Engineering Mechanics : Statics

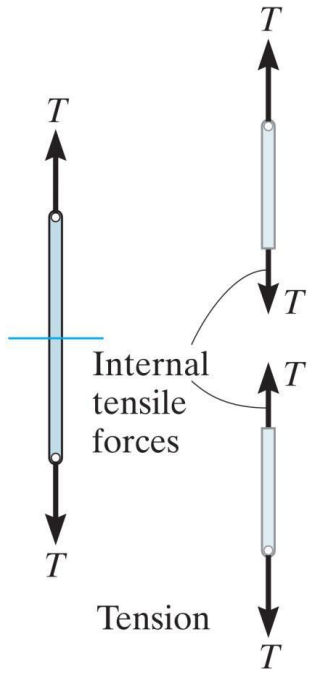
Chapter 6: Structural analysis

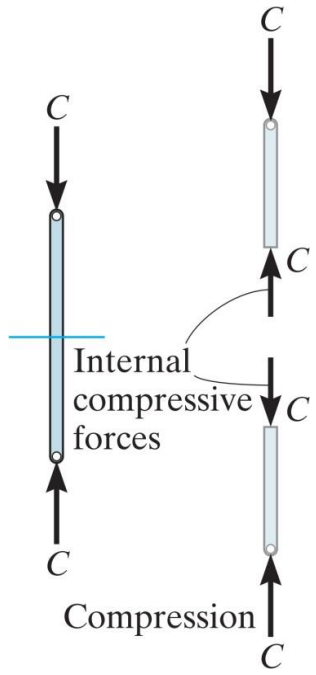
Chapter outline

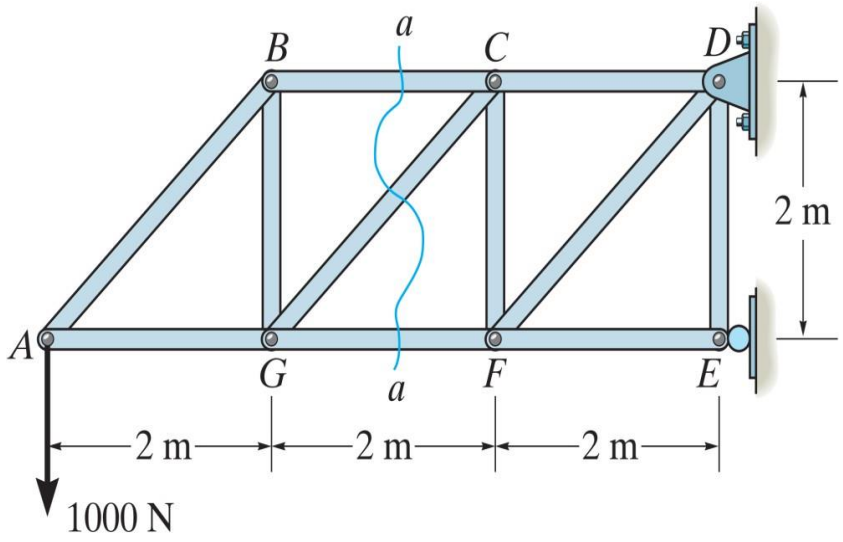
- Simple Trusses
- The Method of Joints
- The Method of Sections

6. 4 The Method of sections

- Used to determine the loadings within a body
- If a body is in equilibrium, any part of the body is in equilibrium
- To determine the forces within the members, an imaginary section indicated by the blue line, can be used to cut each member into two and expose each internal force as external

