CSMD: Assignment 6

Juan Pedro Roldán

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1 Introduction

In order to adapt the supplied code, some changes were made

- Point loads were computed considering the contributions of the distributed load P = 1.0
- Material parameters were changed to those given in the assignment
- A loop was included inside the main scripts to consider the eight different cases (eight different area/length relationships)

2 Beam results

Figures 1 to 9 show the maximum displacements, moments and shear force of the different beams.
We can see that if we use the Euler-Bernoulli formulation, the results with respect to forces (moments and shear forces) are practically the same, no matter the relationship between area and length. This is due to the fact that this formulation is valid for slender beams, and then, low values of log10(Area/L). As we do not take into account the effects of the shear forces, cross-section inertia plays a weak role with respect to internal forces in this problem. Euler displacements are relatively similar to the reduced integration scheme, as the full integration methods suffers the so-called shear locking, overestimating the effects of shear forces for thin beams (left half of the plots).
If we now compare the internal forces in both timoshenko formulations, we can see again here the shear-locking effect in the Moment and Shear plots: for thin beams, the Timoshenko full integration scheme shows really high values of Mx and Shear Force.
The Timoshenko reduced integration beam captures the best of both formulations: accounts for the shear effects but has good performance for thin beams

2.1 Euler beam plots

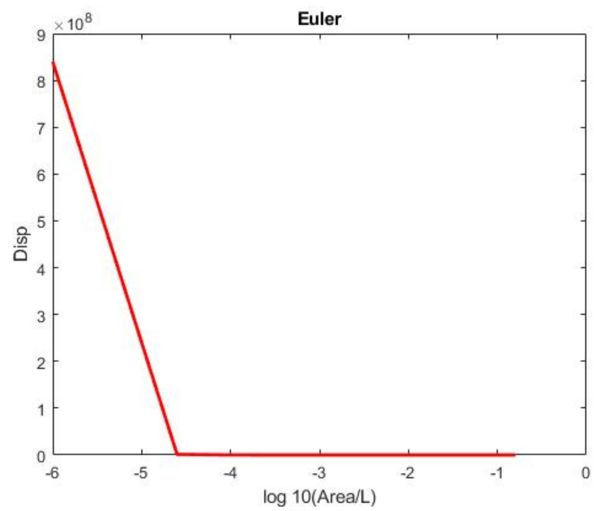

Figure 1: Maximum displacements vs log10 (cross-section/beam length)

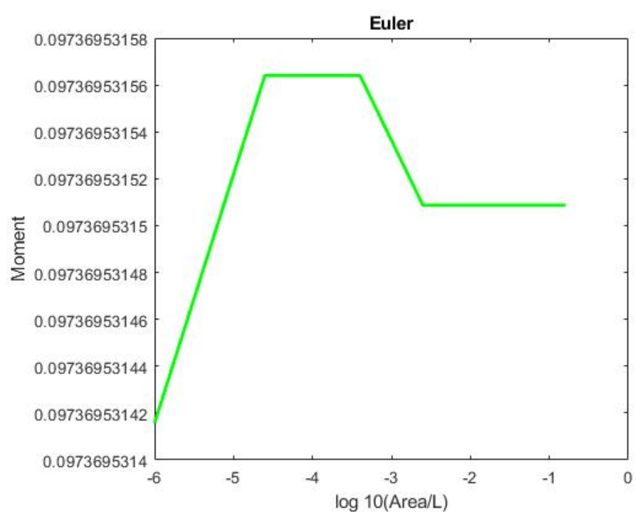

Figure 2: Maximum Mx vs log10 (cross-section/beam length)

