
SSLV04 - Hollow roll in plane constraints

Summary:

This test is drawn from Guide VPCS (test SSLV04/89) and has as an aim a hollow roll charged in internal pressure.

With this three-dimensional problem is dealt with various modelings:

- in 3D : 9 modelings (pentahedral, hexahedrons, tetrahedrons and pyramids, degrees 1 and 2),
- in 2D plane constraints: 4 modelings (triangles and quadrangles degrees 1 and 2, quadrangles with 9 nodes),
- in 2D axisymmetric: 3 modelings (triangles and quadrangles degrees 1 and 2, quadrangles with 9 nodes).

The features tested are:

- pressure distributed,
- basic effect (with fixed or variable pressure),
- imposed displacements,
- matrices of rigidity,
- strains and stresses with the nodes,
- nodal reactions (modeling K),
- use of `MACR_LIGN_COUP` on a concept `mult_elas` and a concept `comb_fourier` (modeling I)

There are 16 modelings.

1 Problem of reference

1.1 Geometry

Coordinates of the points:

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
<i>x</i>	0,100	0,200	$0.1 \cos(22.5)$	$0.2 \cos(22.5)$	$\sqrt{2}/2$	$\sqrt{2}$
<i>y</i>	0.	0.	$0.1 \sin(22.5)$	$0.2 \sin(22.5)$	$\sqrt{2}/2$	$\sqrt{2}$
<i>z</i>	0	0.	0.	0.	0.	0.

1.2 Material properties

The Young modulus of material is equal to $E = 2.10^5 \text{ MPa}$.

The Poisson's ratio is equal to $\nu = 0.3$.

1.3 Boundary conditions and loadings

Internal pressure:

$$P = 60 \text{ MPa}$$

Pressure interns variable (modeling P only):

P vary linearly 60 MPa with $t = 1.s$ with 120 MPa with $t = 2.s$

2 Reference solution

2.1 Method of calculating used for the reference solution

In constraint planes (cylinder on free board at the ends)

$$\begin{aligned}\sigma_{zz} &= 0 \\ \sigma_{rr} &= P \frac{a^2}{b^2 - a^2} \left[1 - \frac{b^2}{r^2} \right] \\ \sigma_{\theta\theta} &= P \frac{a^2}{b^2 - a^2} \left[1 + \frac{b^2}{r^2} \right] \\ \sigma_{r\theta} &= 0 \\ u_r &= \frac{P}{E} \frac{a^2}{b^2 - a^2} \left[(1 - \nu) + (1 + \nu) \frac{b^2}{r^2} \right] r \\ \varepsilon_{rr} &= \frac{P}{E} \frac{a^2}{b^2 - a^2} \left[(1 - \nu) - (1 + \nu) \frac{b^2}{r^2} \right] \\ \varepsilon_{\theta\theta} &= \frac{u_r}{r}\end{aligned}$$

One obtains:

$$\begin{array}{ll} u_r = 59.10^{-6} & u_r = 40.10^{-6} \\ \sigma_{rr} = -60. & \sigma_{rr} = 0. \\ \sigma_{\theta\theta} = 100. & \sigma_{\theta\theta} = 40. \\ \text{for } r=0.1 : \sigma_{zz} = \sigma_{r\theta} = 0. & ; \text{ for } r=0.2 : \sigma_{zz} = \sigma_{r\theta} = 0. \\ \varepsilon_{rr} = -45.10^{-5} & \varepsilon_{rr} = -6.10^{-5} \\ \varepsilon_{\theta\theta} = 59.10^{-5} & \varepsilon_{\theta\theta} = 2.10^{-4} \end{array}$$

Passage in the system of Cartesian axes:

$$\begin{aligned}\sigma_{xx} &= \sigma_{rr} \cos^2 \theta + \sigma_{\theta\theta} \sin^2 \theta - 2 \sigma_{r\theta} \sin \theta \cos \theta \\ \sigma_{yy} &= \sigma_{rr} \sin^2 \theta + \sigma_{\theta\theta} \cos^2 \theta + 2 \sigma_{r\theta} \sin \theta \cos \theta \\ \sigma_{xy} &= \sigma_{rr} \sin \theta \cos \theta - \sigma_{\theta\theta} \sin \theta \cos \theta - 2 \sigma_{r\theta} (\cos^2 \theta - \sin^2 \theta)\end{aligned}$$

with:

- $\theta = 0^\circ$ at the points *A* and *B*,
- $\theta = 22.5^\circ$ at the points *C* and *D*,
- $\theta = 45^\circ$ at the points *E* and *F*.

2.2 Results of reference

Displacements (u, v) and constraints $(\sigma_{xx}, \sigma_{yy}, \sigma_{zz}, \sigma_{xy})$ at the points *A, B, C, D, E, F*.

2.3 Bibliographical references

- 1 Guide VPCS. SSLV04/89
- 2 Y.C. FUNG. Foundations of solid mechanics. Prentice-hall, Inc. Englewood Cliffs. NJ. 1965
p. 243 to 245.
- 3 J. COURBON. Resistance of the materials p 649

3 Modeling A

3.1 Characteristics of modeling

Elements 3D (PENTA6 and HEXA8).

Grid obtained by extrusion starting from a grid 2D resembling the grid below (30 elements in the radial direction with die-refinement progressive and 15+15 elements in the circumferential direction).

Along the axis Z : 1 layer of elements
Total thickness: 0.01m

Limiting conditions:

node F : $u_z=0$

face AB blocked in dy

face EF blocked normally

pressure on the face AE $p=60$.

Names of the nodes: $A=N993$ $B=N1443$ $C=N1$
 $D=N31$ $E=N496$ $F=N495$

3.2 Characteristics of the grid

Many nodes: 1922

Many meshes and types: 900 PENTA6, 450 HEXA8 and 90 QUAD4 (faces internal skin).

3.3 Sizes tested and results

Localization	Size	Reference	Type of reference	Tolerance
Field nor_DNOR Not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_PRES not \bar{A}	Normal vector, component X	1.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{A}	Normal vector, component Y	0.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	1.5 %

Localization	Size	Reference	Type of reference	Tolerance
Mesh M1380, not A				
SIRO_ELEM	SIG_NX	60.0	'ANALYTICAL'	2.0%
Normal constraint with the face of the element	SIG_NY	0.0	'ANALYTICAL'	1.0
	SIG_NZ	0.0	'ANALYTICAL'	0.01
	SIG_N	-60.0	'ANALYTICAL'	2.0%

SIRO_ELEM	SIG_TX	0.0	'ANALYTICAL'	0.01
Tangential constraint in the plan of the element	SIG_TY	0.0	'ANALYTICAL'	1.0%
	SIG_TZ	0.0	'ANALYTICAL'	1.0

SIRO_ELEM	SIG_TIX	0.0	'ANALYTICAL'	0.01
First value of the constraint tangential in the plan of the element	SIG_TIY	0.0	'ANALYTICAL'	0.01
	SIG_TIZ	0.0	'ANALYTICAL'	1.0
	SIG_TI	0.0	'ANALYTICAL'	1.0

SIRO_ELEM	SIG_T2X	0.0	'ANALYTICAL'	2.0
Second value of the constraint tangential in the plan of the element	SIG_T2Y	-100.0	'ANALYTICAL'	1.0%
	SIG_T2Z	0.0	'ANALYTICAL'	0.01
	SIG_T2	100.0	'ANALYTICAL'	1.0%

Mesh M1351, not E				
SIRO_ELEM	SIG_NX	42,426	'ANALYTICAL'	1.5%
Normal constraint with the face of the element	SIG_NY	42,426	'ANALYTICAL'	2.0%
	SIG_NZ	0.0	'ANALYTICAL'	0.01
	SIG_N	-60.0	'ANALYTICAL'	1.0%

SIRO_ELEM	SIG_TX	0.0	'ANALYTICAL'	1.0
Tangential constraint in the plan of the element	SIG_TY	0.0	'ANALYTICAL'	1.0
	SIG_TZ	0.0	'ANALYTICAL'	0.2

SIRO_ELEM	SIG_TIX	0.0	'ANALYTICAL'	0.01
First value of the constraint tangential in the plan of the element	SIG_TIY	0.0	'ANALYTICAL'	0.01
	SIG_TIZ	0.0	'ANALYTICAL'	0.1
	SIG_TI	0.0	'ANALYTICAL'	0.2

SIRO_ELEM	SIG_T2X	70,711	'ANALYTICAL'	1.5%
Second value of the constraint tangential in the plan of the element	SIG_T2Y	-70,711	'ANALYTICAL'	1.5%
	SIG_T2Z	0.0	'ANALYTICAL'	0.01
	SIG_T2	100.0	'ANALYTICAL'	1.0%

Localization	Size	Valor of Référence	Type of reference	Tolerance
not A	Field DEPL, comp. X	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %