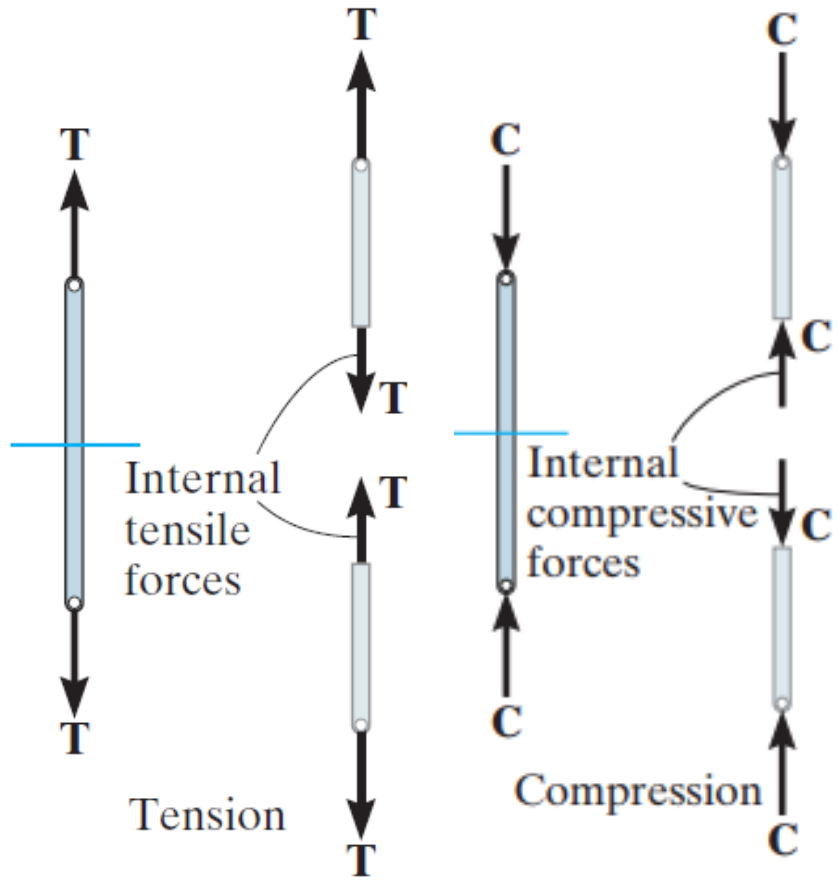






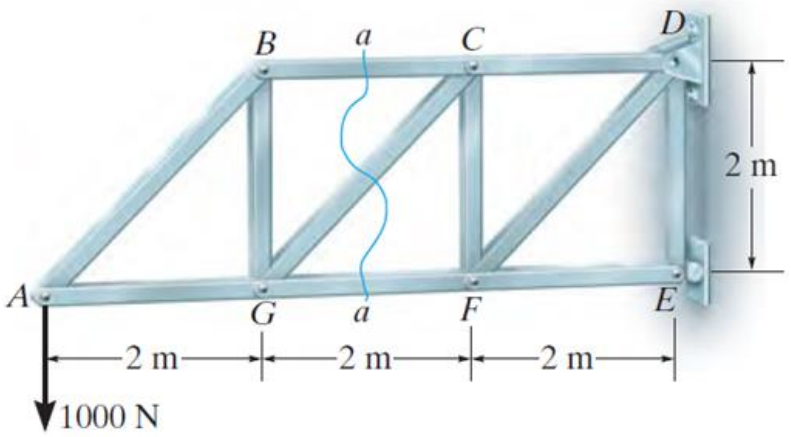
6. 4 The Method of Sections

1. When we need to find the force in only a few members of a truss, we can analyze the truss using the method of section. It is based on the principle that if the truss is in equilibrium then any segment of the truss is also in equilibrium.
2. When applying the equilibrium equations, we should carefully consider ways of writing the equations so as to yield a direct solution for each of the unknowns, rather than having to solve simultaneous equations.
3. Always assume that the unknown member forces at the cut section are tensile forces, i.e., "pulling" on the member. By doing this, the numerical solution of the equilibrium equations will yield positive scalars for members in tension and negative scalars for members in compression.

