SSNV227 – Tension, in large displacements, of a bar made up of a material very-elastic of Summarized the Mooney-Rivlin

type:

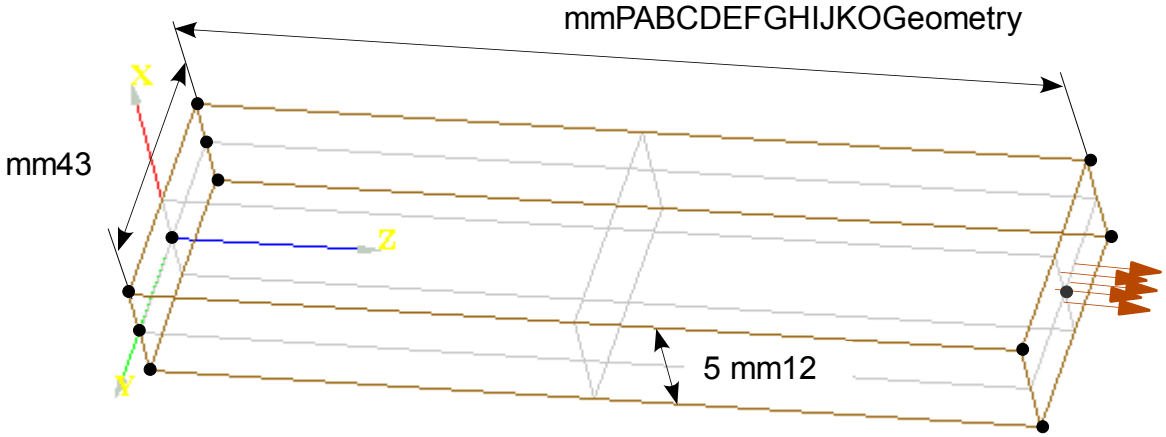
This test represents computation in large displacements of a bar, made up of a material of subjected the Mooney-Rivlin type has a tractive effort.

The modelization A allows to test:

- the modelization 3D with meshes HEXA20,
- a material of the type "HYPER_ELAS"
- the loading of the following type TYPE_CHARGE=' SUIV'

1 Problem of reference

1.1



Not	$X(mm)$	$Y(mm)$	$Z(mm)$
A	-2.5	6.0	0.0
B	-2.5	-6.0	0.0
C	2.5	-6.0	0.0
D	2.5	6.0	0.0
E	-2.5	6.0	43.0
F	-2.5	-6.0	43.0
G	2.5	-6.0	43.0
H	2.5	6.0	43.0
I	0.0	0.0	43.0
J	0.0	6.0	0.0
K	0.0	-6.0	0.0
O	0.0	0.0	0.0

1.2 Material properties

the material is of the Mooney-Rivlin type, whose properties are the following ones:

- $C10=0.709 \quad N/mm^2$
- $C20=0. \quad N/mm^2$
- $C01=2.3456 \quad N/mm^2$
- Poisson's ratio $\nu=0,499$
- Modulates compressibility $k=\frac{6(C10+C01)}{3(1-2*\nu)}=3054.6 \quad N/mm^2$

1.3 Boundary conditions and loadings

- Boundary conditions
  - Face $ABCD$: $DZ=0$
  - Not O : $DY=0$
  - Points J, K : $DX=0$

- formulate Distributed pressure on the face $EFGH$. Two types of computation are carried out:
  - Computation into small disturbance : the pressure applied is of $P=6.\times10^{-6}N/mm^2$.
  - Computation in large displacements : the pressure applied grows linearly $P=0.N/mm^2$ until $6.0N/mm^2$

1.4 Initial conditions

Without Reference solution

2 object

2.1 Method of calculating used for the reference solution

Assumption of the Small Disturbances (HP)

Young Modulus $E=6(C01+C10)\times(1+\nu)=18.3\,N/mm^2$
Section $A=60\mathrm{mm}^2$

In HP, displacement DZ according to Z is such that:

$$K=\frac{DZ}{(A\times P)}$$

where:
K represents the stiffness of the bar
A represents the section of the bar ($A=60\mathrm{mm}^2$)

From the equilibrium the structure, one has $DZ\times E=Lz\times P$

where:
Lz represents the length of the following bar Z
E represents the Young Modulus $E=6(C01+C10)\times(1+\nu)=18.3154\,N/mm^2$

What gives us $DZ=\frac{Lz\times P}{E}=14{,}086510^{-6}mm$

Large displacements: Following pressure

the loading is applied on the structure deformed (following pressure). The stress according to Z (SIZZ) is thus identical to the pressure applied.

