Structural Analysis Method of Sections

For a civil engineer, there’s no such thing as a “little mistake.”

If you had everything, where would you keep it?
All loads are made on the pins/joints
No pin can be analyzed that has more than two unknowns
We have only two equilibrium conditions: sum forces in x and y direction
All the forces in the members lie along the members
Review – Method of Joints

- If a member is in compression, it is pushing on the pin at each end of the member.
- If a member is in tension, it is pulling on the pin at each end of the member.
- A member may carry no force, then it is known as a zero force member.
The second method of truss analysis that we will consider is called the method of sections.

The method of sections depends on our ability to separate the truss into two separate parts, hence two separate FBDs, and then perform an analysis on one of the two parts.
Method of Sections

- The method of sections utilizes both force and moment equilibrium.
- The method of sections is often utilized when we want to know the forces in just a few members of a complex truss.
- We usually divide the truss at the members we want to know.
Method of Sections

- Unless we have more information, we will not separate the truss using more than three members.
- The separation must divide the truss into two completely separate parts.
Method of Sections

- To illustrate the method of sections, we will analyze the truss shown in following problem, but this time we will only determine the forces in members BC, CG, and GF.
Method of Sections

- First we will consider the truss itself, assuming that we already know the reactions at A and E.
Method of Sections

• We could use the method of joints to find the members we are looking for but the method of sections is lazier.
Method of Sections

- Actually we could have found the reaction at only one of the supports since only one of the supports will be in our final FBD.
Method of Sections

• Let's begin by removing members

• Assume that the members are in compression (your choice)
Method of Sections

• So if we remove BC we have
Method of Sections

- Now that isn’t two forces BC, it is the compressive force in member BC acting on each pin it is connected to.
Method of Sections

• Now we do the same thing with member CG
Method of Sections

- And finally with member FG
Method of Sections

- Notice that we have effectively separated the truss into two parts or sections
Method of Sections

- Each of the two parts of the truss must still be in equilibrium so we can choose either side and make our calculations.
Method of Sections

- We will choose the left side
- For the remainder of this analysis, we can ignore the right side of the truss

![Diagram of a truss structure with forces and distances labeled]

- Distances: 1.5 m, 1.5 m, 1.5 m, 1.5 m, 2.0 m
Method of Sections

- This is the FBD of the section that we will now work with
Method of Sections

- Notice that anything that is not directly connected to the side we are using is not included in the FBD
Method of Sections

- We can now use our equilibrium calculation to solve for the three cut members
Method of Sections

- Since we are not looking at a point we can use all three equations of equilibrium
Method of Sections

- We can start by taking the moments about point G and solving for BC

\[
\sum M_G = 0 \\
-(1.5m)(35kN) + (2.0m)(BC) = 0 \\
BC = \frac{(1.5m)(35kN)}{2.0m} = 26.25kN \\
BC = 26.25kN \]
Method of Sections

- We also could have chosen to sum the moments about C to solve for FG
Method of Sections

• The point we choose to sum moments about doesn’t have to be on the FBD but it should eliminate two of the unknowns.
Method of Sections

• Now we can sum forces in the y-direction and solve for CG

• CG is on a 3-4-5 triangle

\[
\sum F_y = 0
\]

\[
35kN - 40kN - \frac{4}{5} CG = 0
\]

\[
CG = \frac{5}{4} 5kN = -6.25kN
\]

\[
CG = 6.25kN \quad \boxed{T}
\]
Method of Sections

- Finally, we can sum the forces in the x-direction and solve for FG

- Notice I have redrawn the FBD using my new information about CG

\[ \sum F_x = 0 \]

\[ -26.25kN + \frac{3}{5}6.25kN - FG = 0 \]

\[ FG = \frac{3}{5}6.25kN - 26.25kN = -22.5kN \]
An Example Problem

• Problem 6-33