SSNP111 - Passage of the points of Gauss with the nodes on quadratic elements

Summary:

It is about a test of static mechanics nonlinear.

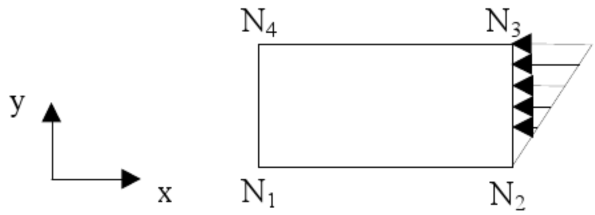
The goal is to test, in the order `CALC_CHAMP`, matrices allowing to pass from the points of integration to the nodes tops. The treated case relates to a plane plate subjected on one of its faces to a pressure varying linearly.

1 Problem of reference

1.1 Geometry

Plane rectangular plate.

$N_1 N_2 = 40\,mm$
$N_1 N_4 = 30\,mm$



1.2 Properties of materials

The elastic properties of material are the following ones:

- $E = 200\,000\,MPa$
- $\nu = 0$

The properties material defining a plastic material in linear work hardening are the following ones:

- Slope of the traction diagram $C = 1930\,Mpa$
- Elastic limit $\sigma^y = 181\,Mpa$

1.3 Boundary conditions and loadings mechanical

Face $N_1 N_2$: blocked according to ox

Node N_1 : blocked according to oy

Node N_2 : blocked according to oy

Pressure varying linearly:

$P_{res}(N2) = 0$
$P_{res}(N3) = 300\,MPa$

2 Reference solution

2.1 Method of calculating used for the reference solution

Cumulated plastic deformation P is equal to:

$$P=\frac{\sigma_L-\sigma^y}{C}$$

with: σ_L : constraint with the node considered
σ^y : elastic limit
C : slope of the traction diagram

The constraints are given by:

$$\sigma_{xx}(N_i)=-P_{res}(N_i)$$

The plastic deformation is given by:

$$|\varepsilon_{xx}^p(N_i)=P(N_i)|$$

2.2 Results of reference

One calculates with the nodes N_2 and N_3 the uniaxial constraint, plastic deformation, as well as the cumulated plastic deformation.
Maybe for the problem considered:

	N_2	N_3
σ_{xx}	0	– 300
ε_{xx}	0	$-6.1658\ 10^{-2}$
ε_{xx}^p	0	$6.1658\ 10^{-2}$

2.3 Uncertainty on the solution

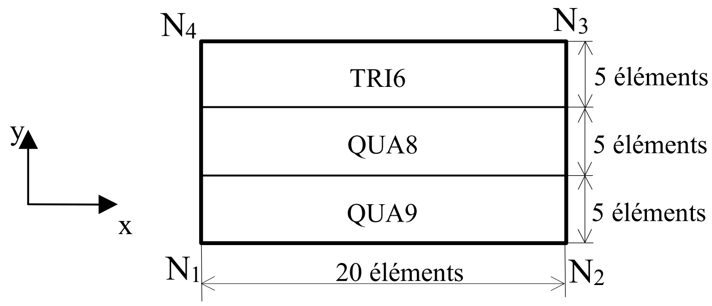
Analytical solution.

2.4 Bibliographical references

[1] LORENTZ E., PROIX J.M., VAUTIER I., VOLDOIRE F., WAECKEL F.: Initiation with the thermo - plasticity in the code Aster. Manuel de Référence of the course. EDF-DER, SCE IMA, Dept. Mechanics and digital Models, HI-74/96/013/0

3 Modeling A

3.1 Characteristics of modeling



3.2 Characteristics of the grid

Many nodes: 1072
Many meshs and types: 100 `QUAD9`
100 `QUAD8`
200 `TRIA6`

3.3 Sizes tested and results

Identification	Type of reference	Value
Cumulated plastic deformation Node N_2 with the sequence number 10	'AUTRE_ASTER'	0.0
Cumulated plastic deformation Node N_3 with the sequence number 10	'AUTRE_ASTER'	6.16E-2
Plastic deformation Node N_2 with the sequence number 10	'AUTRE_ASTER'	0.0
Plastic deformation Node N_3 with the sequence number 10	'AUTRE_ASTER'	-6.16E-2
Constraints with the Node N_2 with the sequence number 10	'AUTRE_ASTER'	0.0
Constraints with the Node N_3 with the sequence number 10	'AUTRE_ASTER'	-300.0

One calculates the indicators of discharge and loss of radiality in the mesh M_1 :

- at the first point of Gauss (`DERA_ELGA`),
- with the node N_{601} (`DERA_ELNO`).

Identification	Type of reference	Value
Discharge at the first point of Gauss of the mesh M_1 with the sequence number 7	'NON_REGRESSION'	8.67857E-1
Discharge with the node N_{601} mesh M_1 with the sequence number 7	'NON_REGRESSION'	8.91978E-1
Loss of radiality at the first point of Gauss of the mesh M_1 with the sequence number 7	'NON_REGRESSION'	3.39734E-3

4 Summary of the results

The results coincide with the reference solution. They thus make it possible to rule on the validity of the matrices of passage of the points of gauss to the nodes tops.