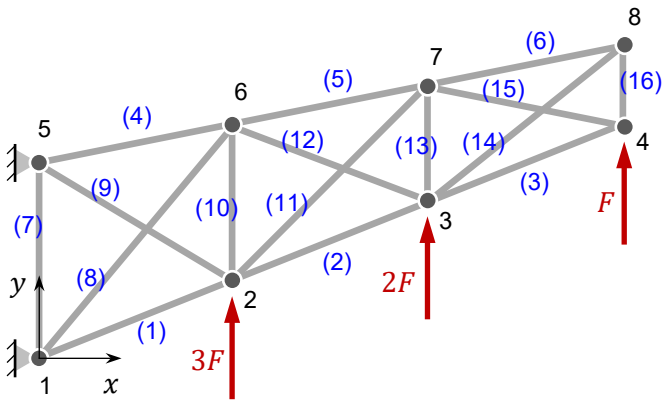
Assignment 1

2D bars: Cantilever structure

Consider the articulated bars structure in Figure 1. The position of nodes 1 and 5 is fixed and a force $F = 920$ N acts in the indicated nodes and direction. All bars are made of the same material, with a Young's modulus $E = 75000$ MPa, a circular section area $A = 120$ mm^2, a second moment of area $I = 1400$ mm^4, and a thermal expansion coefficient of $\alpha = 23 \times 10^{-6}$ K^{-1}.



Node	x (m)	y (m)
1	0	0
2	0.5	0.2
3	1	0.4
4	1.5	0.6
5	0	0.5
6	0.5	0.6
7	1	0.7
8	1.5	0.8

Figure 1. Sketch of the 2D bars cantilever structure.

In such conditions:

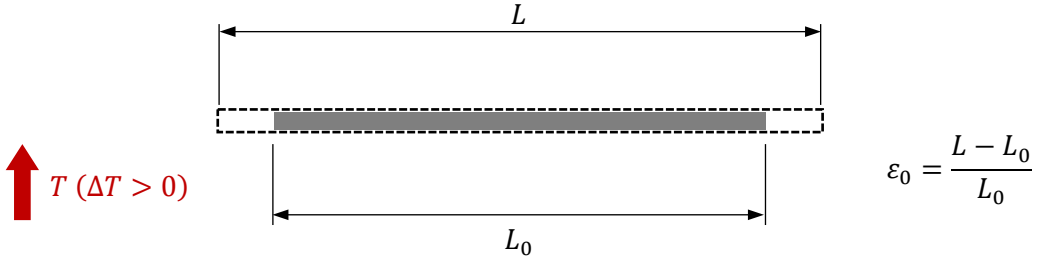
A) Determine the deformed structure and the stress state of each bar.

B) Considering there is a sudden change of the overall temperature of the structure, determine the resulting deformed configuration and the stress of each bar for:

1. A temperature increase of $\Delta T = 10$°C.
2. A temperature decrease of $\Delta T = -5$°C.

Repeat and determine the results without considering external forces (i.e., $F = 0$). Note: treat the thermal expansion effects on each bar as an initial (imposed) strain:

$$\varepsilon_0 = \alpha \Delta T$$



The assignment can be done in groups of maximum 2 people. Only one of the members must submit a compressed ZIP file to Atenea containing the following:

- All the MATLAB® script files.
- A report with the following information:
    - Names of the group members.
    - For part A:
        - Displacement obtained for node 4.
        - Reactions obtained at nodes 1 and 5.
        - Table with the stress of each bar.
        - Plot of the deformed structure depicting the stress of each bar.
        - Assessment of the risk of buckling. Consider the critical stress for buckling as

$$\sigma_{cr} = \frac{\pi^2 EI}{L^2 A}$$

    - For parts B1 and B2:
        - Maximum and minimum stress.
        - Plot of the deformed structure depicting the stress of each bar.
        - Maximum and minimum stress for $F = 0$.
        - Plot of the deformed structure depicting the stress of each bar for $F = 0$.