Statics and Dynamics
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Lecture – 08
Statics 2.2

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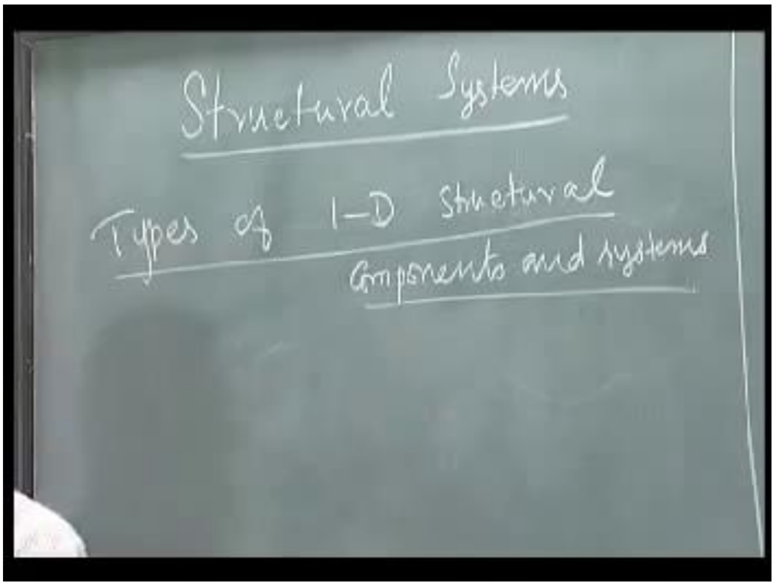

Now, let us look at types of one dimensional structural components or systems. I could have components or rigid bodies or systems of rigid bodies that make up a structure. This structure could be one dimensional structure, or two dimensional structure, or three dimensional structure, but consisting of only one dimensional members.

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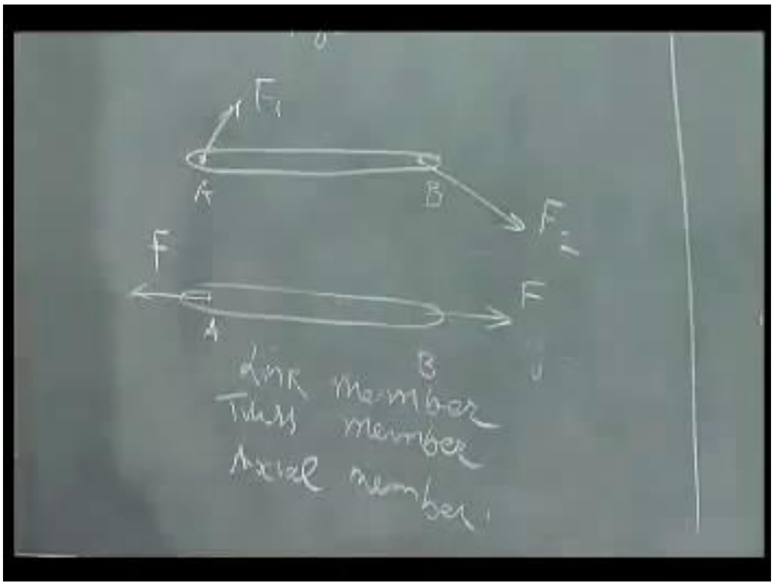

So, we are going to use the names, members joints etcetera in this particular module. Let us take up a simple one; the simplest of one dimensional members that we know of, is a single one dimensional rigid body like this, a straight one dimensional rigid body like this. Now, the forces acting on these we have already examined could be, the internal forces could be axial shear or moment resultants. We will look at one particular type of force action. Supposing, I know that for this particulars straight one d bar, if the forces are going to act, only force resultants are going to act that a and b; say something like this. From an earlier observation, we already know that we can reduce this system of forces, or this rigid body, as force acting like this.

