

## SSL12 - Truss of bars under three requests

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### Summarized:

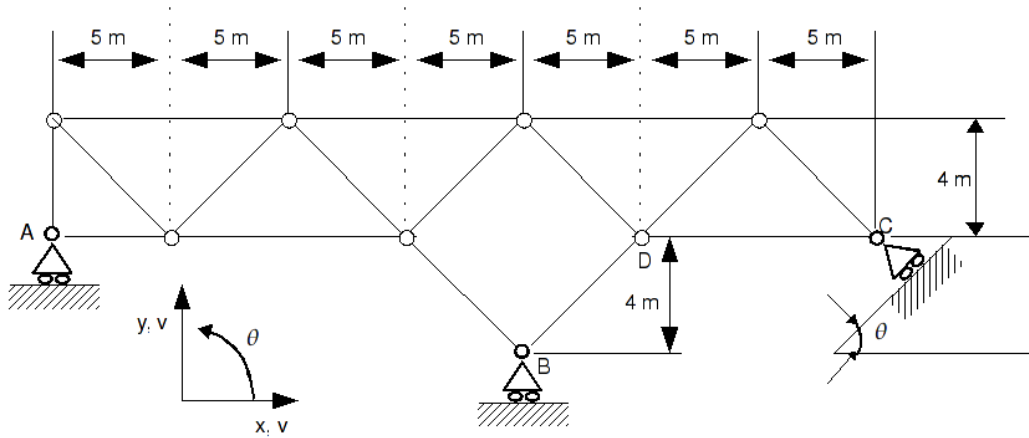
Static response in linear mechanics of structures of a triangulated system of pinned bars (plane truss) under 3 requests:

- displacement of bearing,
- specific forces,
- effect of thermal expansion.

This test makes it possible to validate the element `BARS` under various cases of loading. It of the command validates also `option LIAISON_OBLIQUE AFFE_CHAR_MECA`.

## 1 Problem of reference

### 1.1 Geometry



### 1.2 Material properties

isotropic linear elastic Material:  $E = 2.1 \cdot 10^{11} \text{ Pa}$

Linear coefficient of thermal expansion:  $\alpha = 1. \cdot 10^{-5} \text{ } ^\circ\text{C}^{-1}$

### 1.3 Boundary conditions and loadings

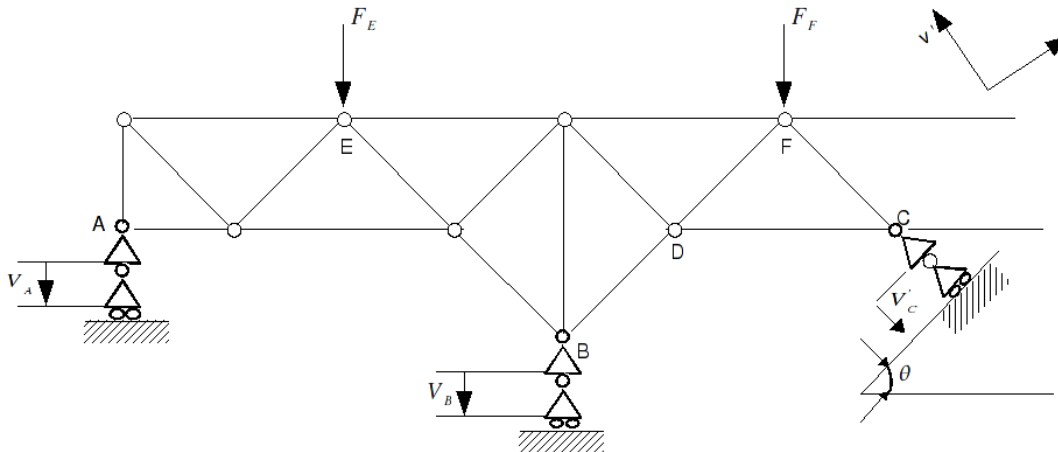
Pinned end in  $A$  ( $u_A = v_A = 0$ ).

Roller bearing in  $B$  and  $C$  ( $v_B = v_C = 0$ ).

### 1.4 Initial conditions

Office plurality of 3 requests:

- displacement of bearing:  $v_A = -0.02 \text{ m}$ ,  $v_B = -0.03 \text{ m}$ ,  $v_C = -0.015 \text{ m}$
- specific forces:  $F_E = -150 \text{ kN}$ ,  $F_F = -100 \text{ kN}$
- effect of thermal expansion of all the bars for a variation in temperature from  $30 \text{ } ^\circ\text{C}$  ratio to the temperature of assembly (geometry of reference).