	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)
	Field SIGM_NOEU, comp. SIXX	- 60.	'ANALYTICAL'	2 %
	Field SIGM_NOEU, comp. SIYY	100.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0,5 (absolute)
	Field SIGM_NOEU, comp. SIXY	0.	'ANALYTICAL'	2 (absolute)
	Field EPSI_NOEU, comp. EPXX	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. EPYY	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. EPXY	0.	'ANALYTICAL'	1E-4 (absolute)
B	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)
	Field SIGM_NOEU, comp. SIXX	0.	'ANALYTICAL'	2 (absolute)
	Field SIGM_NOEU, comp. SIYY	40.	'ANALYTICAL'	2 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	1 (absolute)
	Field SIGM_NOEU, comp. SIXY	0.	'ANALYTICAL'	2 (absolute)
	Field EPSI_NOEU, comp. EPXX	- 6 10 ⁻⁵	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPYY	2. 10 ⁻⁴	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. EPXY	0.	'ANALYTICAL'	1E-4 (absolute)
D	Field DEPL, comp. X	3.69552 10 ⁻⁵	'ANALYTICAL'	0.1 %
	Field DEPL, comp. Y	1.53073 10 ⁻⁵	'ANALYTICAL'	1 %
E	Field DEPL, comp. X	4.17193 10 ⁻⁵	'ANALYTICAL'	0.1 %
	Field DEPL, comp. Y	4.17193 10 ⁻⁵	'ANALYTICAL'	0.1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	6 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	6 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0.1 (absolute)
	Field SIGM_NOEU, comp. SIXY	- 80.	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	10 %
	Field EPSI_NOEU, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	10 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. EPXY	- 5.2 10 ⁻⁴	'ANALYTICAL'	1 %
F	Field DEPL, comp. X	2.82843 10 ⁻⁵	'ANALYTICAL'	0.1 %
	Field DEPL, comp. Y	2.82843 10 ⁻⁵	'ANALYTICAL'	0.1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	6 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0.2 (absolute)
	Field SIGM_NOEU, comp. SIXY	- 20.	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	8 %
	Field EPSI_NOEU, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	2 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. EPXY	- 1.3 10 ⁻⁴	'ANALYTICAL'	1 %

4 Modeling B

4.1 Characteristics of modeling

Elements 3D (PENTA15 and HEXA20).

Grid obtained by extrusion starting from the grid 2D below (modeling F)

Along the axis Z : 2 layers of elements

Total thickness: 0.01m

Limiting conditions:

node $F = u_z = 0$

face AB blocked in dx

face EF blocked normally

pressure on the face AE $p = 60$.

Names of the nodes: $A = NO2$ $B = NO361$ $C = NO121$
 $D = NO584$ $E = NO155$ $F = NO503$

4.2 Characteristics of the grid

Many nodes: 2115

Many meshes and types: 400 PENTA15, 100 HEXA20 40 QUAD8 (faces skin interns)

4.3 Sizes tested and results

Localization	Size	Reference	Type of reference	Tolerance
Mesh MA751, not <i>A</i>				
Normal constraint with the face of the element	SIRO_ELEM <i>SIG_NX</i>	0.0	'ANALYTICAL'	3.
	<i>SIG_NY</i>	60.0	'ANALYTICAL'	0.5%
	<i>SIG_NZ</i>	0.0	'ANALYTICAL'	0.01
Tangential constraint in the plan of the element	SIRO_ELEM <i>SIG_TX</i>	0.0	'ANALYTICAL'	0.1
	<i>SIG_TY</i>	0.0	'ANALYTICAL'	0.1
	<i>SIG_TZ</i>	0.0	'ANALYTICAL'	0.1
First value constraint tangential in the plan of the element	SIRO_ELEM <i>SIG_T1X</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_T1Y</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_T1Z</i>	0.0	'ANALYTICAL'	0.05
Second value of the constraint tangential in the plan of the element	SIRO_ELEM <i>SIG_T2X</i>	100.0	'ANALYTICAL'	0.15%
	<i>SIG_T2Y</i>	0.0	'ANALYTICAL'	4.5
	<i>SIG_T2Z</i>	0.0	'ANALYTICAL'	0.20
Mesh MA769, not <i>E</i>				
Normal constraint with the face of the element	SIRO_ELEM <i>SIG_NX</i>	-42,426	'ANALYTICAL'	6.0%
	<i>SIG_NY</i>	42,426	'ANALYTICAL'	4.0%
	<i>SIG_NZ</i>	0.0	'ANALYTICAL'	0.01
Tangential constraint in the plan of the element	SIRO_ELEM <i>SIG_TX</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_TY</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_TZ</i>	0.0	'ANALYTICAL'	0.03
First value constraint tangential in the plan of the element	SIRO_ELEM <i>SIG_T1X</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_T1Y</i>	0.0	'ANALYTICAL'	0.01
	<i>SIG_T1Z</i>	0.0	'ANALYTICAL'	0.01
Second value of the constraint tangential in the plan of the element	SIRO_ELEM <i>SIG_T2X</i>	70,711	'ANALYTICAL'	3.5%
	<i>SIG_T2Y</i>	70,711	'ANALYTICAL'	4.5%
	<i>SIG_T2Z</i>	0.0	'ANALYTICAL'	0.1

Localization	Size	Valor of Référence	Type of reference	Tolerance
not <i>A</i>				
-	Field DEPL, comp. <i>X</i>	0.	'ANALYTICAL'	1E-4 (absolute)
-	Field DEPL, comp. <i>Y</i>	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	1 %
Mesh MA251	Field SIGM_ELNO, comp. <i>SIXX</i>	100.	'ANALYTICAL'	1 %
Mesh MA251	Field SIGM_ELNO, comp. <i>SIYY</i>	- 60.	'ANALYTICAL'	1 %
Mesh MA251	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0,02 (absolute)
Mesh MA251	Field SIGM_ELNO, comp. <i>SIXY</i>	0.	'ANALYTICAL'	0.5 (absolute)
Mesh MA251	Field EPSI_ELNO, comp. <i>EPXX</i>	$5.9 \cdot 10^{-4}$	'ANALYTICAL'	1 %

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Mesh MA251	Field EPSI_ELNO, comp. EPYY	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MA251	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh MA251	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
Not B				
-	Field DEPL, comp. X	0.	'ANALYTICAL'	1E-4 (absolute)
-	Field DEPL, comp. Y	4 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh MY551	Field SIGM_ELNO, comp. SIXX	40.	'ANALYTICAL'	0.1 %
Mesh MY551	Field SIGM_ELNO, comp. SIYY	0.	'ANALYTICAL'	0,1 (absolute)
Mesh MY551	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	0.015 (absolute)
Mesh MY551	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.15 (absolute)
Mesh MY551	Field EPSI_ELNO, comp. EPYY	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY551	Field EPSI_ELNO, comp. EPZZ	- 0.6. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY551	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh MY551	Field EPSI_ELNO, comp. EPXX	0.	'ANALYTICAL'	1E-2 (absolute)
E				
	Field DEPL, comp. X	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh MY399	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	10 %
Mesh MY399	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	10 %
Mesh MY399	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	0,5 (absolute)
Mesh MY399	Field SIGM_ELNO, comp. SIXY	80.	'ANALYTICAL'	1 %
Mesh MY399	Field EPSI_ELNO, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY399	Field EPSI_ELNO, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY399	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh MY399	Field EPSI_ELNO, comp. EPXY	5.2 10 ⁻⁴	'ANALYTICAL'	1 %
F				
-	Field DEPL, comp. X	- 2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh MY695	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	1 %
Mesh MY695	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	1 %
Mesh MY695	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	0,05 (absolute)
Mesh MY695	Field SIGM_ELNO, comp. SIXY	20.	'ANALYTICAL'	0.1 %
Mesh MY695	Field EPSI_ELNO, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY695	Field EPSI_ELNO, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh MY695	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh MY695	Field EPSI_ELNO, comp. EPXY	1.3 10 ⁻⁴	'ANALYTICAL'	1 %

5 Modeling C

5.1 Characteristics of modeling

Elements 3D (TETRA4).

AB is on the axis OX

Cutting: 21 equidistant nodes on the segments AB , CD and EF

21 equidistant nodes on the arcs ACE and BDF

Along the axis Z : 1 layer of elements

Total thickness: 0.01m

Limiting conditions:

node F : $u_z = 0$

face AB blocked in dy

face EF blocked normally

pressure on the face AE $p = 60$.

