Engineering Mechanics
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Module 02
Lecture No 24
Plane trusses VI: method of sections for calculating forces in a simple truss

Having done method of joints, now we go to other method called method of sections where if the number of joints becomes too large, that method comes out to be handy. Imagine a huge big truss where you have to keep going from one point to the other, the method may become a very very time-consuming method.

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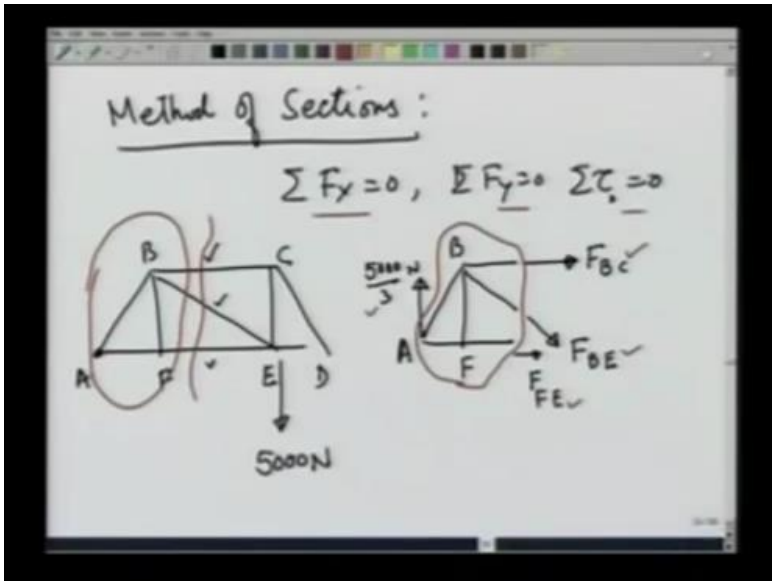

In that case, the method that is used is known as the method of sections in which case we cut a section through the truss so that maximum of 3 members are cut and then I have 3 questions to solve. Namely summation FX equal to 0, summation FY equal to 0 and summation Tao about some point equal to 0. That gives me those 3 forces. Let me illustrate this method again by the same truss that we have solved so far.

A, B, C, D, E, and F and here is a load of 5000 newtons. Suppose I want to now get the forces in members BC, BT and FE. What one would do in that case is make a cut through these members and look at this section on the truss and see how this is in equilibrium. In particular, if I make

this section AB, I made a cut here, I made a cut here and I made a cut here. ABF, this member would be pulled this way by a force FBC. It does not matter what direction you take.

If the direction is opposite, you will get a negative sign. Already we have seen that at A, there is a force of 5000 over 3 newtons. This may be pulled this way by FBE and this way by FFE. So now, this section of the truss is in equilibrium under the forces FBC, FBE and FFE and the Force 5000 over 3 newtons which is known already. I have 3 unknowns and 3 equations. Namely summation Fx equals 0, summation FY equal to 0 and summation Tao is 0. So I can solve for 3 these unknowns.. Let us do that.

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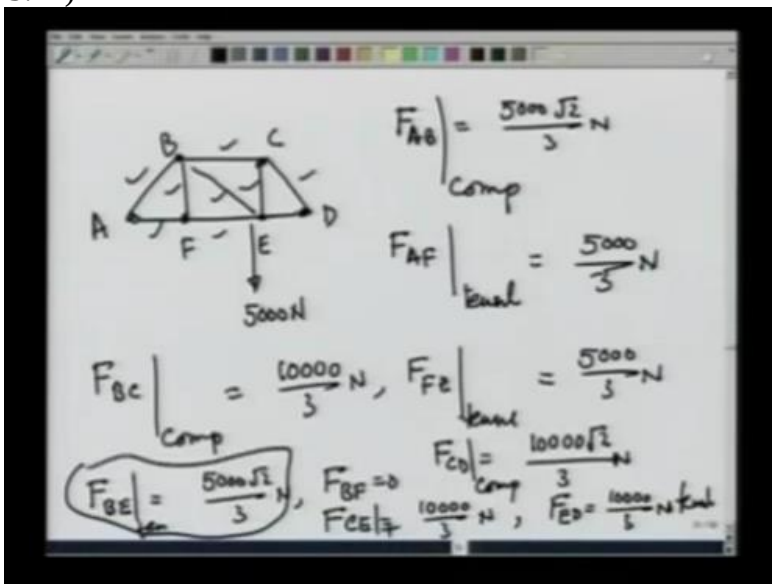

