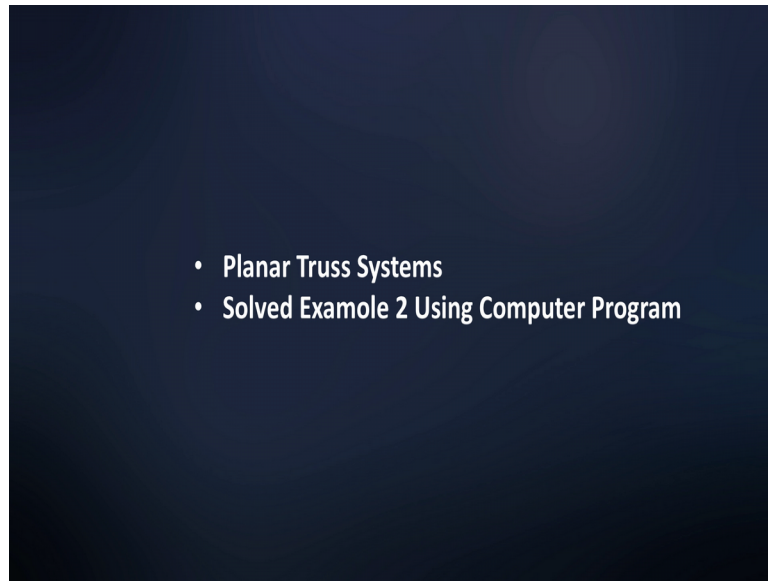**Computer Methods of Analysis of Offshore Structures**
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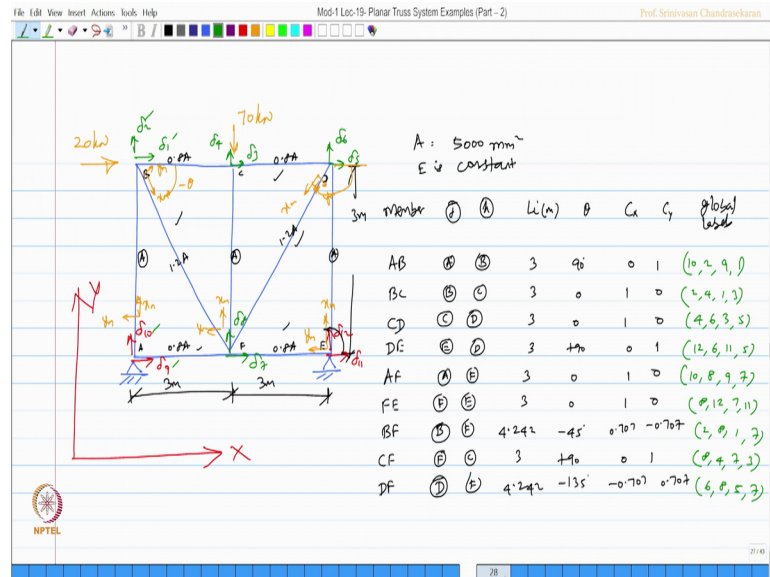
Module - 01
Lecture - 19
Planar truss system examples

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- Planar Truss Systems
- Solved Examole 2 Using Computer Program

Let us do one more problem. But directly let us do this problem with the computer methods. So the problem is like this.

So there are members are arranged in this manner, these are my supports, and these are my loads. The dimensions are given: this is 3, meter 3, meter this is also 3 meter ok. Let us mark the nodes A B C D E F. So, this has area A, this has area A, area A; this has 0.8 A, 0.8 A, 0.8 A, and 0.8A and these 2 members has 1.2 A where A, is 5000 mm square and E is constant. Let us mark the unrestrained degrees of freedom for this problem. So, this is delta 1, delta 2, delta 3, and delta 4, 5, 6, 7 and 8; let us also mark the restrained degrees 9, 10, 11 and 12.

So, the reference axes system is this way, this is x y and each member will have a local axes. To do that we have to identify the j and k ends of each member let us do that here. So, let us say member j end k ends of each member, length of the member in meters, let us enter theta. Let us find C x and C y then enter the global labels, because these are the input from a computer program. Say members AB, BC, CD, DE, AF, FE, BF, CF and DF there are 9 members 1, 2, 3, 4, 5, 6, 7, 8, 9 members ok.

