Engineering Mechanics
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Statics – 2.7

Now quite often you will have a problem like this. Let's say I am just going to give a problem and ask you a question related to trusses. Let's say I build a bridge. Let's say some bridge like this, please remember all these nodes are pinned nodes and let's say I have built a bridge like this. There is a force acting on this due to the vehicle moving on this, let's say that force is P. I am particularly interested in finding out what will be the force in this particular member. In a design let's say I have this question that is posed to me. I need to find out this load so that I can verify certain fact related to this. In the method that we followed, let me just number them. Let's say if it is A, B, C, D, E, F, G, H, I and I am interested in the force in section G H. The earlier method what we did is we went by sectioning in such a way that each of the sections had one joint in it or one pin in it and then we revealed all the forces that emanate from this joint.

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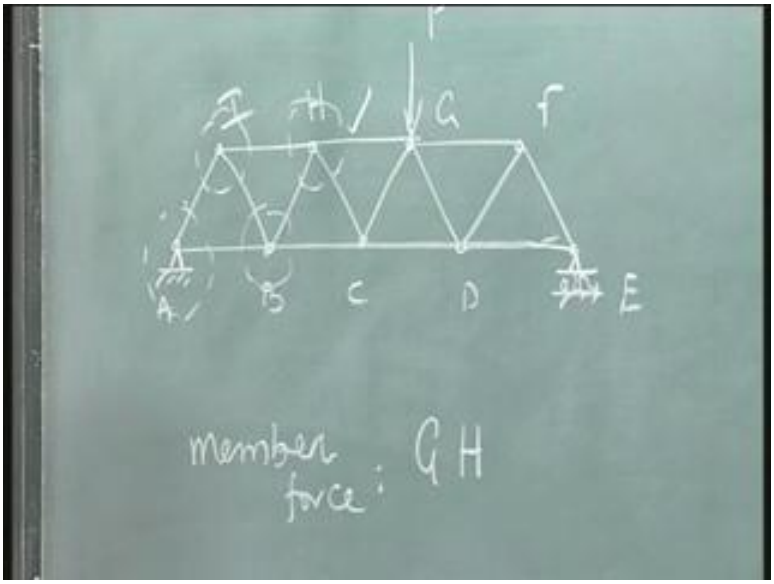

Then solve the problem but if you do that for this truss, I have just shown only 1, 2, 3, 4. Sometimes the truss may have hundreds of spans and if I need to find out a member force like this, it becomes a tedious task. Is there a simple procedure? The answer is there in the earlier statement itself. I did a section like this who prevents me from making another section which includes many joints. The question that we can ask is can I section this truss that includes many joints. The answer is why not and that's what we are going to do here.

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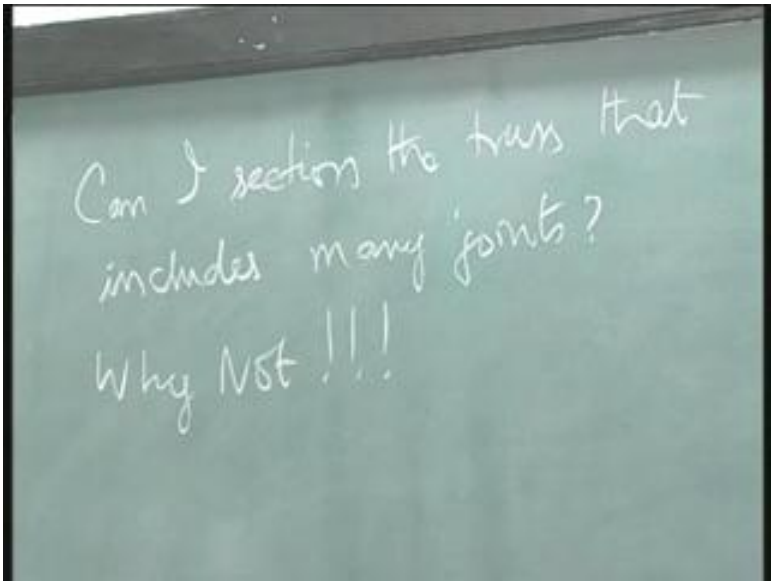

We call that kind of method as method of sections. To me it does not make a difference whether I did it like this or many joints at a time, I would call this is also a method of section but a particular method of section. We called it as method of joints in earlier case. How do I find out G H? Of course one of the important things that I have to do is I have to section G H then only then only I can reveal the forces in it. One important thing I know is I have to section. I have to remove the supports so that there is no more attachment to the fixed frame of reference. What else can I do? I can cut in some way and take a block and look at the forces and see if I can solve for G H. I will just do a few cuts to reveal and explain to you this particular method. Let me just erase it and draw a fresh one.

