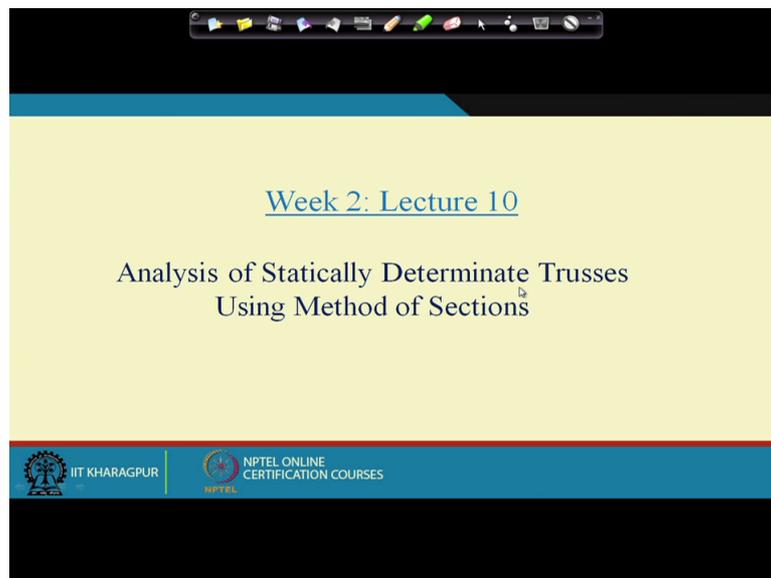


Structural Analysis 1
Professor Amit Shaw
Department of Civil Engineering
Indian Institute of Technology Kharagpur
Lecture 10
Analysis of Truss: Method of Sections

Okay, welcome to lecture 10. Let us continue with what we have been doing in this week. We have been discussing analysis of statically determinate truss. We learnt analysis of statically determinate truss means for this week we are only focusing on determination of internal forces, the member forces in the truss. We have already discussed one method, method of joints and I believe that by now you are comfortable with method of joints.

What we will be doing today and next class, we will discuss another method called method of sections, okay. So today we will start analysis of statically determinate trusses using method of sections.

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If you recall that in the last lecture we stopped at this problem and we said that the demonstration method of sections will be done through this problem. But before we do that let us try to understand what method of section is.

(Refer Slide Time: 01:34)

Method of Joints

Tension (+)

Determine force in member CD. ABC is an equilateral triangle. D, E and F are mid points of the respective side (L). 60°

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You know what method of joint is in a truss we have members, joints and supports. Method of joints is you take every joints, whatever required joints separately, draw the free body diagram of those joints then apply equilibrium conditions on those free body diagrams and then get a system of equations and find out and solve those equations to get the unknowns, the member forces. Now method of section is let us just consider a truss. Now in method of joints we can take these joints and draw free body diagram of these joints, right?

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Method of Sections: Concept

Tension (+)

P_1 , P_2 , P_3

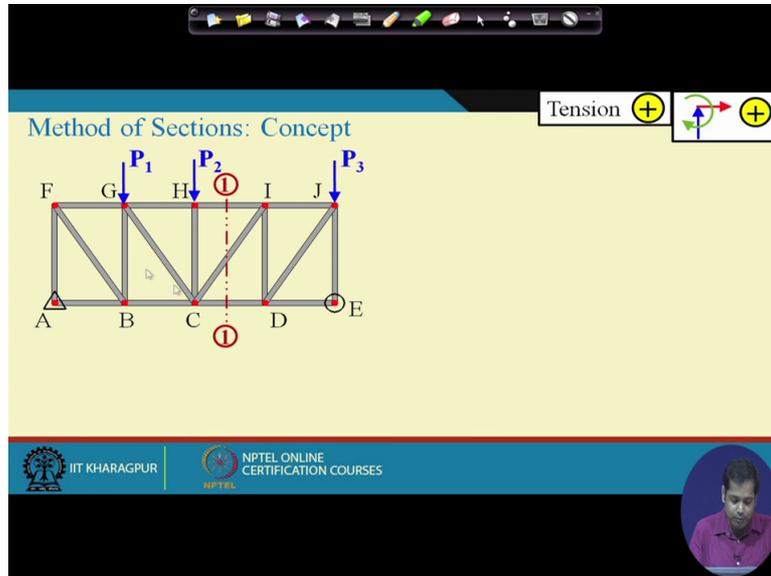
A, B, C, D, E, F, G, H, I, J

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Now method of section is take one section in this truss. Let us say section 1-1 and break this truss and this section. So if you break the truss in this section we have two part of the truss.

