SSNX101 – Control of the loading in nonlinear

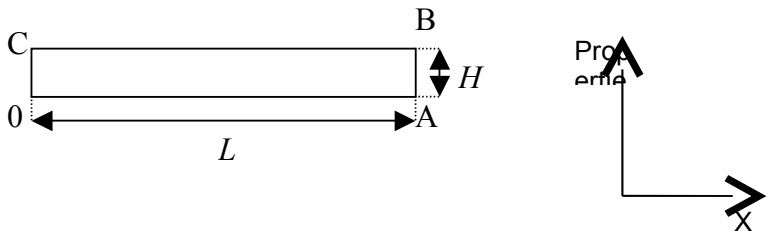
Abstract:

To validate the control of the loading by length of arc (LONG_ARC), one studies the buckling of an elastic clamped beam, modelled in small strains and large 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 control or with linear control more search.

1Problem of reference

1.1Geometry

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



1.2of the material

the material is supposed to be elastic there. 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 large rotations (DEFORMATION=' GREEN').

1.3Boundary conditions and loadings

the left side (OC) is clamped ($DX=DY=0$).
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 control is done by controlling the displacement of the node is outside the field of definition with a right profile of the EXCLU type node: A

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

2Reference solution

2.1Méthode de calcul

to validate control 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 control. The second phase is also tested by combining control and the linear search.

2.2Quantities and results of reference

to compare the solutions, it is checked that:

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

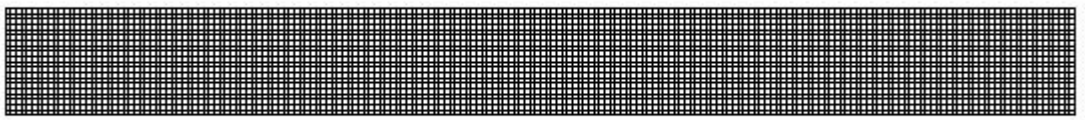
3Modelization A

3.1Characteristic of the modelization

The modelization is 2D of standard plane stress (C_PLAN).

3.2Characteristics of the mesh

The mesh is composed of 200×20 is 4000 elements QUAD8. It is represented on the figure below.



3.3Quantities tested and results

One tests:

- the potential energy obtained by making the difference between the solution obtained with control and the reference solution after application of gravity
- the potential energy obtained by making the difference between the solution obtained with control and the reference solution after application of compression
- the potential energy obtained by making the difference between the solution obtained with linear control more search and the reference solution after application of compression
- the variation of displacement of the node A following y between 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 control correspond perfectly. It is also possible to utilize in more the linear search, even if in this case that does not improve the velocity of convergence.

4Summary of the results

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