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## SSLS07 - Thin cylinder under axial loading uniform

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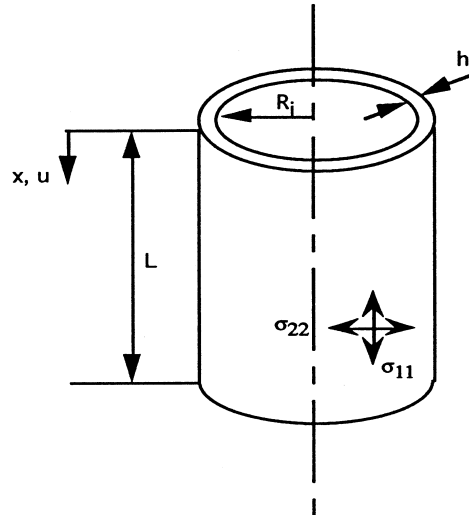
### Abstract:

The purpose of this test from guide VPCS (SSLS 07/89) is validating a linear loading (`FORCE_POUTRE`) in axisymmetric modelization.

One will use for that the 2 commands: `AFFE_CHAR_MECA` (modelization A) and `AFFE_CHAR_MECA_F` (modelization B).

## 1 Problem of reference

### 1.1 Geometry



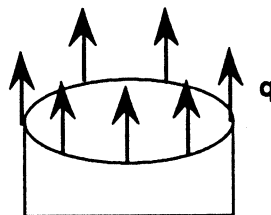
Average radius :  $R_o = 1\text{ m}$   
Thickness :  $h = 0.02\text{ m}$   
Height :  $L = 4\text{ m}$   
Internal radius :  $R_i = R_o - h/2$

### 1.2 Material properties

Young's modulus :  $E = 2.1 \times 10^{11}\text{ Pa}$   
Poisson's ratio :  $\nu = 0.3$

### 1.3 Boundary conditions and loadings

- axial Displacement no one at the low end ( $u=0$ ) + conditions of uniform
- symmetry Axial loading per unit of length  $q = 10000\text{ N/m}$ , applied at the high end



### 1.4 Initial conditions

Without object for the static analysis.

## 2 Reference solution

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

$$: \sigma_{11} = \frac{q}{h}$$

$$\text{Circumferential stress: } \sigma_{22} = 0$$

$$\text{Lengthening of the cylinder: } U_x = \frac{qL}{Eh}$$

$$\text{Radial displacement: } U_r = -\frac{q \nu R_0}{Eh}$$

### 2.2 Results of reference

$$\sigma_{11} = 5 \times 10^5 \text{ Pa}$$

$$U_x = 9.52 \times 10^{-6} \text{ m}$$

$$U_r = -7.14 \times 10^{-7} \text{ m}$$

### 2.3 Uncertainty on the analytical

solution Solution.

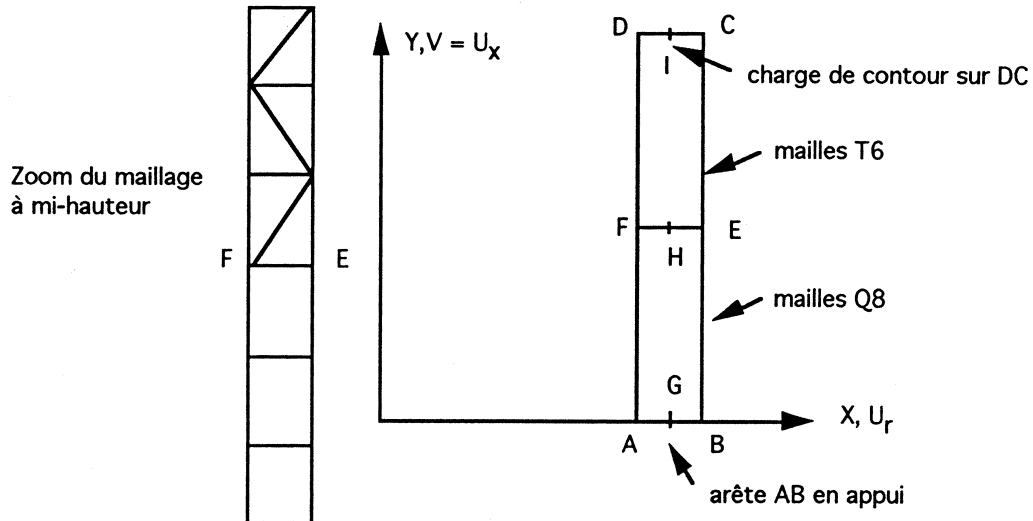
### 2.4 Bibliographical reference

- 1) Guide VPCS – Edition 1990 (SSLS 07/89)
- 2) R.J. ROARK and W.C. YOUNG: Formulated for stress and strain, 5th edition, New York, Mc Graw-Hill, 1975