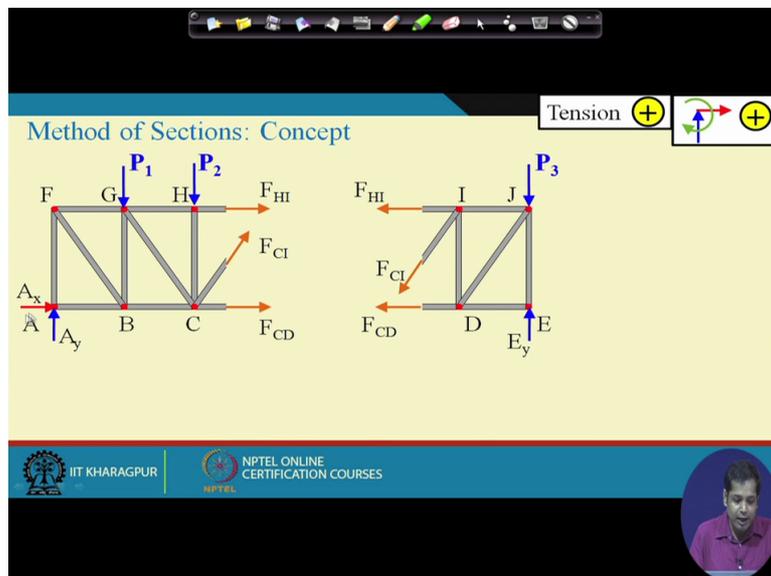
One part is this and another part is this. Now if you break it and this part is separated from this part.

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So this part is separated from this part, okay. Now draw the free body diagram of both the parts. If we draw the free body diagram then the free body diagram will be this, okay.

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It was a hinge support so it is represented by two forces horizontal and vertical reactions and the roller support here, only one reaction at E. Now this section breaks member HI, member CI, and member CD, right?

(Refer Slide Time: 03:11)

The slide displays a truss structure with a cut through members HI, CI, and CD. The left part of the truss shows external forces P_1 and P_2 at nodes G and H, and reaction forces A_x , A_y at node A and F_{CD} at node C. The right part shows external force P_3 at node J and reaction force E_y at node E. Internal forces at the cut are labeled F_{HI} , F_{CI} , and F_{CD} . A sign convention for tension is shown in the top right, indicating that tension is positive.

And FHI, FCI, FCD, they are the forces in those members. Now if we break it and then that section is to be represented by the member forces that we discussed while we discussed about free body diagrams. Now as per our sign convention, tension is positive. So tension means in the member it will be in this direction, right?

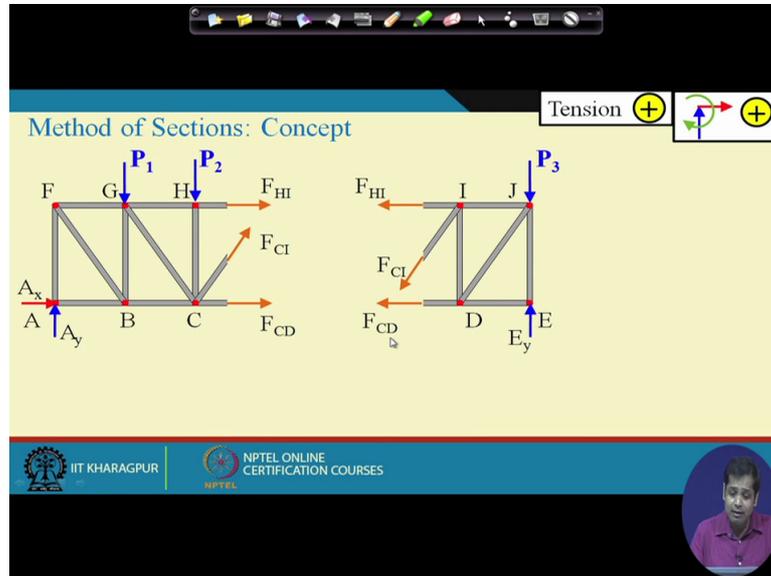
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The slide displays the same truss structure and cut as the previous slide. The internal forces at the cut are labeled F_{HI} , F_{CI} , and F_{CD} . The sign convention for tension is shown in the top right, indicating that tension is positive.

