SSLL110 - System of 3 bars in U under Summarized

inertia loading:
This test allows a simple checking of computations of gravity for the elements of bar in linear static structural mechanics. The model is linear.

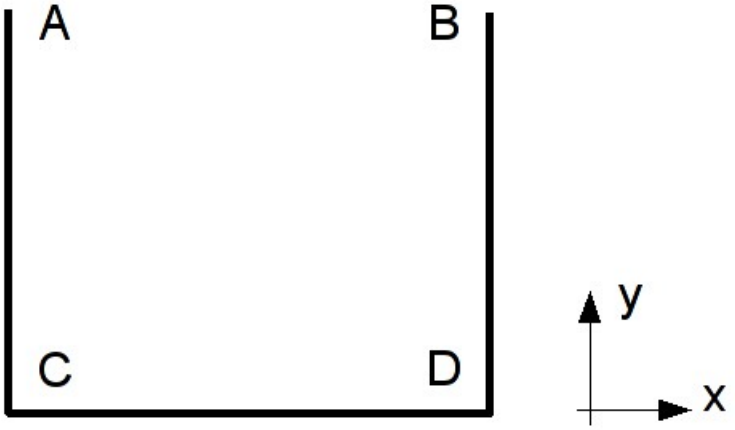
Only one modelization is used: it makes it possible to test the application of gravity on elements of bar, located in a reference different from the direction of gravity.

The values tested are displacements, the generalized forces and the forced.

1 Problem of reference

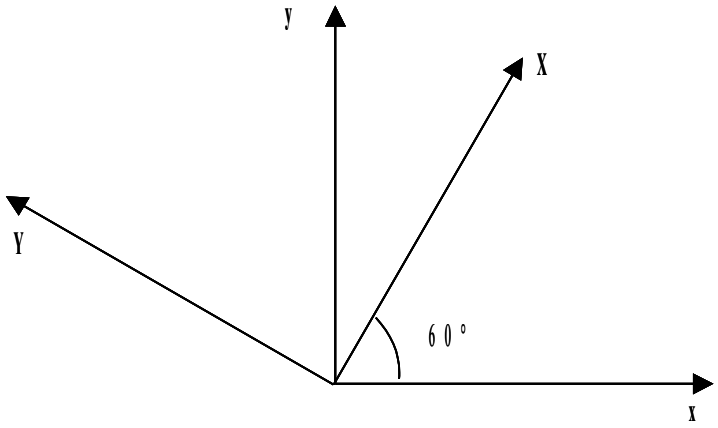
1.1 Geometry

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



The area 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 in which is drawn here is turned from $60°$ ratio with the reference 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

Fixed support in A and B.

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

Only one loading is applied: gravity. Gravity is obviously related to the reference 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 of 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 analytical reference solution

Solution:

- Normal force 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 analytical

solution Solution.

3 Modelization A

3.1 Characteristic of the modelization

Each bar is modelled by only one element.

3.2 Characteristics of the mesh

Three meshes SEG2.

3.3 Quantities tested and results

Identification	Reference
$u_x(C)$	2.0E
$u_x(C)$	-05.2.0E
$N(AC)$	-05.4.0E+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.