Names of the nodes: $A = N165$ $B = N4$ $C = N209$
 $D = N82$ $E = N244$ $F = N1068$

5.2 Characteristics of the grid

Many nodes: 1115

Many meshes and types: 3724 TETRA4 and 1760 TRIA3 (faces skin interns)

5.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
Field nor_DNOR Not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_PRES not \bar{A}	Normal vector, component X	1.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{A}	Normal vector, component Y	0.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	1.5 %

Localization	Size	Value of Référence	Type of reference	Tolerance
Mesh M5444, not <i>A</i>				
Normal constraint with the face of the element	SIRO_ELEM SIG_NX	60.0	'ANALYTICAL'	8.0%
	SIG_NY	0.0	'ANALYTICAL'	1.5
	SIG_NZ	0.0	'ANALYTICAL'	0.1
Tangential constraint in the plan of the element	SIRO_ELEM SIG_TX	0.0	'ANALYTICAL'	0.1
	SIG_TY	0.0	'ANALYTICAL'	1.0
	SIG_TZ	0.0	'ANALYTICAL'	1.0
First value of the constraint tangential in the plan of the element	SIRO_ELEM SIG_T1X	0.0	'ANALYTICAL'	0.01
	SIG_T1Y	0.0	'ANALYTICAL'	0.01
	SIG_T1Z	0.0	'ANALYTICAL'	1.5
Second value of the constraint tangential in the plan of the element	SIRO_ELEM SIG_T2X	0.0	'ANALYTICAL'	2.5
	SIG_T2Y	-100.0	'ANALYTICAL'	2.0%
	SIG_T2Z	0.0	'ANALYTICAL'	0.20
Mesh M5404, not <i>E</i>				
Normal constraint with the face of the element	SIRO_ELEM SIG_NX	42,426	'ANALYTICAL'	6.0%
	SIG_NY	42,426	'ANALYTICAL'	9.0%
	SIG_NZ	0.0	'ANALYTICAL'	1.00
Tangential constraint in the plan of the element	SIRO_ELEM SIG_TX	0.0	'ANALYTICAL'	1.0
	SIG_TY	0.0	'ANALYTICAL'	1.0
	SIG_TZ	0.0	'ANALYTICAL'	1.0
First value of the constraint tangential in the plan of the element	SIRO_ELEM SIG_T1X	0.0	'ANALYTICAL'	0.01
	SIG_T1Y	0.0	'ANALYTICAL'	0.01
	SIG_T1Z	0.0	'ANALYTICAL'	1.50
Second value of the constraint tangential in the plan of the element	SIRO_ELEM SIG_T2X	-70,711	'ANALYTICAL'	2.0%
	SIG_T2Y	70,711	'ANALYTICAL'	4.0%
	SIG_T2Z	0.0	'ANALYTICAL'	0.10

Localization	Size	Valor of Référence	Type of reference	Tolerance
not <i>A</i>	Field DEPL, comp. X	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)
	Field SIGM_NOEU, comp. SIXX	- 60.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. SIYY	100.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0,1 (absolute)
	Field SIGM_NOEU, comp. SIXY	0.	'ANALYTICAL'	3 (absolute)
	Field EPSI_NOEU, comp. EPXX	$-4.5 \cdot 10^{-4}$	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPYY	$5.9 \cdot 10^{-4}$	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)

	Field EPSI_NOEU, comp. EPXY	0.	'ANALYTICAL'	1E-4 (absolute)
<i>B</i>	Field DEPL, comp. X	$4 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)
	Field SIGM_NOEU, comp. SIXX	0.	'ANALYTICAL'	2 (absolute)
	Field SIGM_NOEU, comp. SIYY	40.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	1 (absolute)
	Field SIGM_NOEU, comp. SIXY	0.	'ANALYTICAL'	1 (absolute)
	Field EPSI_NOEU, comp. EPXX	$-6 \cdot 10^{-5}$	'ANALYTICAL'	15 %
	Field EPSI_NOEU, comp. EPYY	$2 \cdot 10^{-4}$	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
		Field EPSI_NOEU, comp. EPXY	0.	'ANALYTICAL'
<i>D</i>	Field DEPL, comp. X	$3.69552 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	$1.53073 \cdot 10^{-5}$	'ANALYTICAL'	1 %
<i>E</i>	Field DEPL, comp. X	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	11 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	10 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0,5 (absolute)
	Field SIGM_NOEU, comp. SIXY	-80.	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPXX	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	20 %
	Field EPSI_NOEU, comp. EPYY	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	20 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
		Field EPSI_NOEU, comp. EPXY	$-5.2 \cdot 10^{-4}$	'ANALYTICAL'
<i>F</i>	Field DEPL, comp. X	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	10 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0,4 (absolute)
	Field SIGM_NOEU, comp. SIXY	-20.	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. EPXX	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	11 %
	Field EPSI_NOEU, comp. EPYY	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
		Field EPSI_NOEU, comp. EPXY	$-1.3 \cdot 10^{-4}$	'ANALYTICAL'

6 Modeling D

6.1 Characteristics of modeling

Element 3D (TETRA10).

AB is on the axis OX

Cutting: 11 equidistant nodes on the segments AB , CD and EF
11 equidistant nodes on the arcs ACE and BDF

Along the axis Z : 1 layer of elements
Total thickness: 0.01m

Limiting conditions:

node F : $u_z=0$
face AB blocked in dy
face EF blocked normally
pressure on the face AE $p=60$.

Names of the nodes: $A=N184$ $B=N4$ $C=N207$
 $D=N50$ $E=N22$ $F=N726$

6.2 Characteristics of the grid

Many nodes: 1395
Many meshes and types: 652 TETRA10 and 480 TRIA6 (faces skin interns)

6.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
not <i>A</i>	Field DEPL, comp. <i>X</i>	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %
	Field DEPL, comp. <i>Y</i>	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM_NOEU, comp. <i>SIXX</i>	- 60.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIYY</i>	100.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	1 (absolute)
	Field SIGM_NOEU, comp. <i>SIXY</i>	0.	'ANALYTICAL'	1 (absolute)
	Field EPSI_NOEU, comp. <i>EPXX</i>	$- 4.5 \cdot 10^{-4}$	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. <i>EPYY</i>	$5.9 \cdot 10^{-4}$	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. <i>EPXY</i>	0.	'ANALYTICAL'	1E-4 (absolute)
	<i>B</i>	Field DEPL, comp. <i>X</i>	$4 \cdot 10^{-5}$	'ANALYTICAL'
Field DEPL, comp. <i>Y</i>		0.	'ANALYTICAL'	1E-4 (absolute)
Field SIGM_NOEU, comp. <i>SIXX</i>		0.	'ANALYTICAL'	1 (absolute)
Field SIGM_NOEU, comp. <i>SIYY</i>		40.	'ANALYTICAL'	1 %
Field SIGM_NOEU, comp. <i>SIZZ</i>		0.	'ANALYTICAL'	1 (absolute)
Field SIGM_NOEU, comp. <i>SIXY</i>		0.	'ANALYTICAL'	1 (absolute)
Field EPSI_NOEU, comp. <i>EPXX</i>		$- 6 \cdot 10^{-5}$	'ANALYTICAL'	1 %
Field EPSI_NOEU, comp. <i>EPYY</i>		$2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
Field EPSI_NOEU, comp. <i>EPZZ</i>		0.	'ANALYTICAL'	1E-4 (absolute)
Field EPSI_NOEU, comp. <i>EPXY</i>		0.	'ANALYTICAL'	1E-4 (absolute)
<i>D</i>		Field DEPL, comp. <i>X</i>	$3.69552 \cdot 10^{-5}$	'ANALYTICAL'
	Field DEPL, comp. <i>Y</i>	$1.53073 \cdot 10^{-5}$	'ANALYTICAL'	1 %
<i>E</i>	Field DEPL, comp. <i>X</i>	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. <i>Y</i>	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIXX</i>	20.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. <i>SIYY</i>	20.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	2 (absolute)
	Field SIGM_NOEU, comp. <i>SIXY</i>	- 80.	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. <i>EPXX</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	5 %
	Field EPSI_NOEU, comp. <i>EPYY</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	2 %
	Field EPSI_NOEU, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. <i>EPXY</i>	$- 5.2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
<i>F</i>	Field DEPL, comp. <i>X</i>	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field DEPL, comp. <i>Y</i>	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIXX</i>	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIYY</i>	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	2nd-3 (absolute)
	Field SIGM_NOEU, comp. <i>SIXY</i>	- 20.	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. <i>EPXX</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	2 %

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Field EPSI_NOEU, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	2 %
Field EPSI_NOEU, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
Field EPSI_NOEU, comp. EPXY	- 1.3 10 ⁻⁴	'ANALYTICAL'	1 %