Now so the member forces in HI is this, member forces in CI is this and member forces in CD is this. And same in the other part of the truss, these forces are this. Now if you join them together what will happen? This and this force they are equal and opposite. They will balance each other. This and this they are equal and opposite, balance each other and similarly this

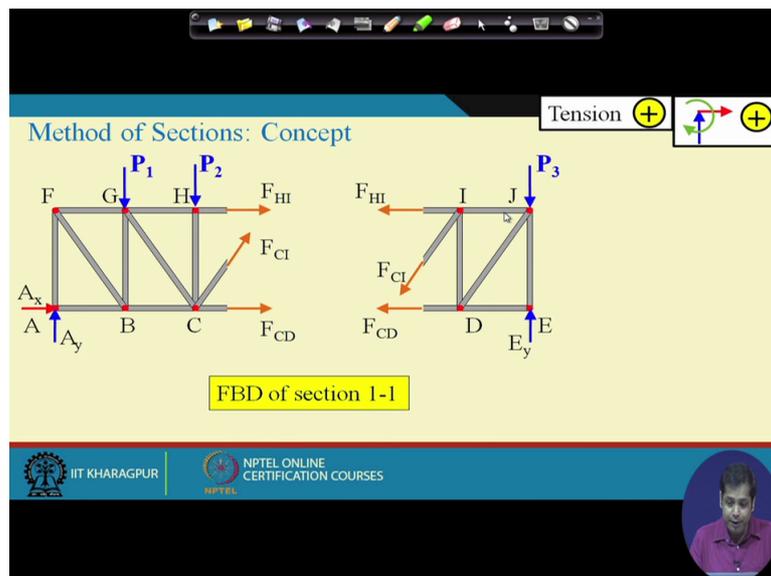
and this they are opposite, they will balance each other. Then the section will be in equilibrium, right?

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There is no net internal force at that section. So it is consistent with the equilibrium condition, this free body diagram. Now next step is to apply the equilibrium condition on this section. So this is the free body diagram of section 1-1, okay.

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What we will do today is we will demonstrate this, this method is called method of sections. And we will demonstrate this method through some examples. Now let us start with this

example. This was the example we took in the last class. We need to determine the forces in this member, member CD. We need to find out (mo) forces in this member, okay.

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Method of Joints Vs Sections

Determine force in member CD.
ABC is an equilateral triangle.
D, E and F are mid points of the respective side (L).

Tension +

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Now just to (appreci) appreciate the method of section in a better way let us analyse this same structure doing both method, method of joints as well as method of sections. Let us start with method of (gen) joints and then see what are the steps need to be performed in method of joints and beside this if we apply method of section then what are the steps required, okay. So first step is you expect whether you use method of joints and section.

Let us first try to inspect the truss visually before we actually go for analysis and find out if we have some information about this structure. If you can slightly simplify it. Simplify means for instance in this case just by visual inspection we can say that member FD is a zero force member, okay. Why member FD is a zero force member?

Same concept if you remember last class we discussed, suppose if we draw the free body diagram of joint F then the free body diagram will be something like this. This is F and then this is FFD and this is FFC and this one is FFA. Now this is the free body diagram of joint F.

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Method of Joints Vs Sections

Tension (+)

Determine force in member CD. ABC is an equilateral triangle. D, E and F are mid points of the respective side (L).

Visual inspection
FD is a zero force member
 $F_{FD} = 0$

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Now this force FC and FA, their line of action is same. But FD has a different line of action. FD has one component normal to this line of action and another component along this line of action. Now there is no other forces which can balance the component of FD normal to this line of action.

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Method of Joints Vs Sections

Tension (+)

Determine force in member CD. ABC is an equilateral triangle. D, E and F are mid points of the respective side (L).

Visual inspection
FD is a zero force member
 $F_{FD} = 0$

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So the normal component has to be zero. If the normal component is zero naturally the force in FD is equal to zero. So we do not need this step as I said earlier also, you do not need this step. This step needs to be performed in your mind. Just by looking at the truss you should be able to say what are the zero force members, okay.

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Method of Joints Vs Sections

Tension (+)

Determine force in member CD. ABC is an equilateral triangle. D, E and F are mid points of the respective side (L).

Visual inspection
FD is a zero force member
 $F_{FD} = 0$

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So in this case member FD is a zero force member, okay. Now first let us determine the support reactions. Draw the free body diagram of the entire structure. Again this is hinge support and this is roller support. They are represented by their reactions. It is an equilateral triangle. This angle 60 degree and this side is L.