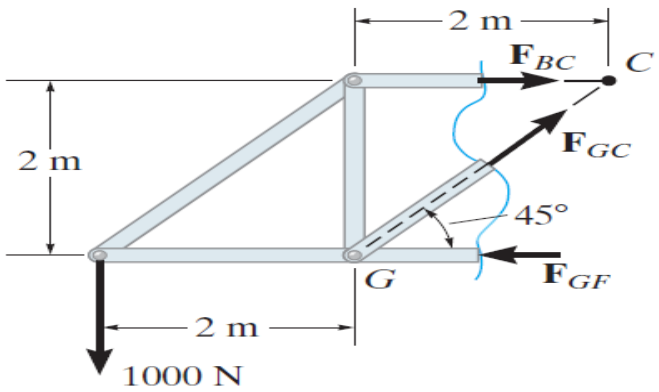


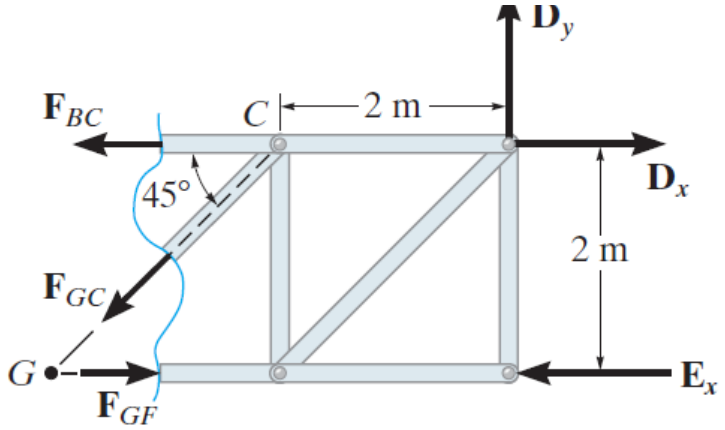
6. 4 The Method of Sections

If the forces in members *BC*, *GC*, and *GF* are to be determined then section *aa* would be appropriate.



Members *BC* and *GC* are assumed to be in *tension* since they are subjected to a "pull," whereas *GF* in *compression* since it is subjected to a "push."