Localization	Size	Value of Référence	Type of reference	Tolerance
Mesh M1111, not A				
SIRO_ELEM	SIG_NX	60.0	'ANALYTICAL'	1.0%
Normal constraint with the face of the element	SIG_NY	0.0	'ANALYTICAL'	3.0
	SIG_NZ	0.0	'ANALYTICAL'	1.0
	SIRO_ELEM	SIG_TX	0.0	'ANALYTICAL'
Tangential constraint in the plan of the element	SIG_TY	0.0	'ANALYTICAL'	2.5
	SIG_TZ	0.0	'ANALYTICAL'	1.0
	SIRO_ELEM	SIG_TIX	0.0	'ANALYTICAL'
First principal value of the constraint tangential in the plan of the element	SIG_TIY	0.0	'ANALYTICAL'	0.01
	SIG_TIZ	0.0	'ANALYTICAL'	1.0
	SIRO_ELEM	SIG_T2X	0.0	'ANALYTICAL'
Second principal value of the constraint tangential in the plan of the element	SIG_T2Y	-100.0	'ANALYTICAL'	1.0%
	SIG_T2Z	0.0	'ANALYTICAL'	0.1
	Mesh M1093, not E			
SIRO_ELEM	SIG_NX	42,426	'ANALYTICAL'	14%
Normal constraint with the face of the element	SIG_NY	42,426	'ANALYTICAL'	5.0%
	SIG_NZ	0.0	'ANALYTICAL'	1.0
	SIRO_ELEM	SIG_TX	0.0	'ANALYTICAL'
Tangential constraint in the plan of the element	SIG_TY	0.0	'ANALYTICAL'	2.0
	SIG_TZ	0.0	'ANALYTICAL'	1.0
	SIRO_ELEM	SIG_TIX	0.0	'ANALYTICAL'
First principal value of the constraint tangential in the plan of the element	SIG_TIY	0.0	'ANALYTICAL'	0.01
	SIG_TIZ	0.0	'ANALYTICAL'	1.5
	SIRO_ELEM	SIG_T2X	-70,711	'ANALYTICAL'
Second principal value of the constraint tangential in the plan of the element	SIG_T2Y	70,711	'ANALYTICAL'	4.0%
	SIG_T2Z	0.0	'ANALYTICAL'	2.0

7 Modeling E

7.1 Characteristics of modeling

Elements C_PLAN (TRIA3 + QUAD4)

Grid 2D resembling the grid below (30 elements in the radial direction with déaffinement progressive and 15+15 elements in the circumferential direction).

Limiting conditions:

side *AB* blocked in *dy*
side *EF* blocked normally
pressure on *AE* $p=60$.

Names of the nodes:	$A=N1$	$B=N451$	$C=N496$
	$D=N495$	$E=N990$	$F=N989$

7.2 Characteristics of the grid

Many nodes: 961
Many meshes and types: 900 TRIA3, 450 QUAD4

7.3 Sizes tested and results

Localization	Size	Values of Référence	Type of reference	Tolerance
Field nor_DNOR Not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component X	-0.707	'ANALYTICAL'	0.1 %
Field nor_DNOR not \bar{F}	Normal vector, component Y	-0.707	'ANALYTICAL'	0.1 %
Field nor_PRES not \bar{A}	Normal vector, component X	1.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{A}	Normal vector, component Y	0.0	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component X	-0.707	'ANALYTICAL'	1.5 %
Field nor_PRES not \bar{E}	Normal vector, component Y	-0.707	'ANALYTICAL'	1.5 %

Localization	Size	Valor of Référence	Type of reference	Tolerance	
not A	Field DEPL, comp. X	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %	
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)	
	Field SIGM_NOEU, comp. $SIXX$	-60.	'ANALYTICAL'	2 %	
	Field SIGM_NOEU, comp. $SIYY$	100.	'ANALYTICAL'	1 %	
	Field SIGM_NOEU, comp. $SIZZ$	0.	'ANALYTICAL'	1E-5 (absolute)	
	Field SIGM_NOEU, comp. $SIXY$	0.	'ANALYTICAL'	2 (absolute)	
	Field EPSI_NOEU, comp. $EPXX$	$-4.5 \cdot 10^{-4}$	'ANALYTICAL'	1 %	
	Field EPSI_NOEU, comp. $EPYY$	$5.9 \cdot 10^{-4}$	'ANALYTICAL'	1 %	
	Field EPSI_NOEU, comp. $EPZZ$	0.	'ANALYTICAL'	1E-4 (absolute)	
	Field EPSI_NOEU, comp. $EPXY$	0.	'ANALYTICAL'	1E-4 (absolute)	
	B	Field DEPL, comp. X	$4 \cdot 10^{-5}$	'ANALYTICAL'	1 %
		Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-10 (absolute)
		Field SIGM_NOEU, comp. $SIXX$	0.	'ANALYTICAL'	1.5 (absolute)
Field SIGM_NOEU, comp. $SIYY$		40.	'ANALYTICAL'	2 %	
Field SIGM_NOEU, comp. $SIZZ$		0.	'ANALYTICAL'	1E-5 (absolute)	
Field SIGM_NOEU, comp. $SIXY$		0.	'ANALYTICAL'	1 (absolute)	
Field EPSI_NOEU, comp. $EPXX$		$-6 \cdot 10^{-5}$	'ANALYTICAL'	12 %	
Field EPSI_NOEU, comp. $EPYY$		$2 \cdot 10^{-4}$	'ANALYTICAL'	1 %	
Field EPSI_NOEU, comp. $EPZZ$		0.	'ANALYTICAL'	1E-4 (absolute)	
Field EPSI_NOEU, comp. $EPXY$		0.	'ANALYTICAL'	1E-4 (absolute)	

Code_Aster

Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 21/52
Clé : V3.04.004 Révision :
54f6701b8b6b

<i>D</i>	Field DEPL, comp. <i>X</i>	3.69552 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. <i>Y</i>	1.53073 10 ⁻⁵	'ANALYTICAL'	1 %
<i>E</i>	Field DEPL, comp. <i>X</i>	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. <i>Y</i>	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. <i>SIXX</i>	20.	'ANALYTICAL'	7 %
	Field SIGM_NOEU, comp. <i>SIYY</i>	20.	'ANALYTICAL'	7 %
	Field SIGM_NOEU, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	1E-5 (absolute)
	Field SIGM_NOEU, comp. <i>SIXY</i>	- 80.	'ANALYTICAL'	1 %
	Field EPSI_NOEU, comp. <i>EPXX</i>	0.7 10 ⁻⁴	'ANALYTICAL'	15 %
	Field EPSI_NOEU, comp. <i>EPYY</i>	0.7 10 ⁻⁴	'ANALYTICAL'	15 %
	Field EPSI_NOEU, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
	Field EPSI_NOEU, comp. <i>EPXY</i>	- 5.2 10 ⁻⁴	'ANALYTICAL'	1 %
	<i>F</i>	Field DEPL, comp. <i>X</i>	2.82843 10 ⁻⁵	'ANALYTICAL'
Field DEPL, comp. <i>Y</i>		2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
Field SIGM_NOEU, comp. <i>SIXX</i>		20.	'ANALYTICAL'	3 %
Field SIGM_NOEU, comp. <i>SIYY</i>		20.	'ANALYTICAL'	2 %
Field SIGM_NOEU, comp. <i>SIZZ</i>		0.	'ANALYTICAL'	1E-5 (absolute)
Field SIGM_NOEU, comp. <i>SIXY</i>		- 20.	'ANALYTICAL'	7 %
Field EPSI_NOEU, comp. <i>EPXX</i>		0.7 10 ⁻⁴	'ANALYTICAL'	5 %
Field EPSI_NOEU, comp. <i>EPYY</i>		0.7 10 ⁻⁴	'ANALYTICAL'	5 %
Field EPSI_NOEU, comp. <i>EPZZ</i>		0.	'ANALYTICAL'	1E-4 (absolute)
Field EPSI_NOEU, comp. <i>EPXY</i>	- 1.3 10 ⁻⁴	'ANALYTICAL'	7 %	

8 Modeling F

8.1 Characteristics of modeling

Elements C_plan (QUAD8 + TRIA6)

Limiting conditions:

side AB blocked in dx
side EF blocked normally
pressure on AE $p=60$.

Names of the nodes: $A=N2$ $B=N361$ $C=N121$
 $D=N584$ $E=N155$ $F=N503$

8.2 Characteristics of the grid

Many nodes: 591
Many meshes and types: 200 TRIA6, 50 QUAD8

8.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>not A</i>				
-	Field DEPL, comp. X	5.9 10 ⁻⁵	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIXX	100.	'ANALYTICAL'	1 %
M1 mesh	Field SIGM_ELNO, comp. SIYY	-60.	'ANALYTICAL'	1 %
M1 mesh	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.3 (absolute)
M1 mesh	Field EPSI_ELNO, comp. EPXX	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
M1 mesh	Field EPSI_ELNO, comp. EPYY	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
M1 mesh	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2(absolute)
M1 mesh	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2(absolute)
<i>B</i>				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4(absolute)
Mesh 151	Field SIGM_ELNO, comp. SIXX	40.	'ANALYTICAL'	5 %
Mesh 151	Field SIGM_ELNO, comp. SIYY	0.	'ANALYTICAL'	0.1 (absolute)
Mesh 151	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	0.015(absolute)
Mesh 151	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.1 (absolute)
Mesh 151	Field EPSI_ELNO, comp. EPXX	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh 151	Field EPSI_ELNO, comp. EPYY	- 6 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh 151	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2(absolute)
Mesh 151	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2(absolute)
<i>E</i>				
-	Field DEPL, comp. X	4.17193 10 ⁻⁵	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	-4.17193 10 ⁻⁵	'ANALYTICAL'	0.1 %
M75	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	5 %
M75	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	5 %
M75	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4(absolute)
M75	Field SIGM_ELNO, comp. SIXY	80.	'ANALYTICAL'	1 %
M75	Field EPSI_ELNO, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	20 %
M75	Field EPSI_ELNO, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	20 %
M75	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2(absolute)
M75	Field EPSI_ELNO, comp. EPXY	- 5.2 10 ⁻⁴	'ANALYTICAL'	1 %
<i>F</i>				
-	Field DEPL, comp. X	2.82843 10 ⁻⁵	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	-2.82843 10 ⁻⁵	'ANALYTICAL'	0.1 %
M223	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	1 %
M223	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	1 %

Code_Aster

Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 24/52
Clé : V3.04.004 Révision :
54f6701b8b6b

M223	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4 (absolute)
M223	Field SIGM_ELNO, comp. SIXY	20.	'ANALYTICAL'	1 %
M223	Field EPSI_ELNO, comp. EPXX	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M223	Field EPSI_ELNO, comp. EPYY	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M223	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2 (absolute)
M223	Field EPSI_ELNO, comp. EPXY	$-1.3 \cdot 10^{-4}$	'ANALYTICAL'	1 %

9 Modeling G

9.1 Characteristics of modeling

Modeling C_PLAN (QUAD9)

Limiting conditions:

side AB blocked in dy
side EF blocked normally
pressure on AE $p=60$.

