ASSIGNMENT 1: BEAMS

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1 ASSIGNMENT

- Program in Matlab the Timoshenko 2 Nodes Beam element with reduce integration for the shear stiffness matrix.

Modified the shear stiffness matrix

```
K_s = [ 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 ] ;
```

Verified the stress evaluation with one point integration

```
gaus0 = 0.0;
bmat_b = [ 0, -1/len, 0, 1/len];
bmat_s1 = [-1/len,-(1-gaus0)/2, 1/len,-(1+gaus0)/2];
Str1_g0 = D_matb*(bmat_b *transpose(u_elem));
Str2_g0 = D_mats*(bmat_s1*transpose(u_elem));
```

- 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

From figure 2 to 4 we compare, respectively, the maximum displacement, moment and shear for the 3 elements against the $\frac{a}{L}$ relationship.

In the figure 2 the vertical axis is in logarithm scale. The Euler Bernulli elements has a higher value of displacement for slender elements. However, from values higher than $\frac{a}{L} = 0.02$ the vertical displacement for Euler-Bernulli and Timoshenko elements are the same.

Figure 3 compares the maximum moment of the thre elements.The 2 nodes Timoshenko Reduce Integration element has a better performance than 2 nodes Timoshenko Full Integration element in slender elements.

All the elements have similar values of shear as shown figure 4.

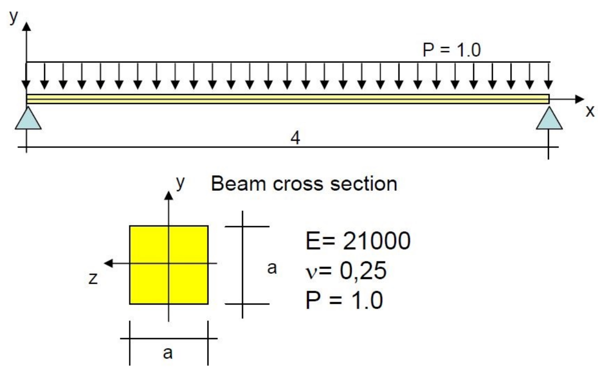

Figure 1: Problem.

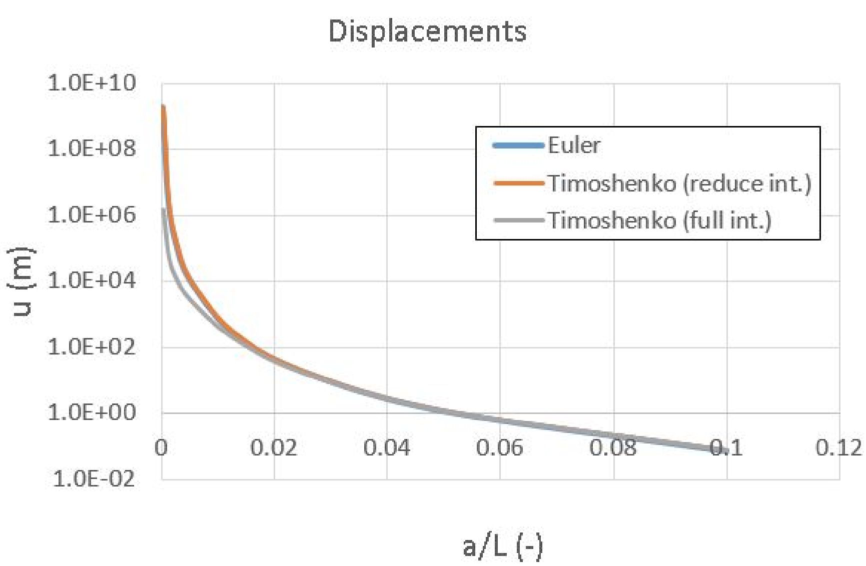

Figure 2: Vertical displacements.

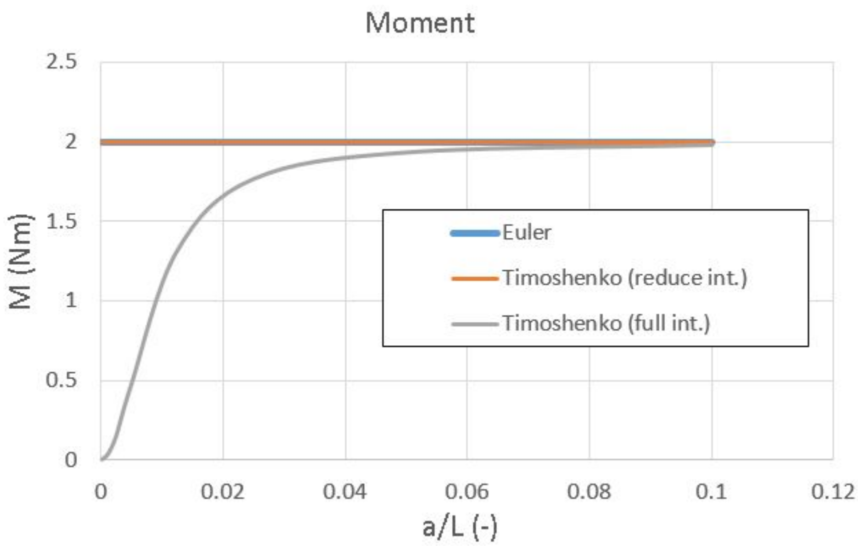

Figure 3: Moments.

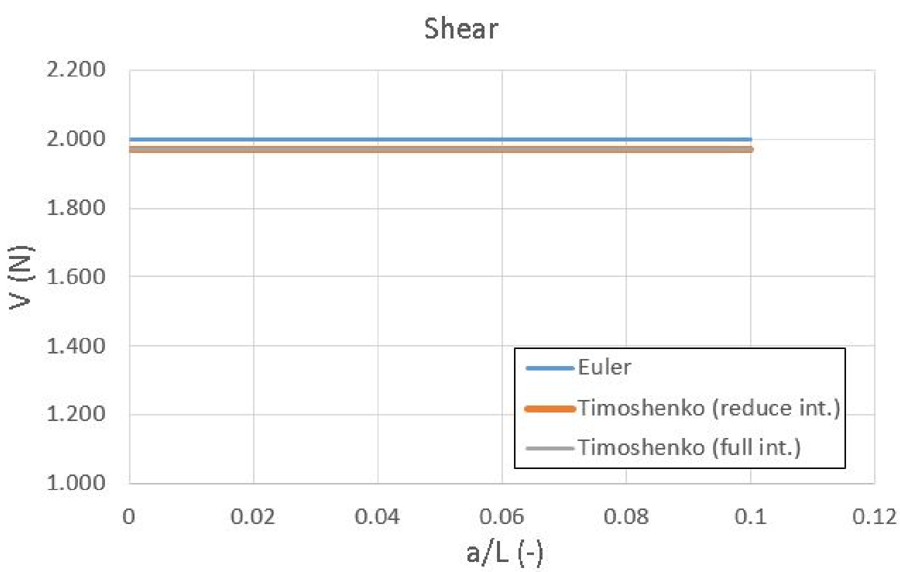

Figure 4: Shear.

2 CONCLUSIONS

Timoshenko Full Integration elements have problem with slender beams and Timoshenko Reduce Integration elements have a better performance that coincides with Euler Bernoulli elements.