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Method of Joints Vs Sections

Tension (+)

A_x , A_y , B_x , B_y

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So first take support reactions. First take summation of F_x is equal to zero. Summation of F_x means forces we have in x direction is A_x and P. They both are positive. You see this is our sign convention when we do the algebraic operation. So it gives you A_x plus P is equal to

zero and which gives you eventually A_x is equal to minus P . So this is horizontal reaction at support A.

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Method of Joints Vs Sections

Tension (+)

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

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Now let us take moment about A. If you take moment about A then only forces which will contribute to the moment is this and this force.

(Refer Slide Time: 08:40)

Method of Joints Vs Sections

Tension (+)

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

$$\sum M_A = 0 \Rightarrow P(L/2)\cos 60^\circ - B_y L = 0$$

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Then moment of this force about A will be clockwise and moment of B_y about this point will be anticlockwise.

(Refer Slide Time: 08:49)

Method of Joints Vs Sections

Tension \oplus

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

$$\sum M_A = 0 \Rightarrow P(L/2) \cos 60^\circ - B_y L = 0$$

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So this will be positive and this will be negative as per our sign convention. Now what will be the moment of P? Moment of P will be P into this distance. This distance is $L/2 \cos 60$ degree.

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Method of Joints Vs Sections

Tension \oplus

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

$$\sum M_A = 0 \Rightarrow P(L) \cos 60^\circ - B_y L = 0$$

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And then into P and then this distance is L, so $B_y L$ is equal to zero and eventually you will get B_y is equal to this.

(Refer Slide Time: 09:21)

Method of Joints Vs Sections

Tension (+)

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

$$\sum M_A = 0 \Rightarrow P(L/2)\cos 60^\circ - B_y L = 0$$

$$\Rightarrow B_y = P\sqrt{3}/4$$

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Once you have B_y is equal to this, next is take summation of forces in y direction. Summation of forces in y direction is zero. Y direction forces we have only A_y and B_y . They both are vertically upward. As per our sign convention this is positive. So this is positive and B_y we already determined here. So A_y will be this.

(Refer Slide Time: 09:43)

Method of Joints Vs Sections

Tension (+)

Support Reactions

$$\sum F_x = 0 \Rightarrow A_x = -P$$

$$\sum M_A = 0 \Rightarrow P(L/2)\cos 60^\circ - B_y L = 0$$

$$\Rightarrow B_y = P\sqrt{3}/4$$

$$\sum F_y = 0 \Rightarrow A_y + B_y = 0$$

$$\Rightarrow A_y = -P\sqrt{3}/4$$

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So these are all support conditions, right? These are all support reactions. This is support reaction and this is support reactions. So we have determined support reactions.

(Refer Slide Time: 09:58)

Method of Joints Vs Sections

Tension (+)

Support Reactions

$\sum F_x = 0 \Rightarrow A_x = -P$
 $\sum M_A = 0 \Rightarrow P(L/2)\cos 60^\circ - B_y L = 0$
 $\Rightarrow B_y = P\sqrt{3}/4$
 $\sum F_y = 0 \Rightarrow A_y + B_y = 0$
 $\Rightarrow A_y = -P\sqrt{3}/4$

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Now irrespective of method of sections and joints we use if we have to determine the support reactions so similar approach may be followed, okay. Now once the support reaction is determined then let us move on. These are the support reaction just now we have determined.

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Method of Joints Vs Sections: Joints

Tension (+)

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

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Now first we need to determine member force in CD. Therefore what we can do is in order to get the member force in CD we need to draw the free body diagram of C, right? Now free body diagram of joint C. Now at joint C how many members we have? We have three members. So as we discussed when we choose a joint you have only two equations per joint, right? When you choose a joint then make sure that at this joint you have only two unknowns.

Even if you choose a joint with three unknowns that is also possible but in that case just from that particular joint you cannot get all the unknowns. You need to get the information from other joints as well. Now in this case joint C has three members. So at least one member force should be known in order to determine member forces in CD by free body diagram of joint C and that member could be this member.

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Method of Joints Vs Sections: Joints

Tension \oplus

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now if we need to determine this member then free body diagram of joint E will give us this member. But again free body diagram at joint E you have three members, right? In order to get the force in this member at least one member force, either member ED or member EB should be known. Then only we can use free body diagram of joint E to determine member force in AC.

(Refer Slide Time: 11:53)

Method of Joints Vs Sections: Joints

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now in order to get this member force we need to take the free body diagram of joint B. So in this way in order to get the member force in CD we need to (deter) consider the free body diagram of joint B first, get member force in this member and then once this is known at joint D, at joint E only unknowns are this and this member forces.