## 3 Modelization A

### 3.1 Characteristic of modelization

AXIS, meshes T6 and Q8



Position of the points:

- $E, F$  with remote
- $G, H, I$  middle height  $R_o$  of the axis

Cutting: 100 elements according to height  
1 element in the thickness

limiting Conditions:  $DY = 0$   
on  $AB$

Loading: Distributed force = 500.000  
on  $CD$

Name of the nodes:

Not  $A = N1$       Not  $C = N452$       Not  $E = N201$       Not  $G = N51$       Not  $I = N503$   
Not  $B = N101$       Not  $D = N504$       Not  $F = N203$       Not  $H = N202$

### 3.2 Characteristic of the mesh

Many nodes: 553  
Number of meshes and types: 50 QUAD8, 100 TRIA6, 204 SEG3

### 3.3 Values tested

Standard	Localization of value	Reference
Points $G, H, I$	$u_r(m)$	$-7.14 \cdot 10^{-7}$
Items $C, D, I$	$u_x(m)$	$9.52 \cdot 10^{-6}$

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.

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Items <i>A, B, C, D, E, F, G</i>	$\sigma_{22}(Pa)$	0.
Items <i>A, B, C, D, E, F, G</i>	$\sigma_{11}(Pa)$	$5. 10^{-5}$

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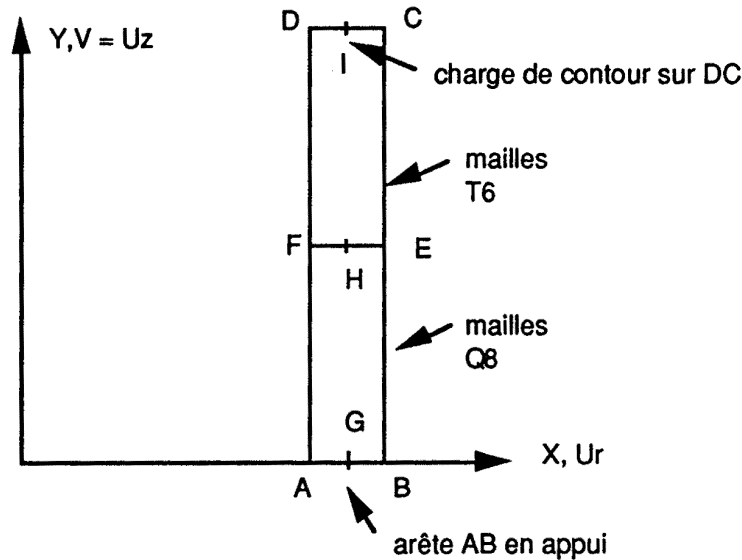
### 3.4 Remark

the provided  $F_y$  value corresponds to the pressure  $p = q/h$ .

## 4 Modelization B

### 4.1 Characteristic of modelization

AXIS, meshes T6 and Q8



Position of the points:

- $E, F$  with remote
- $G, H, I$  middle height  $R_o$  of the axis

Cutting: 100 elements according to height  
1 element in the thickness

the load is broken up in the following way:

- load  $q1$  varying linearly of 0 in  $D$  with  $10000 N/m$  in  $C$  : field of displacements **U1**
- charges  $q2$  varying linearly  $10000 N/m$  in  $D$  to 0 in  $C$  : field of displacements **U2**

the results are given separately for each field **U1** and **U2**.

Name of the nodes:

Not  $A=N1$       Not  $C=N452$       Not  $E=N201$       Not  $G=N51$       Not  $I=N503$   
Not  $B=N101$       Not  $D=N504$       Not  $F=N203$       Not  $H=N202$

### 4.2 Characteristic of the mesh

Many nodes: 557

Number of meshes and types: 50 QUAD8, 100 TRIA6, 204 SEG3

### 4.3 Values tested

Fields	Standard	Localization of value	Reference
<b>U1</b>	Not $G(N51)$	$u_r(m)$	$-3,583. 10^{-7}$
	Not $H(N202)$		$-3,583. 10^{-7}$
			$-1,012. 10^{-6}$

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	Not $I(N503)$		
	Point $C(N452)$	$u_x(m)$	$4,896. 10^{-6}$
	Not $D(N504)$		$4,658. 10^{-6}$
	Point $I(N503)$		$4,777. 10^{-6}$
<b>U2</b>	Point $G$	$u_r(m)$	$- 3,559. 10^{-7}$
	Not $H$		$- 3,559. 10^{-7}$
	Not $I$		$2,973. 10^{-7}$
	Item $C(N452)$		$4,627. 10^{-6}$
	Not $D(N504)$		$4,865. 10^{-6}$
	Point $I(N503)$		$4,746. 10^{-6}$

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## 5 Summary of the results

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key word `FORCE_CONTOUR` used starting from two commands `AFFE_CHAR_MECA` and `AFFE_CHAR_MECA_F` provides right results.