y$

$\Rightarrow D_y = 900\,N$



③ Draw FBD

④ Write Equil Eqns.

$\Sigma M_G = 0 = F_{BC}(3m) - A_y(4m) - A_x(3m)$

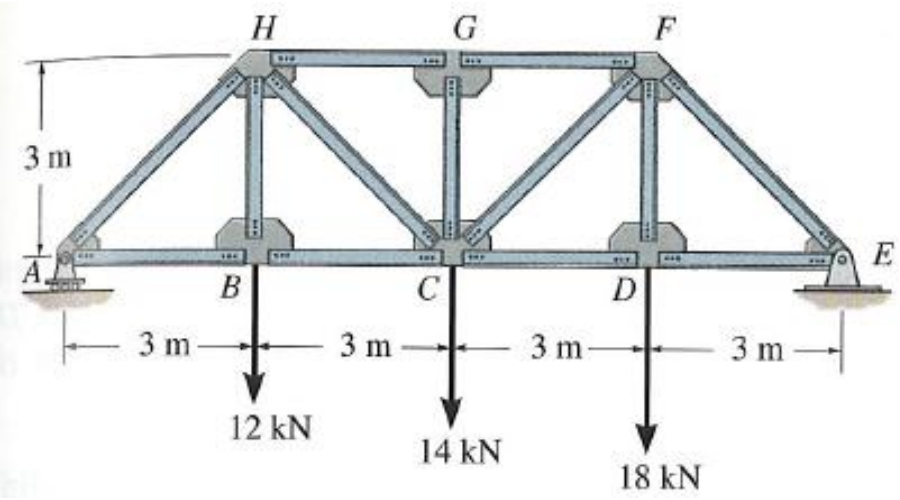
$\Rightarrow F_{BC} = \frac{1200\,Nm + 1200\,Nm}{3m} \Rightarrow F_{BC} = 800N\,(T)$

$\Sigma M_C = 0 = -F_{EG}(3m) - A_y(8m)$

$\Rightarrow F_{EG} = -2400/3 \Rightarrow F_{EG} = -800N\,(C)$

$\Sigma F_y = 0 = A_y - \frac{3}{5} F_{CG} \Rightarrow F_{CG} = 500N\,(T)$

EXAMPLE 2



Given: Loads as shown on the truss.

Find: The force in members GF CF, and CD.

Plan:

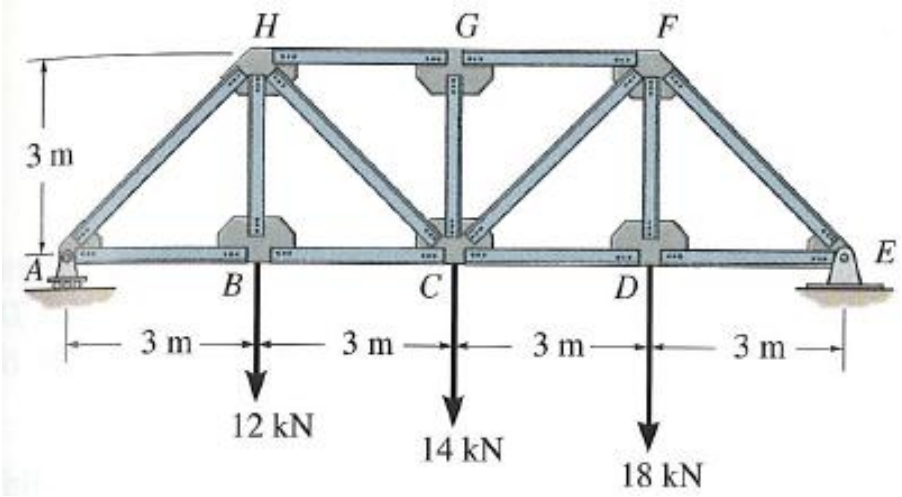
a) Find reactions at E

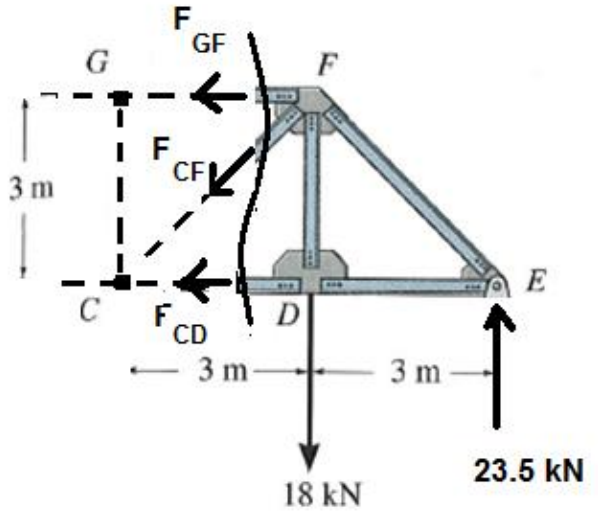
b) Take a cut through the members GF CF, and CD.

c) Work with the right part of the cut section. Why?

d) Apply the EofE to find the forces in DE, DL, and ML.

EXAMPLE 2 (continued)





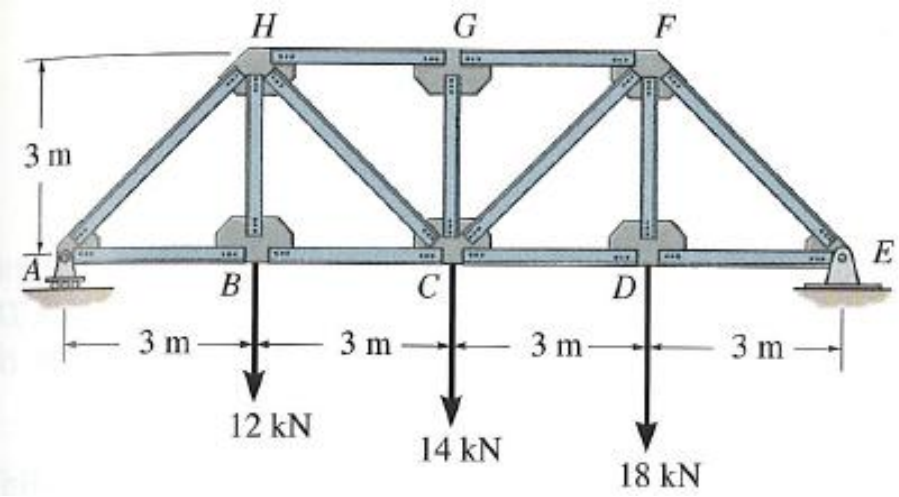
Analyzing the entire truss, we get $\Sigma F_X = E_X = 0$.
Also, $\Sigma M_A = 12E_Y - 18(9) - 14(6) - 12(3) = 0$ and therefore

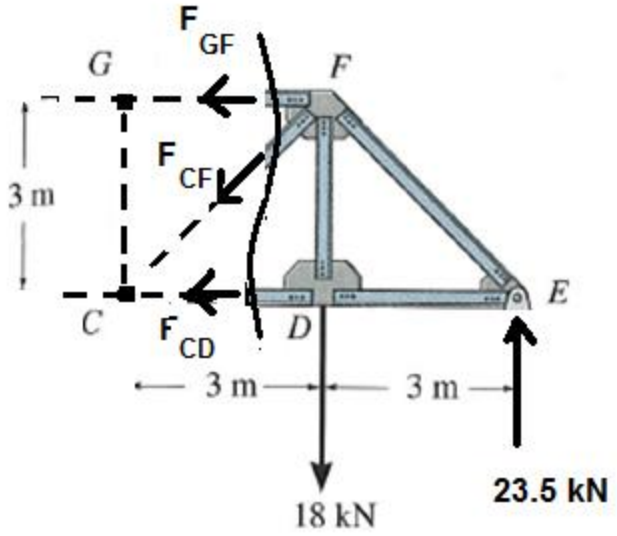
$E_Y = 23.5$ kN

$$\circlearrowleft + M_C = -18(3) + 23.5(6) + F_{GF}(3) = 0$$

$$F_{GF} = -29 \text{ kN (C)}$$

EXAMPLE 2 (continued)





