

## SSNV227 – Traction, in great displacements, of a bar made up of a material very-rubber band of the Mooney-Rivlin type

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### Summary:

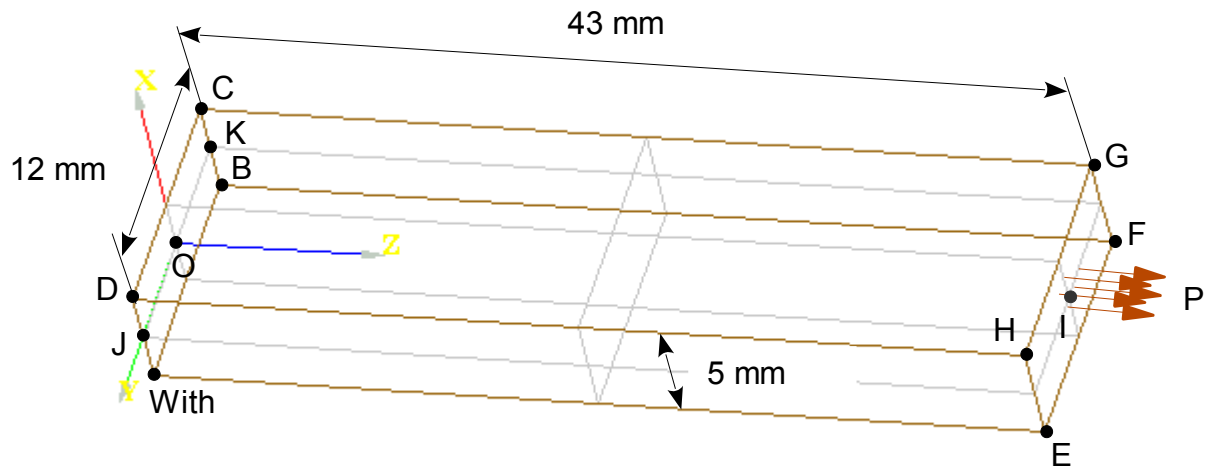
This test Represents calculation in great displacements of a bar, made up of a material of the type Mooney-Rivlin soumhas a tractive effort.

Modeling With allows to test:

- modeling 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 Geometry



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 type Mooney-Rivlin, giftT them properties are the following ones:

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

## 1.3 Boundary conditions and loadings

- Boundary conditions
  - Face  $ABCD$  :  $DZ=0$
  - Not  $O$  :  $DY=0$
  - Points  $J, K$  :  $DX=0$
- Pressure distributed uniformly on the face  $EFGH$ . Two types of calculation are carried out:
  - Calculation into small disturbance : the pressure applied is of  $P=6.\times 10^{-6} N/mm^2$ .
  - Calculation in great displacements : the pressure applied grows linearly  $P=0. N/mm^2$  until  $6.0 N/mm^2$

## 1.4 Initial conditions

Without object

## 2 Reference solution

### 2.1 Method of calculating used for the reference solution

#### Assumption of the Small Disturbances (HP)

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

In HP, displacement  $DZ$  according to  $Z$  is such as:

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

where:

$K$  represent the stiffness of the bar

$A$  represent the section of the bar ( $A = 60 \text{ mm}^2$ )

Starting from balance the structure, one has  $DZ \times E = Lz \times P$

where:

$Lz$  represent the length of the following bar  $Z$

$E$  represent the Young Modulus  $E = 6(C01 + C10) \times (1 + \nu) = 18.3154 \text{ N/mm}^2$

What gives us  $DZ = \frac{Lz \times P}{E} = 14,0865 \cdot 10^{-6} \text{ mm}$

#### Great displacements: Following pressure

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

The other values of reference are values of not-regression obtained with modelledtion A.

### 2.2 Results of reference

#### Assumption of the Small Disturbances (HP)

Size	Component	Not	Type of Reference	Reference
DEPL	$DZ$	$I$	'ANALYTICAL'	$1.40865 \times 10^{-5} \text{ mm}$

#### Great displacements: Following pressure

Size	Component	Not	Type of Reference	Reference (mm)
DEPL	<i>DX</i>	<i>G</i>	'NON_REGRESSION'	-0.390384
	<i>DY</i>	<i>G</i>	'NON_REGRESSION'	0.390384
	<i>DX</i>	<i>H</i>	'NON_REGRESSION'	0.93691
	<i>DY</i>	<i>H</i>	'NON_REGRESSION'	-0.93691
	<i>DZ</i>	<i>I</i>	'NON_REGRESSION'	17.42597

Size	Component	Not	Type of Reference	Reference
EPSI_NOEU	<i>EPXX</i>	<i>I</i>	'NON_REGRESSION'	-0.15615
	<i>EPYY</i>		'NON_REGRESSION'	-0.15615
	<i>EPZZ</i>		'NON_REGRESSION'	0.405255
	<i>EPXY</i>		'NON_REGRESSION'	0.0
	<i>EPXZ</i>		'NON_REGRESSION'	0.0
	<i>EPYZ</i>		'NON_REGRESSION'	0.0

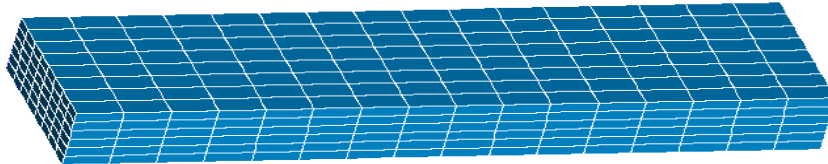
Size	Component	Not	Type of Reference	Reference $N/mm^2$
SIGM_NOEU	<i>SIXX</i>	<i>I</i>	'NON_REGRESSION'	0.0
	<i>SIYY</i>		'NON_REGRESSION'	0.0
	<i>SIZZ</i>		'ANALYTICAL'	6.0
	<i>SIXY</i>		'NON_REGRESSION'	0.0
	<i>SIXZ</i>		'NON_REGRESSION'	0.0
	<i>SIYZ</i>		'NON_REGRESSION'	0.0

## 2.3 Uncertainty on the solution

Analytical and digital solution.

## 3 Modeling A

### 3.1 Characteristics of modeling



### 3.2 Characteristics of the grid

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

### 3.3 Sizes tested and results

#### Assumption of the Small Disturbances (HP)

Size	Component	Not	Type of Reference	Reference	Tolerance
DEPL	<i>DX</i>	<i>G</i>	'ANALYTICAL'	$1.40865 \times 10^{-5}$ mm	0.1 %

#### Great displacements: Following pressure

Size	Component	Not	Type of Reference	Reference (mm)	Tolerance
DEPL	<i>DX</i>	<i>G</i>	'NON_REGRESSION'	-0.390384	0.1 %
	<i>DY</i>	<i>G</i>	'NON_REGRESSION'	0.390384	0.1 %
	<i>DX</i>	<i>H</i>	'NON_REGRESSION'	0.93691	0.1 %
	<i>DY</i>	<i>H</i>	'NON_REGRESSION'	-0.93691	0.1 %
	<i>DZ</i>	<i>I</i>	'NON_REGRESSION'	17.42597	0.1 %

Size	Component	Not	Type 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

Size	Component	Not	Type of Reference	Reference <i>N / mm<sup>2</sup></i>	Tolerance
SIGM_NOEU	SIXX	I	'NON_REGRESSION'	0.0	0.001
	SIYY		'NON_REGRESSION'	0.0	0.001
	SIZZ		'ANALYTICAL'	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

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The got results are satisfactory.