Computer Methods of Analysis of Offshore Structures
Prof. Srinivasan Chandrasekaran
Department of Ocean Engineering
Indian Institute of Technology, Madras

Module - 01
Lecture - 16
Planar non-orthogonal frame using computer code

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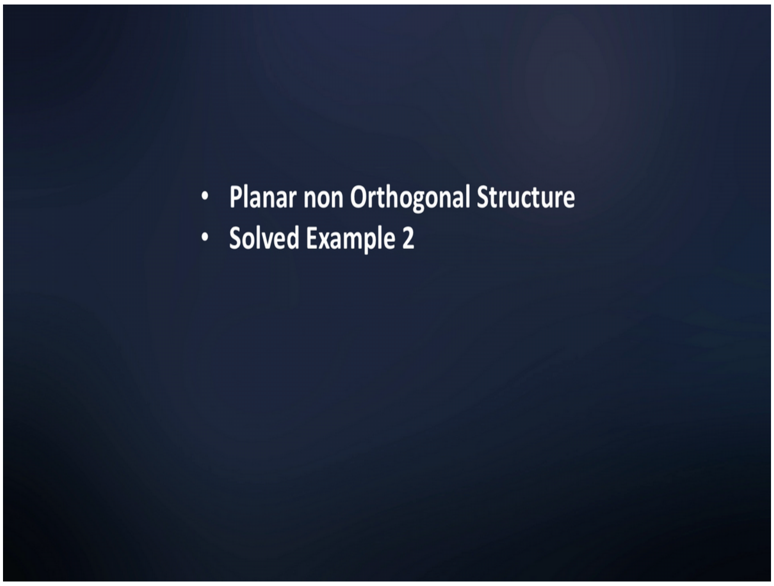

Friends, let us continue with the discussion on the 16th lecture in module 1; where we are going to solve another example problem in planar non-orthogonal frame. But we will solve this problem directly using the computer code. We will not solve this by hand directly, will simulate the labels and the program lines in the code use a solution directly from the code and interpret the results.

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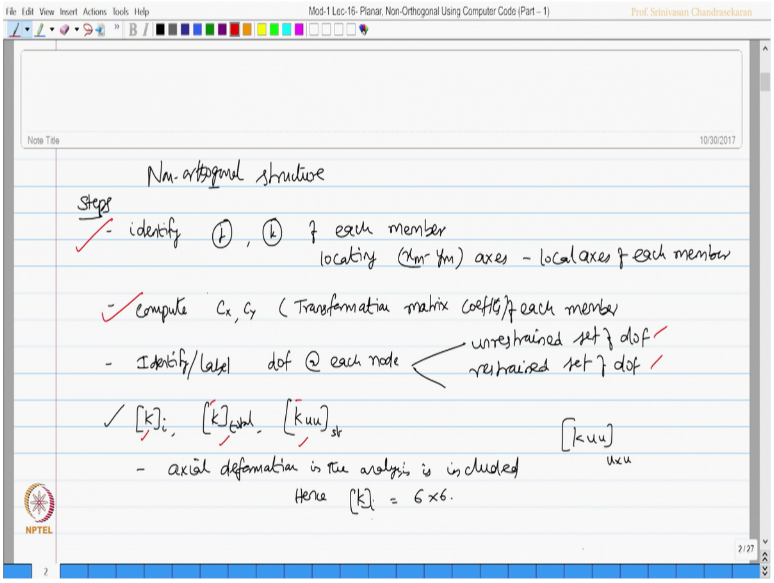

The example problem is like this before looking at the problem let us quickly revise we have to identify the j and k ends of each member, locate the local axes, compute transformation matrix coefficients and then the matrix get the transpose identify unrestrained and restrained set of degrees of freedom labels get local stiffness matrix then global stiffness matrix get K bar global total matrix and K bar uu for the structure.

