

## SSNL105 - Tally stayed

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### Summary:

Test of mechanics of the structures in static nonlinear elasticity.

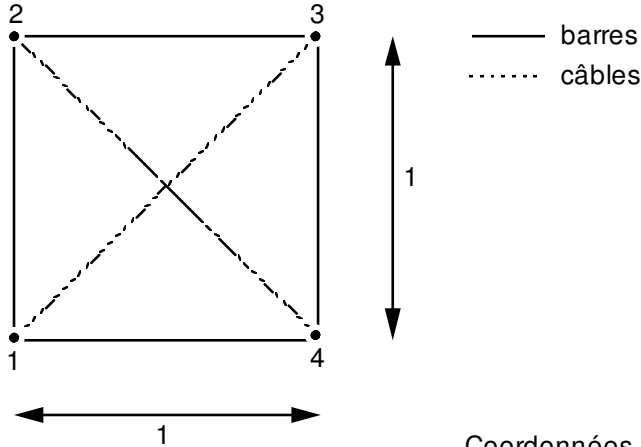
The framework is made of pin jointed struts. The stays consist of two cables. Only one modeling is built.

This test makes it possible to check the behavior in traction and compression of the elements of cable (traction possible, worthless compression) and the elastic behavior of the bars.

## 1 Problem of reference

### 1.1 Geometry

Tally square plan provided with two stays (cables) on the two diagonals.



Coordonnées des points :

1	0.	0.
2	0.	1.
3	1.	1.
4	1.	0.

The cables are not connected in their mediums.

### 1.2 Material properties

$$E = 2.1 \cdot 10^{11} \text{ Pa}$$

$$\nu = 0.3$$

### 1.3 Boundary conditions and loadings

$$DZ = 0. \quad \text{nodes 1,2,3,4}$$

$$DY = 0. \quad \text{nodes 1,4}$$

$$DX = 0. \quad \text{node 1}$$

$$FX = 1000. \text{ N} \quad \text{node 3}$$

## 2 Reference solution

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### 2.1 Method of calculating used for the reference solution

The solution is obtained by elementary statics.

$$\begin{aligned} \text{In the cable } 1-3 \quad N &= 1000 \sqrt{2} N \\ &\simeq 1414.2 N \end{aligned}$$

$$\begin{aligned} \text{In the bar } 3-4 \quad N &= -1000 N \\ N &= 0 \text{ everywhere else (and in particular in cable 2-4).} \end{aligned}$$

### 2.2 Uncertainty on the solution

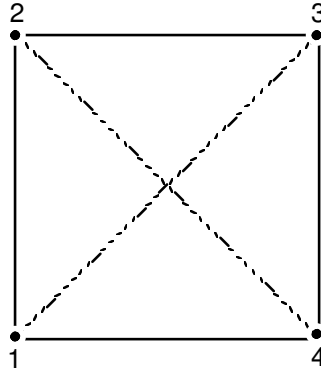
The reference solution is exact.

### 2.3 Bibliographical references

Simple problem imagined to put in contrast the behavior of two cables: one with traction, the other with compression.

## 3 Modeling A

### 3.1 Characteristics of modeling



Bars 1–2, 2–3, 3–4 and 4–1 are modelled each one by 1 element `BAR`.  
The cables are modelled each one by an element `CABLE`.

### 3.2 Characteristics of the grid

There are thus 4 elements `BAR` and 2 elements `CABLE`.

### 3.3 Sizes tested and results of modeling A

One starts by testing the tractive efforts  $N$  in the cables and the bars:

Identification	Reference	Tolerance
$N$ in the bar 3–4 with <code>NUME_ORDRE=2</code>	-1000.0	0,03%
$N$ in the cable 1–3 with <code>NUME_ORDRE=2</code>	-1414,2	0,03%
$N$ in the bar 1–2 with <code>NUME_ORDRE=2</code>	0	1,0E-3%
$N$ in the bar 2–3 with <code>NUME_ORDRE=2</code>	0	1,0E-3%
$N$ in the bar 4–1 with <code>NUME_ORDRE=2</code>	0	1,0E-3%
$N$ in the cable 4–2 with <code>NUME_ORDRE=2</code>	0	1,0E-3%

#### 3.3.1 Other values tested

One tests also the nodal force with the node `N3`, which must be equal to the external effort applied (either  $1000N$  according to `DX`):

Identification	Reference	Tolerance
<code>FORC_NODA</code> , direction <code>DX</code> , with the node <code>N3</code> and with <code>NUME_ORDRE=2</code>	-1000.0	0,03%

One also tests the structural parameters of data results:

Identification	Reference	Tolerance
<code>INST</code> for <code>NUME_ORDRE= 2</code>	2	0%
<code>ITER_GLOB</code> for <code>NUME_ORDRE= 2</code>	2	0,00%

## 4 Summary of the results

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The results show that the behavior of the cables is in conformity so that one expects some: no compression, rubber band in traction.