Comparison of uniform versus taper channel section beam models
RAL 2007
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1. Comparing a workbench model with a beam model to validate the approach.

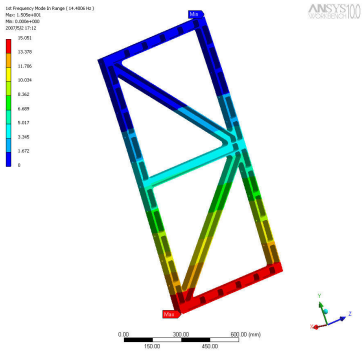


Figure 1. Workbench model of uniform channel section beam, first frequency 14.4Hz

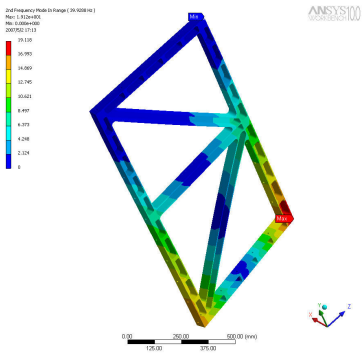


Figure 2. Workbench model of uniform channel section beam, second frequency 39.9Hz

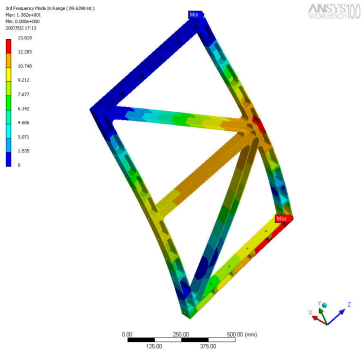


Figure 3. Workbench model of uniform channel section beam, third frequency 89.6Hz

Table 1. Uniform versus taper channel section beam

Mode	Uniform channel beam model 12.6kg	Uniform channel workbench model 16.5kg	Mode shape the same for both models
1	16.1	14.4	Bending in x
2	41.8	39.9	Torsion
3	98.2	89.6	Panting in x
4	107.7	136.3	
5	110.4	164.6	
6	142.1	263.1	
7	145.4	284.3	
8	155.0	310	
9	156.7	335.8	
10	157.2	345.6	

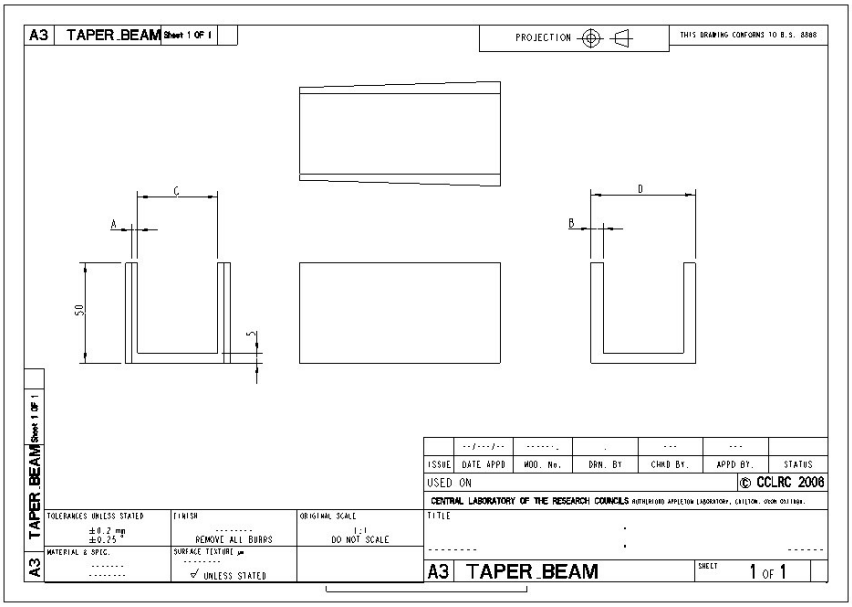
Table 2. Uniform versus taper channel section beam. The models have an additional 10Kg on each of the bottom corners of the frame, making the total additional mass 20kg.

