Mechanics of Material
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Stresses and displacement due to torsion or inflation
Lecture – 86
Displacement field

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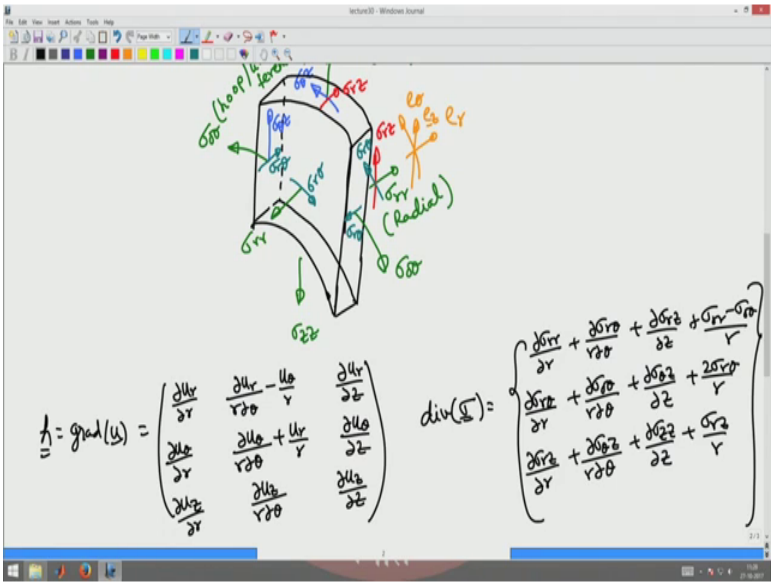

Now, we are ready to solve the problem, first we have to understand how this cross section subject to inflation we will deform due to p i the internal pressure p i.

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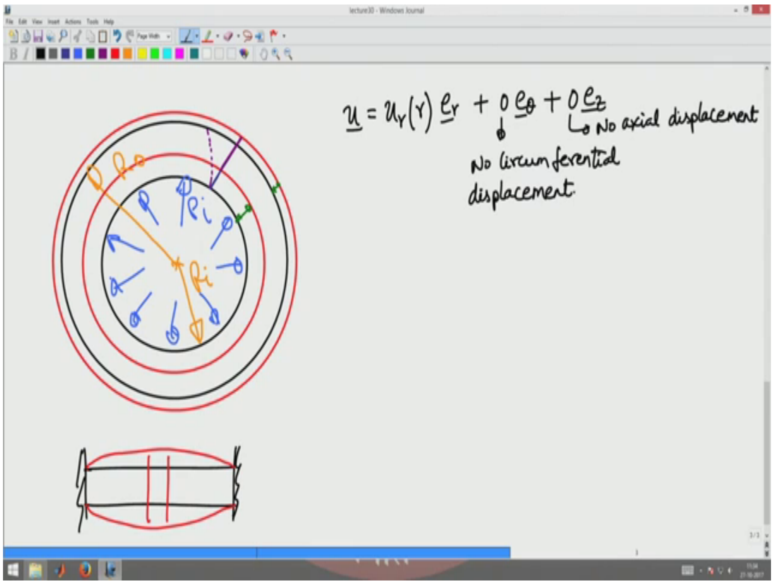

Now, first for that we have to understand how these circles will deform ok. What do you expect? You expect the circle to deform into another circle with the increased radius because you are inflating from inside ok. So, basically what do you expect is, this circle to be formed on another circle like that ok. You expect this inner circle to deform into a circle which is shown in red color here.

Now, similarly the outer circular will also expand and deform into another circle will also deform to another circle as shown there ok. The displacement of the inner circle radially outward need not be same as the displacement of the outer circle in the same radial direction. That is this distance and this distance need not be the same because the cylinder thickness can change due to the application of this inner pressure inside pressure.

So, that is one first observation. The second observation is let us look at what happens to a line here what happens to a radial line like that. The radial line like that will remain as a radial line except that it is going to now translate and move radially outward and maybe lengthen or shorten depending upon what happens to the thickness is going to become some straight line like that ok. It is not going to do something what I am drawing right now, we are going to do something like that it is not going to become a curved line it is going to remain straight and it is going to move like that.

So, with this observations, now let us estimate or let us guess what a displacement field would be u in cynical coordinates. In cylindrical coordinate there is clearly a radial displacement of the circles ok. Since there is a radial displacement of a circle there is a radial component of the displacement field, which will vary along the radius of the radial location of that circle radial location of that point. Because we said that the inner circle would not necessarily move the same distance as the outer circle moves. The inner circle can move more outer circle can move less there can be a thickness change ok. So, it depends upon the radial location.

Now, if this radial displacement were to depend upon the circumferential coordinates theta, then what will happen is the circle will become an ellipse, which we said will not happen and hence is not a function of theta. In general this radial displacement will be a function of z because you are ends fixed and hence what will happen is, there will be a bulging of the cylinder that is since the ends are fixed law this cylinder to bulge out like this and hence the this radial displacement should change with its axial location. But we will ignore that saying the pipe is long enough and we are looking at the centre portion of the pipe wherein it is more or less constant.

So, that is why we dropped the z variation also ok. And hence we say at this radial displacement is dependent upon only the radial location of the point e r plus we assume that there is no change in the straight line is not deforming into a curved line. So, there is no tangential a circumferential displacement of the point. So, it is zero times e theta, plus I said that I am fixing the length of the cylinder ok. So, I am assuming that there is no length change in the cylinder and hence there is no actual displacement also 0 times e z; there is no axial displacement.

Since the cylinder is assumed to be fixed at both the ends and this is no circumferential displacement ok. Because the cylinder is assumed to not rotate or twist due to the application of the inner inside pressure I am found the guessed what a displacement field is.