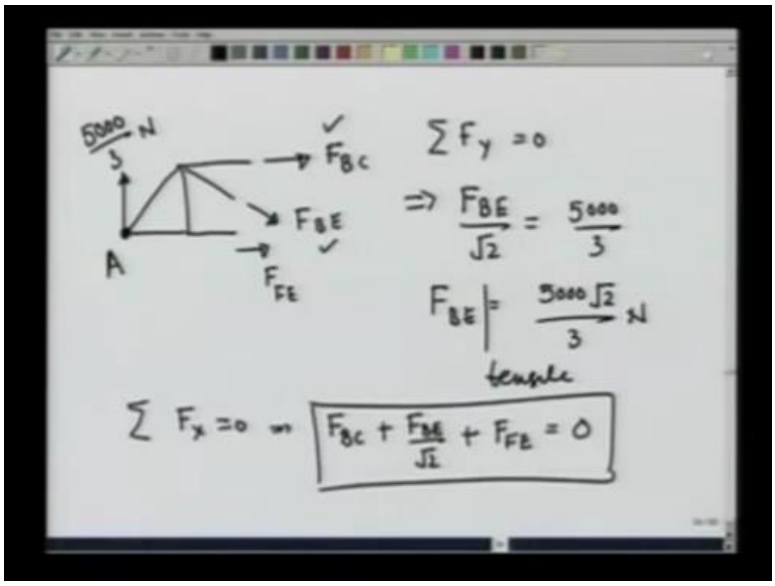

So what I have is this section of the truss. This is being pulled this way by force FBC, this is being pulled this way by force FBE and this is being pulled this way by force FFE and there is a net force here which is already been solved for 5000 over 3 newtons. Right away, summation FY equal to 0 gives me that FBE over root 2 is equal to 5000 over 3 or FBE is equal to 5000 root 2 over 3 newtons.

And you can see that this is actually pulling the rod and therefore this is going to be a tensile force. Let us compare this what we had gotten earlier. We had obtained FBE to be tensile of 5000 root 2 over 3 newtons. Now summation Fx is equal to 0 gives me that FBC + FBE over root 2 + FFE is equal to 0. Only FBE is known and therefore FBC I get a relationship between FBC and FFE.

From this equation, I cannot get it. So what I will do is, instead go to Torque equation about this point. If I calculate the torques about point A, there are 2 torques, FBC and due to FBC and FBE acting on the truss and these torques must add up to 0 and that is what will give me FBC in terms of FBE. Let us do that next.

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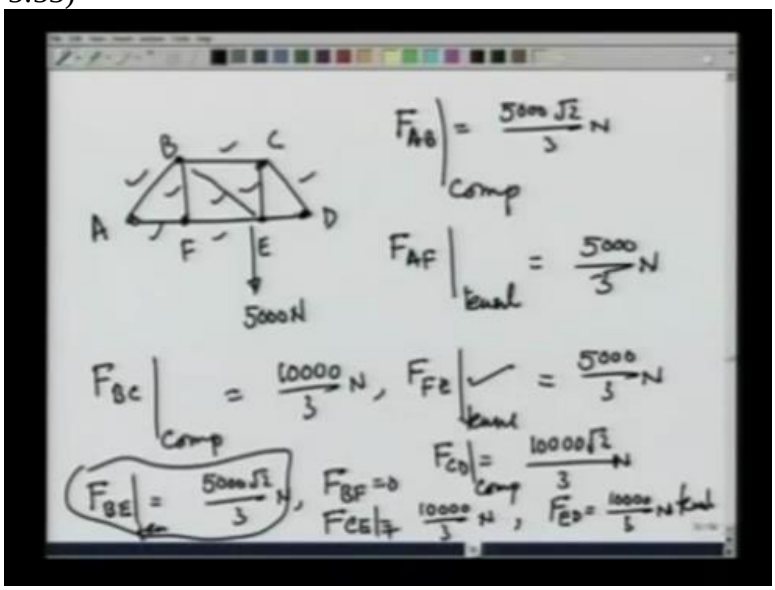

