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## ZZZZ234 - Test of the values of reference for the elements beams, bars, cables, discrete.

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### Abstract:

Validation of key word `FORC_REFE` (Force and Moment of reference for the structural elements) and of `CREA_CHAMP`, for the following modelizations:

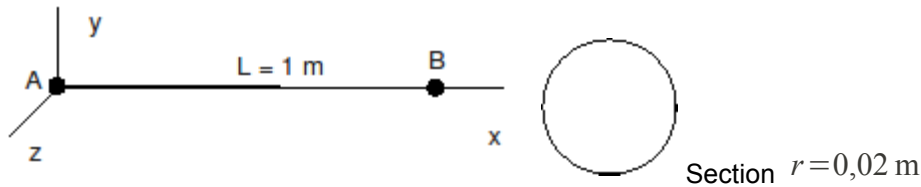
- Beam elements: `POU_D_E`, `POU_D_T`, `POU_D_TG`, `POU_D_EM`, `POU_D_TGM`, `POU_D_T_GD`
- Element of bar: `BAR`,
- Cable element: `CABLE`,
- Discrete elements **3D** : `DIS_T`, `DIS_TR`,
- Discrete elements **2D** : `2D_DIS_T`, `2D_DIS_TR`.

## 1 Problem of reference

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### 1.1 Geometry

Straight beam length  $L=1$  , direction  $x$  .



Material properties:

$$E=2.10^{11} Pa$$
$$\nu=0.3$$

### 1.2 Boundary conditions and loadings

the boundary conditions and the loadings are detailed during the description of the modelizations.

## 2 Reference solution

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### 2.1 Results of analytical

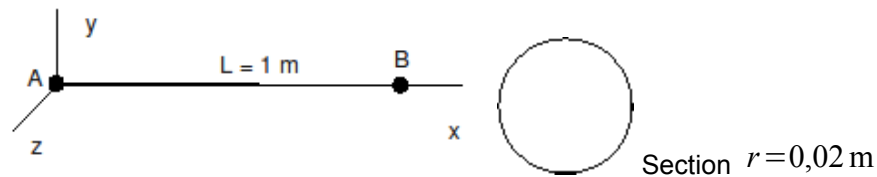
reference Reference (theory of the beams)

### 2.2 Uncertainty on the solution

No

## 3 Modelization A

### 3.1 Characteristic of the modelization



Element `POUTRE` (6 modelizations):

- modelization `POU_D_T`
- modelization `POU_D_E`
- modelization `POU_D_TG`
- modelization `POU_D_EM`
- modelization `POU_D_TGM`
- modelization `POU_D_T_GD`

Fixed support in  $A$  :  $D X = D Y = D Z = D R X = D R Y = D R Z = 0$

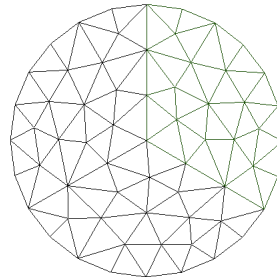
Loading in  $B$  :

- $F X = 1000 \text{ N}$
- $F Y = 1100 \text{ N}$
- $F Z = 1200 \text{ N}$
- $M X = 1300 \text{ N.m}$
- $M Y = 1400 \text{ N.m}$
- $M Z = 1500 \text{ N.m}$

### 3.2 Characteristics of the mesh

an element `SEG2`

Mesh of the section for multifibre elements `POU_D_EM` and `POU_D_TGM`. The mesh is composed of 102 `TRIA3` and 64 nodes.



