# Transcript for 5.3 The Method of Joints

## 0:01

Hello. In today's video lecture, we're going to talk about the method of joints. In this method - as well as in the method of sections and the analysis of frames and machines - we are trying to determine the forces acting on each individual member in a structure.

If each member is a two-force member, as it would be in a truss (which is what we are analyzing), we need to find the magnitude of the force and whether the member is in tension or compression. Each member is either in tension, with two equal and opposite forces pulling on it, or in compression, with two equal and opposite forces pushing together on it.

## Assumptions (0:43)

The method of joints works under the following assumptions:

1. The structure being analyzed is in static equilibrium.
2. The members in the truss are connected with pin joints. At these pin joints, forces can be exerted but no moments. This is necessary for two-force members.
3. Each pin joint is also in static equilibrium. At every joint, the sum of the forces must equal zero.
4. Each member connected to a pin either pushes or pulls along the pin in a known direction. The line of action of the force is the line between the two connection points in the member.

## Method (1:32)

For the method of joints, we follow this process:

1. Label all joints if they are not already labeled. Typically, we use letters. For example, joints A, B, C, and D. Members are named by their endpoints: AB, BC, AC, BD, and CD.

2. Treat the entire truss as a rigid body and solve for the external reaction forces. Using equilibrium equations - sum of forces in the x-direction equals zero, sum of forces in the y-direction equals zero, and sum of moments about a point equals zero - we can determine the reaction forces.

3. Separate the truss into individual joints. Each joint is treated like a pin. Draw the known forces, including reaction forces and applied loads.

4. Draw all member forces acting on each pin, creating a free-body diagram for each joint. Assume tension in each member. Replace each member with the force it exerts on the pin.

5. Write the equilibrium equations for each joint. Because the pins behave like particles, we only use force equations - no moment equations. Each joint can provide up to two equations: sum of forces in the x-direction equals zero, and sum of forces in the y-direction equals zero.

6. Solve the equations. With five members, we have five unknowns and more than enough equations. Start at a joint

with only two unknowns, solve for those forces, and then move to adjacent joints. Continue working across the truss.

Positive results indicate tension (because we assumed tension). Negative results indicate compression.

## Modifications (6:06)

For space trusses (3D trusses), the method is similar but expanded:

1. Optionally analyze the entire truss as a 3D rigid body to find reaction forces. This can involve up to three force equations and three moment equations.

2. Start at a joint with three or fewer unknown forces and draw a free-body diagram.

3. Use three equilibrium equations at each joint: sum of forces in the x-, y-, and z-directions equals zero.

4. Assume tension in all members. Positive results indicate tension; negative results indicate compression.

5. Use angles or the ratio method to break vectors into x, y, and z components.

6. Solve the equilibrium equations, working joint by joint across the truss.

Thank you for watching today's video lecture.