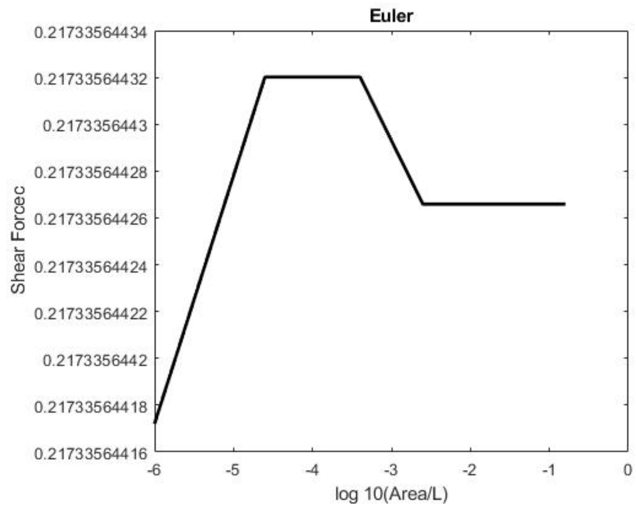

Figure 3: Maximum Shear vs log10 (cross-section/beam length)

2.2 Timoshenko Full integrated beam plots

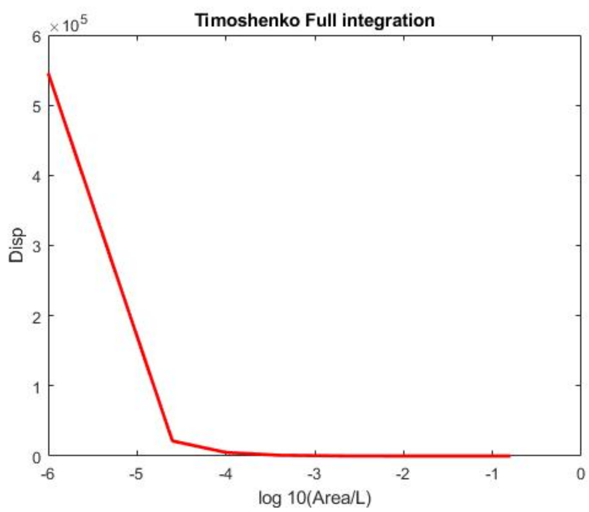

Figure 4: Maximum displacements vs log10 (cross-section/beam length)

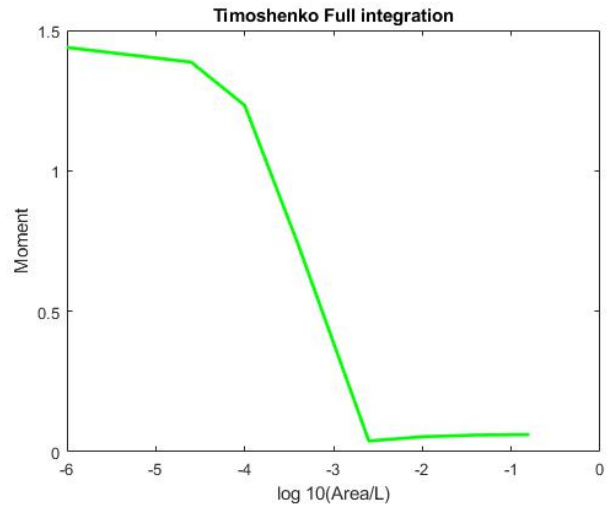

Figure 5: Maximum Mx vs log10 (cross-section/beam length)

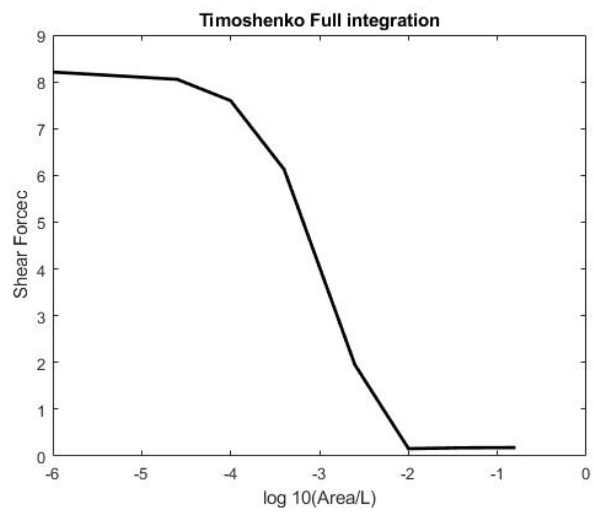

Figure 6: Maximum Shear vs log10 (cross-section/beam length)

