

SSNL103 - Cantilever beam in large rotations subjected to one Summarized

moment:

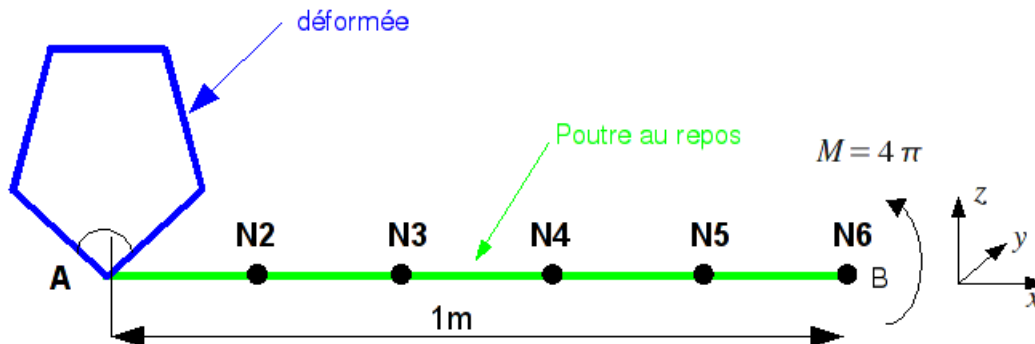
Computation of the static deformed shape of a beam fixed at an end and subjected to one bending moment at the other end.

The beam is modelled by 5 elements `MECA_POU_D_T_GD`.

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

1 Problem of reference

1.1 Geometry



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

1.2 Material properties

Behavior elastic: $E=1.0\text{ Pa}$. The Poisson's ratio does not intervene in pure bending.

Characteristics of the section:

$$I_y = I_z = 2.0\text{ m}^4$$

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

1.3 Boundary conditions and loadings

Fixed support in A . One seeks the equilibrium 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

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

As the moment is constant along the beam, the deformed shape is circular and its radius has as a value, taking into account the data: $R = \frac{l}{2\pi}$, the deformed shape 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. Leaves II: computational aspects. Comput. Meth. Appl. Mech. Engrg. 58,79 - 116 (1986).

3 Modelization A

3.1 Characteristic of the modelization

the beam is modelled by 5 linear elements MECA_POU_D_T_GD leaned on of meshes the SEG2 : who remain right. The deformed shape is thus a pentagon.

3.2 Quantities tested and results

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

One also tests the parameters of the data structure results:

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

3.2.1 Remarks

For the problems of large rotations, the static equilibrium is in general reached in a nombre of iterations of about 10.

4 Summary of the results

the deformed shape of the modelled beam is a CLOSED PENTAGON. But the nodes, in deformed situation, are apart from the circle of reference because beam elements `MECA_POU_D_T_GD` preserve their length but remain right instead of becoming deformed in arcs of a circle.