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Method of Joints Vs Sections: Joints

FBD of Joint A

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Get the free body diagram of joint E, calculate this member force and then once this is known take joint C where only unknowns are this and this, calculate member force in CD.

(Refer Slide Time: 12:39)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint A

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So this is one way we can go. Another way is you take joint A, calculate member force here, member AF, then take joint F. Joint F, though it have three members, it is zero force member. So essentially this member you do not need to consider. We do not contribute anything to the equilibrium at joint F. So once we know the member force in AF, by taking joint F we can get the member force in FC. And then once it is done then take joint C to get the member force in CD.

(Refer Slide Time: 13:23)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint A

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So this is another approach, another way. Now you will realise that if we follow the second path then our computation will be easier as this member is zero force member. Now let us

first consider joint A. So this is the free body diagram of joint A. two support reactions, member force FAD and member force in AF and this angle is 60 degree.

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Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint A

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Then apply summation of forces in y direction is equal to zero. What are the forces we have in y? Ay and then vertical component of FAF, vertical component of this force. Now so Ay which is upward vertical as per our sign convention positive and then AF sin 60 degree. Again it is upward so it is positive. Ay support reaction is already determined. So if you substitute that so what we get is member force in AF is equal to this, okay.

(Refer Slide Time: 14:39)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint A

$\sum F_y = 0$
 $\Rightarrow A_y + F_{AF} \sin 60^\circ = 0$
 $\Rightarrow F_{AF} = P/2$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now so this member force is known now, okay. If you want to determine member force in AD then we can take again summation of F_x is equal to zero and determine the member force in AD. But since that is not required right now because the problem was what was asked is the member force only in CD. And in order to get the member force in CD and if we go in this way we do not need member force in AD.

(Refer Slide Time: 15:13)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint A

$\sum F_y = 0$
 $\Rightarrow A_y + F_{AF} \sin 60^\circ = 0$
 $\Rightarrow F_{AF} = P/2$

$\sum F_x = 0$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So let us not do this here. So we know the member force in AF is equal to this, right? Now next take the free body diagram of joint F. If we draw the free body diagram of joint F then this is member force AF, this is member force in FC and their line of action is same.

(Refer Slide Time: 15:38)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint F

F_{FC}
 F_{AF}

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now since FD is a zero force member so FFD is equal to zero that why it is not shown here. Now you see from this free body diagram it is obvious that since their line of action is same, in order to maintain the equilibrium these two forces needs to be same, right? At this joint these two forces needs to be same and in opposite direction. So directly writing summation of F_x is equal to zero and summation of F_y is equal to zero we can say that this force and this force they are same.

And since we have already determined the member force in AF so member force in FC is equal to P by 2, right?

(Refer Slide Time: 16:21)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint F

$F_{AF} = F_{FC} = P/2$

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

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Now in such situations as we have just started learning method of sections and method of joints I am writing all this free body diagram explicitly all the joints. But you know when you really actually solve your problem just again by inspection you can say that member force in this member and the force in this member will be same, okay.

(Refer Slide Time: 16:47)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint F

$F_{AF} = F_{FC} = P/2$

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

So you do not need this step. Directly you can write this expression. Now this is now known and this is now known. Then last is take free body diagram of joint C. If we take free body diagram of joint C then it has three members CF or FC, CD and CE. They are all inclined at 30 degree angle. This is 30 degree, this is 30 degree and FC is a member force in CF and CD is member force in CD and CE is the member force in CE.

(Refer Slide Time: 17:26)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

Now we have already determined this. This member force is already known. So this is known.

(Refer Slide Time: 17:32)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So at joint C only unknown are this and this, two unknowns. We have two equations. We can determine these two unknowns.

(Refer Slide Time: 17:39)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So let us let us write the equilibrium equation. First equilibrium equation is F_x is equal to zero. Now what are the components have we have in x direction? The component of FC, component of CE, component of CD there will be no component because it is in y direction. So if we write this then component of FC is in this direction and as per our sign convention this is positive.

And then component of CE is in this direction, component of FC is again in this direction and as per our sign convention this is negative.

(Refer Slide Time: 18:26)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$\sum F_x = 0$
 $\Rightarrow F_{CE} \sin 30^\circ - F_{FC} \sin 30^\circ = 0$

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

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Now so finally from the situation we get FC is equal to P by 2. Again you know to get this information explicitly, writing this equilibrium equation may not be necessary because this free body diagram is symmetric where only horizontal component you have the component from this and component from this and both these members are inclined at same angle. So naturally the member forces in this and member forces in this, they have to be same to maintain the equilibrium, okay.

