Mechanics of Material

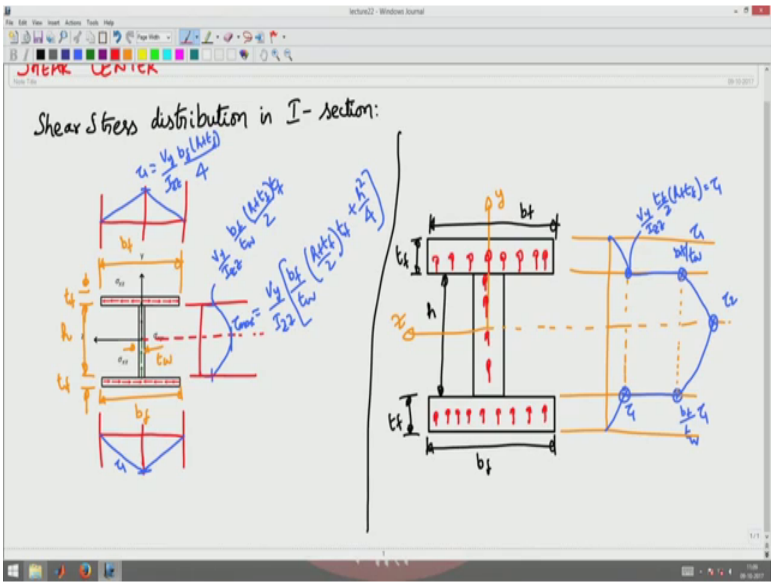
Dr. U. Saravanan
Department of Civil Engineering
Indian Institute of Technology, Madras

Stresses and deflection in beams loaded about one principal axis
Lecture - 62
Definition of shear center

Welcome to 20 second lecture in Mechanics of Materials. The last lecture we saw 2 different possibilities by which the shear stress distribution can be in an eye section. Basically we saw that there can be a possibility of sigma x g shear stress arising, when the flanges of the eye section is thin and there will be only sigma x y shear stresses on the flange thickness is thick compared to the web thickness, flange width is small compared to the web thickness.

So, basically we saw that in both the cases the shear stress values will be different depending upon how the stress are distributed?

(Refer Slide Time: 00:51)

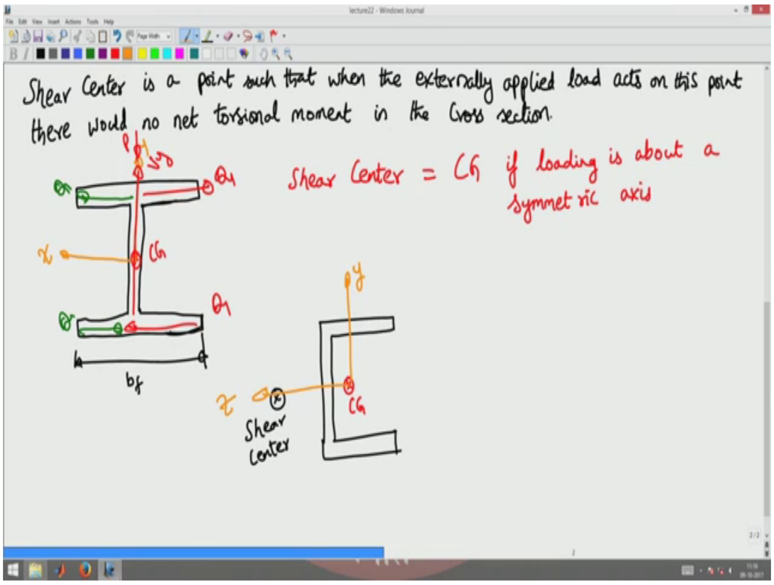


So, basically also we saw that depending upon how the section is built up, whether the sigma x g shear is going to be resisted by the nails or weld sigma x y stress is going to be resisted by nails or the weld. Now do you see appropriate shear stress distribution to compute the connection details the connection shear stresses are do the connection detailing.

So, in the last class also we alluded to the possibility of that arising a torsion movement because these shear stress distribution. Now eye section there would not be a torsion movement because the movements are balanced, because the fronts were of equal width in both the directions.

So, now, we will go ahead and understand what do we mean by a shear center and how do you compute the shear center for a cross section. Shear center is a geometric property and we will see how to compute the shear center.

(Refer Slide Time: 01:56)



First let us define what a shear center is a point such that, when the externally applied load acts on this point there would be no net torsional no net torsional movement in the cross section.

For example, if you take a eye section if you take the eye section it is of equal length and either side of the web. So, this is b f then what happens is your C G is at the center this is z and your C G is this is your C G.

And a shear center will coincide with the C G, because as you saw in the last class you know the shear stress distribution were to be horizontal, there would not be a net torsion produced in a cross section because this moment is balance by this 2 are of a same magnitude Q 1 Q 1 and this is of also magnitude Q 1 Q 1.

So, the red Q 1 produces a clockwise movement whereas, a green Q 1 produces anti clockwise movement, which balances each other and hence there is no net torsion and your shear stress there is a V y acting like that vertical shear force to balance this there will be a shear force externally applied in this cross section or the C G. So, I will also act through the C G or a cross section. So, there would not be any torsion produced in the cross section of the load or to act along the C G or the cross section. So, this happens for all symmetric sections loaded about the planar symmetry.

So, basically now shear center would be the C G if loading is about a if loading is about the symmetric axis we earned different about the symmetric axes yet in this course we will do that shortly. What will be loading about the symmetric axis that is equal area is distributed on the either side of that axis then; this shear center will coincide with the C G or the cross section along that direction along with symmetric axis direction.

So, in other sections the shear center will would not be the C G or the cross section. For example, if we look at the channel section we will see today by regional derivation that for this the shear center lies here this is a shear center whereas, the C G or the cross section would be here this is C G or the cross section. Because this is not the y axis here is not the symmetric axis whereas, z axis is a symmetric axis. So, the shear centre lies on the symmetric axis z axis whereas, y is not a symmetric axis.

So, basically your loading has to be along the shear center here now same thing we have to see what is the shear center for angle section and for a t section?