For the member AB, I am taking this as A and B. So, similarly this becomes a local axis. So, this becomes my x m this becomes may y m. Similarly, I can mark for all the members I am entering the values. The length of the member is 3 meters, theta is anticlockwise degree 90, so I can enter C x and C y. For member BC similarly B and C: 3 meters 0, 1, 0. For the member CD, C and D ends are j and k ends 3 meters CD is this member 0, 1, 0.

For DE, this is E and D. So, I should say that this is my x m and this is my y m for the member DE. So, this is 3 meters plus 90 degree because this angle is 90 degree, so it become 0 and 1. So AF, AF is this member the horizontal member which has got A and F as j and k ends length is 3 meters 0 degree is 1 and 0. FE is this number where, F and E are j and k ends length is 3 meters 0 degree 1 and 0. BF is this member, I say B and F it means this is my x m and this becomes my y m. So you know x m is inclined minus theta by 45 degrees. So, let us enter that as minus 45 and this becomes 0.707 minus 0.707. And length of this member is root 2 times of 3 which is 4. 242.

CF is a vertical member, so I should say F and C it means the member is oriented this manner; this is my x m and y m for this member the member as the length of 3 meters, the angle is plus 90 that is 0 and 1. So, DF is the last member which has got at D and F. So, the inclination is this way this is x m and this becomes y m. Remember from x m it is anticlockwise. So, x m measured from this angle will be 135. So, I should say this is length is 4.242 it is minus 135 degrees, therefore this becomes 0.707 and this becomes 0.707.

Let us enter the global labels y axis labels first x axis labels next. Let us take the member AB reference axes, so very simple 10, 2, 9 and 1; so 10, 2, 9 and 1. Similarly, for this member 2, 4, 1 and 3; for the next member 4, 6, 3 and 5; for the next member 12, 6, 11 and 5; for the next member 10, 8, 9 and 7; for the next member 8, 12, 7 and 11; for the next member 2, 8, 1 and 7; for the next member 8, 4, 7, and 3; for the next member 6, 8, 5 and 7.
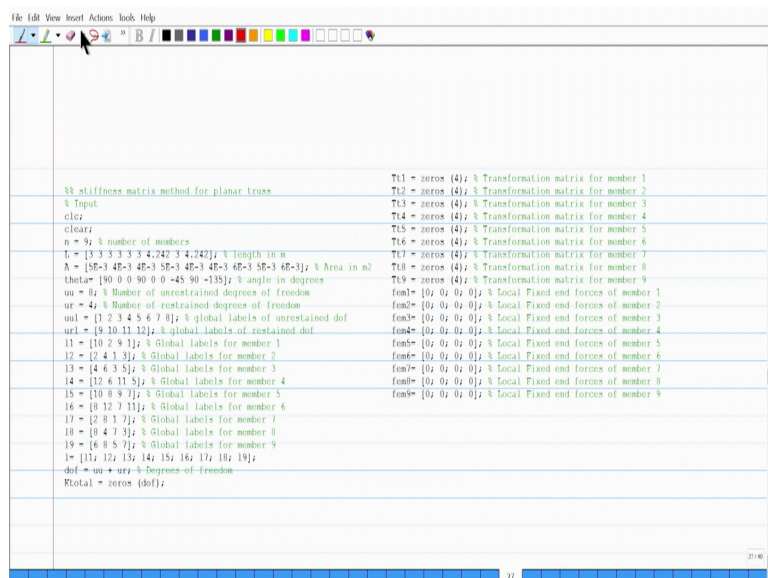
Having done this, let us try to find out the transformation coefficients, that is their Stiffness coefficients.
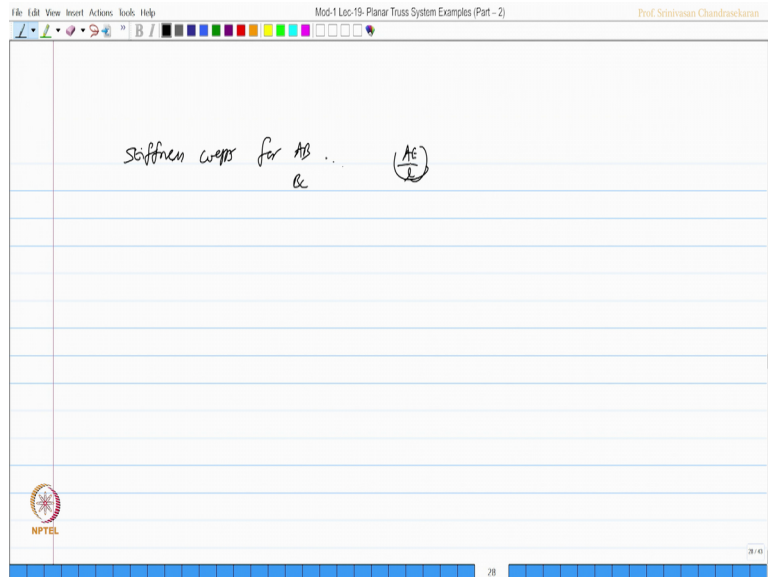
The Stiffness coefficients for the member AB, BC and so on is nothing but AE by l. I can find out them value and get the local stiffness matrix, let us look at the program.

