SSLS107 - Cylindrical panel subjected to its own Summarized

weight:

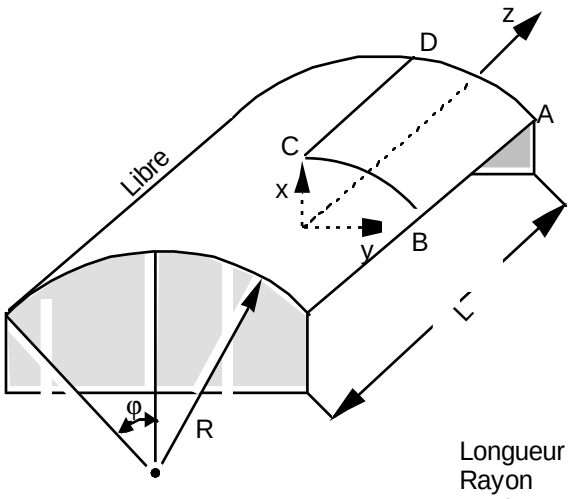
This test makes it possible to validate two finite elements of thick shell in linear elasticity. The modelization A tests the quadrangle, the modelization B tests the triangle associated with the formulation. This problem of cylindrical panel under inertia loading is a classical test of shell.

The results of reference are analytical solutions.

One will and the note the good performances obtained with the quadrangle results much less good got with the triangle.

1 Problem of reference

1.1 Geometry



Longueur	L = 6. m
Rayon	R = 3. m
Epaisseur	t = 0.03 m
Section angulaire	φ = 40°

Coordinated of the points:

	A	B	C	D
x	$3.\cos 40°$	$3.\cos 40°$	3.	3.
y	$3.\sin 40°$	$3.\sin 40°$	0.	0.
z	3.	0.	0.	3.

1.2 Material properties

$E = 3.10^{10} Pa$
$\nu = 0.$
$\rho = 2.0833\,10^{4}\, kg/m^{3}$

1.3 Boundary conditions and loadings

rigid Diaphragm at each end: $u = v = 0 \quad \theta_z = 0$.

Loading 1: Force due to gravity $g = -10\, m/s^2$

Loading 2: Force shell charges distributed vertical $F_x = -6250.\mathrm{N}$

Two loadings leading to the same solution are tested.

2 Reference solution

2.1 Method of calculating used for the reference solution

the parameters of the problem and the results of reference (analytical solutions) are given by BATOZ and DHATT [bib1].

2.2 Results of reference

Displacement of the point B following X
Displacement of the following C point X.

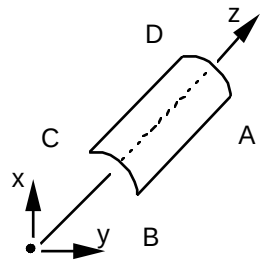
2.3 Bibliographical references

•BATOZ J.L., DHATT G.: Modelization of structures by finite elements. Volume 3 shells, p445-448 (1992).

3 Modelization A

3.1 Characteristic of the modelization

Element of COQUE_3D MEC3QU9H



Modelization of a quarter of cylinder

Cutting:

6 on AB and DC
6 on AD and BC : 36 meshes limiting

QUAD9 Conditions:

in all the nodes of:	DDL_IMPO:
arc (AD)	(GROUP_NO: AD DX: 0. , DY: 0. , DRZ: 0.)
segment] CD [	(GROUP_NO: CDsansCD DY: 0. , DRY: 0. , DRZ: 0.)
arc (BC)	(GROUP_NO: BC DX: 0. , DRX: 0. , DRY: 0.)
in C	(GROUP_NO: C DY: 0. , DRZ: 0.)

Loading:

```
FORCE_COQUE:        (      FX: -6250.)
PESANTEUR:          (10.  -1.  0.  0.)
```

Names of the nodes:

Not A	$N03$
Not B	$N02$
Not C	$N01$
Not D	$N04$

3.2 Characteristic of the mesh

Many nodes: 169
Number of meshes and types: 36 QUAD9

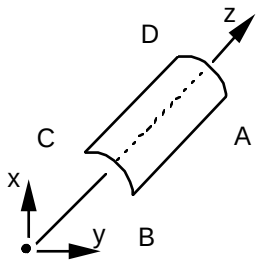
3.3 Values tested

Identification	Reference
Not B displacement DX	– 3.61 10-2
Point C displacement DX	5.44 10-3

4 Modelization B

4.1 Characteristic of the modelization

Shell element 3D MEC3TR7H



Modelization of a quarter of cylinder

Cutting:

12 on AB and DC
12 on AD and BC : 288 meshes limiting

TRIA7 Conditions:

in all the nodes of:	DDL_IMPO:
arc (AD)	(GROUP_NO: AD DX: 0. , DY: 0. , DRZ: 0.)
segment) CD (	(GROUP_NO: CDsansCD DY: 0. , DRY: 0. , DRZ: 0.)
arc (BC)	(GROUP_NO: BC DX: 0. , DRX: 0. , DRY: 0.)
in C	(GROUP_NO: C DY: 0. , DRZ: 0.)

The mesh is of directed type: 

Loading:

```
FORCE_COQUE:        (      FX: -6250.)
PESANTEUR:          (10.  -1.  0.  0.)
```

Names of the nodes:

Not A	$N03$
Not B	$N02$
Not C	$N01$
Not D	$N04$

4.2 Characteristic of the mesh

Many nodes: 913
Number of meshes and types: 288 TRIA7

4.3 Values tested

Identification	Reference
Not B displacement DX	– 3.61 10-2
Point C displacement DX	5.41 10-3

5 Summary of the results

element MEC3QU9H makes it possible to obtain a good solution with a coarse mesh, while element MEC3TR7H requires a very fine mesh to reach a satisfactory accuracy.

It is noted that the reference solution is the analytical solution obtained from the theory of the “deep” shells. The 2 shell elements converge towards this solution and not towards the theory of the “not very deep” shells.