This is the result that we got earlier. We usually call this as a link member. Since these members form a structural system call truss system, they are also called the truss name. One of the ways in which engineers could accomplish forming structural system, is by simple members like this, the advantages are many, construction is easy. You have a uniform type of member that we have start using right. Like what we did in the earlier clipping, where we use the s form universally. Another to think to note ,is the find out, if you find out the internal forces in this member, we will get an idea as to what type of internal forces act in this. Let us examine that

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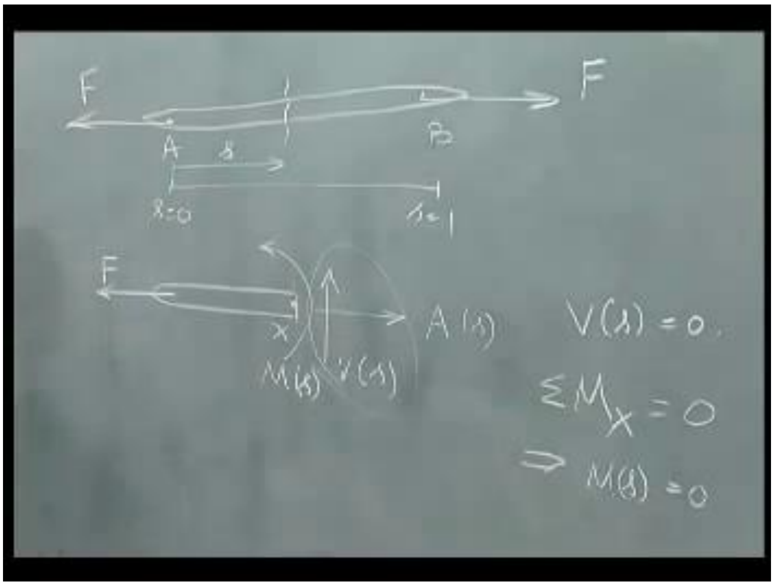

Supposing I take this particular member, which is a link member, and I already know that the force acting on this can be reduce simply as, equivalent opposite forces acting at a and b like this. Now I wish to examine, let us say I take s equal to 0 to s equal to one, and I wish to find out what will be the internal forces acting on this. If you do that, if you have to know that, you have to section at a particular s from let say a. Let us examine that; this is the force F acting on it. All the possible ones are a at s shear axial force, shear force at s and bending moment at s. Now we will use the three equations of equilibrium. Total vertical set of forces equal to 0.

You have only one shear force acting here, which means automatically I will have v of s equal to 0, examine the vertical forces. If I take moment about this, let me call this as capital x. If I take moment about this; notices F is not going to take part in the moment equation; a and v by the very fact that they are acting at this particular point will not take part, which means I will have only m s available there, is equal to 0 implies m of s equal to 0, that automatically means, I do not have the shear force; I do not have bending moment as internal forces in this member. The only one that is acting is AFS.

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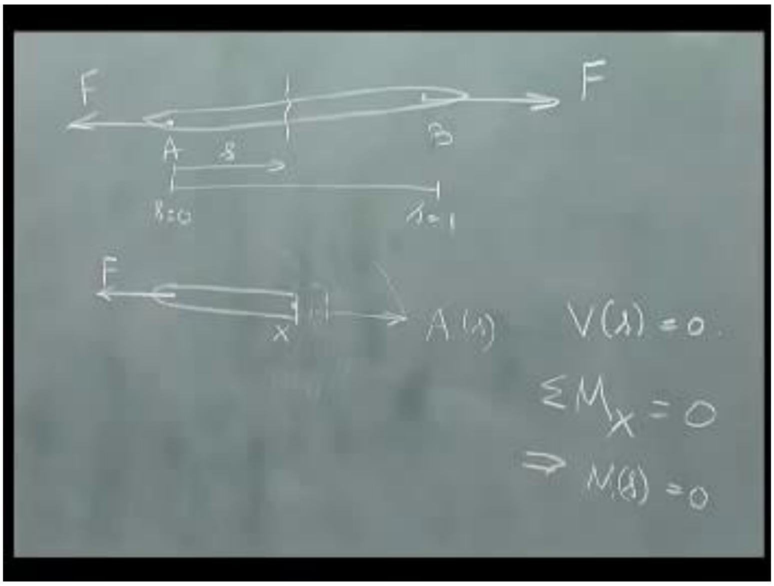