2.3 Timoshenko Reduced integrated beam plots

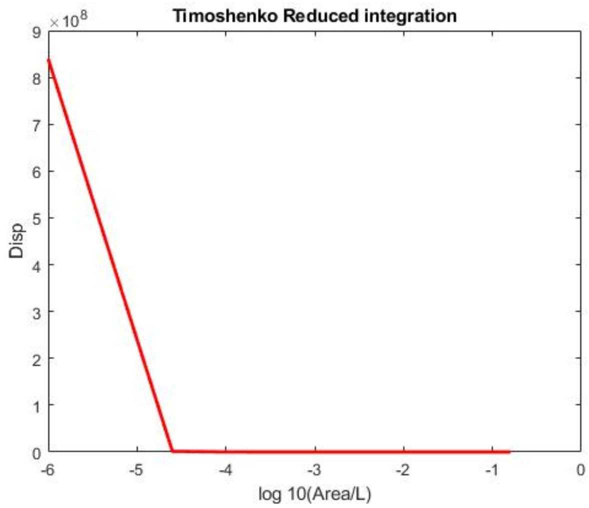

Figure 7: Maximum displacements vs log10 (cross-section/beam length)

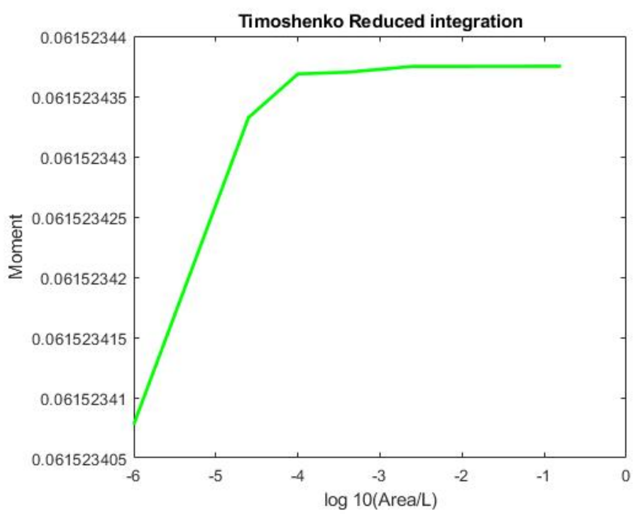

Figure 8: Maximum Mx vs log10 (cross-section/beam length)

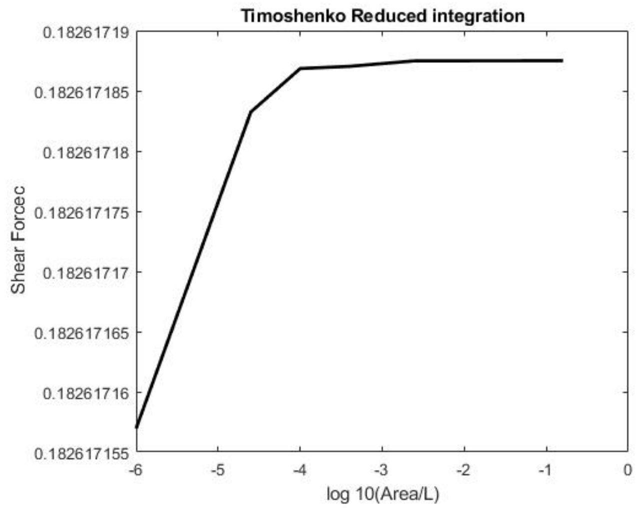

Figure 9: Maximum Shear vs log10 (cross-section/beam length)