(Refer Slide Time: 18:58)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$\sum F_x = 0$
 $\Rightarrow F_{CE} \sin 30^\circ - F_{FC} \sin 30^\circ = 0$
 $\Rightarrow F_{CE} = F_{FC} = P/2$

$A_x = -P \quad B_y = -A_y = P\sqrt{3}/4$

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That we can say just by looking at the free body diagram. Now once we know this next we take the next equilibrium equation, summation of forces in y direction is equal to zero. Now again vertical component of this, vertical component of this and then member force CD itself. So they all are in vertically downward direction. Again as per our sign convention all forces are negative forces.

(Refer Slide Time: 19:22)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$$\sum F_x = 0$$

$$\Rightarrow F_{CE} \sin 30^\circ - F_{FC} \sin 30^\circ = 0$$

$$\Rightarrow F_{CE} = F_{FC} = P/2$$

$$\sum F_y = 0$$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So FCD and then FCE is (comp) vertical component and then FFC is vertical component. You already know FCE FFC is equal to P by 2 and we substitute that to get FCD is equal to minus P root 3 by 2. So this is the member force in member CD.

(Refer Slide Time: 19:53)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$$\sum F_x = 0$$

$$\Rightarrow F_{CE} \sin 30^\circ - F_{FC} \sin 30^\circ = 0$$

$$\Rightarrow F_{CE} = F_{FC} = P/2$$

$$\sum F_y = 0$$

$$\Rightarrow -F_{CD} - F_{CE} \cos 30^\circ - F_{FC} \cos 30^\circ = 0$$

$$\Rightarrow F_{CD} = -P\sqrt{3}/2$$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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As you remember we mentioned two ways you can represent the member forces. One (mem) way is FCD is equal to, the member force is represented with sign. Positive is tension, negative is compression. And otherwise you write the magnitude of the force and in bracket write whether it is a compression or tension.

Now if you follow this representation then please make sure that throughout your analysis negative stands for compression and positive stands for tension. Do not mix up sign convention in different free body diagram. And if you stick to sign convention then this expression carries some meaning. Otherwise you need to represent the force in member forces like this.

(Refer Slide Time: 20:47)

Method of Joints Vs Sections: Joints

Tension (+)

FBD of Joint C

$$\sum F_x = 0$$

$$\Rightarrow F_{CE} \sin 30^\circ - F_{FC} \sin 30^\circ = 0$$

$$\Rightarrow F_{CE} = F_{FC} = P/2$$

$$\sum F_y = 0$$

$$\Rightarrow -F_{CD} - F_{CE} \cos 30^\circ - F_{FC} \cos 30^\circ = 0$$

$$\Rightarrow F_{CD} = -P\sqrt{3}/2$$

$$F_{CD} = P\sqrt{3}/2 (C)$$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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But I always suggest you use a sign convention and stick to the sign convention throughout your analysis. It is not necessary that you use the sign convention that we are using here, you can use any sign convention but whatever sign convention you use you need to be consistent with the sign convention, okay. Now you see in method of joints then what we have done is if we need to find out the force in member CD then we have to go either this way or this way.

We need to consider several joints, free body diagram of several joints and apply equilibrium conditions and finally reach C and from free body diagram of C we could calculate the member force in CD. Now let us see if using method of section how things become very easy at least for this problem. But this remains same. This is the first step, visual inspection.

This is a zero force member and then support reactions by considering the free body diagram of entire structure and this step remains same whether method of section or method of joints.

(Refer Slide Time: 22:14)

Method of Joints Vs Sections: Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now let us take with section here, section 1-1, okay. And then section 1-1, then break this entire structure into two parts. One is on this side of this part and another is this side of the section, okay.

(Refer Slide Time: 22:32)

Method of Joints Vs Sections: Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now let us consider this side of the section and draw the free body diagram of this part, okay.

(Refer Slide Time: 22:41)

Method of Joints Vs Sections: Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

Now take this part and it is separated from the entire structure, okay. Now so this section cuts member CE, member CD and member AD and member FD. So naturally there will be the member forces that needs to be shown in this free body diagram. And what are the member forces differs is, in member this is the member AD. So this will be member force in AD. So again tension is positive.

(Refer Slide Time: 23:29)

Method of Joints Vs Sections: Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

When you are writing in a member so this direction is positive. This represent it is under tension. Similarly write member force in FD. Though FD is zero just for the demonstration so that things become clear I am writing it explicitly here. So if this is the member force in

member FD then this section intersect member CD as well. So this is member CD and this is the force in member CD and it intersects member CE. And this is member CE, it is the part of member CE and this is force in CE.

