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Computational Solid Mechanics & Dynamics

Assignment 6 Beams

a) Program In MATLAB the Timoshenko 2 Nodes Beam element with reduce integration for the shear stiffness matrix

Ans.

The changes are supposed to made in the shear stiffness matrix , so that the matrix changes from full integration to reduced integration matrix which is done to omit shear locking so that we can use Gauss quadrature of one order less than required

```
 %Shear For full integration
     K_shear = [   1    ,    len/2 ,    -1    ,    len/2 ;
         len/2 , len^2/3 , -len/2 , len^2/6 ;
        -1    ,  -len/2 ,     1    ,  -len/2 ;
        len/2 , len^2/6 , -len/2 ,  len^2/3 ];

% % shear Reduced integration
   K_shear = [   1    ,    len/2 ,    -1    ,    len/2 ;
               len/2 , len^2/4 , -len/2 , len^2/4 ;
               -1    ,  -len/2 ,     1    ,  -len/2 ;
               len/2 , len^2/4 , -len/2 ,  len^2/4 ];
```

For For stress evaluation gaus1 = gaus2 = 0.0 therefore following changes are also made.

```
gaus1 =0;
    gaus2 =0;
```

b) Solve the following problem with a 64 element mesh with the
2 nodes Euler Bernoulli element
2 nodes Timoshenko Full Integrate element
2 nodes Timoshenko Reduce Integration element.

Ans.

In Euler Bernoulli theory, the main assumption is,

The deflection of all points in a transverse section are small and equal to these of the beam axis, zero transverse displacement, the transfer cross section remains plane and orthogonal to the beam axis after deformation.

And Timoshenko beam theory considers transvers shear force deformation

From the graphs bellow, we can say that Euler Bernoulli and Timoshenko Reduced Integral formulation does not give large difference in output on the other hand there comparing these two with Timoshenko Full Integral formulation there is vast difference in bending moment as compared to vertical displacement.

In case of shear force (as Euler Bernoulli formulation does not calculate transverse shear), again we see large difference between the outputs of full and reduced Timoshenko formulation

