
SSLS105 - Hemisphere doubly gripped

Summarized:

One treats the case of the hemisphere doubly gripped in linear elasticity, which makes it possible to evaluate the quality of the plane facets for the representation of a deep shell.

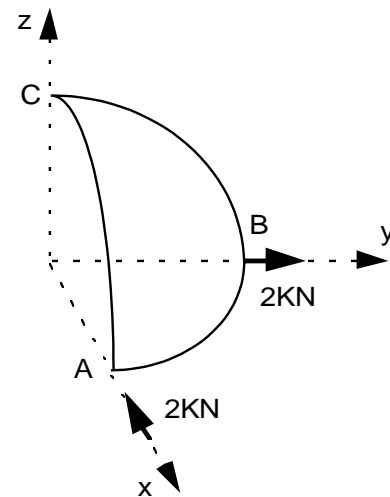
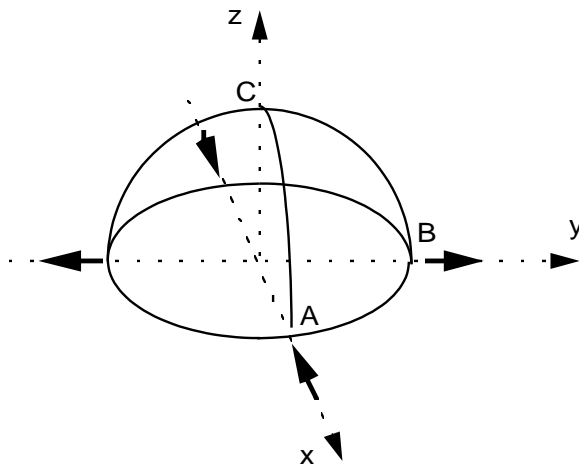
The values tested are the deflections at the points of application of the forces.

One has 3 modelizations:

- A : elements DKT
- B : elements of COQUE_3D in QUAD9
- C : elements SHB

1 Problem of reference

1.1 Geometry



Rayon $R = 10. \text{ m}$
Epaisseur $t = 0.04 \text{ m}$

Coordinated of the points:

	A	B	C
x	10.	0.	0.
y	0.	10.	0.
z	0.	0.	10.

1.2 Material properties

$$E = 6.825 \cdot 10^7 \text{ Pa} , \nu = 0.3$$

1.3 Boundary conditions and loadings

On a quarter of the hemisphere:

Not C not of displacement in z
Side AC symmetry compared to the plane xz
Side BC symmetry compared to the free yz
Side AB plane

Forces specific in A : $F = -2. \text{ KN}$
Specific force in B : $F = +2. \text{ KN}$

2 Reference solution

2.1 Method of calculating used for the reference solution

the reference solution is that given in the file "Test No LE3" of the tests of reference published by NAFEMS [bib1].

2.2 Results of reference

Displacement of the following A point x .

2.3 Bibliographical references

[1] A. Morris. Dynamics Working Group - College of Aeronautics, Cranfield, the U.K. Free vibrations benchmarks. NAFEMS - Test No LE3 - (1986).

3 Modelization A

3.1 Characteristic of the modelization

Shell element DKT

Modelization of a quarter of the hemisphere in TRIA3.

Names of the nodes:

Not <i>A</i>	<i>N03</i>
Not <i>B</i>	<i>N02</i>
Not <i>C</i>	<i>N01</i>

3.2 Characteristic of the mesh

Many nodes: 734

Number of meshes and types: 1373 TRIA3

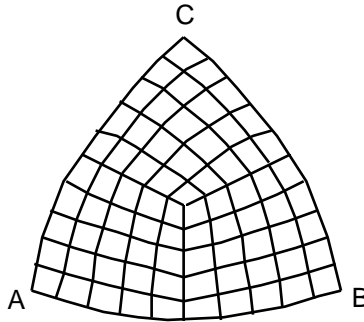
3.3 Quantities tested and results of the Standard modelization

A	Identification of reference	Values of reference	Tolérance for mule (%)
Not <i>A</i> displacement <i>u</i>	"SOURCE_EXTERNE"	-0.185	1.0
Point <i>B</i> displacement <i>v</i>	"SOURCE_EXTERNE"	+0.185	1.0

4 Modelization B

4.1 Characteristic of the modelization

Shell element COQUE_3D MEC3QU9H



Modélisation d'un quart de l'hémisphère en QUAD

Names of the nodes:

Not <i>A</i>	<i>N01</i>
Not <i>B</i>	<i>N021</i>
Not <i>C</i>	<i>N041</i>

4.2 Characteristic of the mesh

Many nodes: 256

Number of meshes and types: 75 QUAD9

4.3 Quantities tested and results of the Standard modelization

B	Identification of reference	Values of reference	Tolerance (%)
Not <i>A</i> displacement <i>u</i>	"SOURCE_EXTERNE"	- 0.185	1.0
Point <i>B</i> displacement <i>v</i>	"SOURCE_EXTERNE"	+0.185	1.0

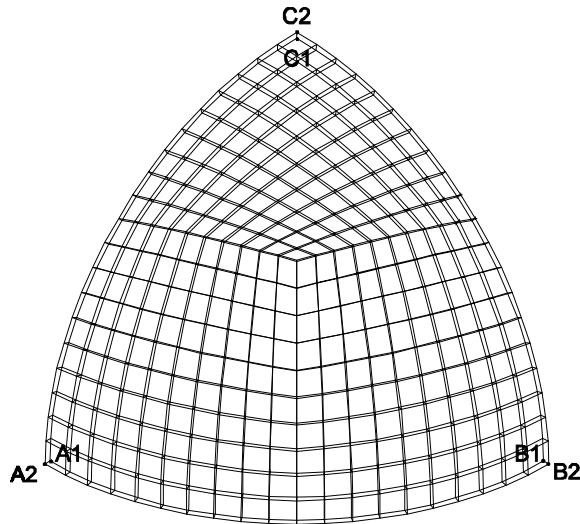
Mesh	Node	Standard size	of reference	Values of reference	Tolerance (%)	
MA000055	NO000124	DEGE_ELNO	EXX	"NON_DEFINI"	-1.53818E-07	0.01
			EYY	"NON_DEFINI"	4.65793E-08	0.01
			EXY	"NON_DEFINI"	-3.21601E-07	0.01
			KXY	"NON_DEFINI"	1.33715E-03	0.01
			KYY	"NON_DEFINI"	-1.44543E-03	0.01
			KXY	"NON_DEFINI"	5.19032E-04	0.01
			GAX	"NON_DEFINI"	3.03593E-07	0.01
			GAY	"NON_DEFINI"	4.37127E-07	0.01

Mesh	Not	Standard size	of reference	Values of reference	Tolérance formule (%)	
MA000055	3	DEGE_ELGA	EXX	"NON_DEFINI"	-3.93612E-08	0.01
			EYY	"NON_DEFINI"	7.45291E-08	0.01
			EXY	"NON_DEFINI"	-1.16538E-07	0.01
			KXY	"NON_DEFINI"	1.49356E-03	0.01
			KYY	"NON_DEFINI"	-1.321576E-03	0.01
			KXY	"NON_DEFINI"	-2.170326E-04	0.01
			GAX	"NON_DEFINI"	-1.43938E-07	0.01
			GAY	"NON_DEFINI"	-4.00829E-08	0.01

5 Modelization C

5.1 Characteristic of the modelization

Shell element COQUE_MASSIF SHB8



Modelization of a quarter of the hemisphere in SHB8

5.2 Characteristic of the mesh

Many nodes: 662

Number of meshes and types: 300 SHB8

Names of the nodes:

Not <i>A1</i>	<i>N40</i>	Not <i>A2</i>	<i>N42</i>
Not <i>B1</i>	<i>N01</i>	Not <i>B2</i>	<i>N02</i>
Not <i>C1</i>	<i>N662</i>	Not <i>C2</i>	<i>N658</i>

5.3 Quantities tested and results of the Standard modelization

C	Identification of reference	Values of reference	Tolérance for mule (%)
Not <i>A</i> displacement <i>u</i>	"SOURCE_EXTERNE"	- 0.185	0.1
Point <i>B</i> displacement <i>v</i>	"SOURCE_EXTERNE"	+0.185	0.1

6 Summary of severe

the Test results which requires a fine mesh, in particular for element DKT.

The results with element MEC3TR7H were not retained as test because it is necessary to have many elements (1801) and thus a time of convergence much longer to obtain correct values compared to the other modelizations ($> 500 s$ for a relative error about 4%).

Even thing with element SHB6, which very badly only converges but which converges well if one mixes it with SHB8, in particular close to the point of application of the forces.

Results in conformity with the reference solution.