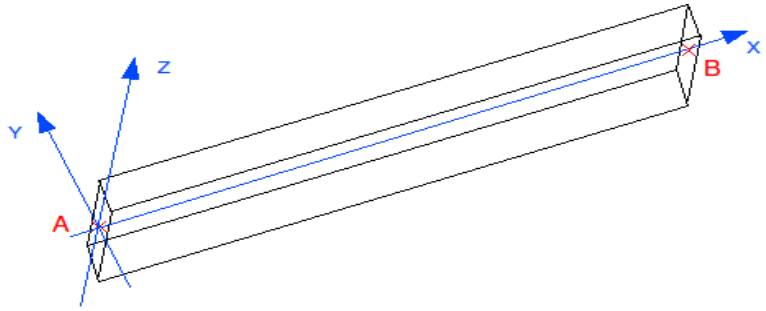
SSNL123 - Buckling of a beam Multifibre

Summary:
This test relates to the validation of the buckling of a beam multifibre with a model POU_D_TGM.
This problem makes it possible to test:
- linear finite elements of beams type with a model POU_D_TGM,
- the taking into account of the orientation,
- the calculation of the first modes of buckling.

1 Problem of reference

1.1 Geometry



Length of the bar: $3\mathrm{m}$
Articulated in A
Simply supported in B
Forces in B

Section of the bar:
height: $0.04\mathrm{m}$
width: $0.02\mathrm{m}$

1.2 Properties of material

Material for the linear element:
Elasticity: $E=2.1\mathrm{E}+11\ Pa$

1.3 Conditions with the loadings

At the point A : blocking of the degrees of freedom: dx, dy, dz, DRX
At the point B : blocking of the degrees of freedom : dx, dy, dz, DRX
Loading at the point B : = $(F_x, 0, 0)$.

2 Reference solution

2.1 Sizes and results of reference

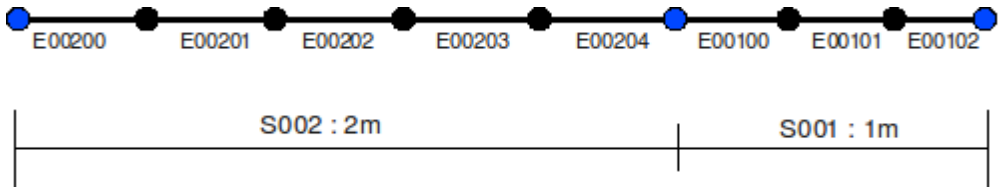
For an bi--articulated beam, the theory of the buckling of Euler gives as solution:

$$Ncd = n^2 . \frac{\pi^2 EI}{L^2}$$ where n is the number of the mode.

3 Modeling A

3.1 Characteristics of modeling and the grid

Linear element: POU_D_TGM



Mechanical characteristics of the section (homogeneous units to meters)

A	IY	IZ	AY	AZ	JX	JG
8.0e-04	2.5e-08	1.05e-07	1.191790e+00	1.172840e+00	7.093682e-08	1.438125e-12

Loading at the point B .	Fx
Moment 1	$-1\,000\,N$
Moment 2	$-2\,000\,N$

3.2 Sizes tested and results

The sizes tested and analyzed are the first values of the loads of buckling in the 2 directions.

	Values Theoretical	Tolerance (%)
1st Mode/ I_z	5757.3N	0.2
1st Mode/ I_y	24180.5 NR	0.2
2nd Mode/ I_z	23029.1 NR	0.2
3rd Mode/ I_z	51815.4 NR	0.2
2nd Mode/ I_y	96722.1 NR	0.2
4th Mode/ I_z	92116.3 NR	0.7

The moments of calculation 1 and 2 give the same results. The calculation of the vector of prestressed after STAT_NON_LINE be thus carried out in a correct way.

4 Summary of the results

This case test shows the good performance of a modeling of the behavior of the beams by an approach multifibre. A loop, carried out with the language python, makes it possible to recover information with the various steps of time.

- The calculation of the matrix of rigidity, option RIGI_MECA, is realized from one AFFE_CHAR_MECA_F.
- The calculation of the vector of the internal efforts is carried out by one CREA_CHAMP from one STAT_NON_LINE by recovering them SIEF_ELGA .