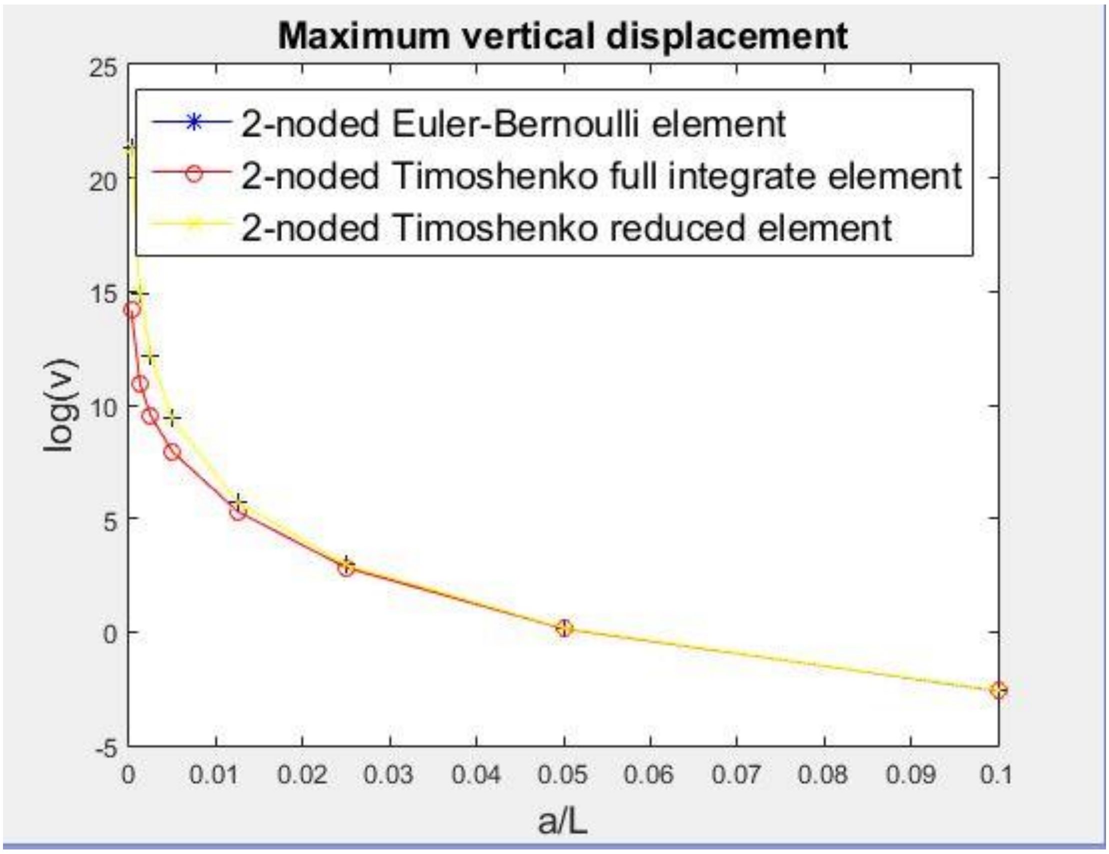

Figure 1 Vertical displacement

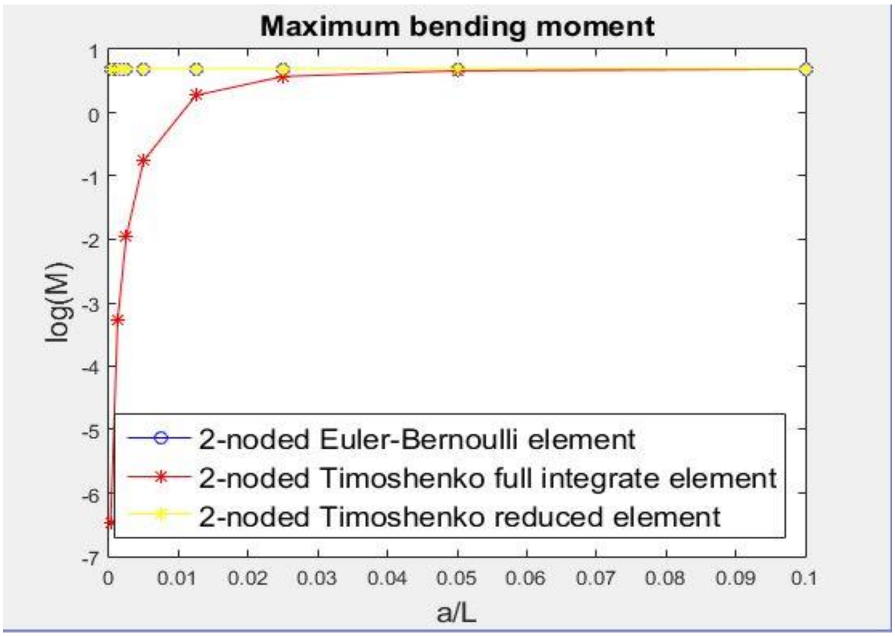

Figure 2 Bending Moment

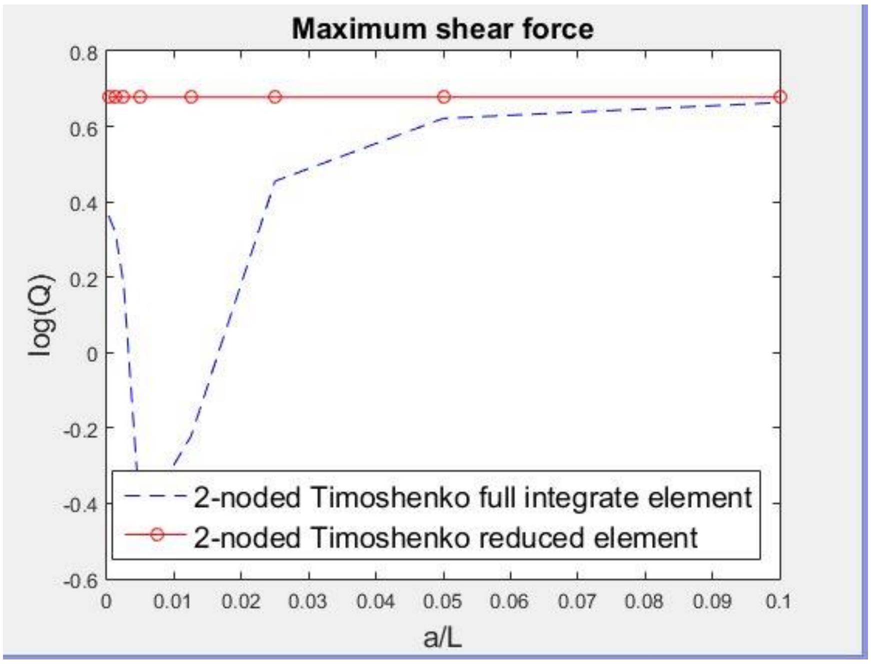

Figure 3 Shear Force