SSLS 119 - embedded Hook subjected to a shearing action at its end

Summary:

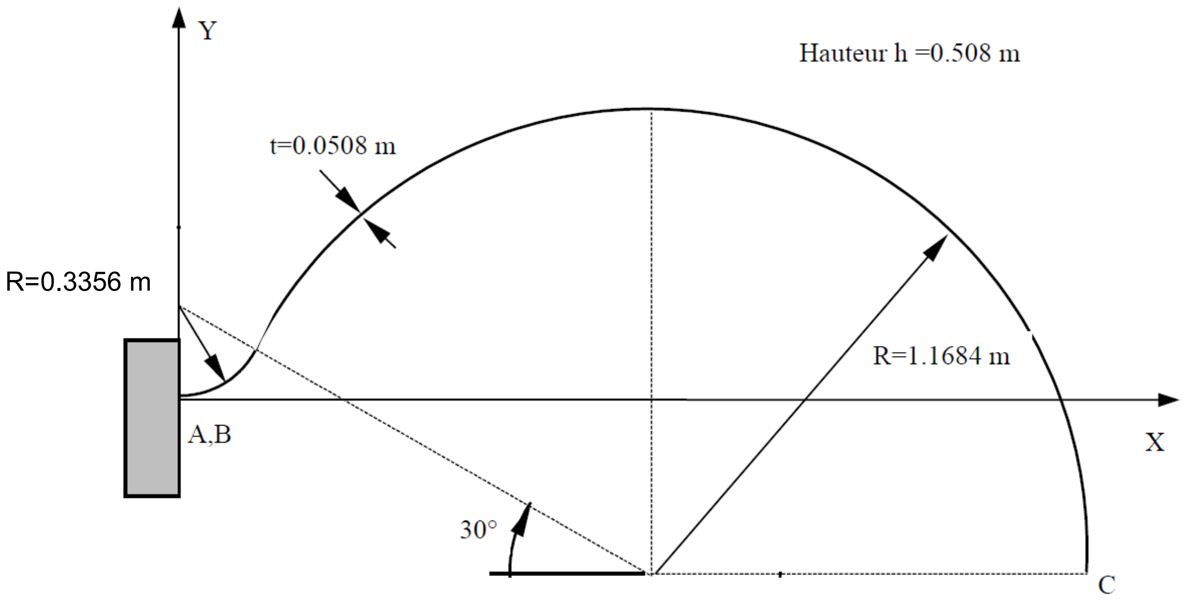
This test represents a calculation statics of a hook embedded subjected to a shearing force, consisted of an elastic material. This test makes it possible to validate following modelings finite elements:

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

One studies blocking in transverse shearing particularly there.

1 Problem of reference

1.1 Geometry



1.2 Properties of material

The properties of material constituting the beam are:

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

1.3 Boundary conditions and loadings

- Boundary conditions: Side AB embedded
- Linear force $Fz=8.7594\,N/m$ for the hulls.
- Surface force $Fz=172.4307\,N/m^2$ for the 3D.

1.4 Initial conditions

Without object

2 Reference solution

This test makes it possible to test blocking in transverse shearing as well as the effects of the rigidity of rotation around the normal. 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 rigidity around the normal of the elements of plate by multiplying minimal rigidity according to the other directions by this coefficient in order to avoid the singular matrices of rigidity.

2.1 Results of reference

The results of reference result from a calculation by finite elements voluminal:

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 grid.

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 Modeling A

3.1 Characteristics of modeling

Modeling DST

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

3.2 Characteristics of the grid

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

4 Results of modeling A

4.1 Values tested

grid	Identification	Reference	*Aster*	% difference
20×136	DZ	1,252 E-01	4.45694 E-01	256.00%

5 Modeling B

5.1 Characteristics of modeling

Modeling 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 grid

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

6 Results of modeling B

6.1 Values tested

grid	Identification	Reference	*Aster*	% difference
20×136	DZ	1,252 E-01	1.06726 E-01	– 14.75%

7 Modeling C

7.1 Characteristics of modeling

Modeling COQUE_3_D

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

7.2 Characteristics of the grid

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

8 Results of modeling C

8.1 Values tested

grid	Identification	Reference	*Aster*	% difference
20×136	DZ	1,252 E-01	1.31195 E-01	4.79%

9 Modeling D

9.1 Characteristics of modeling

Modeling 3D CUB8

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

9.2 Characteristics of the grid

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

10 Results of modeling D

10.1 Values tested

grid	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 Modeling E

11.1 Characteristics of modeling

Modeling `3D CU20`

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

11.2 Characteristics of the grid

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

12 Results of modeling E

12.1 Values tested

grid	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 Modeling F

13.1 Characteristics of modeling

Modeling `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 grid

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

14 Results of modeling F

14.1 Values tested

grid	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

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