# SSLS112 - Offsetting composite plates

**Summary:**

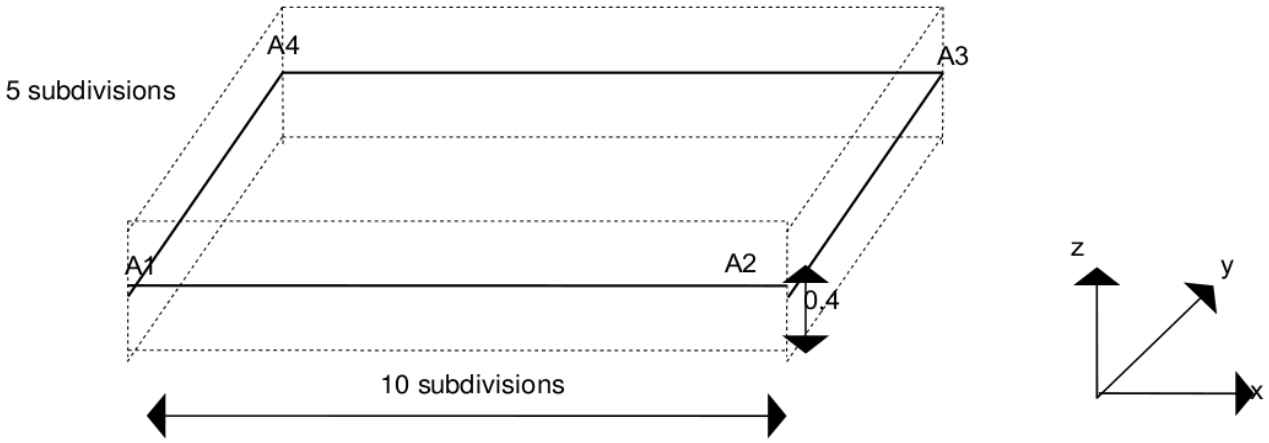
This test makes it possible to validate the offsetting of composite plates.

The reference is given by a first resolution where one models a quadri-layer presenting nona - material symmetry compared to the average plan.

The validation is done in the second calculation where one models to it quadri-layer of the preceding model by 2 double-layered offset compared to the average plan of the first calculation.

# 1 Problem of reference

## 1.1 Geometry




coordinates of the points (in $m$ ): $A1(0,0,0)$ $A2(10,0,0)$ $A3(10,5,0)$ $A4(0,5,0)$

## 1.2 Material properties

The material consists of 4 orthotropic layers thickness 0.1.

The first layer is characterized by:

$EL=20000.10^6\,Pa$ $ET=20000.10^6\,Pa$ $VLT=0.3$ $GLT=2000.10^6\,Pa$

the second layer by:

$EL=15000.10^6\,Pa$ $ET=15000.10^6\,Pa$ $VLT=0.3$ GLT = 1500.10^6 Pa

the third layer by:

$EL=20000.10^6\,Pa$ $ET=20000.10^6\,Pa$ $VLT=0.3$ $GLT=2000.10^6\,Pa$

and the fourth layer by:

$EL=15000.10^6\,Pa$ $ET=15000.10^6\,Pa$ $VLT=0.3$ $GLT=1500.10^6\,Pa$

## 1.3 Boundary conditions and loadings

The node $A1$ is embedded:

$dx=0.$ $dy=0.$ $dz=0.$

$dRx=0.$ $dRy=0.$ $dRz=0.$

The node $A2$ is blocked according to the following ddls:

$dx=0.$ $dy=0.$

A modal force is applied $Fz=-1000.\mathrm{N}$ on the node $A3$ .

# 2 Reference solution

## 2.1 Method of calculating used for the reference solution

The reference solution is resulting from the first calculation with ASTER with the quadricouche describes in the problem of reference.

## 2.2 Results of reference

They are made up by the values of the field of displacement $DX , DY , DZ , DRX , DRY$ at the point $A3$ (node $N1$ for ASTER) and with the node $N10$ coordinates $(9,2,0)$ .

## 2.3 Uncertainty on the solution

Worthless, since it is about the same calculation carried out by two different ways.

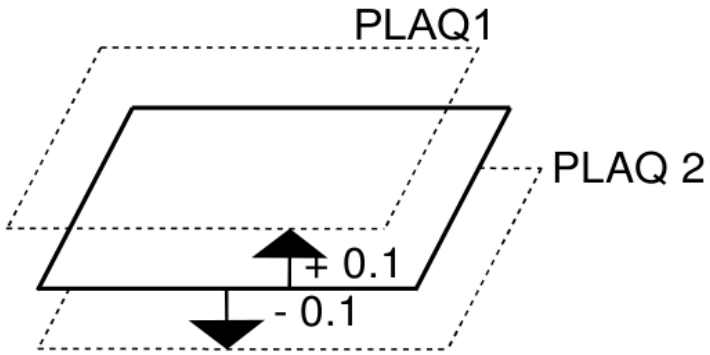
# 3 Modeling A

## 3.1 Characteristics of modeling

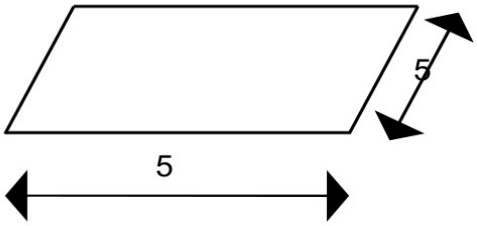
The model consists of 2 double-layered plates corresponding to the average plan of the quadri-layer of the model of reference.

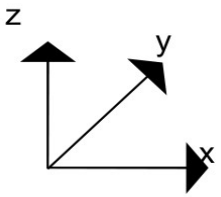
To represent these 2 plates, one leaves the grid of the average plan of the quadri-layer which one offsets distances $-0.1$ and $0.1$ .

The elements used are elements of plate DKT.



## 3.2 Characteristics of the grid




The grid is regular.
There are 10 subdivisions according to $x$ and 5 subdivisions according to $y$ ; that is to say on the whole 50 meshs DKQ (quad4) and 66 nodes.

## 3.3 Values tested

| Identification | Reference $(\times 10^{-6} m)$ |
|---|---|
| $DX(N1)$ | – 3.680419 |
| $DY(N1)$ | – 0.493941 |
| $DZ(N1)$ | – 5697.7635 |
| $DRX(N1)$ | – 436.1676 |
| $DRY(N1)$ | 508.6670 |
| $DX(N10)$ | – 2.172360 |
| $DY(N10)$ | – 0.783905 |
| $DZ(N10)$ | – 3946.2632 |
| $DRX(N10)$ | –412.1209 |
| $DRY(N10)$ | 455.0638 |

# 4 Synthesis

The results got with offset multi-layer plates agree with the reference.

This test thus validates offsetting for the multi-layer plates.