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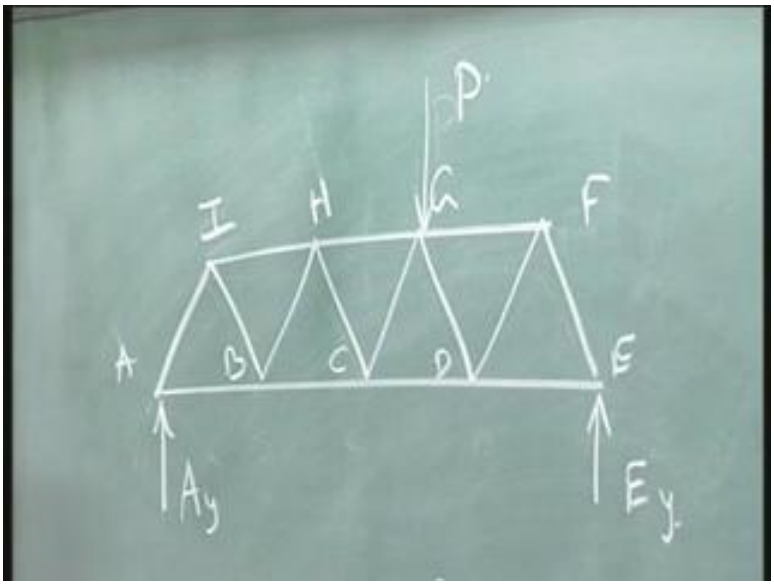

For now we can easily find out these two reactions. Let's say this span is the same, let's say l l l l, let's say the height is also equal to l. What we need to find out is this member force G H so which automatically means that I need to section this G H. This is already known, this is already known by total equilibrium. How do I section? I can probably section in such a way that I take this side of it or I could probably do like this. Let's see if that is a good section to find out the member force G H.

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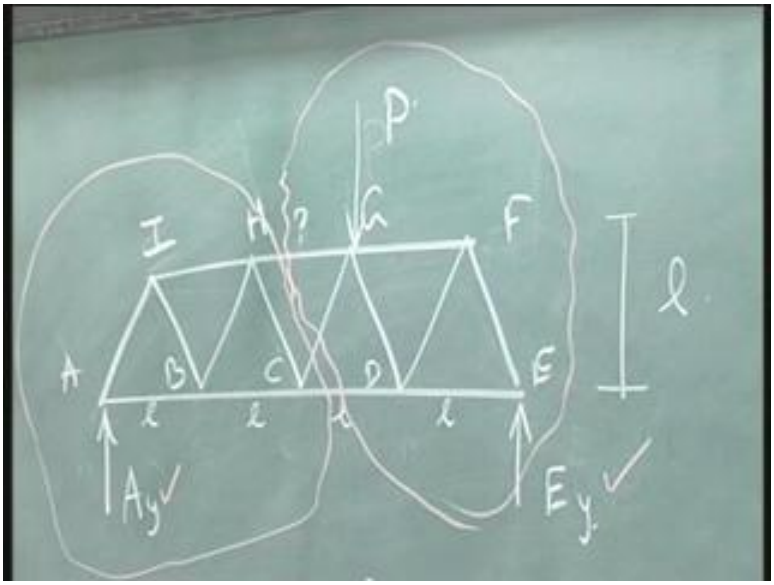

Let me just draw that to make it clear from which I am going to draw this section, I am going to call this section as 1, this section as 2, this is F E. We have D, we have G this is cut. C D is cut, what else is cut? There is a member going like this which is C G that is also cut. So like before let's just represent these forces because of this sectioning. G H will act like this. How do I know it acts like this? I will take the force to be emanating from the joint G. Similarly for this, the force is emanating from D, so I am going to call this as C D and this is C G force C G is acting on this. All are assumed to be at tension. What do I want to know? I want to know this particular member force G H but I have two more forces here all the rest are known. E_y is already known by earlier treatment of the entire body and there is a force acting on G which is equal to P.