## 3.3 Quantities tested and results

Modelization POU\_D\_T :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	2.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	3.2753E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	3.2753E+003	ANALYTIQUE	0,1 0%

Modelization POU\_D\_E :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	2.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	3.2753E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	3.2753E+003	ANALYTIQUE	0,1 0%

Modelization POU\_D\_TG :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	2.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	3.2753E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	3.2753E+003	ANALYTIQUE	0,1 0%

Modelization POU\_D\_EM :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-2.2209E+008	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	1.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	1.0000E+003	ANALYTIQUE	0,1 0%

Modelization POU\_D\_TGM :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-2.2991E+008	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	1.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	1.0000E+003	ANALYTIQUE	0,1 0%

Modelization POU\_C\_T :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	0.0000E+000	ANALYTIQUE	0,1 0%

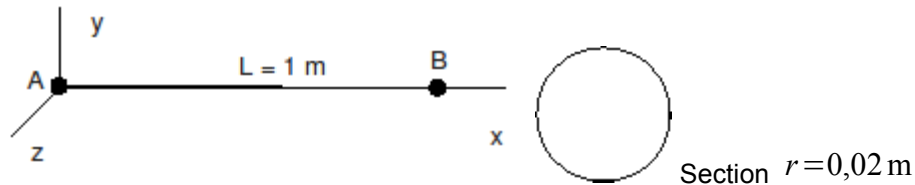
For all the modelizations, of the tests ensure non regression code. They relate to following displacement  $Y$  to the node  $B$  like on ITER\_GLOB for the NUME\_ORDRE=1.

## 3.4 Remarks

to converge, the loading of modelization POU\_D\_T\_GD was divided by 100.

## 4 Modelization B

### 4.1 Characteristic of the modelization



Modelization BARS :

Point: *A*  $DX = DY = DZ = 0$

Point: *B*  $DY = DZ = 0$

Force in *B* :  $FX = -1000 N$

### 4.2 Characteristics of the mesh

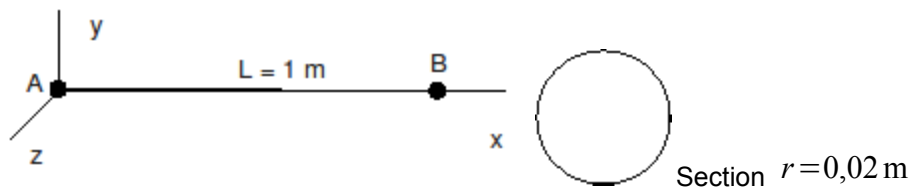
an element SEG2

### 4.3 Quantities tested and results

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	-4.0000E+003	ANALYTIQUE	0,1 0%
<i>DX</i> to the node <i>B</i>	-3.7894E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	1.0000E+000	NON_REGRESSION	0.00%

## 5 Modelization C

### 5.1 Characteristic of the modelization



Modelization CABLE :

Null displacement in  $A$  :  $DX = DY = DZ = 0$

Force in  $B$  :  $FX = 1000 N$

### 5.2 Characteristics of the mesh

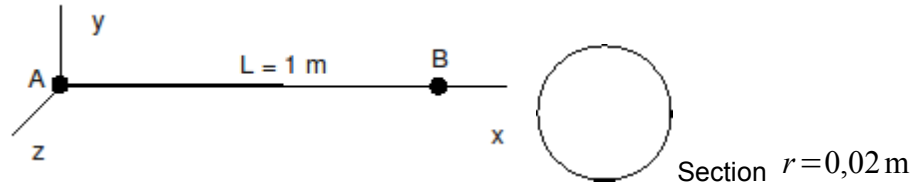
an element SEG2

### 5.3 Quantities tested and results

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-7.5787E-003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	-7.5787E-003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	-7.5787E-003	ANALYTIQUE	0,1 0%
$DX$ to the node $B$	3.7894E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	3,0000E+000	NON_REGRESSION	0.00%

## 6 Modelization D

### 6.1 Characteristic of the modelization



DISCRET element 3D , 4 modelizations:

- modelization DIS\_T : T\_L (mesh SEG2)
- modelization DIS\_T : T\_N (mesh POI)
- modelization DIS\_TR : TR\_L (mesh SEG2)
- modelization DIS\_TR : TR\_N (mesh POI)

Modelization DIS\_T : T\_L ( AB : net SEG2)

- Displacement null in A :  $DX = DY = DZ = 0$
- Force in B :  $FY = -1000 N$

Modelization DIS\_T : T\_N (mesh POI)

- null Rotations in A :  $DRX = DRY = DRZ = 0$
- Force in B :  $FY = -1000 N$

The mesh of this modelization is composed of a mesh POI (not A ) for the discrete element (T\_N) and of a mesh SEG2 ( AB ) for the element beam.