Names of the nodes: $A=N1$ $B=N347$ $C=N21$
 $D=N432$ $E=N39$ $F=N229$

9.2 Characteristics of the grid

Many nodes: 441
Many meshes and types: 100 QUAD9

9.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>not A</i>				
-	Field DEPL, comp. X	$5.9 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-
				4(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIXX	- 60.	'ANALYTICAL'	1 %
M1 mesh	Field SIGM_ELNO, comp. SIYY	100.	'ANALYTICAL'	1 %
M1 mesh	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4
				(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.05
				(absolute)
M1 mesh	Field EPSI_ELNO, comp. EPXX	$-4.5 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M1 mesh	Field EPSI_ELNO, comp. EPHY	$5.9 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M1 mesh	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2
				(absolute)
M1 mesh	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2
				(absolute)
<i>B</i>				
-	Field DEPL, comp. X	$4 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-
				4(absolute)
M10 mesh	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	0.1(absolute)
M10 mesh	Field SIGM_ELNO, comp. SIYY	40.	'ANALYTICAL'	1 %
M10 mesh	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4
				(absolute)
M10 mesh	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.01
				(absolute)
M10 mesh	Field EPSI_ELNO, comp. EPXX	$-6 \cdot 10^{-5}$	'ANALYTICAL'	1 %
M10 mesh	Field EPSI_ELNO, comp. EPHY	$2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M10 mesh	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2
				(absolute)
M10 mesh	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2
				(absolute)
<i>E</i>				
-	Field DEPL, comp. X	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	$4.17193 \cdot 10^{-5}$	'ANALYTICAL'	1 %
M91 mesh	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	5 %
M91 mesh	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	5 %
M91 mesh	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	1E-4
				(absolute)
M91 mesh	Field SIGM_ELNO, comp. SIXY	- 80.	'ANALYTICAL'	1 %
M91 mesh	Field EPSI_ELNO, comp. EPXX	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M91 mesh	Field EPSI_ELNO, comp. EPHY	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M91 mesh	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-2
				(absolute)
M91 mesh	Field EPSI_ELNO, comp. EPXY	$-5.2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
				(absolute)
<i>F</i>				
-	Field DEPL, comp. X	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %
-	Field DEPL, comp. Y	$2.82843 \cdot 10^{-5}$	'ANALYTICAL'	0.1 %

Code_Aster

Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 27/52
Clé : V3.04.004 Révision :
54f6701b8b6b

M100 mesh	Field SIGM_ELNO, comp. <i>SIXX</i>	20.	'ANALYTICAL'	1 %
M100 mesh	Field SIGM_ELNO, comp. <i>SIYY</i>	20.	'ANALYTICAL'	1 %
M100 mesh	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
M100 mesh	Field SIGM_ELNO, comp. <i>SIXY</i>	-20	'ANALYTICAL'	0.1 %
M100 mesh	Field EPSI_ELNO, comp. <i>EPXX</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M100 mesh	Field EPSI_ELNO, comp. <i>EPYY</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
M100 mesh	Field EPSI_ELNO, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-2 (absolute)
M100 mesh	Field EPSI_ELNO, comp. <i>EPXY</i>	$-1.3 \cdot 10^{-4}$	'ANALYTICAL'	1 %

10 Modeling H

10.1 Characteristics of modeling

Elements **AXIS** (TRIA3 + QUAD4)

Limiting conditions:

node F blocked in dy
pressure on AE $p=60$.

Names of the nodes: $A=N111$ $B=N1$ $C=N112$
 $D=N3$ $E=N113$ $F=N4$

10.2 Characteristics of the grid

Many nodes: 113
Many meshes and types: 40 QUAD4, 80 TRIA3

10.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>A</i>				
not	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
-	Field SIGM_ELNO, comp. SIXX	- 60.	'ANALYTICAL'	6 %
M1 mesh19	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	1.1 (absolute)
M1 mesh19	Field SIGM_ELNO, comp. SIZZ	100.	'ANALYTICAL'	1.5 %
M1 mesh19	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	1.2 (absolute)
M1 mesh19	Field EPSI_ELNO, comp. EPXX	- 4.5 10 ⁻⁴	'ANALYTICAL'	3 %
M1 mesh19	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
M1 mesh19	Field EPSI_ELNO, comp. EPZZ	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
M1 mesh19	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
<i>B</i>				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
M1 mesh	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	1(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.5(absolute)
M1 mesh	Field SIGM_ELNO, comp. SIZZ	40,	'ANALYTICAL'	1.3 %
M1 mesh	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.15 (absolute)
M1 mesh	Field EPSI_ELNO, comp. EPXX	- 6 10 ⁻⁵	'ANALYTICAL'	6 %
M1 mesh	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
M1 mesh	Field EPSI_ELNO, comp. EPZZ	2. 10 ⁻⁴	'ANALYTICAL'	2 %
M1 mesh	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
<i>E</i>				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M120	Field SIGM_ELNO, comp. SIXX	-60	'ANALYTICAL'	6 %
Mesh M120	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	1.1 (absolute)
Mesh M120	Field SIGM_ELNO, comp. SIZZ	100.	'ANALYTICAL'	1.5 %
Mesh M120	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	1.2 (absolute)
Mesh M120	Field EPSI_ELNO, comp. EPXX	-4.5 10 ⁻⁴	'ANALYTICAL'	3 %
Mesh M120	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh M120	Field EPSI_ELNO, comp. EPZZ	5-90 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M120	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
<i>F</i>				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M5	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	1(absolute)
Mesh M5	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.5(absolute)
Mesh M5	Field SIGM_ELNO, comp. SIZZ	40.	'ANALYTICAL'	1 %
Mesh M5	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.15 (absolute)
Mesh M5	Field EPSI_ELNO, comp. EPXX	-6 10 ⁻⁵	'ANALYTICAL'	3 %
Mesh M5	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)

Code_Aster

Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 30/52
Clé : V3.04.004 Révision :
54f6701b8b6b

Mesh M5	Field EPSI_ELNO, comp. EPZZ	$2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
Mesh M5	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)

11 Modeling I

11.1 Characteristics of modeling

Elements **AXIS** (TRIA6 + QUAD8)

Limiting conditions:

Node F blocked in dy
pressure on AE $p=60$.

Names of the nodes: $A=N8$ $B=N174$ $C=N5$
 $D=N170$ $E=N3$ $F=N159$

11.2 Characteristics of the grid

Many nodes: 175
Many meshes and types: 20 QUAD8, 40 TRIA6

11.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
not A				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M2	Field SIGM_ELNO, comp. SIXX	- 60.	'ANALYTICAL'	6 %
Mesh M2	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	1.1 (absolute)
Mesh M2	Field SIGM_ELNO, comp. SIZZ	100.	'ANALYTICAL'	1.5 %
Mesh M2	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	1.2 (absolute)
Mesh M2	Field EPSI_ELNO, comp. EPXX	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M2	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh M2	Field EPSI_ELNO, comp. EPZZ	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M2	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
B				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M59	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	1(absolute)
Mesh M59	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.5(absolute)
Mesh M59	Field SIGM_ELNO, comp. SIZZ	40,	'ANALYTICAL'	1.3 %
Mesh M59	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.15 (absolute)
Mesh M59	Field EPSI_ELNO, comp. EPXX	- 6 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M59	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh M59	Field EPSI_ELNO, comp. EPZZ	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M59	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
E				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M1	Field SIGM_ELNO, comp. SIXX	-60	'ANALYTICAL'	6 %
Mesh M1	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	1.1 (absolute)
Mesh M1	Field SIGM_ELNO, comp. SIZZ	100.	'ANALYTICAL'	1.5 %
Mesh M1	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	1.2 (absolute)
Mesh M1	Field EPSI_ELNO, comp. EPXX	-4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M1	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh M1	Field EPSI_ELNO, comp. EPZZ	5-90 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M1	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-2 (absolute)
F				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M48	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	1(absolute)
Mesh M48	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.5(absolute)
Mesh M48	Field SIGM_ELNO, comp. SIZZ	40.	'ANALYTICAL'	1 %
Mesh M48	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.15 (absolute)
Mesh M48	Field EPSI_ELNO, comp. EPXX	-6 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M48	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-2 (absolute)
Mesh M48	Field EPSI_ELNO, comp. EPZZ	2 10 ⁻⁴	'ANALYTICAL'	1 %

Mesh M48 Field EPSI_ELNO, comp. EPXY 0. 'ANALYTICAL' 1E-2
(absolute)

There is compared to the end of this test a loading in rotation into axisymmetric pure with the same loading as a Fourier mode 0. One finds many identical results.

