Mechanics of Material
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Stresses and deflection in beams not loaded about principal axis
Lecture – 77
Load about principal axis

Next we move on to the next case, where we are loading only about one of the principal axis v ok.

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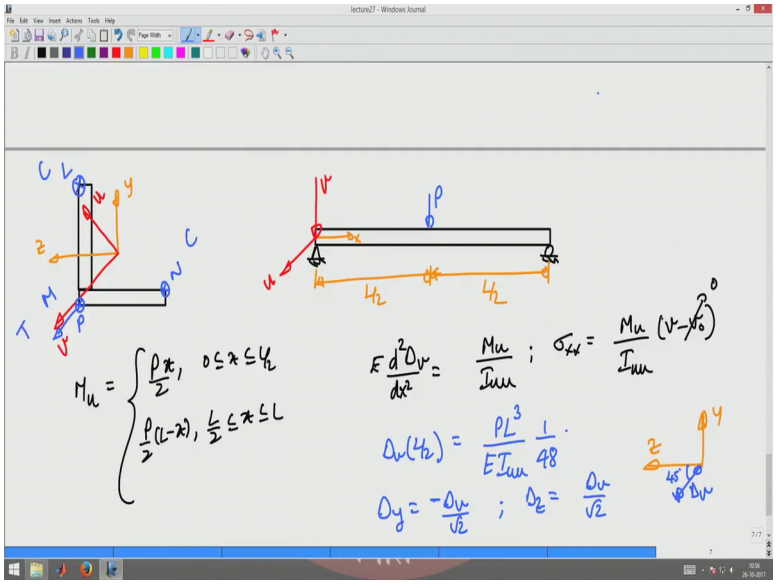

In this case, again, let us first go from back. Now the stress will be given by in this case the stress or the moment that will be produced this only m u moment the moment produces a mu moment that will be P into x for 0 less than x less than L by 2, P by 2 into x and it will be P by 2 into L minus x for bending moment in the region L by 2 less than x less than L ok.

Now, then from the bending equation you have E d square delta v by dx square is equal to mu by Iuu ok. So, basically now and your stress sigma xx would be mu by Iuu into v minus v naught where v naught is the portion of the cj the cross section another v since we assume that the centroid the origin of the coordinate system coincide this v naught would be 0 ok. So, this will be given by this expression in here ok. So, let us again look

at what kind of stresses are produce at L what kind of stresses are produce at the L M and N ok.

Now, clearly you exploring only along one direction the neutral axis is the u axis, uu axis ok. So, basically now because of this force you can feel that p would M would be in tension L would be in compression. So, thus M also it will be in compression because u the point n is above the u axis, it is in the negative v direction, it is in the negative v direction ok. So, basically from here you conclude that L and M are in compression, and M is in tension in this case ok. And again to find delta v you have to use the same relationship that we found before and we will find the delta v at L by 2 is again given by PL cube by E Iuu into 1 by 48 in this case ok.

That is along with delta v direction. Since this displacement is not along yrz in this case also there will be a y and z displacement, but the y and z displacement would be delta y would be delta v by root t2 with the negative sign and delta z would be delta v by root 2. Again the solving the v displacement 2 y and z directions that is you have a displacement this is Y and this is Z, you have a displacement along this direction which is delta v at a angle of 45 degrees. So, if I solve this along z it will be delta v by 42 and along y it will be minus delta v by cos 45 sin 45 that is 1 by root 2 ok.

So, the relationship between delta v delta z and delta y is given by this relationships ok. So, now, what you are seen is the deflection will be confined to a particular plane, only when the plane coincides with the principal axis of the cross section. The plane does not coincide with the loading plane does not coincide with the principal axis of the cross section, then there will be deflection in more than one direction and you are to be able to compute what this deflections are from simple equation that we derived in the last lecture ok. As an illustration we use a angle section to get these expressions ok.

Thank you.