## 2 Reference solution

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

Determination of the unknown the hyperstatic one by the method of cut to know the tractive effort.

### 2.2 Results of reference

Not	Quantity and unit	Value
<i>BD</i>	Effort tractive ( <i>N</i> )	- 8.2112 E+03

### 2.3 Uncertainty on the analytical

solution Solution.

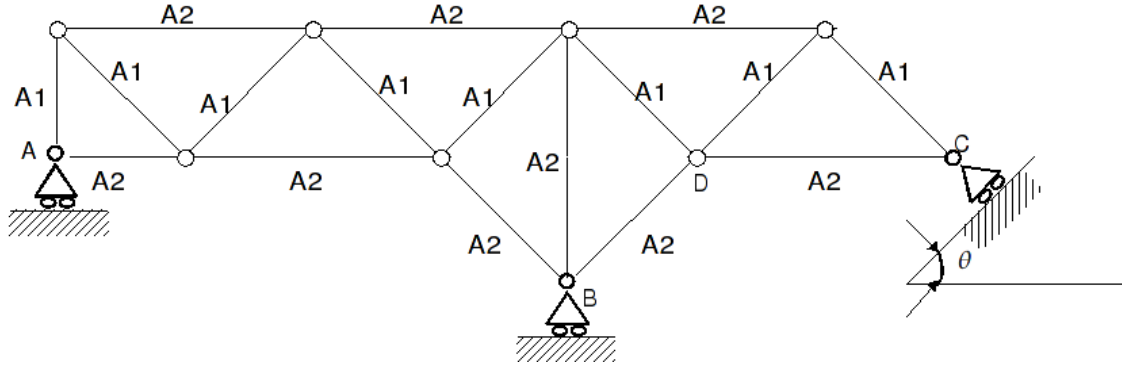
### 2.4 Bibliographical references

[1] Mr. LAREDO, Strength of materials, Paris, Dunod, 1970, p. 579.

## 3 Modelization A

### 3.1 Characteristic of the Standard

modelization of modelization used: element BARS.



### 3.2 Characteristics of the mesh

$$\theta = 30^\circ \quad A1 = 1.41 E - 03 \text{ m}^2 \quad A2 = 2.82 E - 03 \text{ m}^2$$

## 3.3 Quantities tested and results

Identification	Reference	Aster	% difference
<b>Charges: thermal thermal expansion</b>			
Option: "EFGE ELNO"			
Nets <i>MI0</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>B</i> , Cmp: <i>N</i>	12946.	1.29541 E+04	0.063
Nets <i>MI6</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	4285.2	4.28926 E+03	0.095
Nets <i>MI7</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	- 10189.	- 1.02076 E+04	0.183
<b>Charges: specific forces</b>			
Option: "DEPL"			
The node is outside the field of definition with a right profile of the EXCLU type node: <i>E</i> , Cmp: <i>DY</i>	- 1.0566 E-02	- 1.05800 E-02	0.133
Option: "EFGE ELNO"			
Nets <i>MI0</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>B</i> , Cmp: <i>N</i>	- 87137.	- 8.71128 E+04	- 0.028
Mesh <i>MI6</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	24158.	2.41596 E+04	0.007
Nets <i>MI7</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	- 57524.	- 5.74954 E+04	- 0.050
<b>Load: imposed displacements</b>			
Option: "EFGE ELNO"			
Nets <i>MI0</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>B</i> , Cmp: <i>N</i>	65979.1	6.59757 E+04	- 0.005
Mesh <i>MI6</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	21839.1	2.18453 E+04	0.029
Nets <i>MI7</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	- 51925.6	- 5.19877 E+04	0.120
<b>Charges: office plurality of the 3 requests</b>			
Option: "EFGE ELNO"			
Nets <i>MI0</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>B</i> , Cmp: <i>N</i>	- 8211.2	- 8.18302 E+03	- 0.343
Mesh <i>MI6</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	50282	5.02942 E+04	0.024
Nets <i>MI7</i> , The node is outside the field of definition with a right profile of the EXCLU type node: <i>C</i> , Cmp: <i>N</i>	- 1.1964 E+05	- 1.19691 E+05	0.043

## 3.4 Remarks

No strain of bending intervenes in the computation of the solution.

## 4 Summary of the results

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the variations compared to the references are lower than 0.18% for the requests (thermal thermal expansion, specific face, imposed displacement) separate and lower than 0.34% when these requests are cumulated.