$$\circlearrowleft +\Sigma M_F = 23.5\,(3) - F_{CD}\,(3) = 0$$

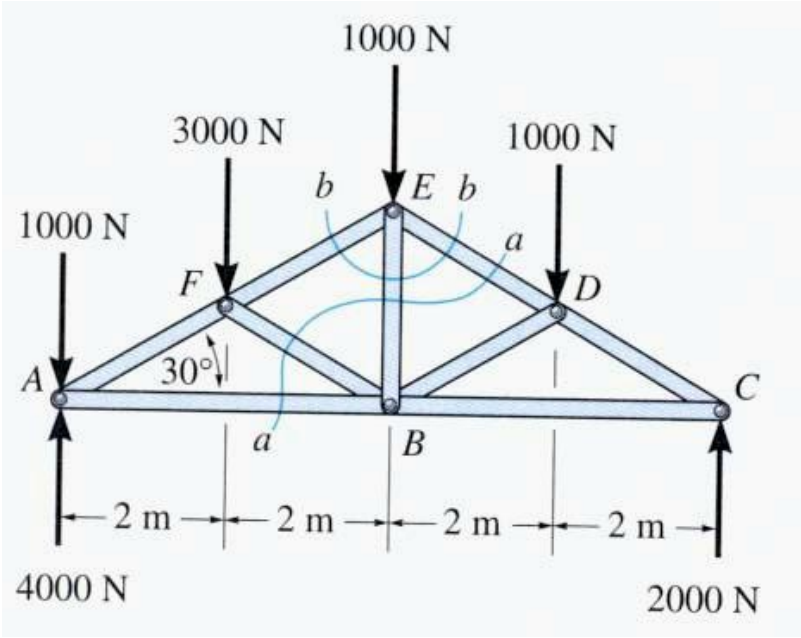
$$\underline{F_{CD} = 23.5\ (T)}$$

$$\rightarrow +\Sigma F_X = -F_{GF} - F_{CF}\,\sqrt{2}/2 - F_{CD} = 0 = 29 - F_{CF}\,0.707 - 23.5$$

$$\rightarrow \qquad \underline{F_{CF} = 7.78\ kN\ (T)}$$

CONCEPT QUIZ

1. Can you determine the force in member ED by making the cut at section a-a? Explain your answer.



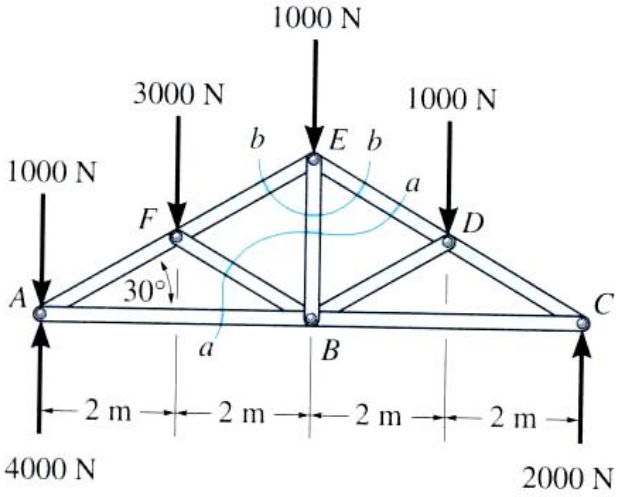
A) No, there are 4 unknowns.

B) Yes, using $\Sigma M_D = 0$.

