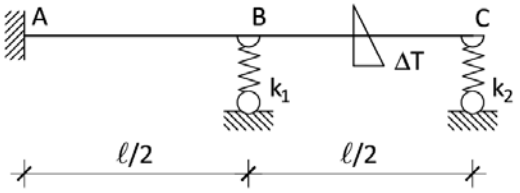
Exercise 3

STUDENT IDENTIFICATION NUMBER: _ _ _ _ _ _
a b c d e f



$$k_1 = n_1 \cdot \frac{EI}{\ell^3} \qquad \text{with} \quad n_1 = 1 + 2 \cdot e$$

$$k_2 = n_2 \cdot \frac{EI}{\ell^3} \qquad \text{with} \quad n_2 = 20 - 2 \cdot f$$

Consider the structure sketched above, subjected to the indicated change of temperature, and assume for the springs the specified stiffness values k_1 and k_2, where *e* and *f* coincide with the corresponding digits of your student id number. The material parameters are Young modulus E and thermal expansion coefficient α, while the beam cross section is doubly symmetric, with area A and depth h in the represented plane, and relevant moment of inertia I.

For this structure:

- evaluate the displacement components and the rotations at sections B and C;
- sketch the deformed configuration of the beam axis;
- evaluate the reaction forces;
- compute the amount of the stored energy;
- determine and graphically represent the internal forces distribution.

Compare the numerical results obtained by considering two slender beam elements to the corresponding analytical solution. Give a clear indication of the assumed reference system and sign convention.

Solve the exercise and deliver the required results only by fully compiling the next page 2.

The delivery must follow the instructions contained in the document "Delivery Deadlines" published in WeBeep.

Exercise 3 - SOLUTION

SURNAME:
STUDENT IDENTIFICATION NUMBER: _ _ _ _ _ _
a b c d e f

NAME:
PERSON CODE:

n_1 = n_2 =

NUMERICAL SOLUTION

EQUIVALENT NODAL FORCES – quoted sketch

DISPLACEMENTS AND ROTATIONS AT NODES

horizontal displacement at node B: u_B =

vertical displacement at node B: v_B =

rotation at node B: φ_B =

horizontal displacement at node C: u_C =

vertical displacement at node C: v_C =

rotation at node C: φ_C =

DEFORMED SHAPE – quoted graph

REACTION FORCES – quoted sketch

STORED ENERGY

AXIAL FORCE DISTRIBUTION – quoted graph

BENDING MOMENT DISTRIBUTION – quoted graph

ANALYTICAL SOLUTION

DISPLACEMENTS AND ROTATIONS AT NODES

horizontal displacement at node B: u_B =

vertical displacement at node B: v_B =

rotation at node B: φ_B =

horizontal displacement at node C: u_C =

vertical displacement at node C: v_C =

rotation at node C: φ_C =

DEFORMED SHAPE – quoted graph

REACTION FORCES – quoted sketch

STORED ENERGY

AXIAL FORCE DISTRIBUTION – quoted graph

BENDING MOMENT DISTRIBUTION – quoted graph

SHEAR FORCE DISTRIBUTION – quoted graph