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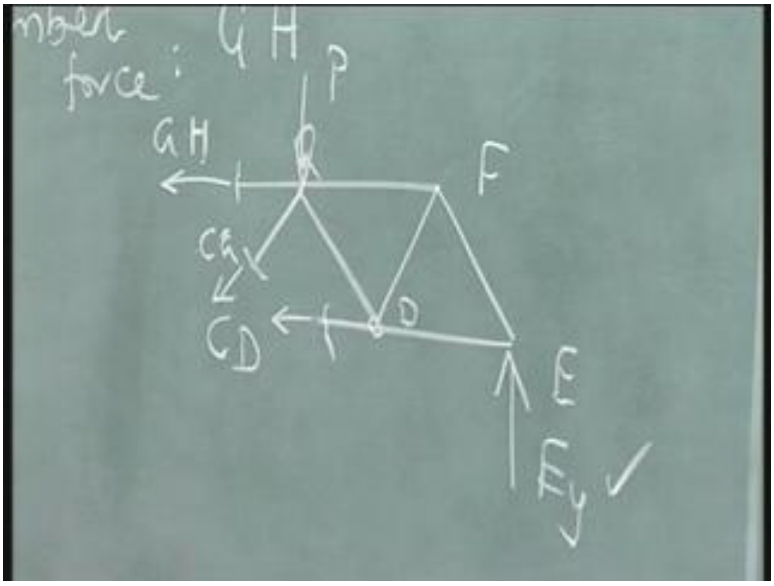

How many forces are unknowns here? G H is not known, C G is not known C D is not known but I want only G H. earlier we have done this particular exercise of finding out a member force directly. In this case what joint will you take or what point will you take in such a way that I can get a single equation in G H. The answer is pretty simple, I will extend this force, this force, find the meeting point. What is this meeting point? This meeting point is nothing but C and if I take moment of all the forces about C, it will not involve C G and C D which means immediately I can get G H. The rest of the exercise is simple so let me take moment about C of this particular section one. Let's say this is positive, this is l, l and this is l. If this is in static equilibrium, total moment at C is equal to zero implies this about this point, this force is in the anticlockwise sense it is E_y times the length which is 2 l.

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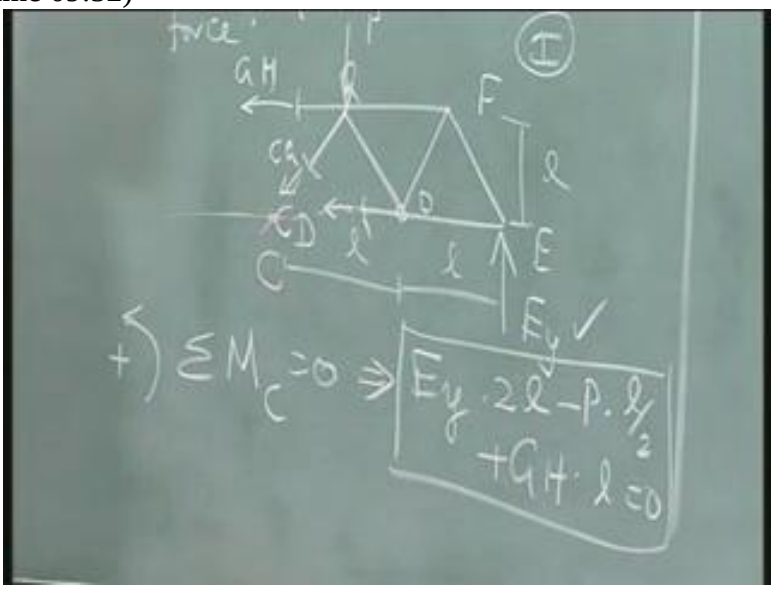

The other force that is existing is P and that is in the clockwise sense about C which is about l by 2 from C and therefore it is minus P times l by 2. Is there any other force? G H is acting. G H is in the anticlockwise sense and the height is equal to l so which means it is plus G H times l equals zero. I know l, in this particular case I need not know l also. I can find out G H to be nothing but P minus 2 l. Simple. In a similar way if I look at this particular section, I will be revealing the same three forces and I can take moment about C in order to solve for the same thing. In this left hand side section, I have only one force in addition to G H that I need to write down. That makes it a little more simple. So it's a matter of a choice. Is there any other way by which I can section and find out this particular thing. The answer is well possible but this is the simplest thing that you can do and you can immediately solve for this problem.

This kind of solving is called method of sections where you are interested in only one member force or a couple of member forces and so on. Is there any other way of cutting? For example can I ask you what if I had cut like this? Is this cutting okay? Not okay because this is what we did for method of joints. We had to know the other forces in order to solve for G H. A sectioning like this is similar to sectioning like this except that it reveals B C, C H in addition to G H and B C and C H are coincident at C again. I will be taking moment about C but for a section which is separated by this. It will be like this. Is this clear? Thank you.

