

**Manuel de Validation**  
**V3.03 booklet: Linear statics of the plates and hulls**  
**Document: V3.03.116**

## SSLS116 - Membrane loading of an offset plate

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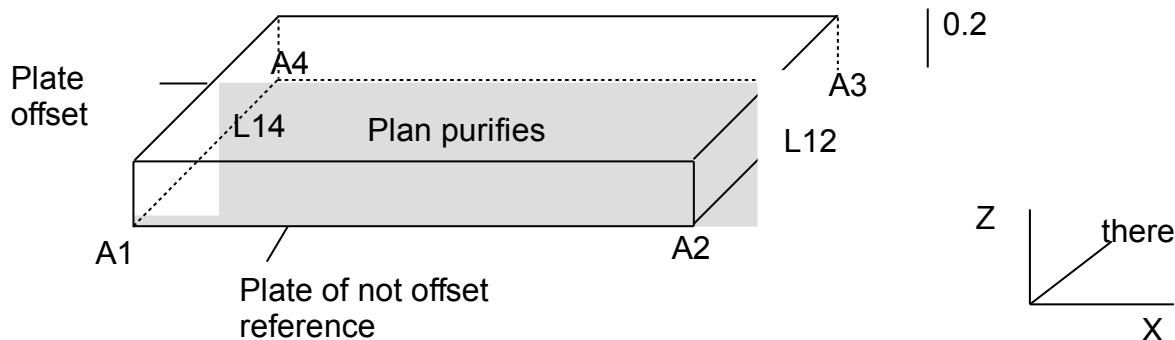
### Summary:

This test relates to the offsetting of a plate compared to the plan of the grid or plan of diagram. The loading is purely membranous.

The reference is given by a first resolution where a not offset plate is modelled. It validates the second calculation where one models a plate offset compared to the plan of the grid.

## 1 Problem of reference

### 1.1 Geometry



One represented here the plate offset compared to the plan of diagram (which is confused here with the lower plan of the offset plate).

To avoid overloading the diagram, one does not trace the plate of not offset reference, for which the plan of diagram is also the average plan.

### 1.2 Properties of materials

The material constituting plate is characterized by the following data:

$$\begin{aligned}
 EL &= 20000. \text{Pa} & ET &= 20000. \text{Pa} & EN &= 20000. \text{Pa} \\
 \nu LN &= 0. & \nu LT &= 0 & \nu TN &= 0. & GLT &= 2000. \text{Pa} & GLN &= 0. & GTN &= 0. \\
 \rho &= 1000. \text{kg/m}^3
 \end{aligned}$$

### 1.3 Boundary conditions and loadings

The mesh  $L14$  is embedded  $DX = DY = DZ = 0$ .  
 $DRX = DRY = DRZ = 0$ .

One applies the forces to the mesh  $L12$

$$\begin{aligned}
 FX &= 1000. \text{N} & MY &= 100. \text{N.m} & \text{on the offset plate} \\
 FX &= 1000. \text{N} & & & \text{on the not offset plate}
 \end{aligned}$$

These loadings are applied by means of `FORCE_ARETE` of `AFFE_CHAR_MECA` in the plan of diagram.

**Note:**

*The fact of applying a force  $FX$  on the plate offset on the level of the plan of diagram generates one moment  $MY$  that it is necessary to compensate to find itself under purely membrane conditions on the level of the offset plate.*

## 2 Reference solution

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### 2.1 Method of calculating used for the reference solution

Calculation of the membrane type with the not offset plate is used as reference. Nonthe regression compared to the results got by this first calculation is checked.

### 2.2 Results of reference

They are made up by the values of the field of displacement  $DX$ ,  $DY$ ,  $DZ$ ,  $DRX$ ,  $DRY$  with the nodes  $N66$  and  $N52$  (for  $DKT$  and it  $DST$ ) and with the nodes  $NI$  and  $NI6$  (for  $DKQ$  and it  $DSQ$ ) and of the calculation of the frequencies of the first 4 modes.

### 2.3 Uncertainty on the solution

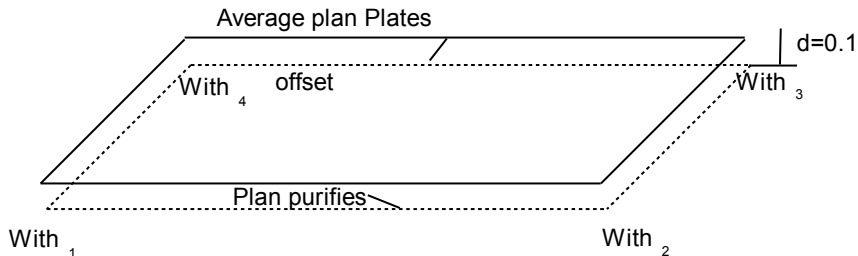
Uncertainty is worthless since it is the same calculation carried out by two different ways.

