SSNL103 - Beam Cantilever in great rotations subjected to one moment

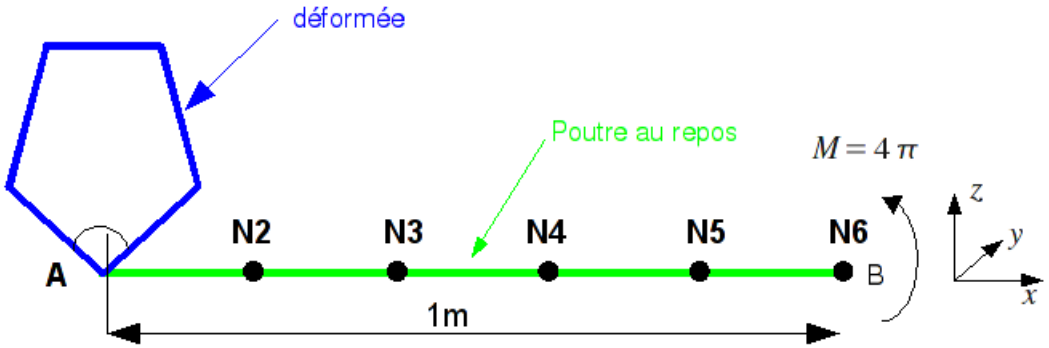
Summary:
Calculation of the static deformation of a beam fixed at an end and subjected to one bending moment at the other end.

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 $l=1\,m$, embedded in A and subjected in B at one moment M.

1.2 Material properties

Elastic behavior: $E=1.0\,Pa$. The Poisson's ratio does not intervene in pure inflection.
Characteristics of the section:

$A=1.0\,m^2$ $I_y=I_z=2.0\,m^4$

$I_x=4.0\,m^4$ (does not intervene) $A_y=A_z=4.$ (does not intervene)

1.3 Boundary conditions and loadings

Embedding in A. One seeks balance under the loading of the moment: $M=4\pi\,N.m$ 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 meshs 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

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.