6. 4 The Method of Sections

Procedure for Analysis

1. The forces in the members of a truss may be determined by the method of sections as:

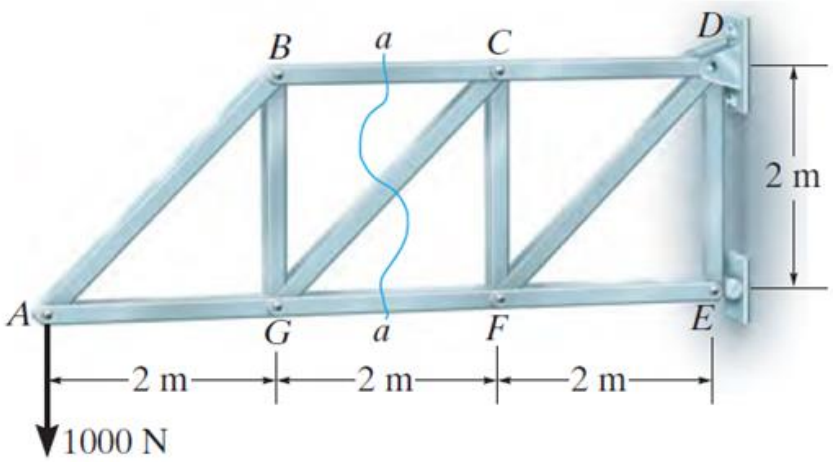
1. Free Body Diagram

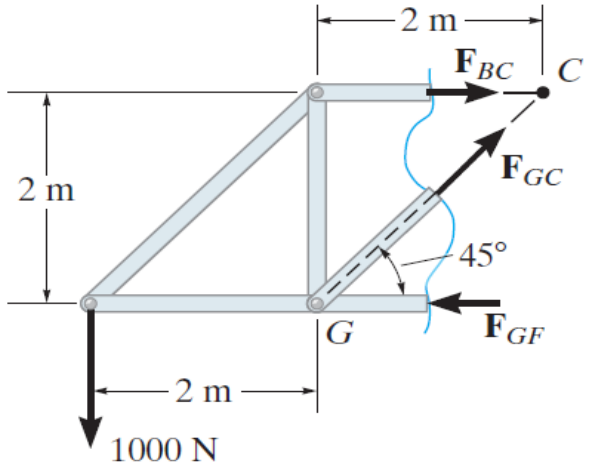
1. Make a decision on how to "cut" or section the truss through the members where forces are to be determined.
2. Before isolating the appropriate section, it may first be necessary to determine the truss's support reactions. If this is done then the three equilibrium equations will be available to solve for member forces at the section.
3. Draw the free-body diagram of that segment of the sectioned truss which has the least number of forces acting on it.
4. Use one of the two methods described above for establishing the sense of the unknown member forces.

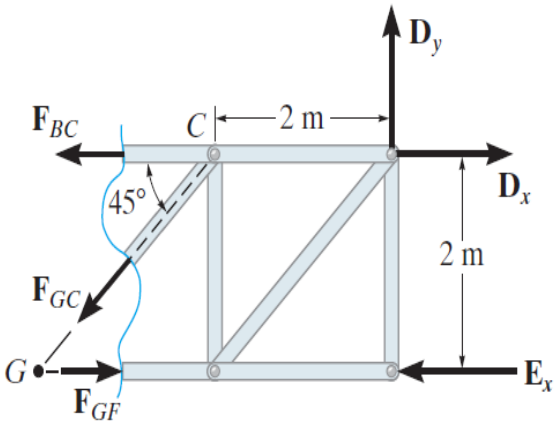
6. 4 The Method of Sections

2. Equations of Equilibrium

1. Moments should be summed about a point that lies at the intersection of the lines of action of two unknown forces, so that the third unknown force can be determined directly from the moment equation.
2. If two of the unknown forces are parallel, forces may be summed perpendicular to the direction of these unknowns to determine directly the third unknown force.







6. 4 The Method of Sections

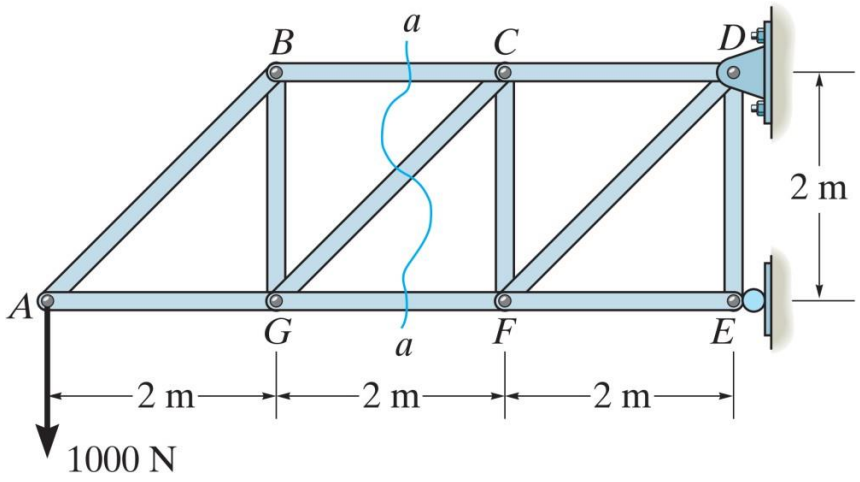
There are 3 types of forces, External, Internal and reactive. Our objective is to find all of these forces.