### 2.4 Bibliography

- [R3.07.03]: Elements of plate  $DKT$ ,  $DST$ ,  $DKQ$ ,  $DSQ$  and  $Q4G$ .
- [R3.07.06]: Treatment of offsetting for the elements of plate  $DKT$ ,  $DST$ ,  $DKQ$ ,  $DSQ$  and  $Q4G$ .

## 3 Modeling A

### 3.1 Characteristics of modeling



The elements used are elements of plate DKT.

### 3.2 Characteristics of the grid

Coordinates of the nodes:

Node	$X(m)$	$Y(m)$	$Z(m)$
A1	0.	0.	0.
A2	10.	0.	0.
A3	10.	5.	0.
A4	0.	5.	0.
N66	10.	5.	0.
N52	8.	2.	0.

66 Nodes  
100 meshes DKT (TRIA3)

### 3.3 Features tested

Orders	Keyword factor
AFFE_CARA_ELEM	OFFSETTING
AFFE_CHAR_MECA	FORCE_ARETE

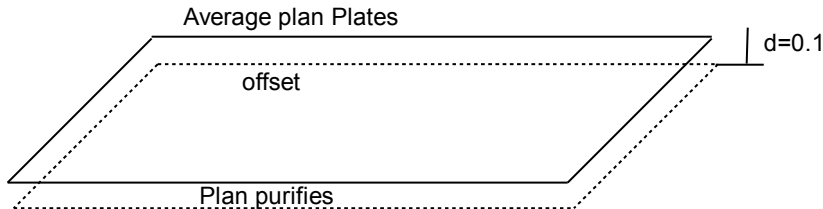
## 4 Results of modeling A

### 4.1 Values tested

Identification	Reference (m)	Aster (m)	% difference
DX (N66)	2.5m	2.5	1.78 E-15
DY (N66)	0.m	4,615 E-14	4,615 E-14
DZ (N66)	0.m	1,158 E-12	1,158 E-12
DRX (N66)	0.rad	2.76 E-13	2.76 E-13
DRY MARTINI (N66)	0.rad	- 7.86 E-14	- 7.86 E-14
DX (N52)	2.	2.	1.49 E-08
DY (N52)	0.	3.90 E-14	3.90 E-14
DZ (N52)	0.	2.72 E-13	2.72 E-13
DRX (N52)	0.	2.34 E-13	2.34 E-13
DRY MARTINI (N52)	0.	- 1.84 E-14	- 1.84 E-14
Frequency 1 <sup>er</sup> mode	1.4439E-03Hz	1.4465 E-03	0,182
Frequency 2 <sup>ème</sup> mode	3.71554 E-03	3.7984 E-03	2,231
Frequency 3 <sup>ème</sup> mode	9.01537 E-03	9.1305 E-03	1,277
Frequency 4 <sup>ème</sup> mode	1.34708 E-02	1.4077 E-02	4,501

## 5 Modeling B

### 5.1 Characteristics of modeling



The elements used are elements of plate `DKQ`.

### 5.2 Characteristics of the grid

Coordinates of the nodes:

Node	$X(m)$	$Y(m)$	$Z(m)$
A1	0.	0.	0.
A2	10.	0.	0.
A3	10.	5.	0.
A4	0.	5.	0.
N1	1.	5.	0.
N16	8.	2.	0.

66 Nodes  
50 meshes `DKQ` (QUAD4)

### 5.3 Features tested

Orders	Keyword factor
<code>AFFE_CARA_ELEM</code>	<code>OFFSETTING</code>
<code>AFFE_CHAR_MECA</code>	<code>FORCE_ARETE</code>

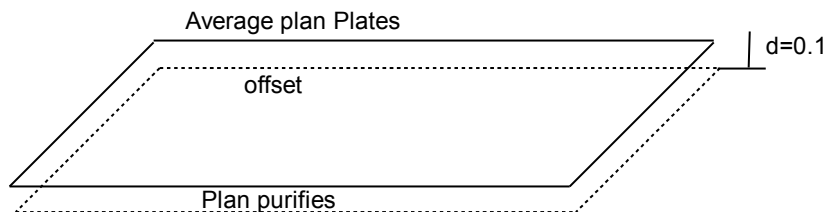
## 6 Results of modeling B

### 6.1 Values tested

Identification	Reference (m)	Aster (m)	% difference
DX (N1)	2.5m	2.5	- 3.42 E-14
DY (N1)	0.m	2.52 E-14	2.52 E-14
DZ (N1)	0.m	- 1,521 E-12	- 1,521 E-12
DRX (N1)	0.rad	1.54 E-14	1.54 E-14
DRY MARTINI (N1)	0.rad	2.63 E-13	2.63 E-13
DX (N16)	2.	2.	1.49 E-08
DY (N16)	0.	2.03 E-14	2.03 E-14
DZ (N16)	0.	- 1.12 E-12	- 1.12 E-12
DRX (N16)	0.	4.29 E-14	4.29 E-14
DRY MARTINI (N16)	0.	2.19 E-13	2.19 E-13
Frequency 1 <sup>er</sup> mode	1.44474E-03 Hz	1.446841 E-03	0,145
Frequency 2 <sup>ème</sup> mode	3.69339 E-03	3.703038 E-03	0,261
Frequency 3 <sup>ème</sup> mode	9.04773 E-03	9.14141 E-03	1,023
Frequency 4 <sup>ème</sup> mode	1.33393 E-02	1.34463 E-02	0,802

## 7 Modeling C

### 7.1 Characteristics of modeling



The elements used are elements of plate `DST`.

