SSLS 119 - clamped Hook subjected to shears at its end

Summarized:

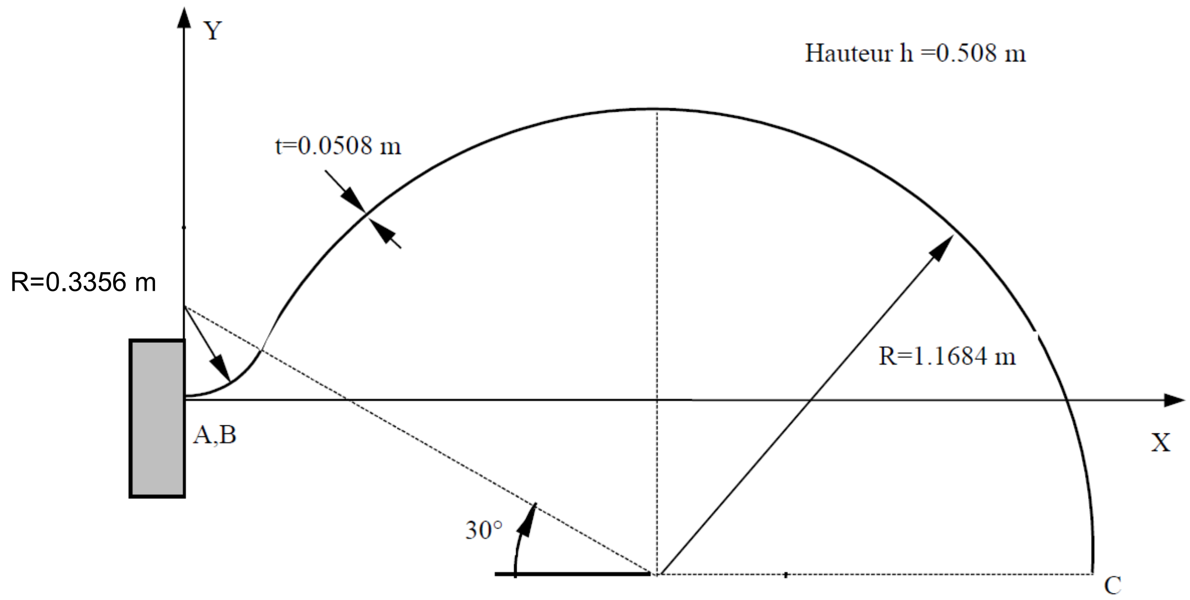
This test represents a static computation of a clamped hook subjected to a shearing force, consisted of an elastic material. This test makes it possible to validate the following modelizations finite elements:

- DST (QUAD4),
- DKT (QUAD4),
- COQUE_3D (QUAD9),
- COQUE_3D (TRIA7),
- 3D linear (HEXA8) and quadratic (HEXA20).

One studies blocking in transverse shears particularly there.

1 Problem of reference

1.1 Geometry



1.2 Properties of the material

the properties of the material constituting the beam are:

$E=22752510\,Pa$	Modulus Young
$\nu=0.35$	Poisson's ratio

1.3 Boundary conditions and loadings

Boundary conditions: Clamped AB side
Forces linear $Fz=8.7594\,N/m$ for the shells.
Surface force $Fz=172.4307\,N/m^2$ for 3D.

1.4 Initial conditions

Without Reference solution

2 object

This test makes it possible to test blocking in transverse shears as well as the effects of the stiffness of rotation around the norm. It makes it possible to validate the choice COEF_RIGI_DRZ = 1. E-05, value by default of this coefficient. This multiplicative factor makes it possible to affect a fictitious stiffness around the norm of the shell elements by multiplying the minimal stiffness according to the other directions by this coefficient in order to avoid the singular stiffness matrixes.

2.1 Results of reference

the results of reference result from a voluminal computation by finite elements:

Value of the deflection in C : $4.93\,inches$ that is to say $1.252\,E-01\,m$.