There are 9 members, I entered the length you can say here 6 times 3 which is taken from here 1 2 3 4 5 6; 6 times 3 correct, then 4.242 3 4.242 you can see here 4.242 3 4.242.

So, I am following exactly the same method by entering the data. Length is entered, area is given, then theta 90 0 0 90 you can see here; 90 0 0 90 then 0 0 minus 45; 0 0 minus

45 is 90 minus 13 we entered. We found the global labels for example member 1, 10 2 9 1 you can see here member 1 has 10 2 9 1 is or not. So we have the value.

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Once I do this, we have got the transformation matrix for each the matrix. Then we compute the transformation matrix, local stiffness matrix for each member which we get here.

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Then we assemble them, get global stiffness matrix, then stiffness matrix completely is plotted from that K uu is obtain K bar uu is obtained, then inverse is obtained. So, now I have K bar uu I also have K bar uu inverse from this.

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Now let us come to the joint load vector. So, looked at this figure the degrees of freedom look at the problem. So at 1 it is plus 20 then 2 and 3 no load at 4 it is minus 70 remaining all are 0. So, typically plus 20 0 0 minus 70 and all zeros that see that here; plus 20 0 0 minus 70 then all are zeros is or not. So, I created the joint road vector then I applied the problem found out unrestrained displacements then found member forces in all the members and got the solution for this problem, which I am going to discuss it here.

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The answer is given in the sheet for all the members, ok.

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The unstrained stiffness matrix available here, the inverse is available here, then the del bar u is available here.

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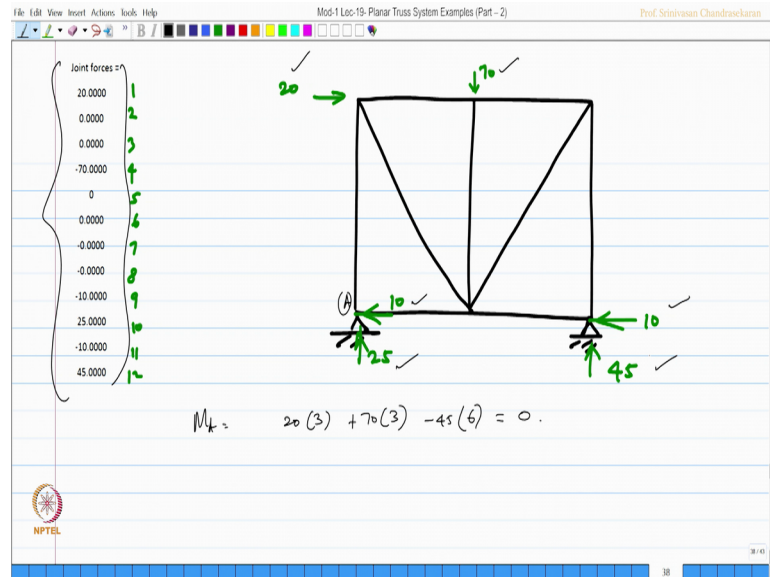
Whereas, the e multiplier is common available, joint forces are then plotted for this problem which I am going to mark here; the end joint forces are marked here. This is the truss system I have, the degrees of freedom you know this is going to be you can check it once again the degrees of freedom are 1, 2, 3, 4 and so on. So, let us mark them here accordingly, so I should mark this has plus 20 then 0 to 3 0 this is minus 70, 4, 5 is 0 remaining all are 0 this is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12.