C) Yes, using $\Sigma M_E = 0$.

D) Yes, using $\Sigma M_B = 0$.

CONCEPT QUIZ



2. If you know F_{ED}, how will you determine F_{EB} ?

A) By taking section b-b and using $\Sigma M_E = 0$

B) By taking section b-b, and using $\Sigma F_X = 0$ and $\Sigma F_Y = 0$

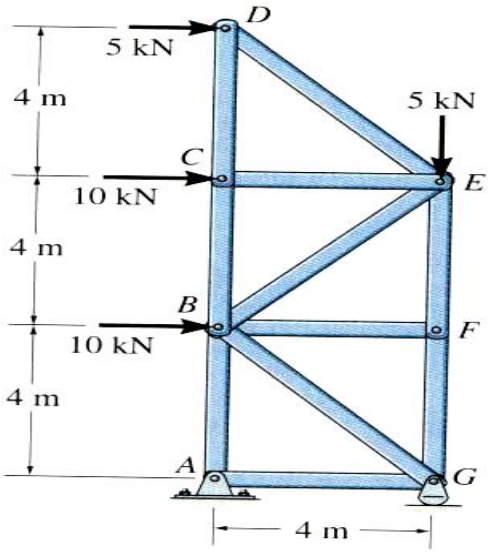
C) By taking section a-a and using $\Sigma M_B = 0$

D) By taking section a-a and using $\Sigma M_D = 0$

GROUP PROBLEM SOLVING

Given: Loading on the truss as shown.

Find: The force in members BC, BE, and EF.



Plan:

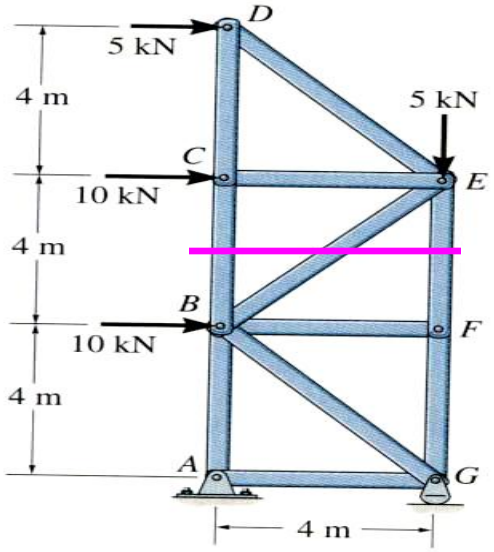
a) Take a cut through the members BC, BE, and EF.

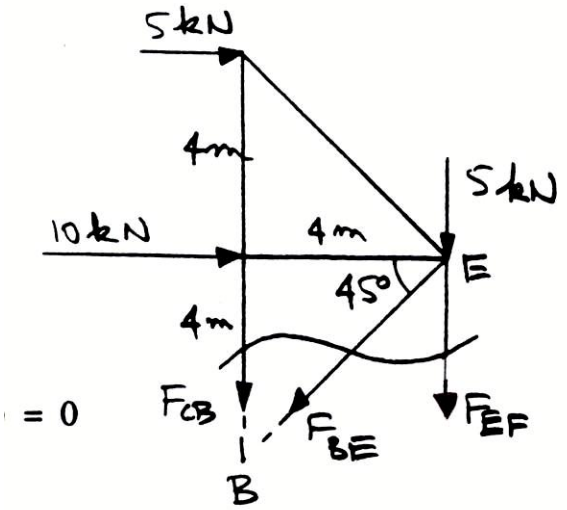
b) Analyze the top section (no support reactions!).

c) Draw the FBD of the top section.

d) Apply the equations of equilibrium such that every equation yields answer to one unknown.