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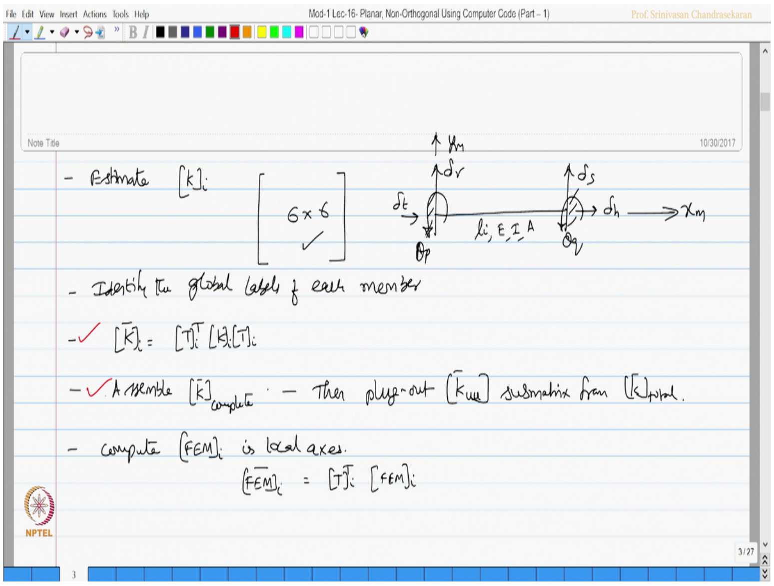

Since axial deformation is added in the analysis you know k of every matrix local will be of size 6 by 6; estimate the k matrix find the K bar assemble and get K uu bar find the fixed end moments from the member loading find FEM bar using this relationship then estimate the joint load bar in reference axes degrees of freedom plug out only the unrestrained values find the displacement in unrestrained degrees and find the end moments and shear force in each member in global degrees of freedom.

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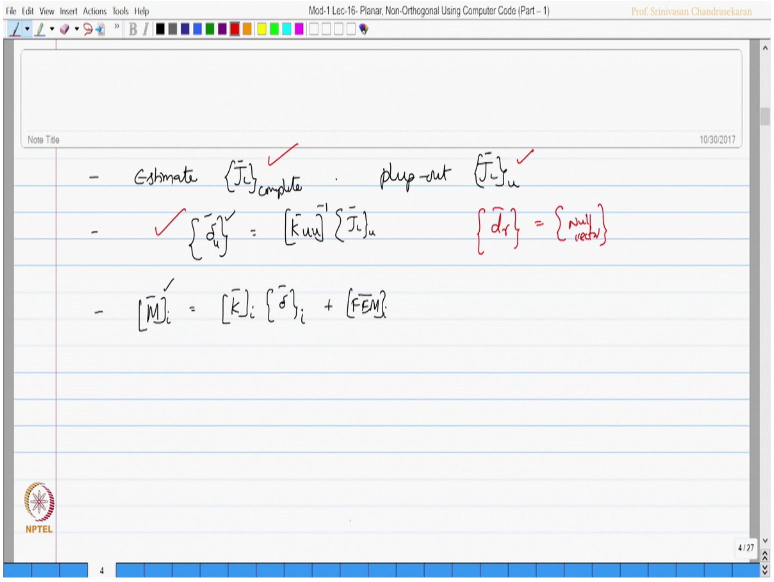

That is the steps involved let us take an example which I marking; here I am taking a similar example which create some similarity with the existing code.

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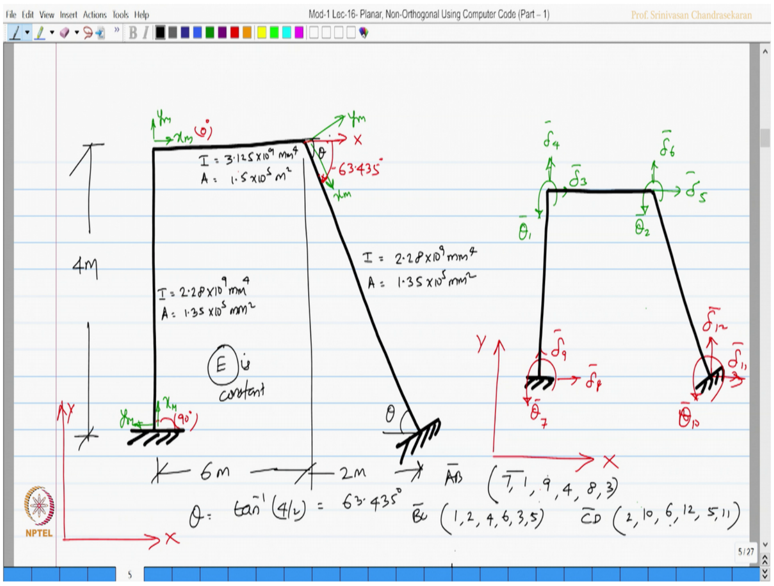

So, it is easy for you to follow let us say the I value of this member is 2.28 10 power 9 mm 4 and cross section area is 1.35 into 10 power 5 mm square, the I value for this member is 3.125 10 power 9 mm 4 and cross section area is 1.5 10 power 5 meter square and moment of inertia for this member is same as the vertical column which is exactly the value which I am writing on the board now.