The other values of reference are values of NON-regression obtained with modelization A.

2.2 Résultats of reference

Assumption of the Small Disturbances (HP)

Component	Quantity	Standard	Point of Reference	Reference
DEPL	DZ	I	"ANALYTIQUE"	$1.40865\times10^{-5}\mathrm{mm}$

Large displacements: Following pressure

Component	Quantity	Standard	Point of Reference	Reference (mm)
DEPL	DX	G	"NON_REGRESSION"	-0.390384
	DY	G	"NON_REGRESSION"	0.390384
	DX	H	"NON_REGRESSION"	0.93691
	DY	H	"NON_REGRESSION"	-0.93691
	DZ	I	"NON_REGRESSION"	17.42597

Quantity	Component	Standard	Point of Reference	Reference
EPSI_NOEU	$EPXX$	I	"NON_REGRESSION"	-0.15615
	$EPYY$		"NON_REGRESSION"	-0.15615
	$EPZZ$		"NON_REGRESSION"	0.405255
	$EPXY$		"NON_REGRESSION"	0.0
	$EPXZ$		"NON_REGRESSION"	0.0
	$EPYZ$		"NON_REGRESSION"	0.0

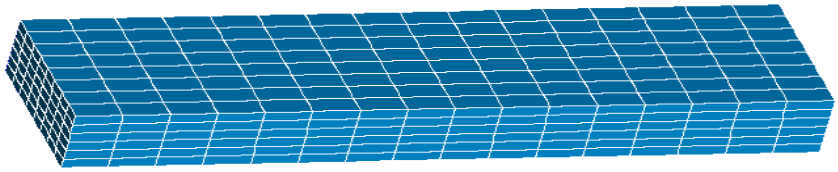
Quantity	Component	Standard	Point of Reference	Reference (N/mm^2)
SIGM_NOEU	$SIXX$	I	"NON_REGRESSION"	0.0
	$SIYY$		"NON_REGRESSION"	0.0
	$SIZZ$		"ANALYTIQUE"	6.0
	$SIXY$		"NON_REGRESSION"	0.0
	$SIXZ$		"NON_REGRESSION"	0.0
	$SIYZ$		"NON_REGRESSION"	0.0

2.3 Uncertainty on the solution

Solution analytical and numerical.

3 Modelization A

3.1 Characteristic of the modelization



3.2 Characteristics of the mesh

Many nodes: 3949
Number of meshes and type: 768 HEXA20

3.3 Quantities tested and Assumption

results of the Small Disturbances (HP)

Component	Quantity	Standard	Point of Reference	Reference	Tolerance
DEPL	DX	G	"ANALYTIQUE"	1.40865×10^{-5} mm	0.1%

Large displacements: Following pressure

Component	Quantity	Standard	Point of Reference	Reference (mm)	Tolerance
DEPL	DX	G	"NON_REGRESSION"	-0.390384	0.1%
	DY	G	"NON_REGRESSION"	0.390384	0.1%
	DX	H	"NON_REGRESSION"	0.93691	0.1%
	DY	H	"NON_REGRESSION"	-0.93691	0.1%
	DZ	I	"NON_REGRESSION"	17.42597	0.1%

Component	Quantity	Standard	Point of Reference	Reference	Tolerance
EPSI_NOEU	*EPXX*	*I*	"NON_REGRESSION"	-0.15615	0.1%
	EPYY		"NON_REGRESSION"	-0.15615	0.1%
	EPZZ		"NON_REGRESSION"	0.405255	0.1%
	EPXY		"NON_REGRESSION"	0.0	0.001
	EPXZ		"NON_REGRESSION"	0.0	0.001
	EPYZ		"NON_REGRESSION"	0.0	0.001

Component	Quantity	Standard	Point of Reference	Reference N/mm^2	Tolerance
SIGM_NOEU	*SIXX*	*I*	"NON_REGRESSION"	0.0	0.001
	SIYY		"NON_REGRESSION"	0.0	0.001
	SIZZ		"ANALYTIQUE"	6.0	0.1%
	SIXY		"NON_REGRESSION"	0.0	0.001
	SIXZ		"NON_REGRESSION"	0.0	0.001
	SIYZ		"NON_REGRESSION"	0.0	0.001

4 Summary of the results

the got results are satisfactory.