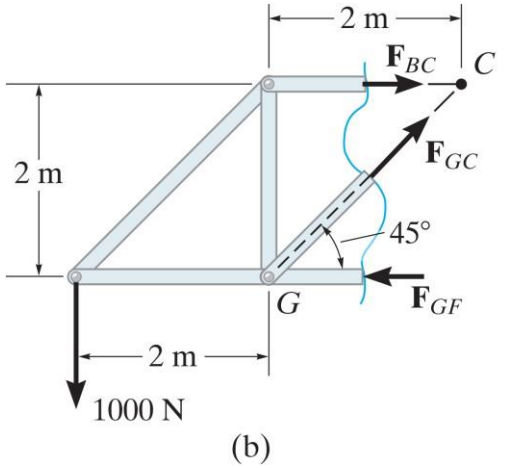
Step 1: Find the reactive forces uses global equilibrium

Step 2: Cut through members of interest (No more than 3 members cut through)

Step 3: Draw free body diagram of the easiest side

Step 4: Solve





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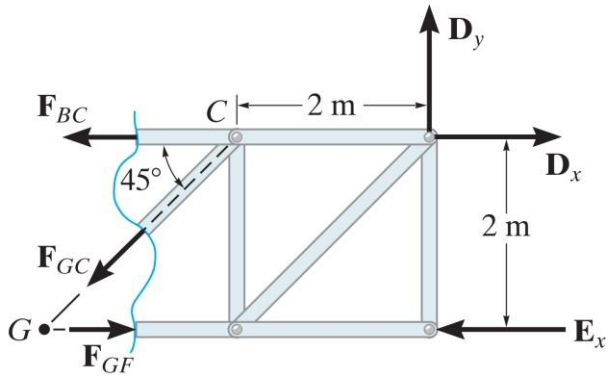
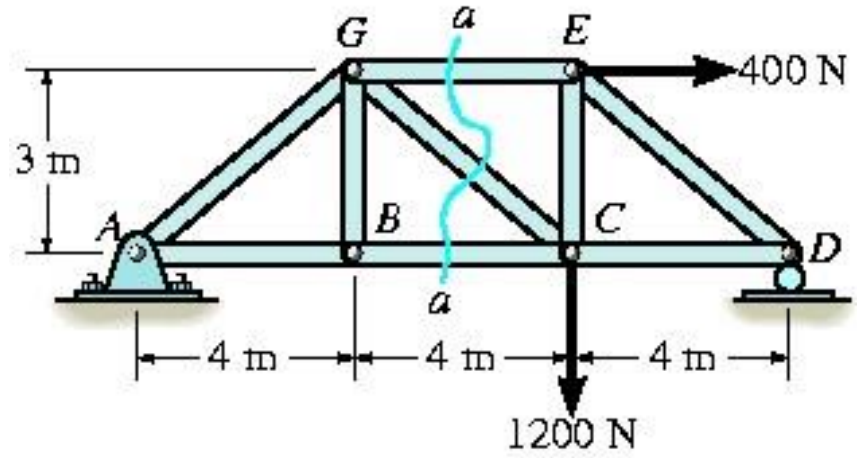


(c)

6. 4 The Method of Sections

Example 6.5

Determine the force in members GE, GC, and BC of the truss. Indicate whether the members are in tension or compression.

