Computational Structural Mechanics and Dynamics - Assignment 6

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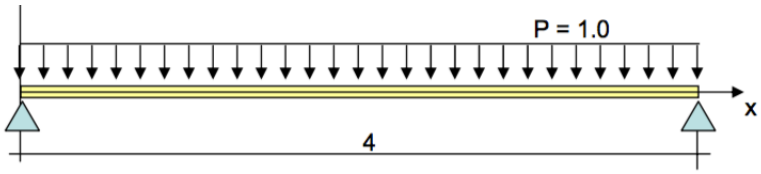
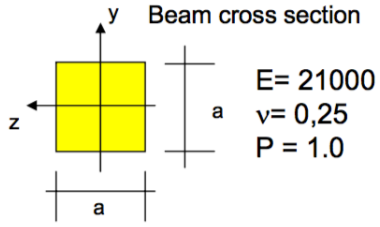
The following assignment is a practice about the behavior of a simple supported beam with different aspects ratios. The analysis is carry out by a MATLAB code provided in order to evaluate the elemental beam results as Displacement, Bending Moment and Shear. In this particular example the beam is evaluated by Euler Bernoulli and Timoshenko methods.

The three cases to implement and discuss the solutions are under these situations:

- ✓ 2 nodes Euler Bernoulli element.
- ✓ 2 nodes Timoshenko Full integration element.
- ✓ 2 nodes Timoshenko Reduce integration element.





For 64 nodes elements, with different cross sections varying from 0.001 to 0.4. The load applied is a distributed one taking values P = 1.0. The boundary conditions are two simple supports, with no rotation restrictions.
The results for the three cases are summarized on the following table, where the maximum value for each state is shown based on the cross-section area.

Euler-Bernoulli

a	L	a/L	Disp Max	Bend Max	Shear Max
0.001	4	0.00025	-1.90E+09	1.999913	2
0.005	4	0.00125	-3.05E+06	1.999913	2
0.02	4	0.005	-1.19E+04	1.999913	2
0.05	4	0.0125	-3.05E+02	1.999913	2
0.1	4	0.025	-1.904.761.905	1.999913	2
0.2	4	0.05	-1.190.476.191	1.999913	2
0.4	4	0.1	-0.074404762	1.999913	2

Timoshenko reduced integration

a	L	a/L	Disp Max	Bend Max	Shear Max
0.001	4	0.00025	-1.90E+09	1.999024	1.96875
0.005	4	0.00125	-3.05E+06	1.999023	1.96875
0.02	4	0.005	-1.19E+04	1.999023	1.96875
0.05	4	0.0125	-3.05E+02	1.999023	1.96875
0.1	4	0.025	-1.906.875	1.999023	1.96875
0.2	4	0.05	-1.197.154.018	1.999023	1.96875
0.4	4	0.1	-0.076161412	1.999023	1.96875

Timoshenko full integration

a	L	a/L	Disp Max	Bend Max	Shear Max
0.001	4	0.00025	-1.46E+06	0.001534	1.96875
0.005	4	0.00125	-5.74E+04	0.037658	1.96875
0.02	4	0.005	-2.80E+03	0.469783	1.96875
0.05	4	0.0125	-2.00E+02	1.314426	1.96875
0.1	4	0.025	-1.687.518.104	1.768721	1.96875
0.2	4	0.05	-1.159.637.903	1.936003	1.96875
0.4	4	0.1	-0.075561027	1.982887	1.96875

As it can show, the method that has values more closer to the exact solution is Bernoulli, considering all the different cross sections given as “Slender beam” and satisfying the necessary conditions to be solved by Bernoulli method.
Another aspect to highlight is the beam properties like a (cross-section) doesn’t affect to the value of the shear and bending moment, keeping fixed for a given span and load. Furthermore the notorious change we find it on the values of displacement, increasing with the beam cross-section due to its mass.
On the other side, we can see how the solutions for the Timoshenko formulations are relatively far from the exact solution as it is expected for a slender beam.