SSNX101 – Piloting of the loading into non-linear

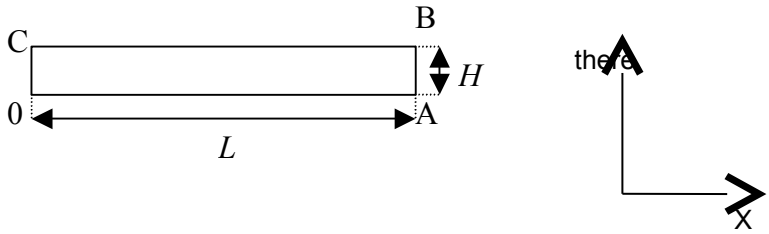
Summary:

To validate the piloting of the loading by length of arc (LONG_ARC), one studies the buckling of an elastic fixed beam, modelled in small deformations and great rotations (DEFORMATION=' GREEN'), in 2 dimensions.
It is checked that the got results are identical that one imposes the loadings in a direct way, by piloting or with linear piloting more research.

1Problem of reference

1.1Geometry

One studies the buckling of a beam length $L=1000\,mm$ and height $h=100\,mm$.



1.2Properties of material

The material is supposed to be elastic. The characteristic materials are the following ones:
Young modulus $E=20\,000\,MPa$
Poisson's ratio $\nu=0.3$
Density $\rho=10^{-6}kg.mm^{-3}$

One takes into account great rotations (DEFORMATION=' GREEN').

1.3Boundary conditions and loadings

The left side (OC) is embedded ($DX=DY=0$).
In addition gravity applies ($g_y=9810\,mm.s^{-2}$) and one imposes a compressive force in the direction $-x$ on the right side AB . The application of piloting is done by controlling the displacement of the node A :

- a displacement of $-1\,mm$ following maximum y between each increment when gravity is imposed
- a displacement of $50\,mm$ according to x and y between each increment when compression is imposed.

2Reference solution

2.1Method of calculating

To validate piloting LONG_ARC, one compares the solution obtained with that of reference resulting from the application of the same loading i.e. (I) gravity then (II) compression without piloting. The second phase is also tested by combining piloting and linear research.

2.2Sizes and results of reference

To compare the solutions, it is checked that:

- the difference of the 2 solutions of field of displacement gives a worthless potential energy
- the difference between 2 consecutive moments in the phase where one imposes gravity led well to a displacement of the node A according to y of $1\,mm$.

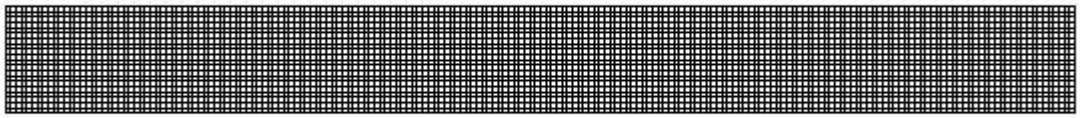
3Modeling A

3.1Characteristics of modeling

Modeling is 2D of the type forced planes (C_PLAN).

3.2Characteristics of the grid

The grid is composed of 200×20 that is to say 4000 elements QUAD8. It is represented on the figure below.



3.3Sizes tested and results

One tests:

- the potential energy obtained by making the difference between the solution obtained with piloting and the reference solution after application of gravity
- the potential energy obtained by making the difference between the solution obtained with piloting and the reference solution after application of compression
- the potential energy obtained by making the difference between the solution obtained with linear piloting more research and the reference solution after application of compression
- the variation of displacement of the node A according to y between the sequence numbers 2 and 3.

Identification	Reference	*Aster*	Difference
ENER_POT (1)	0	$9.67\ 10^{-24}$	-
ENER_POT (2)	0	$1.22\ 10^{-15}$	- -
ENER_POT (2B)	0	$1.89\ 10^{-15}$	- -
DEPL node A	-1.0	– 1.0	$6.6\ 10^{-14}$ %

3.4Remarks

The solutions obtained with or without piloting correspond perfectly. It is also possible to utilize in more linear research, even if in this case that does not improve the speed of convergence.

4Summary of the results

This test makes it possible to validate piloting by length of arc for a structure 2D in plane constraints. One also checks the possibility of combining piloting with linear research even if, in this case, one does not gain in speed of convergence.