Results resulting from MACR_LIGN_COUP on segment AE :

Tests of NON_REGRESSION are made on the tables resulting from MACR_LIGN_COUP applied to one CHAMP_GD. They constitute the values of reference 'AUTRE_ASTER' for the tables resulting from MACR_LIGN_COUP applied to a result of the type mult_elas .

Localization		Size		Value of Référence	Type of reference	Precision
Not	ABSC_CUR	Field	Compdaring			
A	0	DEPL	D X	-	'NON_REGRESSION'	-
C	0,005	DEPL	D X	-	'NON_REGRESSION'	-
E	0.1	DEPL	D X	-	NON_REGRESSION'	-
A	0	DEPL	D X	1.35511346318	'AUTRE_ASTER'	-
C	0,005	DEPL	D X	1.35531703991	'AUTRE_ASTER'	-
E	0.1	DEPL	D X	1.35511346318	'AUTRE_ASTER'	-

One proceeds in the same way to test the result of MACR_LIGNE_COUPE applied to a concept of the type comb_fourier.

Localization		Size		Value of Référence	Type of reference	Precision
Not	ABSC_CUR	Field	Compdaring			
A	0	DEPL	D X	-	'NON_REGRESSION'	-
C	0,005	DEPL	D X	-	'NON_REGRESSION'	-
E	0.1	DEPL	D X	-	NON_REGRESSION'	-
A	0	DEPL	D X	5.8999716105E-05	'AUTRE_ASTER'	-
C	0,005	DEPL	D X	5.90000189066E-05	'AUTRE_ASTER'	-
E	0.1	DEPL	D X	5.89997161037E-05	'AUTRE_ASTER'	-

12 Modeling J

12.1 Characteristics of modeling

Elements **AXIS** (QUAD9)

Limiting conditions:

node F blocked in dy
pressure on AE $p=60$.

Names of the nodes:	$A = N196$	$B = N1$	$C = N200$
	$D = N5$	$E = N202$	$F = N7$

12.2 Characteristics of the grid

Many nodes: 205
Many meshes and types: 40 QUAD9

12.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
not A				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M39	Field SIGM_ELNO, comp. SIXX	- 60.	'ANALYTICAL'	0.5%
Mesh M39	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.1 (absolute)
Mesh M39	Field SIGM_ELNO, comp. SIZZ	-	'NON_REGRESSION'	-
Mesh M39	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.5 (absolute)
Mesh M39	Field EPSI_ELNO, comp. EPXX	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M39	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M39	Field EPSI_ELNO, comp. EPZZ	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M39	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)
B				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M1	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	0.02(absolute)
Mesh M1	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.01(absolute)
Mesh M1	Field SIGM_ELNO, comp. SIZZ	-	'NON_REGRESSION'	-
Mesh M1	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.005 (absolute)
Mesh M1	Field EPSI_ELNO, comp. EPXX	- 6 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M1	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M1	Field EPSI_ELNO, comp. EPZZ	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M1	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)
E				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M40	Field SIGM_ELNO, comp. SIXX	-60	'ANALYTICAL'	0.5 %
Mesh M40	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.1 (absolute)
Mesh M40	Field SIGM_ELNO, comp. SIZZ	-	'NON_REGRESSION'	-
Mesh M40	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	0.05 (absolute)
Mesh M40	Field EPSI_ELNO, comp. EPXX	-4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M40	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M40	Field EPSI_ELNO, comp. EPZZ	5-90 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M40	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)
F				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	0.1 %
Mesh M2	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	0.02(absolute)
Mesh M2	Field SIGM_ELNO, comp. SIYY	0,	'ANALYTICAL'	0.01(absolute)
Mesh M2	Field SIGM_ELNO, comp. SIZZ	-	'NON_REGRESSION'	-
Mesh M2	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	5th-3 (absolute)
Mesh M2	Field EPSI_ELNO, comp. EPXX	-6 10 ⁻⁵	'ANALYTICAL'	1 %

Code_Aster

Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 36/52
Clé : V3.04.004 Révision :
54f6701b8b6b

Mesh M2	Field EPSI_ELNO, comp. EPYY	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M2	Field EPSI_ELNO, comp. EPZZ	$2 \cdot 10^{-4}$	'ANALYTICAL'	1 %
Mesh M2	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)

13 Modeling K

13.1 Characteristics of modeling

Elements 3D (PENTA6 and HEXA8)

Grid obtained by extrusion starting from the grid 2D below (modeling E)

Along the axis Z : 2 layers of elements
Total thickness: 0.01m

Limiting conditions:

node F : $u_z=0$

face AB blocked in dy

face EF blocked normally

face AE radial displacement imposed on
 $5.9 E-5 m$

Names of the nodes:	$A = No1$	$C = No36$	$D = No166$
plan $z=0.005$	$A2 = No172$	$C2 = No242$	$D2 = No5025$
plan $z=0.01$	$A3 = No173$	$C3 = No243$	$D3 = No503$

Names of the nodes:	$E = No41$	$H = No9$	$G = No38$
plan $z=0.005$	$E2 = No252$	$H2 = No188$	$G2 = No246$
plan $z=0.01$	$E3 = No253$	$H3 = No189$	$G3 = No247$

13.2 Characteristics of the grid

Many nodes: 513

Many meshes and types: 400 PENTA6, 100 HEXA8 40 QUAD4 (faces skin interns)

13.3 Remarks

The loading is here in imposed displacement, contrary to other modelings. The reactions are tested.

13.4 Sizes tested and results

Localization	Size	Value of Référence	Type of reference	Tolerance
C	Field REAC_NODA, comp FX	1.0884 E-3	'AUTRE_ASTER'	0,7 %
	Field REAC_NODA, comp F Y	4.5084 E-4	'AUTRE_ASTER'	1,7 %
C_2	Field REAC_NODA, comp FX	2.1768 E-3	'AUTRE_ASTER'	1 %
	Field REAC_NODA, comp F Y	9.0170 E-4	'AUTRE_ASTER'	1,3 %
C_3	Field REAC_NODA, comp FX	1.0884 E-3	'AUTRE_ASTER'	0,7 %
	Field REAC_NODA, comp F Y	4.5084 E-4	'AUTRE_ASTER'	1,7 %
H	Field REAC_NODA, comp FX	1.1636 E-3	'AUTRE_ASTER'	0,7 %
	Field REAC_NODA, comp F Y	1.8429 E-4	'AUTRE_ASTER'	0,6 %
G	Field REAC_NODA, comp FX	1.0045 E-3	'AUTRE_ASTER'	1 %
	Field REAC_NODA, comp F Y	6.1550 E-4	'AUTRE_ASTER'	1 %
H_2	Field REAC_NODA, comp FX	2.3272 E-3	'AUTRE_ASTER'	0,5 %
	Field REAC_NODA, comp F Y	3.6858 E-4	'AUTRE_ASTER'	0,6 %
G_2	Field REAC_NODA, comp FX	2.0090 E-3	'AUTRE_ASTER'	0,7 %
	Field REAC_NODA, comp F Y	1.2310 E-3	'AUTRE_ASTER'	0,8 %

13.5 Remarks

One checks that the nodal forces of reactions are worthless in all the nodes, except on the nodes of surface AE and of surfaces EF and AB .

14 Modeling L

14.1 Characteristics of modeling

Elements 3D (PYRAM5)

Along the axis Z : each parallelepiped is cut out in 6 pyramids
Total thickness: 0.01m

Limiting conditions:

node F : $u_z=0$
face AB blocked in dy
face EF blocked normally
pressure on the face AE $p=60$.