Mode	Uniform channel beam model 12.6kg	Uniform channel workbench model 16.5kg	Mode shape the same for both models
1	6.2	6.2	Bending in x
2	13.4	15.3	Torsion
3	77.2	74.1	Panting in x
4	80.1	79.6	Bending in z
5	109.8	107.1	
6	111.2	228.4	
7	117.8	252.5	
8	154.9	269.2	
9	156.5	291.9	
10	157.2	304.4	

Conclusion

Table one does show some discrepancy between the workbench and beam models, this is due to the self weight of the structures, the workbench model has features in the frame for mechanical fasteners and extra material in rounds etc.
With the addition of extra mass at the bottom of the frames the self weight of the frame becomes less significant. Table two shows that the beam model is very representative of the workbench model.

2. Taper beam model



SCALE : 1:1 TYPE : PART NAME : TAPER_BEAM SIZE : A3

Dimensions
Case 1
A = 3mm
B = 6mm
C = 40mm
D = 52mm

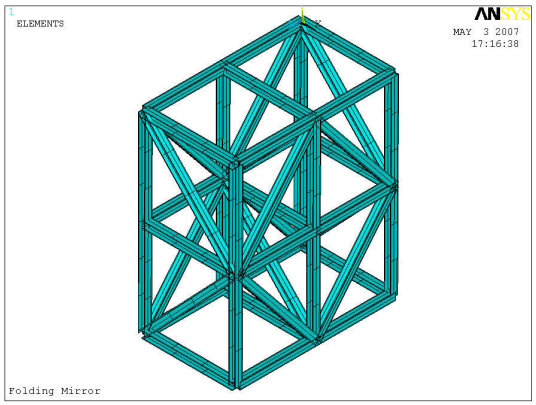
Table 3. Taper channel section beam with no additional mass.

Mode	Taper Beam model, case 1 13.2kg	Mode shape
1	17.0	Bending in x
2	44.6	Torsion
3	97.0	Panting in x
4	107.5	
5	110.3	
6	134.7	
7	141.8	
8	147.1	
9	160.2	
10	161.2	

Table 4. Taper channel section beam with the addition of 10Kg on each of the bottom corners of the frame, making the total additional mass 20kg.

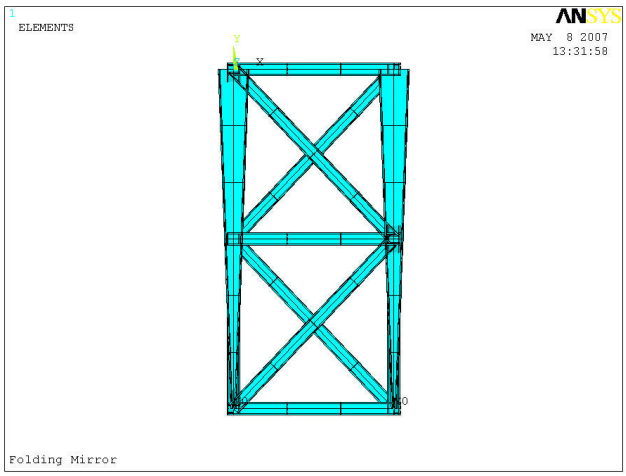
Mode	Taper Beam model, case 1, 13.2kg	Mode shape
1	6.3	Bending in x
2	13.3	Torsion
3	77.4	Bending in z
4	79.8	Panting in x
5	109.6	
6	111.4	
7	119.9	
8	141.8	
9	144.6	
10	160.7	

2.1 Taper beam model in folding mirror design



Mode	Uniform channel beam model in folding mirror design 71kg	Taper channel beam model in folding mirror design 70.4kg	Mode shape the same for both models
1	99.3	99.6	Bending in z
2	105.3	105.7	
3	110.0	110.0	
4	110.3	110.3	
5	110.6	110.6	
6	110.8	110.8	
7	115.4	115.4	
8	116.0	116.9	
9	133.0	131.5	
10	150.5	139.8	

2.2 Big taper beam model in folding mirror design



Mode	Uniform channel beam model in folding mirror design 71kg	Big taper channel beam model in folding mirror design 71.5kg	Mode shape the same for both models
1	99.3	102.7	Bending in z
2	105.3	107.16	
3	110.0	110.0	
4	110.3	110.6	
5	110.6	110.7	
6	110.8	110.9	
7	115.4	117.7	
8	116.0	122.0	
9	133.0	136.6	
10	150.5	141.6	

Conclusion

The taper beam, or at least this design of taper, does not seem to improve the frequency.