

## SSNL103 - Beam Cantilever in great rotations subjected to one moment

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### Summary:

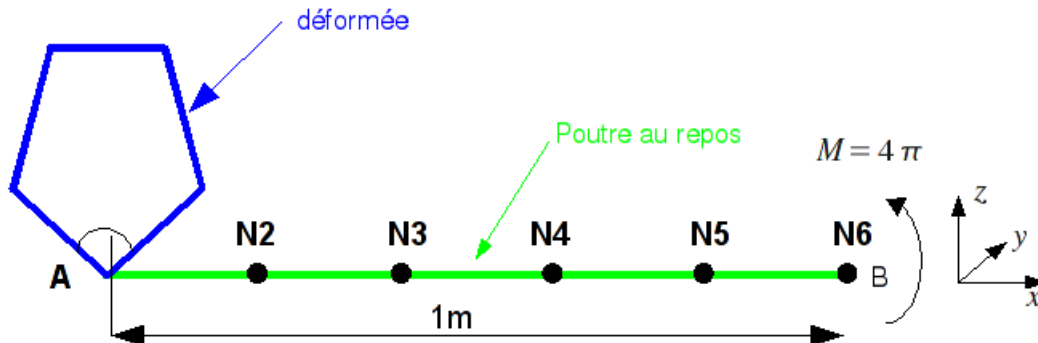
Calculation of the static deformation of a beam fixed at an end and subjected to one bending moment at the other end.

The beam is modelled by 5 elements `MECA_POU_D_T_GD`.

The interest is to test the element of beam `MECA_POU_D_T_GD` and the algorithm of great displacements established in `STAT_NON_LINE`.

## 1 Problem of reference

### 1.1 Geometry



Right beam  $AB$ , length  $l=1\text{m}$ , embedded in  $A$  and subjected in  $B$  at one moment  $M$ .

### 1.2 Material properties

Elastic behavior:  $E=1.0\text{Pa}$ . The Poisson's ratio does not intervene in pure inflection.

Characteristics of the section:

$$A=1.0\text{m}^2 \quad I_y=I_z=2.0\text{m}^4$$

$$I_x=4.0\text{m}^4 \text{ (does not intervene)} \quad A_y=A_z=4. \text{ (does not intervene)}$$

### 1.3 Boundary conditions and loadings

Embedding in  $A$ . One seeks balance under the loading of the moment:  $M=4\pi\text{N.m}$  in  $B$ .

## 2 Reference solution

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

Curve of a beam in great rotation subjected to one bending moment  $M$  is:  $\frac{1}{R} = \frac{M}{EI}$

As the moment is constant along the beam, the deformation is circular and its ray has as a value,

taking into account the data:  $R = \frac{l}{2\pi}$ , the deformation is a complete circle.

### 2.2 Results of reference

NODE	N3	N4	N6
$DX$	-0.30645	-0.69355	-1.0

### 2.3 Bibliographical references

J.C. SIMO and L. CONSIDERING QUOC, A three-dimensional finite strain rod model. Share II: computational aspects. Comput. Meth. Appl. Mech. Engrg. 58.79 - 116 (1986).

## 3 Modeling A

### 3.1 Characteristics of modeling

The beam is modelled by 5 linear elements MECA\_POU\_D\_T\_GD pressed on meshes SEG2 : who remain right. The deformation is thus a pentagon.

### 3.2 Sizes tested and results

Identification	Reference
$DX (N3)$	- 0.30
$DX (N4)$	- 0.70
$DX (N6)$	- 1.00

One also tests the structural parameters of data results:

Identification	Reference
INST for NUME_ORDRE= 1	1.
ITER_GLOB for NUME_ORDRE= 1	10

#### 3.2.1 Remarks

For the problems of great rotations, static balance is in general reached in an iteration count of about 10.

## 4 Summary of the results

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The deformation of the modelled beam is a CLOSED PENTAGON. But the nodes, in deformed situation, are apart from the circle of reference because the elements of beam MECA\_POU\_D\_T\_GD preserve their length but remain right instead of becoming deformed in arcs of a circle.