Names of the nodes: $A=N267$ $B=N142$ $E=N29$ $F=N1$

14.2 Characteristics of the grid

Many nodes: 342
Many meshes and types: 600 PYRAM5 620 QUAD4 (faces skin interns)

14.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>not A</i>				
-	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M3	Field SIGM_ELNO, comp. SIXX	- 60.	'ANALYTICAL'	12 %
Mesh M3	Field SIGM_ELNO, comp. SIYY	100.	'ANALYTICAL'	10 %
Mesh M3	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	2. (absolute)
Mesh M3	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	5. (absolute)
Mesh M3	Field EPSI_ELNO, comp. EPXX	- 4.5 10 ⁻⁴	'ANALYTICAL'	11 %
Mesh M3	Field EPSI_ELNO, comp. EPYY	5.9 10 ⁻⁴	'ANALYTICAL'	10 %
Mesh M3	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M3	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)
<i>B</i>				
-	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M58	Field SIGM_ELNO, comp. SIXX	0.	'ANALYTICAL'	1.(absolute)
Mesh M58	Field SIGM_ELNO, comp. SIYY	40.	'ANALYTICAL'	2 %
Mesh M58	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	0.5 (absolute)
Mesh M58	Field SIGM_ELNO, comp. SIXY	0.	'ANALYTICAL'	2. (absolute)
Mesh M58	Field EPSI_ELNO, comp. EPXX	- 6 10 ⁻⁵	'ANALYTICAL'	5 %
Mesh M58	Field EPSI_ELNO, comp. EPYY	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M58	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M58	Field EPSI_ELNO, comp. EPXY	0.	'ANALYTICAL'	1E-1 (absolute)
<i>E</i>				
-	Field DEPL, comp. X	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M546	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	4 %
Mesh M546	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	60 %
Mesh M546	Field SIGM_ELNO, comp. SIZZ	0.	'ANALYTICAL'	3 (absolute)
Mesh M546	Field SIGM_ELNO, comp. SIXY	- 80.	'ANALYTICAL'	4 %
Mesh M546	Field EPSI_ELNO, comp. EPXX	0.7 10 ⁻⁴	'ANALYTICAL'	35 %
Mesh M546	Field EPSI_ELNO, comp. EPYY	0.7 10 ⁻⁴	'ANALYTICAL'	80 %
Mesh M546	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M546	Field EPSI_ELNO, comp. EPXY	- 5.2 10 ⁻⁴	'ANALYTICAL'	4 %
<i>F</i>				
-	Field DEPL, comp. X	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. Y	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M599	Field SIGM_ELNO, comp. SIXX	20.	'ANALYTICAL'	6 %
Mesh M599	Field SIGM_ELNO, comp. SIYY	20.	'ANALYTICAL'	5 %

Mesh M599	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0.5 (absolute)
Mesh M599	Field SIGM_ELNO, comp. <i>SIXY</i>	0.	'ANALYTICAL'	0.05 (absolute)
Mesh M599	Field EPSI_ELNO, comp. <i>EPXX</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	10 %
Mesh M599	Field EPSI_ELNO, comp. <i>EPYY</i>	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	10 %
Mesh M599	Field EPSI_ELNO, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-1 (absolute)
Mesh M599	Field EPSI_ELNO, comp. <i>EPXY</i>	$-1.3 \cdot 10^{-4}$	'ANALYTICAL'	5 %

15 Modeling M

15.1 Characteristics of modeling

Elements 3D (PYRAM13)

Along the axis Z : each parallelepiped is cut out in 6 pyramids
Total thickness: 0.01m

Limiting conditions:

node F : $u_z=0$
face AB blocked in dy
face EF blocked normally
pressure on the face AE $p=60$.

Names of the nodes: $A=N1403$ $B=N734$ $E=N152$ $F=N4$

15.2 Characteristics of the grid

Many nodes: 1703
Many meshes and types: 600 PYRAM13 620 QUAD8 (faces skin interns)

15.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
not <i>A</i>				
-	Field DEPL, comp. <i>X</i>	5.90 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. <i>Y</i>	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M6	Field SIGM_ELNO, comp. <i>SIXX</i>	- 60.	'ANALYTICAL'	1 %
Mesh M6	Field SIGM_ELNO, comp. <i>SIYY</i>	100.	'ANALYTICAL'	1 %
Mesh M6	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M6	Field SIGM_ELNO, comp. <i>SIXY</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M6	Field EPSI_ELNO, comp. <i>EPXX</i>	- 4.5 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M6	Field EPSI_ELNO, comp. <i>EPYY</i>	5.9 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M6	Field EPSI_ELNO, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M6	Field EPSI_ELNO, comp. <i>EPXY</i>	0.	'ANALYTICAL'	1E-4 (absolute)
<i>B</i>				
-	Field DEPL, comp. <i>X</i>	4 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. <i>Y</i>	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M58	Field SIGM_ELNO, comp. <i>SIXX</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M58	Field SIGM_ELNO, comp. <i>SIYY</i>	40.	'ANALYTICAL'	0.12 %
Mesh M58	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M58	Field SIGM_ELNO, comp. <i>SIXY</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M58	Field EPSI_ELNO, comp. <i>EPXX</i>	- 6 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M58	Field EPSI_ELNO, comp. <i>EPYY</i>	2. 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M58	Field EPSI_ELNO, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M58	Field EPSI_ELNO, comp. <i>EPXY</i>	0.	'ANALYTICAL'	1E-4 (absolute)
<i>E</i>				
-	Field DEPL, comp. <i>X</i>	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. <i>Y</i>	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M546	Field SIGM_ELNO, comp. <i>SIXX</i>	20.	'ANALYTICAL'	1 %
Mesh M546	Field SIGM_ELNO, comp. <i>SIYY</i>	20.	'ANALYTICAL'	1 %
Mesh M546	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0.1 (absolute)
Mesh M546	Field SIGM_ELNO, comp. <i>SIXY</i>	- 80.	'ANALYTICAL'	0.12 %
Mesh M546	Field EPSI_ELNO, comp. <i>EPXX</i>	0.7 10 ⁻⁴	'ANALYTICAL'	1 %
Mesh M546	Field EPSI_ELNO, comp. <i>EPYY</i>	0.7 10 ⁻⁴	'ANALYTICAL'	2 %
Mesh M546	Field EPSI_ELNO, comp. <i>EPZZ</i>	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M546	Field EPSI_ELNO, comp. <i>EPXY</i>	- 5.2 10 ⁻⁴	'ANALYTICAL'	1 %
<i>F</i>				
-	Field DEPL, comp. <i>X</i>	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
-	Field DEPL, comp. <i>Y</i>	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
Mesh M599	Field SIGM_ELNO, comp. <i>SIXX</i>	20.	'ANALYTICAL'	1 %
Mesh M599	Field SIGM_ELNO, comp. <i>SIYY</i>	20.	'ANALYTICAL'	1 %
Mesh M599	Field SIGM_ELNO, comp. <i>SIZZ</i>	0.	'ANALYTICAL'	0.01 (absolute)
Mesh M599	Field SIGM_ELNO, comp. <i>SIXY</i>	-20	'ANALYTICAL'	0.12 %

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Version
default

Titre : SSLV04 - Cylindre creux en contraintes planes
Responsable : DELMAS Josselin

Date : 14/09/2017 Page : 44/52
Clé : V3.04.004 Révision :
54f6701b8b6b

Mesh M599	Field EPSI_ELNO, comp. EPXX	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
Mesh M599	Field EPSI_ELNO, comp. EPYY	$0.7 \cdot 10^{-4}$	'ANALYTICAL'	1 %
Mesh M599	Field EPSI_ELNO, comp. EPZZ	0.	'ANALYTICAL'	1E-4 (absolute)
Mesh M599	Field EPSI_ELNO, comp. EPXY	$-1.3 \cdot 10^{-4}$	'ANALYTICAL'	1 %

16 Modeling NR

16.1 Characteristics of modeling

Elements 3D (PENTA15 and HEXA20)

Grid obtained by extrusion starting from a grid 2D resembling the grid below (8 elements in the radial direction, 4 + 4 elements in the circumferential direction) and duplicated to have a complete section of the cylinder (on 360°).

Along the axis Z : 1 layer of elements
Total thickness: 0.01m

Limiting conditions:

face AB blocked in dy
face EF blocked normally

pressure on the face AE $p = 60$.
basic effect on the sections $p = 60$.

Names of the nodes: $A = N5349$ $B = N6092$ $C = N433$
 $D = N441$ $E = N2180$ $F = N1632$

16.2 Characteristics of the grid

Many nodes: 8832
Many meshes and types: 1024 PENTA15, 512 HEXA20, 1176 QUAD8 and 2048 TRIA6.

16.3 Remarks

Contrary to preceding modelings, one takes into account here the basic effect applying to the sections at the ends of the cylinder.

16.4 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>not A</i>				
	Field DEPL, comp. X	5.60 10 ⁻⁵	'NON_DEFINI '	0.1 %
	Field DEPL, comp. Y	0.	'NON_DEFINI '	1E-4
				(absolute)
	Field SIGM_NOEU, comp. SIXX	- 60.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIYY	100.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4
				(absolute)
<i>B</i>				
	Field DEPL, comp. X	3.4 10 ⁻⁵	'NON_DEFINI '	0.1 %
	Field DEPL, comp. Y	0.	'NON_DEFINI '	1E-4
				(absolute)
	Field SIGM_NOEU, comp. SIXX	0.	'NON_DEFINI '	0.1(absolute)
	Field SIGM_NOEU, comp. SIYY	40.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4
				(absolute)
<i>E</i>				
	Field DEPL, comp. X	2.82843 10 ⁻⁵	'NON_DEFINI '	1 %
	Field DEPL, comp. Y	2.82843 10 ⁻⁵	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'NON_DEFINI '	2 %
	Field SIGM_NOEU, comp. SIYY	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXY	- 80.	'NON_DEFINI '	1 %
<i>F</i>				
	Field DEPL, comp. X	4.17193 10 ⁻⁵	'NON_DEFINI '	1 %
	Field DEPL, comp. Y	4.17193 10 ⁻⁵	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIYY	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
	Field SIGM_NOEU, comp. SIXY	-20.	'NON_DEFINI '	1 %

17 Modeling O

17.1 Characteristics of modeling

Elements `C_PLAN` (QUAD8 + TRIA6)

Grid 2D resembling the grid below (8 elements in the radial direction, 4+4 elements in the circumferential direction) and duplicated to have a complete section of the cylinder (on 360°).