(Refer Slide Time: 24:08)

Method of Joints Vs Sections: Sections

Tension (+)

$A_x = -P$ $A_y = -B_y = P\sqrt{3}/4$

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So this is the free body diagram of section 1-1, okay. Now what we do is we will apply equilibrium equation on this free body diagram and find out the force in member CD, okay. Now what are the equilibrium conditions we have? You remember when we talked about method of joints we say that at every joint we have two equilibrium equations. Those two equilibrium equations are summation of forces in two coordinate directions are zero, right?

And we also said that summation of moment about that point will not give you any information because if you are considering free body diagram of a joint where all the forces are passing through at the same joint, so if you take moment about that point then contribution of all the forces will be zero. So summation of moment at that point or about that point is anyways zero. It will not give you any additional information, right? Now but if we take method of section here, okay.

Now what are the equilibrium conditions we have in method of sections? We have all the equilibrium conditions can be used here. Summation of forces in x direction is equal to zero. Because if you say summation of force in x direction is equal to zero so we have summation of force in x direction is equal to zero in this case. Then we also have summation of Fy is equal to zero. So these two equilibrium equations anywhere we can use.

(Refer Slide Time: 25:58)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum F_x = 0$
 $\sum F_y = 0$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

FBD of section 1-1

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Now suppose in this case if I take moment about joint D, this force will not contribute, this force will not contribute, this force will not contribute. Because these two forces their line of action are passing through joint D.

(Refer Slide Time: 26:07)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum F_x = 0$
 $\sum F_y = 0$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

FBD of section 1-1

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But this force and this force will contribute and this force will contribute.

(Refer Slide Time: 26:21)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum F_x = 0$
 $\sum F_y = 0$

$A_x = -P$ $A_y = -P$ $B_x = -A_y = P\sqrt{3}/4$

FBD of section 1-1

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Similarly if I take say free body diagram at moment at that point. This is E, okay. Moment at E. Then what happens, this force will not contribute, this force will not contribute, but this, this and this, these three forces will contribute because they are not passing through this point, okay.

(Refer Slide Time: 26:45)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum F_x = 0$
 $\sum F_y = 0$

$A_x = -P$ $A_y = -P$ $B_x = -A_y = P\sqrt{3}/4$

FBD of section 1-1

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So here summation of moment about any axis is zero. So all these three equilibrium equations you can use. Now let us do that here, okay. So this is the free body diagram. Now we need to determine the force in member CD, right?

(Refer Slide Time: 27:09)

Method of Joints Vs Sections: Sections

Tension (+)

F_{CE}

F_{CD}

$F_{FD} = 0$

F_{AD}

P

$L/2$

60°

B_y

FBD of section 1-1

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Now let us take free body diagram about B. If we take free body diagram about B then what forces will contribute? This force will not contribute because the line of action is passing through B, this force will not contribute because its line of action is passing through B and again this force will again not contribute because its line of action is passing through B.

(Refer Slide Time: 27:34)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum M_B = 0$

F_{CE}

F_{CD}

$F_{FD} = 0$

F_{AD}

P

$L/2$

60°

B_y

FBD of section 1-1

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So only forces will contribute are this force P, this FD and this CD. Now in this FD is anyways zero, so only forces will contribute is the external load P and member force CD.

(Refer Slide Time: 27:51)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum M_B = 0$

FBD of section 1-1

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Now let us take MB is equal to zero. If we write MB is equal to zero then what happens? This distance is L by 2. So FCD into L by 2 which is again clockwise direction that is why it is positive. And then P into this distance, this distance is L by 2 sin 60 degree and again this is clockwise positive. So this is the summation of moment about B or at B. And then it gives you CD is equal to this. So this is the member force you can write this way as well.

(Refer Slide Time: 28:25)

Method of Joints Vs Sections: Sections

Tension (+)

$\sum M_B = 0$

$\Rightarrow P(L/2)\sin 60^\circ + F_{CD}(L/2) = 0$

$\Rightarrow F_{CD} = -P\sqrt{3}/2$

$F_{CD} = P\sqrt{3}/2 (C)$

FBD of section 1-1

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So now what is the take from this example? Now when we use method of joints then there are several joints needed to be considered. Then free body diagram and then apply the equilibrium equations. But for the same problem if we use method of sections, it is just one

section will give you the required member force, right? So at least for this problem your method of section gives you the result in a much faster way.