2.2 Uncertainties on the solution

Some for hundred following the refinement of the mesh.

2.3 Bibliographical references

1) Raasch Challenge for Shell Elements, N.F. Knight Jr., AIAA Newspaper, vol. 35, N°2, 1997, pp 375-381.

3 Modelization A

3.1 Characteristic of the modelization

Modelization DST

Boundary conditions:
side AB : $u=v=w=0$
$\theta_x=\theta_y=\theta_y=0$
$F_z=8.7594 \text{ N/m}$

3.2 Characteristics of the mesh

Many nodes: 2877
Number of meshes and type: 20 (according to z) et136 (length) QUAD4

4 Results of the modelization A

4.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
20×136	DZ	1.252 E-01	4.45694 E-01	256.00%

5 Modelization B

5.1 Characteristic of the modelization

Modelization DKT

Boundary conditions:
side AB : $u=v=w=0$
$\theta_x=\theta_y=\theta_y=0$
$F_z=8.7594 \text{ N/m}$

5.2 Characteristics of the mesh

Many nodes: 2877
Number of meshes and type: 20 (according to z) and 136 (length) QUAD4

6 Results of the modelization B

6.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
20×136	DZ	1.252 E-01	1.06726 E-01	– 14.75%

7 Modelization C

7.1 Characteristic of the modelization

Modelization COQUE_3_D

Boundary conditions:
side AB : $u=v=w=0$
$\theta_x=\theta_y=\theta_y=0$
$F_z=8.7594 \text{ N/m}$

7.2 Characteristics of the mesh

Many nodes: 11193
Number of meshes and type: 20 (according to z) et136 (length) QUAD9

8 Results of the modelization C

8.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
20×136	DZ	1.252 E-01	1.31195 E-01	4.79%

9 Modelization D

9.1 Characteristic of the modelization

Modelization 3D CUB8

Boundary conditions:
side AB : $u=v=w=0$
$F_z=172.4307 \quad \mathrm{N/m^2}$

9.2 Characteristics of the mesh

Many nodes: 6072
Number of meshes and type: 10 (according to z), 68 (length), 1 (thickness) HEXA8

10 Results of the modelization D

10.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
5×34	DZ	1.252 E-01	1.23233 E-01	– 1.57%
10×68	DZ	1.252 E-01	1.28808 E-01	2.88%
$20\times136\times2$	DZ	1.252 E-01	1.32292 E-01	5.66%

11 Modelization E

11.1 Characteristic of the modelization

Modelization 3D CU20

Boundary conditions:
side AB : $u=v=w=0$
$F_z=172.4307 \text{ N/m}$

11.2 Characteristics of the mesh

Many nodes: 5160
Number of meshes and type: 10 (according to z), 68 (length), 1 (thickness) HEXA20

12 Results of the modelization E

12.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
5×34	DZ	1.252 E-01	1.32077 E-01	5.49%
10×68	DZ	1.252 E-01	1.33518 E-01	6.64%
$20\times136\times2$	DZ	1.252 E-01	1.34315 E-01	7.28%

13 Modelization F

13.1 Characteristic of the modelization

Modelization COQUE_3_D

Boundary conditions:
side AB : $u=v=w=0$
$\theta_x=\theta_y=\theta_y=0$
$F_z=8.7594 \text{ N/m}$

13.2 Characteristics of the mesh

Many nodes: 11193
Number of meshes and type: 40 (according to z), 272 (length) TRIA7

14 Results of the modelization F

14.1 Values tested

mesh	Identification	Reference	*Aster*	% difference
10×68	DZ	1.252 E-01	1.3224 E-01	5.62%
20×136	DZ	1.252 E-01	1.31835 E-01	5.30%
40×272	DZ	1.252 E-01	1.31536 E-01	5.06%

15 Summary of the results

element DST with taking into transverse account of shears do not seem to converge on this case - specific test. The elements COQUE_3D triangles and quadrangles with taking into transverse account of shears do not present the same behavior and behave rather well on this test.