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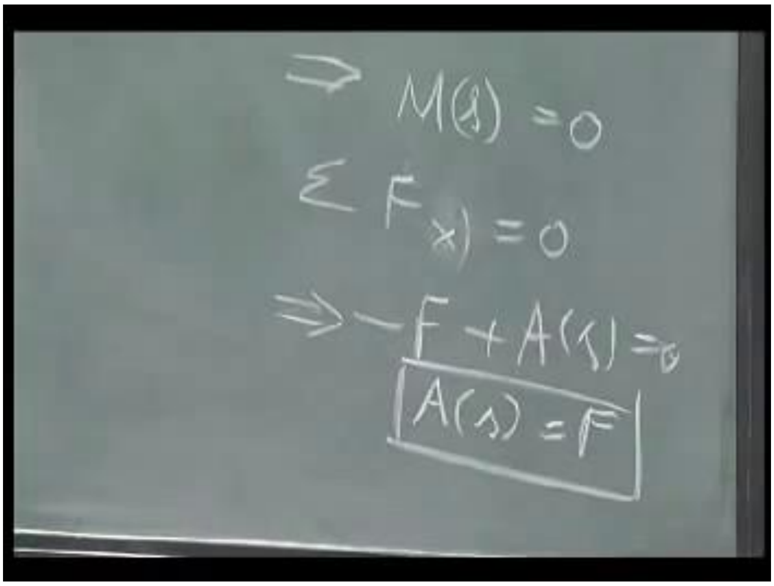

If I take the axial force static equilibrium, I am sorry, I should say F along x is equal to 0, if this direction is x, and this is y. This implies that this is minus F plus a minus F plus a at s equal 0, which means a at s equals f.

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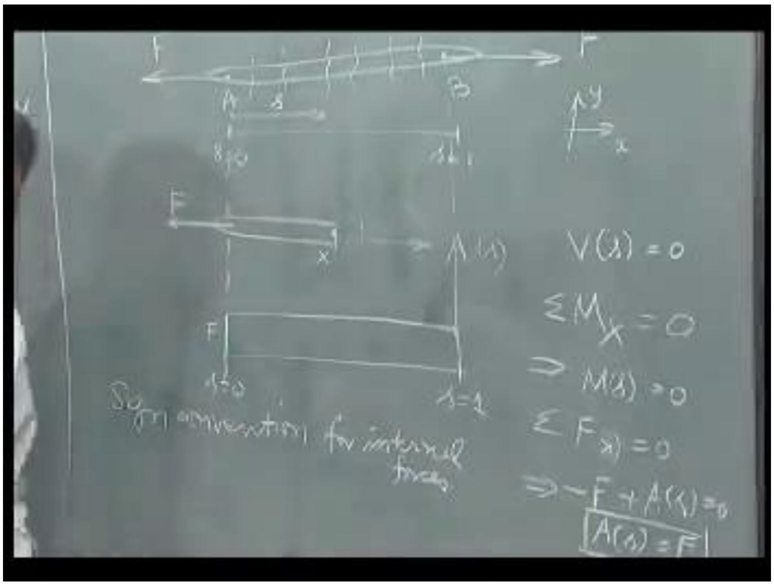

This is a nice result, it tells me that whether I cut here, or cut here, or cut here, or here or here. The actual force at that s will always be equal to the force that is operatively. So, if I draw the distribution of axial force with s. So, this is equal to 0 s is equal to 0 and s equal to one. I know that it will be a constant value, and this value is equal to f. One other important thing to note here is, shall I take this axial force to be positive or negative. That is a question that arises, and that becomes a confusion to me. So, simplest thing that we can do is, introduce what is called as sign convention for internal forces. Let me use my friend Venkateshwara Rao to help me with understanding the sign convention for this. So, I have this member, he is pulling it, I am pulling it, I am applying a force, he applying a force. I know at this particular point, if it is point force that I am applying. So, let me make it point force, so that is easy for me. I am going to introduce pins over here just to make it clear.

That we are applying along a particular point here. So, he is going to the hold this pin only like this, and pulls it only the pin like this and pull it. I know it is going to difficult, because this is a. He is pulling the pin, I am pulling the pin, which means this is having two axial forces are acting at the two ends, which is equal to this force f. One other thing to note here, is every point here on this, is being pulled. Supposing I take this particular end I have a force acting in the opposite direction f. Can you hold it at this point, take this out. So, he is pulling with force f, I am pulling with the force f. The notion here is that it is under tension. If it is in the opposite direction I will be pushing it, he will be pushing it, the net result is that is getting compress. In this particular case it gets bugled, but if it is thick enough it will get compressed. So, let me assume that, if it is in the stretched or the pulled state, I am going to call it as a positive internal force. Or in other words, if this one dimensional member is in tension, I am going to call that internal force which crosses this tension as a positive value. Thanks. So, in this case you notice that there is a pulling action. Simple way to understand this whole, this particular rigid body and examine what is happening here. It is being pulled and therefore, we will have this as a positive value.