Now but it may not be always possible. In some examples in ideal case what we do is in the same problem we use both combination of method of joints and method of sections, okay. That probably is the best way to solve any truss problem if you have to use this kind of approach, okay. Now quickly there are few things very important that is what choice of section is very important. What section you choose?

There is no specification, there is no guideline for that but that you need to understand based on your experience and as you solve many problems probably you will understand in a better way. But the best thing is whenever you solve a problem do not solve it mechanically after solving the problem. Just before you start solving a problem first intuitively you try to understand what are the forces? What could be the forces? What are the compression members?

Tension member, write somewhere and then solve the problem and get the compression and tension member and then check whether your intuition is correct or not. Through this exercise you need to build that capability through which just by looking at the problem you can plan the approach towards a solution, okay.

For instance, but few things that you keep in mind while choosing a section. Suppose section, it is not always a section has to be a line. Section could be a curve section as well. Now but what is important is you see the same problem. Suppose this is the section, right?

(Refer Slide Time: 30:50)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now if I take this part of this truss and draw the free body diagram of this. Then the free body diagram will be this. This is the free body diagram, right? This is the free body diagram.

(Refer Slide Time: 31:15)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now what happens, now this member is CD. This section is chosen in such a way it cuts member CD two times. First time here and the second time here.

(Refer Slide Time: 31:35)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So this is this part and this part is this part. So naturally if you have to draw the free body diagram you have to show the forces in this part as well.

(Refer Slide Time: 31:44)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Now you see this will not contribute anything explicitly. This is not going to give you any explicit information irrespective of your point when you take the moment. Irrespective of your summation of F_x is equal to zero or summation of F_y is equal to zero, this two force will always balance each other, okay.

(Refer Slide Time: 32:06)

Method of Sections: Choice of Sections

Tension \oplus

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So whatever equilibrium equation you write about whatever point you take moment, these two equations will balance each other, right? So these two forces will not give you any new information about the structure, okay.

(Refer Slide Time: 32:20)

Method of Sections: Choice of Sections

Tension \oplus

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So but why it is because this section cuts member CD two times. So if you cut a member two times means it is same as not cutting the member at all. So therefore this section and this sections are equivalent, okay.

(Refer Slide Time: 32:49)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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Because only difference between this section and this section is this section (inters) cuts member CE, member ED and member DB. This also cuts CE, ED and DB. Additionally it cuts member CD two times which is as good as not cutting member CD at all. So these two sections are similar.

(Refer Slide Time: 33:11)

Method of Sections: Choice of Sections

Tension (+)

$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

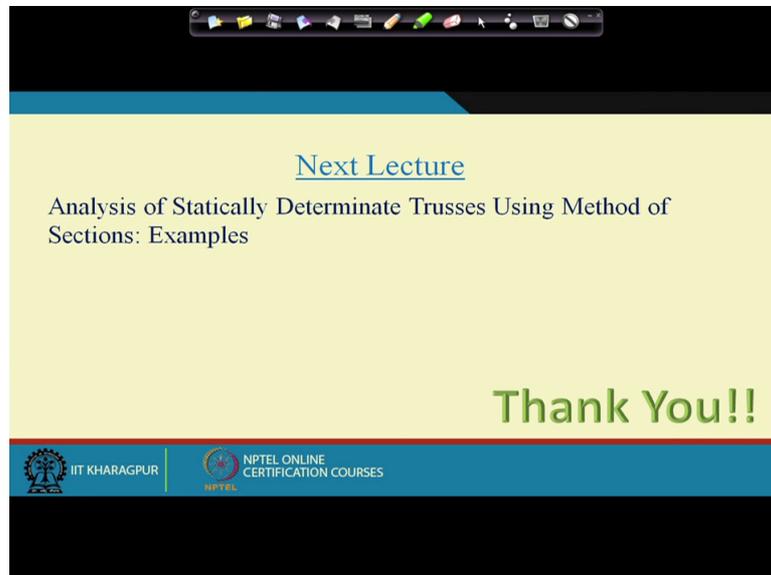
$A_x = -P$ $B_y = -A_y = P\sqrt{3}/4$

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So it is just one demonstration how you choose your sections but again no amount of theoretical demonstration can compensate the effort you put in actually solving the truss problem. So as you solve more examples probably that sense will automatically get

generated. Now we will stop here. Next class what we will do is we will give some more example of analysis of truss using method of sections.

(Refer Slide Time: 33:45)



Thank you.