SOLUTION





$$+\rightarrow \Sigma F_X = 5 + 10 - F_{BE}\cos 45^\circ = 0$$

$$F_{BE} = 21.2 \text{ kN (T)}$$

$$+\circlearrowleft \Sigma M_E = -5(4) + F_{CB}(4) = 0$$

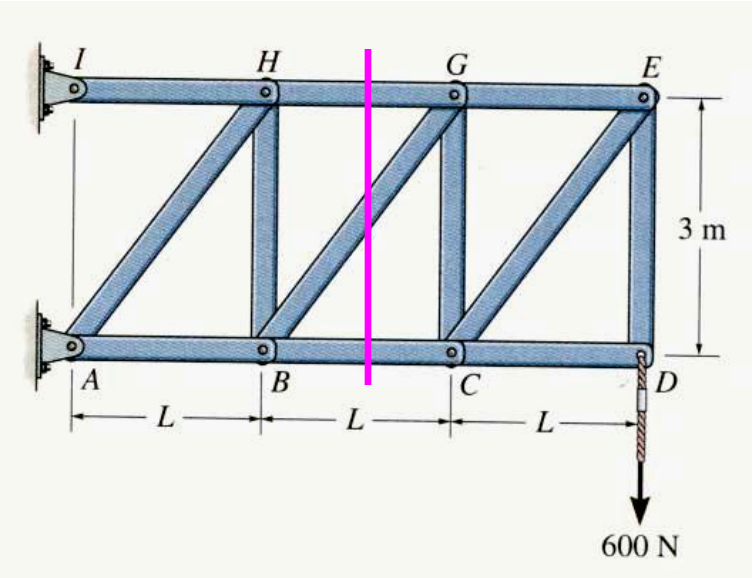
$$F_{CB} = 5 \text{ kN (T)}$$

$$+\circlearrowright \Sigma M_B = -5(8) - 10(4) - 5(4) - F_{EF}(4) = 0$$

$$F_{EF} = -25 \text{ kN or } 25 \text{ kN (C)}$$

ATTENTION QUIZ

1. As shown, a cut is made through members GH, BG and BC to determine the forces in them. Which section will you choose for analysis and why?



A) Right, fewer calculations.

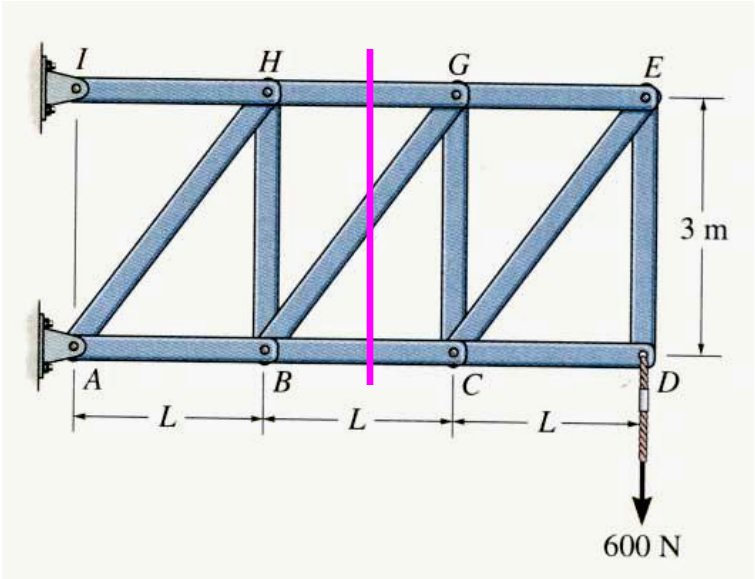
B) Left, fewer calculations.

C) Either right or left, same amount of work.

D) None of the above, too many unknowns.

ATTENTION QUIZ

2. When determining the force in member HG in the previous question, which one equation of equilibrium is best to use?



A) $\Sigma M_H = 0$

B) $\Sigma M_G = 0$

C) $\Sigma M_B = 0$

D) $\Sigma M_C = 0$

End of the Lecture

Let Learning Continue