Modelization DIS\_TR : TR\_L ( AB : net SEG2)

- Fixed support in A :  $DX = DY = DZ = DRX = DRY = DRZ = 0$
- Loading in B :
  - $FX = 1000 N$
  - $FY = 1100 N$
  - $FZ = 1200 N$
  - $MX = 1300 N.m$
  - $MY = 1400 N.m$
  - $MZ = 1500 N.m$

Modelization DIS\_TR : TR\_N ( A : net POI)

- Loading in B :
  - $FX = 1000 N$
  - $FY = 1100 N$
  - $FZ = 1200 N$
  - $MX = 1300 N.m$
  - $MY = 1400 N.m$
  - $MZ = 1500 N.m$

The mesh of this modelization is composed of a mesh POI (not A ) for the discrete element (TR\_N) and of a mesh SEG2 ( AB ) for the element beam.

## 6.2 Characteristics of the mesh

Modelizations DIS\_T, DIS\_TR (T\_L, TR\_L)  
- 1 SEG2

Modelization DIS\_T, DIS\_TR (T\_N, TR\_N)  
- 1 SEG2  
- 1 POI

## 6.3 Quantities tested and Values

### 6.3.1 results tested

Modelization DIS\_T/T\_L :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	-4.0000E+003	ANALYTIQUE	0,1 0%

Modelization DIS\_T/T\_N :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	-4.0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	-4.0000E+003	ANALYTIQUE	0,1 0%

Modelization DIS\_TR/TR\_N :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	0.0000E+000	ANALYTIQUE	0,1 0%

Modelization DIS\_TR/TR\_N :

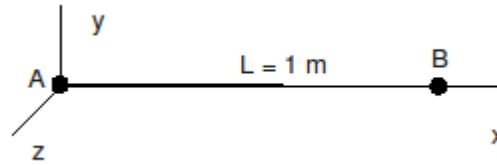
Identification	Reference	Test	Tolerance
normal Force – Field ELGA	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	0.0000E+000	ANALYTIQUE	0,1 0%

For all the modelizations, of the tests ensure non regression code. They relate to following displacement  $Y$  to the node  $B$  like on ITER\_GLOB for the NUME\_ORDRE=1.



## 7 Modelization E

### 7.1 Characteristic of the modelization



DISCRET element 2D , 4 modelizations:

- modelization 2D\_DIS\_T : T\_L (mesh SEG2)
- modelization 2D\_DIS\_T : T\_N (mesh POI)
- modelization 2D\_DIS\_TR : TR\_L (mesh SEG2)
- modelization 2D\_DIS\_TR : TR\_N (mesh POI)

Modelization 2D\_DIS\_T : T\_L

- null Displacement in A :  $\overline{DX} = \overline{DY} = 0$
- Force in B :  $FX = -1000 N$  ,  $FY = -1100 N$

Modelization 2D\_DIS\_T : T\_N

- Forces in B :  $FX = -1000 N$

The mesh of this modelization is composed of a mesh POI (not A ) for the discrete element (T\_N) and of a mesh SEG2 ( AB ) for discrete element (T\_L).

Modelization 2D\_DIS\_TR : TR\_L

- null Displacement in A :  $\overline{DX} = \overline{DY} = \overline{DRZ} = 0$
- Force in B :  $FX = -1000 N$  ,  $FY = -1100 N$

Modelization 2D\_DIS\_TR : T\_N

- Forces in B :  $FX = -1000 N$

The mesh of this modelization is composed of a mesh POI (not A ) for the discrete element (TR\_N) and of a mesh SEG2 ( AB ) for discrete element (TR\_L).