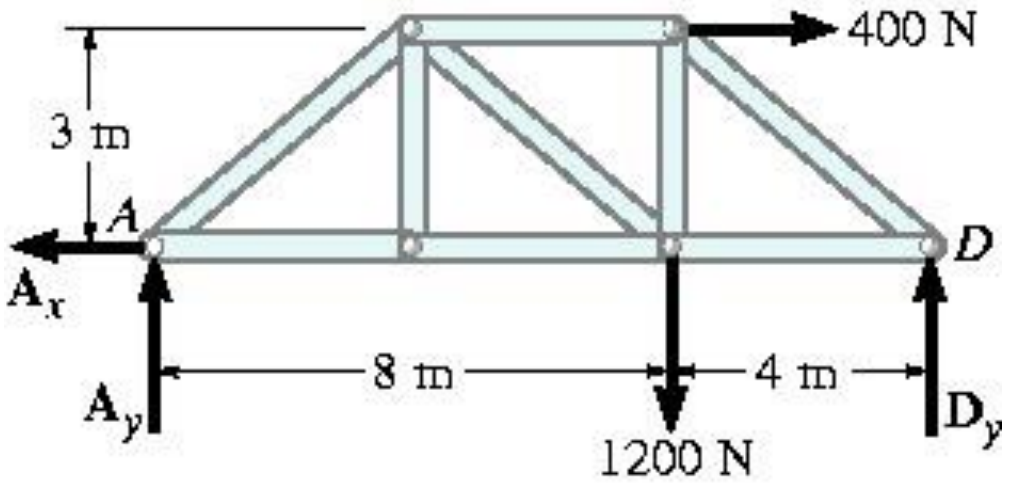


(a)

6. 4 The Method of Sections

Solution

- Choose section aa since it cuts through the three members
- FBD of the entire truss



(b)

6. 4 The Method of Sections

Solution

$$+\rightarrow \sum F_x = 0; 400N - A_x = 0$$

$$A_x = 400N$$

$$\sum M_A = 0;$$

$$-1200N(8m) - 400N(3m) + D_y(12m) = 0$$

$$D_y = 900N$$

$$+\uparrow \sum F_y = 0;$$

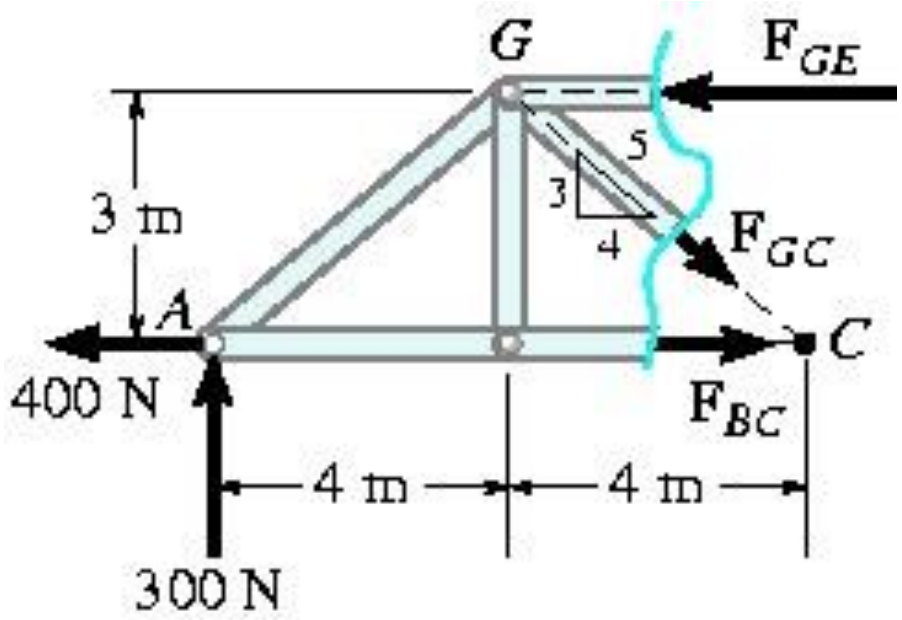
$$A_y - 1200N + 900N = 0$$

$$A_y = 300N$$

6. 4 The Method of Sections

Solution

FBD of the sectioned truss



(c)

6. 2 The Method of joints

Solution

$$\sum M_G = 0;$$

$$-300N(4m) - 400N(3m) + F_{BC}(3m) = 0$$

$$F_{BC} = 800N(T)$$

$$\sum M_C = 0;$$

$$-300N(8m) + F_{GE}(3m) = 0$$

$$F_{GE} = 800N(C)$$

$$+\uparrow \sum F_y = 0;$$

$$300N - \frac{3}{5}F_{GC} = 0$$

$$F_{GC} = 500N(T)$$

HOME ASSIGNMENT

- Draw the FBD of the sectioned truss in E.g. 6.6 & 6.7.