SSLL110 - System of 3 bars out of U under actual weight

Summary:
This test allows a simple checking of calculations of gravity for the elements of bar in linear mechanics of the structures static. The model is linear.

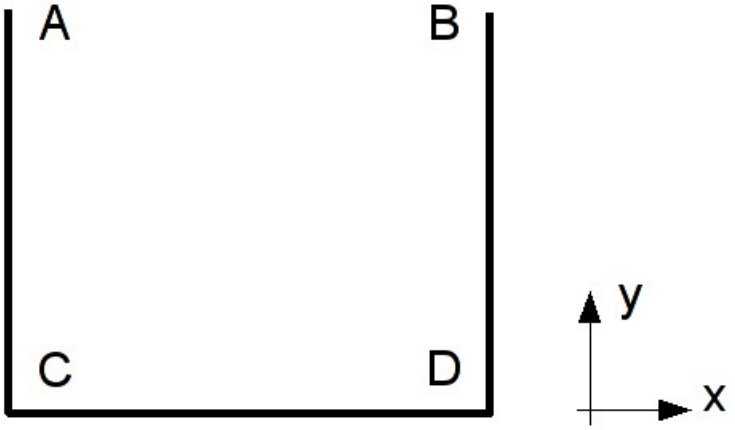
Only one modeling is used: it makes it possible to test the application of gravity on elements of bar, located in a reference mark different from the direction of gravity.

The values tested are the generalized displacements, efforts and the constraints.

1 Problem of reference

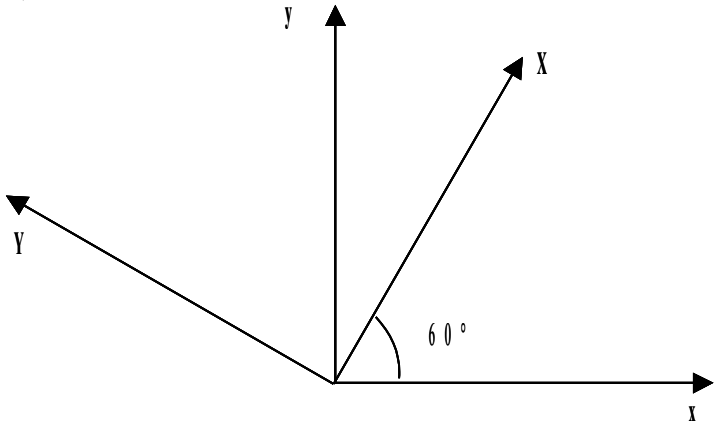
1.1 Geometry

A system of 3 bars in U, drawn here in a local reference mark (x, y):



The surface of the cross sections is worth $A=1\mathrm{m}^2$. The length of each of the 3 bars is worth $L=10\mathrm{m}$.

The reference mark in which is drawn here is turned of $60°$ compared to the reference mark of the laboratory (X, Y) :



1.2 Material properties

$E=2.10^{11}\,Pa$ for the 3 bars.

$\rho=8000\,kg/m^3$ only for the bar CD. For the 2 other bars, $\rho=0$.

1.3 Boundary conditions and loadings

Embedding in A and B.

In order to avoid the movements of rigid body, $DZ=0$ for all the nodes, and $DX=0$ in C and D.

Only one loading is applied: gravity. Gravity is obviously related to the reference mark of the laboratory, therefore in the direction $-Y$; one takes a virtual acceleration of it of $g=20\mathrm{m}/s^2$. In the reference mark of the structure, gravity is thus expressed $(\sin(60)\,g, -\cos(60)\,g)=(0.866\times g, -0.5\times g, 0)$, which is equivalent to $g=10\mathrm{m}/s^2$, in the direction $-y$.

2 Reference solution

2.1 Method of calculating used for the reference solution

Analytical solution:

- Normal effort in each bar AC and BD : $N=\rho.L.A.g/2$
- Displacement U_y in C and D : $U_y=NL/ES$

2.2 Results of reference

- Normal bar tension AC and BD : $N=4.10^5 N$
- displacements in C and D : $U_y=210^{-5}m$

2.3 Uncertainty on the solution

Analytical solution.

3 Modeling A

3.1 Characteristics of modeling

Each bar is modelled by only one element.

3.2 Characteristics of the grid

Three meshs SEG2.

3.3 Sizes tested and results

Identification	Reference
$u_x(C)$	0,00E+00
$u_x(C)$	2.0E -05
$N(AC)$	4.0E+05
$N(BD)$	4.0E+05

4 Summary of the results

This test, very simple, makes it possible simultaneously to check the good performance of gravity in the elements of bar, which is checked by the perfect coincidence of the results with the analytical solution.