GENEL sensitivity to the number of elements

A simple beam has been considered, with the following properties:

Length: L = 0.915 m

Section: tube, r_int = 0.014 m, r_est = 0.016 m

Material: E = 70 GPa

Poisson = 0.33

Original beam: L = 0.915 m

Section: tube, r_int = 0.014 m

r_est = 0.016 m

All proportions are the same as the original beam

The material is a sample aluminum-like isotropic metal

In order to study the accuracy of the GENEL entry and the loss of precision caused by moving from a bar model to a GENEL model, a sensitivity test is carried out. A simple problem is studied: the displacement at the free end caused by a unit force at the same end.

Analytic solution for the displacement of the free end of a clamped beam:

v = F * L^3 / (3*E*I) = 1.7126e-4 m

Where: F = 1 N

L =0.915 m

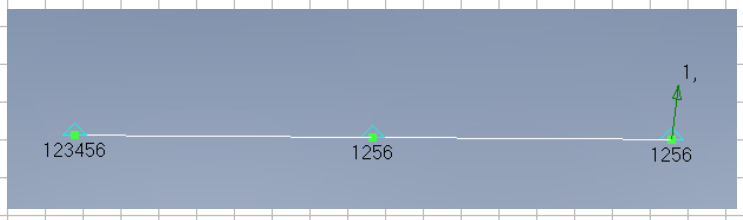
I = 2.13e-8 m^4

E = 7e10 N/m^2

OBS: as GENEL Z flexibility matrix entries are produced in short format (8 characters), only 5 digits are available. The level of convergence to be achieved is 5 significant figures.

CASE 1: 2 bar elements

v = 1.716085e-4 m at the free end for a unit force



The approximated value with 5 digits is v = 1.7161e-4 m

Z matrix [2.1581-5 5.3692-5;
5.3692-5 1.7161-4]

The displacement with GENEL is exactly v = 1.7161e-4 m, as the same load is applied.

The relative error between the analytic value and the GENEL displacement is e = 0.002

CASE 2: 4 bar elements

The displacement at the free end is the same as before v = 1.716085e-4 m

Consequently, the GENEL entry produces the exact approximate displacement as before

Z matrix:	2.7623-6	6.7763-6	1.0790-5	1.4804-5
	6.7763-6	2.1581-5	3.7636-5	5.3692-5
	1.0790-5	3.7636-5	7.2511-5	1.0864-4
	1.4804-5	5.3692-5	1.0864-4	1.7161-4

CONCLUSION: as the GENEL entry inputs the displacements of the nodes of the structure when loaded by a unit force, the value of the final displacement of one of this nodes is exactly equal to the one given as an input.
The only notable convergence difference is given by the accuracy of the model.