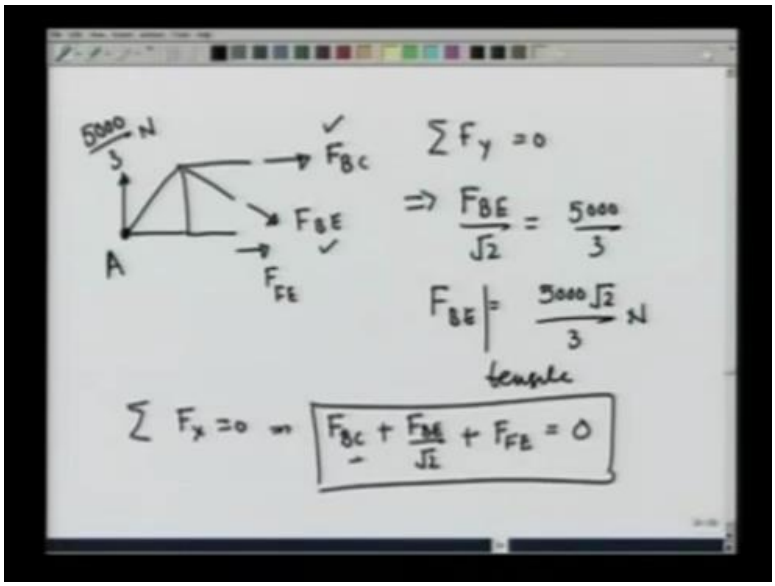

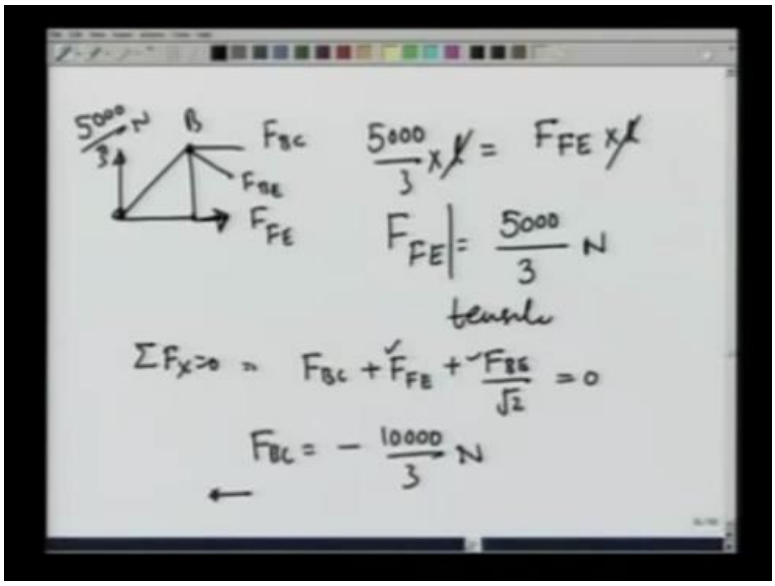

So these are the forces which are acting, FFE, FBE, FBC, 5000 over 3 newtons. Either I can take Torque about these 2 points and calculate FBC in terms of BE. Easier would be to take Torque about point B and balance the torques due to FFE and 5000 over 3 newtons. And that gives me 5000 over 3 times L. One way is equal to FFE and the direction is also correct times L L cancels and FFE comes out to be 5000 over 3 newtons.

This is also pulling the rod and therefore FFE is tensile. We can compare with the earlier answer where we had calculated FFE to be tensile or 5000 over 3 newtons. Now using the equation summation Fx equal to 0, I can also calculate FBC and let us do that. We have summation Fx equal to 0 which gave me FBC + FFE + FBE over root 2 is equal to 0. We already calculated FFE and FBE. FBE is equal to 5000 root 2 over 3 and that gives me FBC is equal to - 10,000 over 3 newtons and this is coming with a - sign.

Therefore FBC is in the opposite direction and it is compressing the rods. So FBC is 10,000 over 3 compressive force which we had of course obtained earlier as you can see. FBC was compressive 10,000 over 3 newtons. So we have learnt two methods of analysing forces in a truss.

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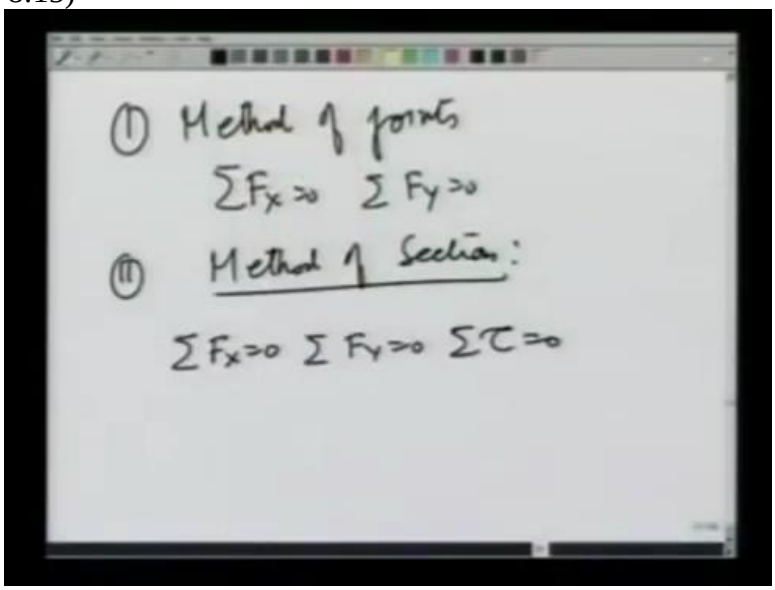

One is method of joints where we take each in joint and make, apply equilibrium conditions there. There is no Torque involved there because of each pin joint the torque due to forces passing through that joint are 0. And therefore the only conditions we have are summation FX equal to 0, summation FY equal to 0. The other method that we have seen is method of sections which can be applied to selectively calculate forces and different members of a truss.

What is done in this is a section is made where maximum of 3 forces are passing through because the equations that we apply are 3 in numbers FY equal to 0 and summation Torque is equal to 0. So in any calculation maximum forces I can calculate are 3. So section is made so that there are maximum 3 forces through that section and then we apply the equilibrium conditions to get these forces.

This is a simple plane analysis of trusses. To summarise, what we have done is analysed plane trusses and gotten forces in them. In an advanced course what you will be learning is how to analyse three-dimensional trusses and also how to take deformities into account.