Limiting conditions:

side *AB* blocked in *dx*
side *EF* blocked normally
pressure on *AE* $p=60$.

Names of the nodes: *A*= N249 *B*= N992 *C*= N1667
 D= N1588 *E*= N3776 *F*= N3228

17.2 Characteristics of the grid

Many nodes: 3840
Many meshes and types: 1026 TRIA6, 512 QUAD8

17.3 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
<i>not A</i>				
	Field DEPL, comp. X	5.90 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM_NOEU, comp. SIXX	- 60.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIYY	100.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM NOEU, comp. SIXY	0.	'ANALYTICAL'	0.3 (absolute)
<i>B</i>				
	Field DEPL, comp. X	4 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM_NOEU, comp. SIXX	0.	'ANALYTICAL'	0.1 (absolute)
	Field SIGM_NOEU, comp. SIYY	40.	'ANALYTICAL'	0.5 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	0.015 (absolute)
	Field SIGM NOEU, comp. SIXY	0.	'ANALYTICAL'	0.1. (absolute)
<i>E</i>				
	Field DEPL, comp. X	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	4.17193 10 ⁻⁵	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	5 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM NOEU, comp. SIXY	-80	'ANALYTICAL'	1 %
<i>F</i>				
	Field DEPL, comp. X	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
	Field DEPL, comp. Y	2.82843 10 ⁻⁵	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIXX	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIYY	20.	'ANALYTICAL'	1 %
	Field SIGM_NOEU, comp. SIZZ	0.	'ANALYTICAL'	1E-4 (absolute)
	Field SIGM_NOEU, comp. SIXY	-20.	'ANALYTICAL'	1 %

18 Modeling P

18.1 Characteristics of modeling

Elements 3D (PENTA15 and HEXA20) – even grid that modeling NR

Grid obtained by extrusion starting from a grid 2D resembling the grid below (8 elements in the radial direction, 4+4 elements in the circumferential direction) and duplicated to have a complete section of the cylinder (on 360°).

Along the axis Z : 1 layer of elements
Total thickness: 0.01m

Limiting conditions:

face EF blocked normally
face AB blocked in dy
pressure on the face AE fp
basic effect on the sections fp

With fp : linear pressure function of being worth time 60. with $t=1s$ and 120. with $t=2s$

Names of the nodes: $A=N5349$ $B=N6092$ $C=N433$
 $D=N441$ $E=N2180$ $F=N1632$

18.2 Characteristics of the grid

Many nodes: 8832

Many meshes and types: 1024 PENTA15, 512 HEXA20, 1176 QUAD8 and 2048 TRIA6.

18.3 Remarks

Contrary to modeling NR, one tests here a basic pressure and effect variables according to time. A linear variation of the pressure involves a linear variation of the constraints.

18.4 Sizes tested and results

Localization	Size	Valor of Référence	Type of reference	Tolerance
not <i>A</i>				
Moment 1.0	Field DEPL, comp. X	5.60 10 ⁻⁵	'NON_DEFINI '	0.1 %
Moment 1.0	Field DEPL, comp. Y	0.	'NON_DEFINI '	1E-10 (absolute)
Moment 1.0	Field SIGM_NOEU, comp. SIXX	- 60.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIYY	100.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4 (absolute)
Moment 2.0	Field SIGM_NOEU, comp. SIXX	-120.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIYY	200.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIZZ	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4 (absolute)
<i>B</i>				
Moment 1.0	Field DEPL, comp. X	3.4 10 ⁻⁵	'NON_DEFINI '	0.1 %
Moment 1.0	Field DEPL, comp. Y	0.	'NON_DEFINI '	1E-10 (absolute)
Moment 1.0	Field SIGM_NOEU, comp. SIXX	0.	'NON_DEFINI '	0.1(absolute)
Moment 1.0	Field SIGM_NOEU, comp. SIYY	40.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4 (absolute)
Moment 2.0	Field SIGM_NOEU, comp. SIXX	0.	'NON_DEFINI '	0.1(absolute)
Moment 2.0	Field SIGM_NOEU, comp. SIYY	80.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIZZ	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXY	0.	'NON_DEFINI '	1E-4 (absolute)
<i>E</i>				
Moment 1.0	Field SIGM_NOEU, comp. SIXX	20.	'NON_DEFINI '	2 %
Moment 1.0	Field SIGM_NOEU, comp. SIYY	20.	'NON_DEFINI '	2 %
Moment 1.0	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIXY	- 80.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXX	40.	'NON_DEFINI '	2 %
Moment 2.0	Field SIGM_NOEU, comp. SIYY	40.	'NON_DEFINI '	2 %
Moment 2.0	Field SIGM_NOEU, comp. SIZZ	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXY	-160.	'NON_DEFINI '	1 %
<i>F</i>				
Moment 1.0	Field SIGM_NOEU, comp. SIXX	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIYY	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIZZ	20.	'NON_DEFINI '	1 %
Moment 1.0	Field SIGM_NOEU, comp. SIXY	-20.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXX	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIYY	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIZZ	40.	'NON_DEFINI '	1 %
Moment 2.0	Field SIGM_NOEU, comp. SIXY	-40.	'NON_DEFINI '	1 %

19 Summary of the results

Summary of the errors max in %

3D	Localization	MOD A	MOD B	MOD C	MOD D	MOD L	MOD M	MOD NR	MOD P
elem		pe6, h8	pe15, h20	te4	te10	py5	py13	pe15, h20	pe15, h20
geom		45°	45°	45°	45°	45°	45°	360°	360°
Nb		1922	2115	1115	1395	342	1703	8832	8832
Dépl.	WITH, E	0.08	0.09	0.17	0.04	0.21	0.00	0.00	0.00
	B, F	0.10	0.07	0.30	0.04	0.16	0.00	0.00	0.00
σ_{xx}	WITH, E	4.59	0.39	10.45	4.41	11.74	0.11	1.64	1.64
	B, F	5.24	0.07	7.78	0.95	5.24	0.11	0.09	0.09
σ_{vv}	WITH, E	5.70	0.92	9.46	1.80	57.57	0.81	1.64	1.64
	B, F	1.89	0.01	2.46	0.49	4.75	0.08	0.09	0.09
σ_{zz}	WITH, E	Good	Good	Good	Good	Good	Good	0.87	0.87
	B, F	Good	Good	Good	Good	Good	Good	0.04	0.04
σ_{xv}	WITH, E	0.15	0.26	2.89	0.27	3.46	0.07	0.03	0.03
	B, F	0.90	0.06	0.81	0.28	4.95	0.09	0.01	0.01

C_PLAN	Localization	MOD E	MOD F	MOD G	MOD O
Type of elements		tria3, quad4	tria6, quad8	quad9	tria6, quad8
Modelled geometry		45°	45°	45°	360°
Many nodes		961	591	441	384
Displacements	WITH, E	0.07	0.09	0.00	0.01
	B, F	0.09	0.07	0.00	0.00
Constraints σ_{xx}	WITH, E	4.65	0.39	0.27	1.44
	B, F	5.19	0.06	0.02	0.08
Constraints σ_{yy}	WITH, E	5.68	0.90	0.16	1.44
	B, F	1.40	0.04	0.05	0.08
Constraints σ_{zz}	WITH, E	Good	Good	Good	Good
	B, F	Good	Good	Good	Good
Constraints σ_{xy}	WITH, E	0.16	0.23	0.20	0.10
	B, F	1.23	0.07	0.09	0.00

AXIS	Localization	MOD H	MOD I	MOD J
Type of elements		tria3, quad4	tria6, quad8	quad9
Many nodes		113	175	205
Displacements	WITH, E	0.01	0.00	0.00
	B, F	0.01	0.00	0.00
Constraints σ_{xx}	WITH, E	5.66	0.17	0.17
	B, F	Good	Good	Good
Constraints σ_{yy}	WITH, E	Good	Good	Good
	B, F	Good	Good	Good
Constraints σ_{zz}	WITH, E	1.29	0.09	0.09
	B, F	1.00	0.07	0.02
Constraints σ_{xy}	WITH, E	Good	Good	Good
	B, F	Good	Good	Good

- The results are more precise with elements of order 2.
- The problem is adapted more to an axisymmetric modeling. The results are better.
- The grids remain insufficient for the elements 3D of order 1: constraints and deformations of modelings A, C, E and L (especially for modeling L in PYRAM5).
- The pyramids give results similar to the other elements 3D, to grid are equivalent.

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

- Modelings NR and P with basic effect and pressure constant or variables give of good results.