### 7.2 Characteristics of the mesh

Modelization 2D\_DIS\_T, 2D\_DIS\_TR (T\_L, TR\_L)  
- 1 SEG2

Modelization 2D\_DIS\_T, 2D\_DIS\_TR : T\_N, TR\_N  
- 1 POI  
- 1 SEG2

### 7.3 Quantities tested and results

Modelization 2D\_DIS\_T / T\_L :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	0.0000E+000	ANALYTIQUE	0,1 0%
$\overline{DY}$ to the node B	-4.1684E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	0.0000E+000	NON_REGRESSION	0.00%

Modelization 2D\_DIS\_T /T\_N :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	0.0000E+000	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	0.0000E+000	ANALYTIQUE	0,1 0%
<i>DY</i> to the node B	-4.1684E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	0.0000E+000	NON_REGRESSION	0.00%

Modelization 2D\_DIS\_TR /TR\_N :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	- 7, 0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	- 7, 0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	- 7, 0000E+003	ANALYTIQUE	0,1 0%
<i>DX</i> with the node B	-7.5789E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	0.0000E+000	NON_REGRESSION	0.00%

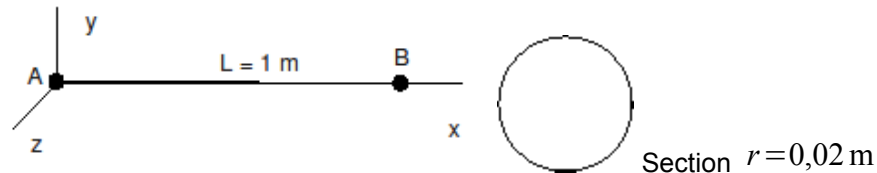
Modelization 2D\_DIS\_TR /TR\_N :

Identification	Reference	Test	Tolerance
normal Force – Field ELGA	- 7, 0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field ELNO	- 7, 0000E+003	ANALYTIQUE	0,1 0%
normal Force – Field NOEU	- 7, 0000E+003	ANALYTIQUE	0,1 0%
<i>DX</i> with the node B	-7.5789E-006	NON_REGRESSION	1,0 E-8 (relative)
ITER_GLOB for NUME_ORDRE=1	0.0000E+000	NON_REGRESSION	0.00%

## 8 Modelization F

This modelization is strictly identical to the modelization A, except that one does it in dynamics (operator `DYNA_NON_LINE` ).

### 8.1 Characteristics of the modelization



Element `POUTRE` (6 modelizations):

- modelization `POU_D_T`
- modelization `POU_D_E`
- modelization `POU_D_TG`
- modelization `POU_D_EM`
- modelization `POU_D_TGM`
- modelization `POU_D_T_GD`

Fixed support in  $A$  :  $D X = D Y = D Z = D R X = D R Y = D R Z = 0$

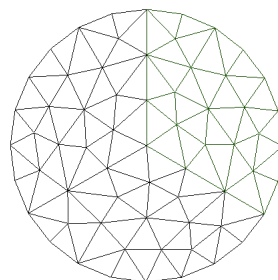
Loading in  $B$  :

- $F X = 1000\text{ N}$
- $F Y = 1100\text{ N}$
- $F Z = 1200\text{ N}$
- $M X = 1300\text{ N.m}$
- $M Y = 1400\text{ N.m}$
- $M Z = 1500\text{ N.m}$

### 8.2 Characteristics of the mesh

an element `SEG2`

Mesh of the section for multifibre elements `POU_D_EM` and `POU_D_TGM`. The mesh is composed of 102 `TRIA3` and 64 nodes.



### 8.3 Quantities tested and results

For all the modelizations, of the tests ensure non regression code. They relate to following displacement  $Y$  to the node  $B$  like on `ITER_GLOB` for the `NUME_ORDRE=1`.

## 9 Summary of the results

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the got results are very satisfactory.