SSLS105 - Doubly gripped hemisphere

Summary:

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 hull.

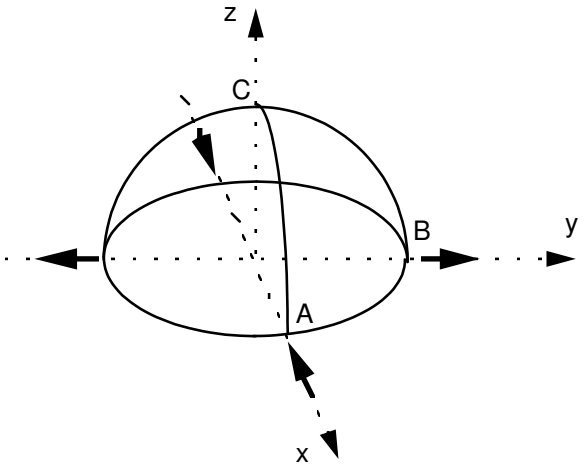
The values tested are the arrows at the points of application of the forces.

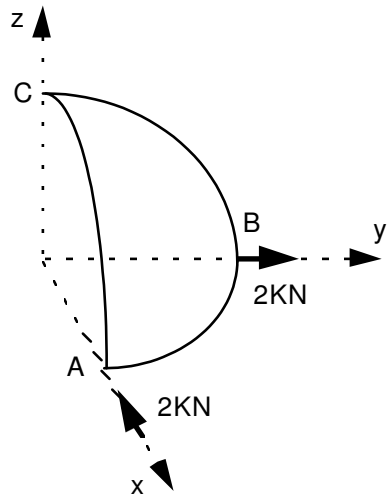
One has 3 modelings:

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

1 Problem of reference

1.1 Geometry





Rayon	R = 10. m
Epaisseur	t = 0.04 m

Coordinates of the points:

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

1.2 Material properties

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

1.3 Boundary conditions and loadings

On a quarter of the hemisphere:

Not C	pas de displacement in z
Side AC	symmetry compared to the plan xz
Side BC	symmetry compared to the plan yz
Side AB	free

Specific force in A : $F=-2.\,KN$
Specific force in B : $F=+2.\,KN$

2 Reference solution

2.1 Method of calculating used for the reference solution

The reference solution is that given in the card 'Test No LE3' of the tests of reference published by NAFEMS [bib1].

2.2 Results of reference

Displacement of the point A according to 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 Modeling A

3.1 Characteristics of modeling

Element of hull DKT

Modeling of a quarter of the hemisphere in TRIA3.

Names of the nodes:

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

3.2 Characteristics of the grid

Many nodes: 734
Many meshs and types: 1373 TRIA3

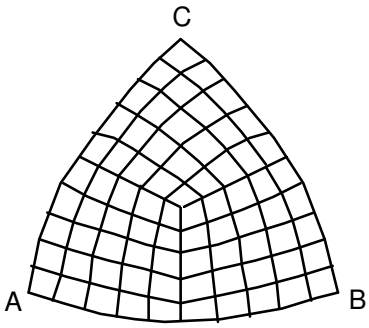
3.3 Sizes tested and results of modeling A

Identification	Type of reference	Values of reference	Tolerance (%)
Not A displacement u	'SOURCE_EXTERNE'	– 0,185	1.0
Not B displacement v	'SOURCE_EXTERNE'	+0,185	1.0

4 Modeling B

4.1 Characteristics of modeling

Element of hull COQUE_3D MEC3QU9H



Modélisation d'un quart de l'hémisphère en QUAD9

Names of the nodes:

Not A	$N01$
Not B	$N021$
Not C	$N041$

4.2 Characteristics of the grid

Many nodes: 256
Many meshs and types: 75 QUAD9

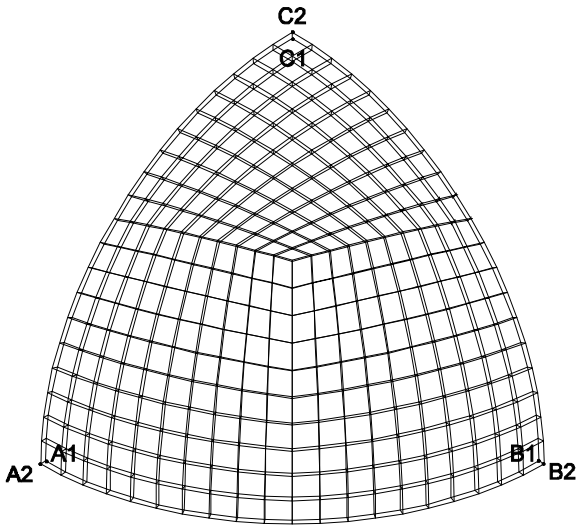
4.3 Sizes tested and results of modeling B

Identification	Type of reference	Values of reference	Tolerance (%)
Not A displacement u	'SOURCE_EXTERNE'	– 0,185	1.0
Not B displacement v	'SOURCE_EXTERNE'	+0,185	1.0

5 Modeling C

5.1 Characteristics of modeling

Element of hull COQUE_MASSIF SHB8



Modeling of a quarter of the hemisphere in SHB8

5.2 Characteristics of the grid

Many nodes: 662
Many meshs and types: 300 SHB8
Names of the nodes:

Not $A1$	$N40$	Not $A2$	$N42$
Not $B1$	$N01$	Not $B2$	$N02$
Not $C1$	$N662$	Not $C2$	$N658$

5.3 Sizes tested and results of modeling C

Identification	Type of reference	Values of reference	Tolerance $(\%)$
Not A displacement u	'SOURCE_EXTERNE'	– 0,185	0.1
Not B displacement v	'SOURCE_EXTERNE'	+0,185	0.1

6 Summary of the results

Severe test which requires a fine grid, in particular for the element DKT.

Results with the 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 other modelings ($>500\,s$ for a relative error about 4%).

Even thing with the 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.