Computer Methods of Analysis of Offshore Structures

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Module – 01
Lecture – 23
Z-Y-X Transformation for 3d Analysis (Part – 2)

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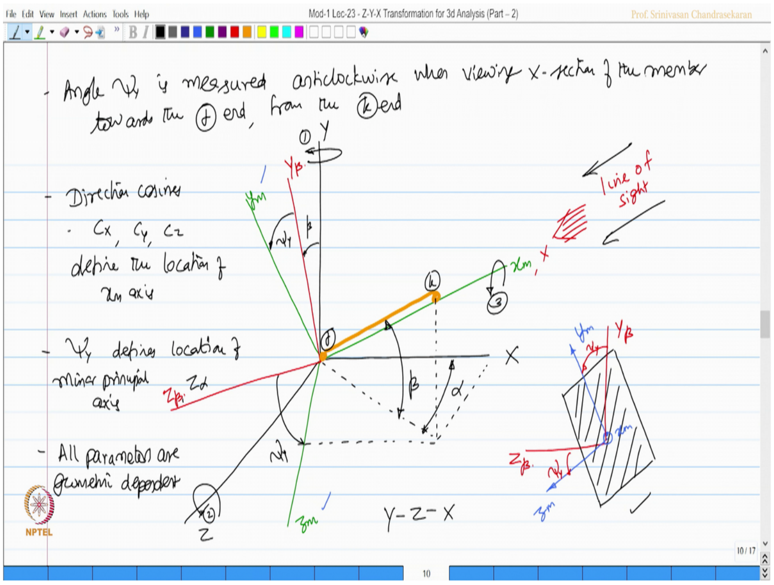

3 axes system, the x y and z. Let us have the local axes x m, y m and z m. Let us also have the transformation transformed axes, y beta and z beta. This is y beta, this is z beta and this will coincide with x. So, now let us say this is my line of sight, I see this from here where the member is placed somewhere here, member is placed here this is my j-th end my k-th end this is my member this is my j-th end and k-th end ok.

So, let us say this angle is actually beta and this angle is actually alpha and this is y z x transformation. So, we did rotation first step, then rotation second step, then rotation third step y z x transformation. So, the angle obviously, this will be beta and this becomes my z beta as well as z alpha. So, the angle between y beta and y m is psi y, the angle between z beta and z m is it not is also psi y. Now if you try to draw a rectangular cross section of this member seeing from the line of sight here.

So, let us say I am trying to draw it here, let me draw the axes. So, this is going to be my y m axes this is going to be my z m axes is not see from here, I am seeing through. So, this becomes my x m, y m is vertical and z m is to the left correct you can see here left and y m is to the right. Let us now mark y beta and z beta. So, this is y beta this is z beta. So, the angle between y beta and y m or z beta and z m is called psi y.

So, now we can write the angle psi y is measured anticlockwise, when viewing the cross section of the member towards the j-th end from the k-th end. When you see from here you will see y m is to the left of y beta and z m is to the left of z beta that is what we are marked here. So, the direction cosines that is C x, C y, C z actually define, the location of x m axes psi y defines the location of minor principle axes in the transformation all parameters are geometric dependent.

Similarly, if you try to do this for z y x transformation, let us do this for z-y-x transformation.

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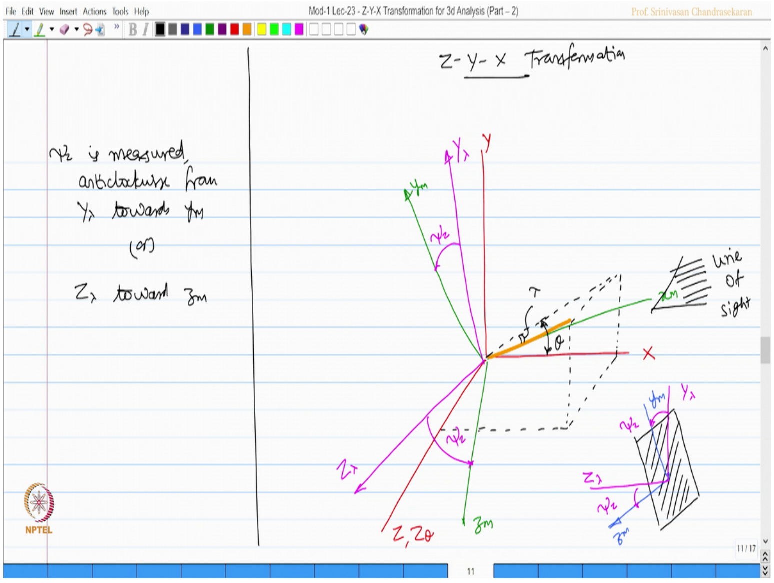

Let say the reference axes is marked in red colour, let us mark the local axes in blue colour, z m axes. Let us also mark the transformed axes of y alpha, y lambda and z lambda. If this is x, we know that z and z theta will be same and the angle psi z will be measured between y lambda and y m.

Similarly, z lambda and z m if we start viewing this by marking a member with j end k end, the angle between this is actually theta and this angle is lambda. So, let us view the sight towards this direction. Now I draw the cross section, I mark the local axes y m vertical because x m looking through y m is vertical y m and z m is to the my left. So, z m is to my left and y alpha is to my right of y.

So, y alpha and z alpha, y lambda and z lambda. So, now this angle is psi z this angle is also psi z. So, psi z is measured anticlockwise from y lambda towards y m or z lambda towards z m as shown in the figure. So, we have equations now to compute these psi angles which are very important we will take up a numerical in the next lecture and try to explain how the psi angle can be computed for different set of problems.

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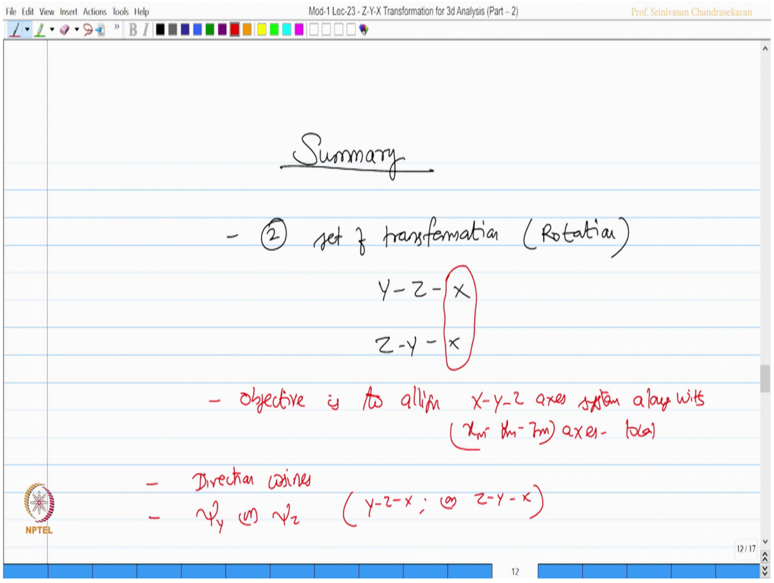

So, friends as a summary we have seen 2 set of transformations. In fact, they are actually rotations 1 is y z x transformation, other is z y x transformation in both cases the last rotation is about x axes. The principle objective is to align x-y-z axes system, along with x-y-z axes system which is local. So we need 2 issues, one is the direction cosine which can be computed from the angle of rotation second is the psi angle whether it will be y or psi z depending upon whether we do y-z-x transformation or z-y-x transformation, the equations are available figures, are clearly drawn I wish you will be able to understand this and estimate this angles for given example problem which we will discuss in the next lecture.

Thank you very much.