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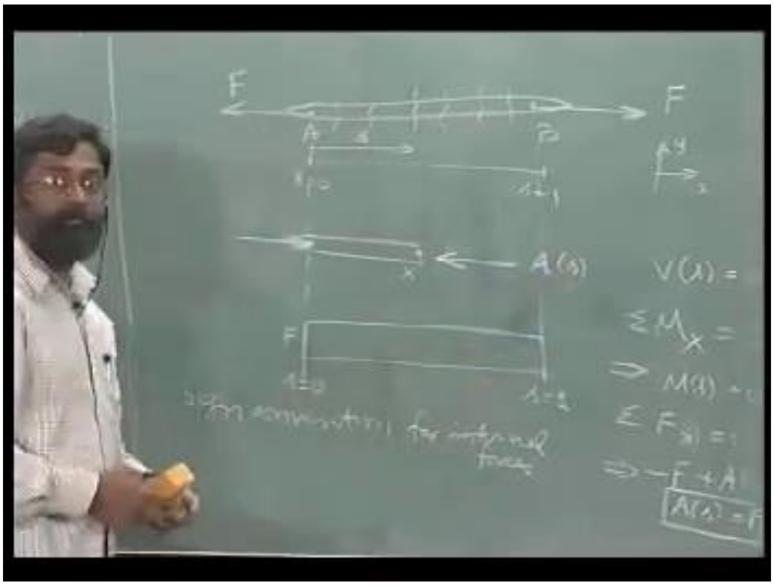

Supposing this external force has been like this, then the internal force direction also will change to like this. And in this particular case, if you hold this, this is pushing it, compressing this particular rigid body, and therefore, the notion of this axial force is negative. So, let me just give it back to the problem here. And therefore, if this is the notion, I will put a plus sign over here, and since I know a is is equal to F it is a plus F all through. So, one thing that I realize in this kind of member is, let me write it down here.

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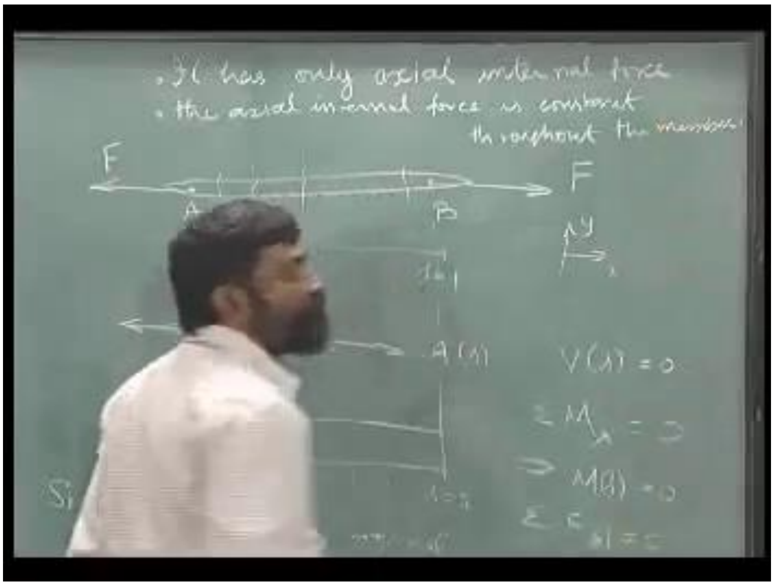

It has only axial force, axial internal force, and the other thing is, the axial internal force is a constant throughout. So such a member is called link member or a truss member. So, we have examined one type of member which is called an axial member or a link member or a truss member. Sometimes they also call it as axial member. So, I am just going write that also. Since the forces acting along the access, I can call that as an axial member. This is a member that we came across in earlier examples of rigid bodies. This is a structure call this truss structure which will consist of members of this sort, and therefore, I can also call them as members of a truss or a truss member so, these three names all good for this particular type. This is a very prevalent type of members that you will see in many structures built in a very simple manner, constructed in a very simple manner.

Thank you.