Now our student venket rao wants to know if I have to find out the horizontal force members G H and D F, this and this I need to find out. Is there a way of sectioning in by which I can solve for them in one single go. Well that's a good question let's see. Definitely I have to cut this, I have to cut this. What all ways can I go about doing this? I can take something like this. Is it possible? In which case I will be revealing a force like this, a force like this, a force like and a force along this. If I take vertical equilibrium, this and this force will come into picture which means I cannot take one single force in order to do this. If you notice force F G, G H are coincident at this point, G C is also coincident so 1, 2, 3 are coincident at this. But this force C D, D E and D F are not coincident which means may be there is no single sectioning I can do, in order to solve this problem. So what I could probably do, if I have to solve for this particular member, I can as well cut like this. So I have revealed these three forces F G, D F and D E.

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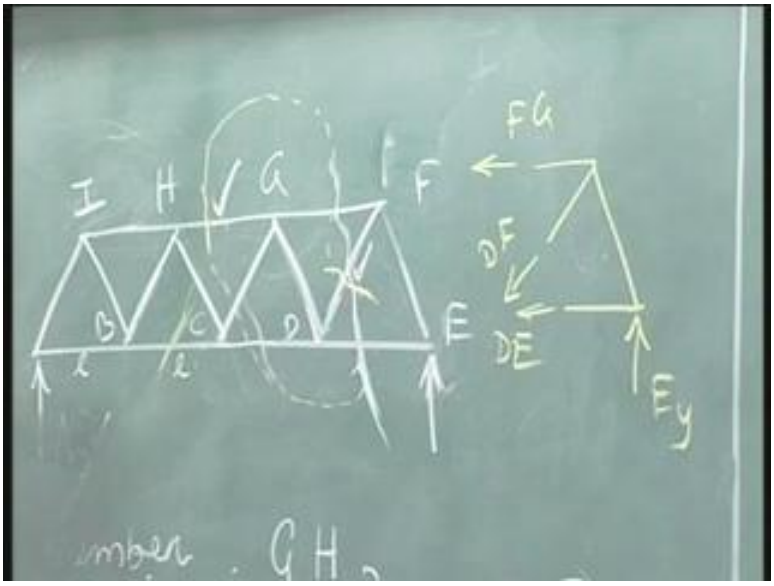

Notice D E and F G are horizontal forces and if I have to eliminate using D E and F G, I just have to take a vertical equilibrium which means only component of D F and E_y will come into picture and I can solve for them. The way to go about solving for D F in this particular case is sigma F_y is equal to 0. So we have to use a suitable equation in order to solve for the member forces. In short you will find out an appropriate section, take a particular section which is simple in which less number of forces are acting. If there are three forces like this acting and I want to find out one of the forces then find out which equation will be the most appropriate to solve. There you go. That's how you can solve for member forces.

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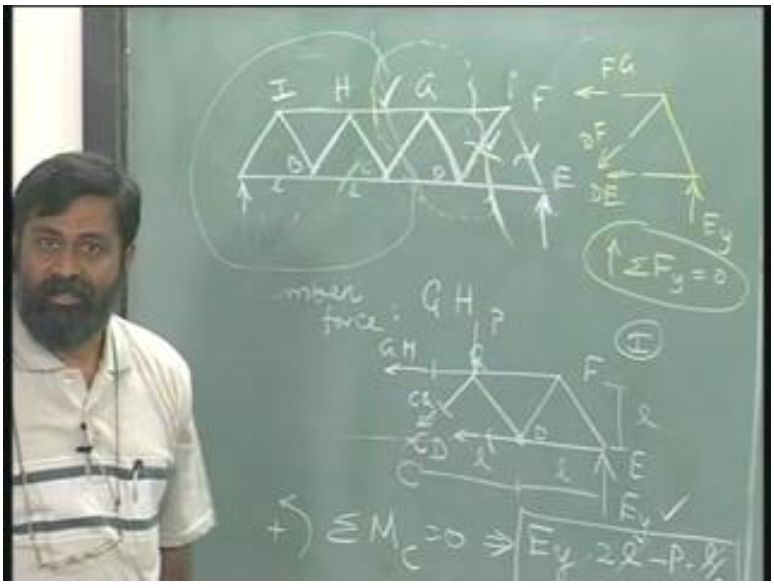

In order to solve for G H, you have already done that. You will take a section like this and then solve for it. So you need to do two separate sectioning in order to solve for this problem. If there are too many forces to be found out, might as well go for F. How will I find out the force in this? I don't have to do anything, I can take the joint E and find out the equilibrium of joint ~~E~~. You have to use your judgment, sometimes you may have to use method of joints in order to find out. After all method of joints is nothing but sectioning in a particular way. Here sectioning is such that one joint is within. The other sections that we did, we had more number of joints that get revealed or included.