

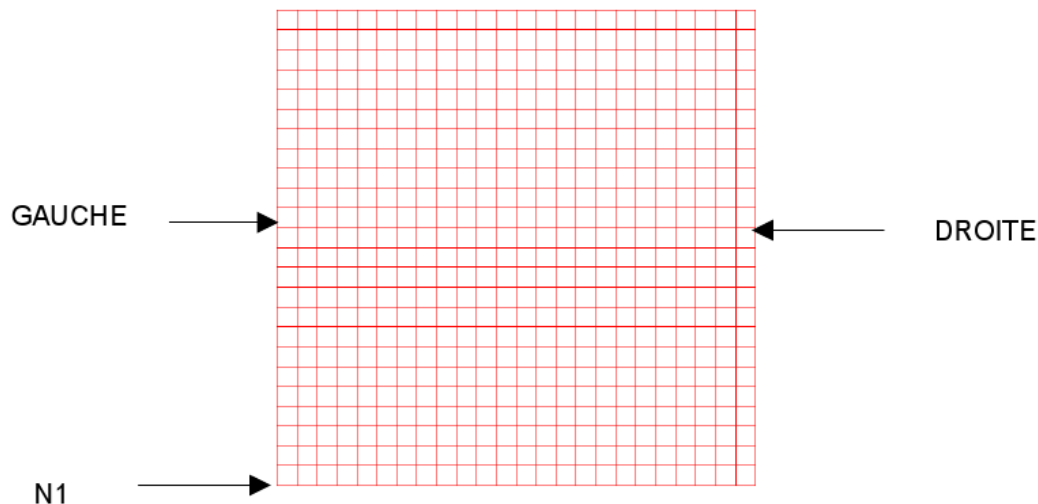
SSLS128 - Static computation of a plate made up of layers

Summarized:

This test makes it possible to validate the case of the multi-layer shells.

1 Problem of reference

1.1 Geometry



It acts of a composite made up of 16 superimposed layers of the same material and fiber directions different forming a plate from 4.48 m thickness. The longitudinal meaning or meaning of fibers of each layer is defined by the first direction of orthotropy.

1.2 Property of the material

the properties of the material are:

longitudinal Young modulus: $E_L = 59000 \text{ MPa}$
transverse Young modulus: $E_T = 59000 \text{ MPa}$
shear modulus in the plane LT : $G_{LT} = 3700 \text{ MPa}$
Poisson's ratio in the plane LT : $\nu_{LT} = 0.08$
rupture criterion in tension in the longitudinal meaning: $X_T = 560 \text{ MPa}$
rupture criterion in compression in the longitudinal meaning: $X_C = -475 \text{ MPa}$
rupture criterion in tension in the transverse meaning: $Y_T = 560 \text{ MPa}$
rupture criterion in compression in the transverse meaning: $Y_C = -475 \text{ MPa}$
rupture criterion in shears in the plane LT : $S_{LT} = 48 \text{ MPa}$

The directional sense of the first layer is 0° compared to the reference of reference, for the second 45° layer, the third 0° and so on.

1.3 Boundary conditions and loadings

NI $DY = 0 \quad DZ = 0 \quad DRX = 0 \quad DRY = 0, \quad DRZ = 0$
 $GAUCHE$ $DX = 0$
 $DROITE$ $FX = -784 \text{ N}$

2 Reference solution given by the software "Plates"

In the first layer with 0°

σ_{xx}	σ_{yy}	σ_{zz}
-242	-67	0

Stresses in the reference of the plate

SL	ST	SLT
-242	-67	0

Stresses in the reference of the Criterion

layer of Tsai-Hill $C_{TH}=0.344$

In the second with 45°

σ_{xx}	σ_{yy}	σ_{zz}
-108	-67	0

Stresses in the reference of the plate

SL	ST	SLT
-88.-88		21

Stresses in the reference of the Criterion

layer of Tsai-Hill $C_{TH}=0.223$

SL is the stress in the first direction of orthotropy of the layer, ST the second and SLT the shearing stress.

σ_{xx} σ_{yy} , σ_{zz} are the stresses in the reference of the user.

3 Modelization A

3.1 Characteristic of the modelization

the shell is modelled by elements DKT. Its characteristics are defined in AFFE_CARA_ELEM :

thickness: $16 \times 0.28 = 4.48 \text{ m}$

locate reference of the shell defined by ANGL_REP = 0.

The various layers are defined by the operator DEFI_COMPOSITE which gives for each layer its thickness, its material and its directional sense compared to the reference of reference defined in AFFE_CARA_ELEM.

3.2 Characteristics of the mesh

Many nodes: 624

Number of meshes and types: 48 SEG2 and 576 QUA4

3.3 Quantities tested and results

For the layer with 0°

Standard	Identification reference	Reference	% tolerance
σ_{xx}	SOURCE_EXTERNE	-242	0.5
σ_{yy}	SOURCE_EXTERNE	67.0.6	

For the layer to 45°

Standard	Identification reference	Reference	% difference
σ_{xx}	SOURCE_EXTERNE	-108	0.5
σ_{yy}	SOURCE_EXTERNE	-67.0.6	

4 Synthesis

the got results are satisfactory. The maximum of difference is approximately 0.6% and it is due to the fact that the results resulting from the software "Plate" are given with little accuracy.