Let us write down the dimensions of the system this is 6 meters; this is 2 meter and the height of the structure is 4 meters E is constant same material maybe T maybe concrete does not matter, let us try to find the value theta. So, theta will be exactly equal to tan inverse of 4 by 2 which is 63.435 degrees which will be as same as this value; is it not? Now let us mark the degrees of freedom for this problem I will do it separately let us say the global reference axes is marked here and the degrees of freedom label or with reference to that. So, this is going to be sorry unrestrained degrees theta bar 1, theta bar 2 delta bar 3, delta bar 4, 5, 6, 7, 8, 9, 10, 11.

Let us now mark the local axes for each member. So, let us say this is my X m and Y m for member 1; this is my X m and Y m for member 2 and this is my X m and Y m for member 3. Now I would like to know what is the angle of inclination of each member with reference to may global axes x; X and y. So, for this member this value is ninety degrees for this member, this is 0 degrees is it not.

For this it is going to be this is my reference axes x. So, one can see here this is rotated clockwise by a value 63.435 degrees which is negative because clockwise. Let us see; what are the labels for member A B, for member A B; what are the labels the global labels are. So, the labels are 7, 1, 9, 4, 8, 3. Similarly for the member B C, the labels are 1, 2, 4, 6 and 3, 5 for the member C D the labels are 2, 10, 6, 12 and 5 11, correct.

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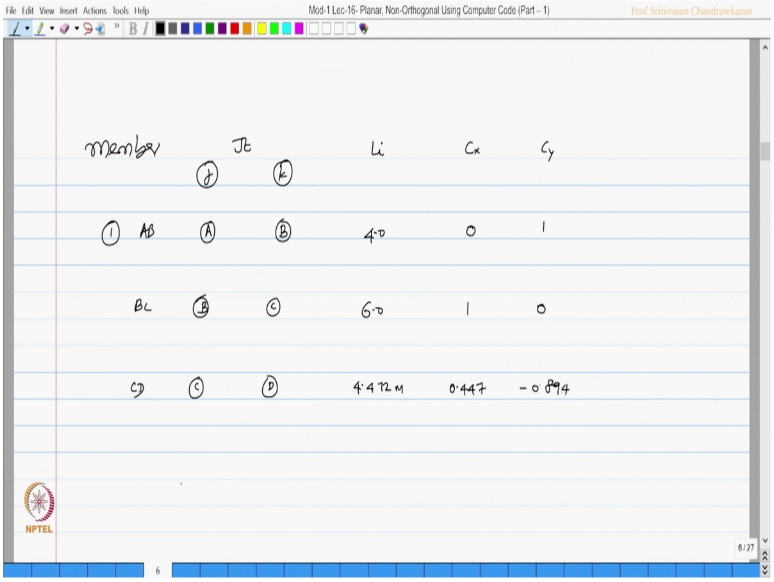

So, rotations along Y, along X, rotations along Y, along X, rotations along Y, along X, rotations along Y, along X; so, one can identify the labels after doing this, let us make a table; let say the member the joint which is may j and k end and then the length of the member then C X C Y after knowing theta. So, I think you will be able to compute this for the member one that is A B for the member B C for the member C D; these are A and B.

Let us say this is A, this is B, C and D; A B, B C and C D l, I you know this member is going to be 4 meters this member is going to be 6 meters this member is going to be square root of sum of squares which is going to be 4.472 meters. So, the angle is 90. So, cos 90 and sin 90; this angle is 0 cos 0 7 0 and this is going to be 0.447 cos of minus theta is simply cos theta sin of minus theta is minus sin theta; you got the values. Once I have this, I can now find a transformation matrix. Let us go to the program directly.