So, let us mark this as minus 10 and this value as plus 25, then this as again minus 10 and this as plus 45, let us check this is point A. So, let us check moment about the point A 20 into 3 plus 70 into 3 minus 45 into 6 is 0. So, it is checked. The reaction is being made the total load is being made.

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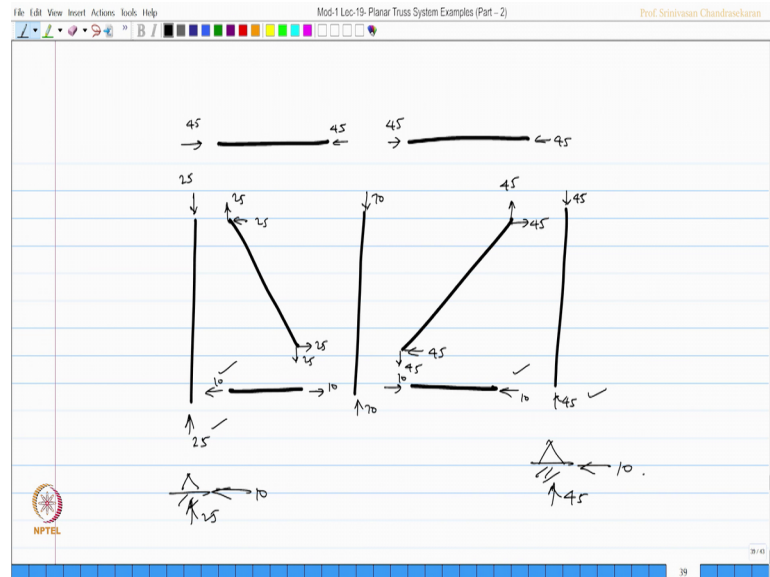
So, I can also draw the member forces for all the members. Let us say member 1, member 2, member 3, member 4, member 5, member 6, 7, 8, and 9.

Let us mark the member values as well. So, this is 25 and 25, this is 45 and 45, this is again 45 and 45, this is 10 and 10, this is this is 10 this is also 10 and 10, this is again 45 and 45. So, this is 45, 45, 45 and 45. For this member this is 25, 25, 25, and 25. For this member it is 70 and 70. The member reactions are formed and they are as same as what you have here which is going to be, so this value is 10 and this value is 25 and this value is 45 and this value is again 10 which is as same as what you have here.

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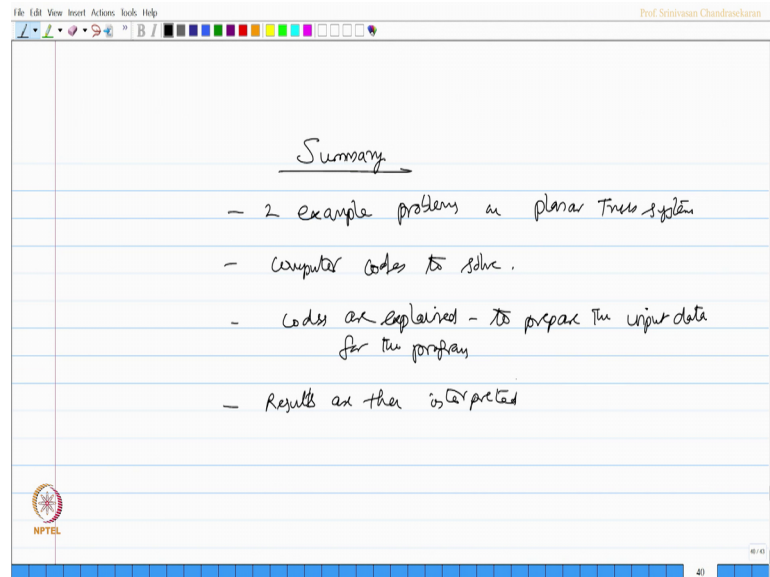
So friends, we now write down the summary. We solved two example problems on planar truss system. We have use the computer codes to solve the problem. Codes are explain to prepare the input data for the program the results are then interpreted.

I hope you have understood, you will practice this computer program in your MATLAB software and try to solve couple of more problems and understand. They are very interesting and simple. I wish that you should exercise all these problems back again at your desktop and try to compare the answers and you will share your views and conveniences you get we are adopting this computer method of structural analysis using stiffness methods for solving a variety of problems.

Thank you very much.