### 7.2 Characteristics of the grid

Coordinates of the nodes:

Node	X	Y	Z
A1	0.	0.	0.
A2	10.	0.	0.
A3	10.	5.	0.
A4	0.	5.	0.
N66	10.	5.	0.
N52	8.	2.	0.

66 Nodes  
100 meshes `DKT` (TRIA3)

### 7.3 Features tested

Orders	Keyword factor
<code>AFFE_CARA_ELEM</code>	<code>OFFSETTING</code>
<code>AFFE_CHAR_MECA</code>	<code>FORCE_ARETE</code>



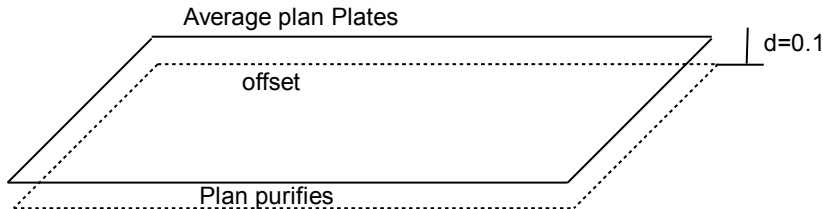
## 8 Results of modeling C

### 8.1 Values tested

Identification	Reference	Aster	% difference
DX (N66)	2.5	2.5	5.73 E-14
DY (N66)	0.	- 6.62 E-15	- 6.62 E-15
DZ (N66)	0.	4.48 E-12	4.48 E-12
DRX (N66)	0.	- 2.19 E-13	- 2.19 E-13
DRY MARTINI (N66)	0.	- 6.69 E-13	- 6.69 E-13
DX (N52)	2.	2.	1.49 E-08
DY (N52)	0.	- 4.08 E-15	- 4.08 E-15
DZ (N52)	0.	3.62 E-12	3.62 E-12
DRX (N52)	0.	- 1.60 E-13	- 1.60 E-13
DRY MARTINI (N52)	0.	- 7.34 E-13	- 7.34 E-13
Frequency 1 <sup>er</sup> mode	1.4439E-03	1.4465 E-03	0,182
Frequency 2 <sup>ème</sup> mode	3.71554 E-03	3.7984 E-03	2,231
Frequency 3 <sup>ème</sup> mode	9.01537 E-03	9.1305 E-03	1,277
Frequency 4 <sup>ème</sup> mode	1.34708 E-02	1.4077 E-02	4,501

## 9 Modeling D

### 9.1 Characteristics of modeling



The elements used are elements of plate DSQ.

### 9.2 Characteristics of the grid

Coordinates of the nodes:

Node	X	Y	Z
A1	0.	0.	0.
A2	10.	0.	0.
A3	10.	5.	0.
A4	0.	5.	0.
N1	1.	5.	0.
N16	8.	2.	0.

66 Nodes  
50 meshes DSQ (QUAD4)

### 9.3 Features tested

Orders	Keyword factor
AFFE_CARA_ELEM	OFFSETTING
AFFE_CHAR_MECA	FORCE_ARETE

## 10 Results of modeling D

### 10.1 Values tested

Identification	Reference	Aster	% difference
DX (N1)	2.5	2.5	- 1.33 E-14
DY (N1)	0.	2.61 E-14	2.61 E-14
DZ (N1)	0.	- 6.26 E-13	- 6.26 E-13
DRX (N1)	0.	- 8.18 E-15	- 8.18 E-15
DRY MARTINI (N1)	0.	9.57 E-14	9.57 E-14
DX (N16)	2.	2.	1.49 E-08
DY (N16)	0.	1.79 E-14	1.79 E-14
DZ (N16)	0.	- 3.97 E-13	- 3.97 E-13
DRX (N16)	0.	- 1.71 E-14	- 1.71 E-14
DRY MARTINI (N16)	0.	9.03 E-14	9.03 E-14
Frequency 1 <sup>er</sup> mode	1.44474E-03	1.446841 E-03	0,145
Frequency 2 <sup>ème</sup> mode	3.69339 E-03	3.703038 E-03	0,261
Frequency 3 <sup>ème</sup> mode	9.04773 E-03	9.14141 E-03	1,023
Frequency 4 <sup>ème</sup> mode	1.33393 E-02	1.34463 E-02	0,802

## 11 Summary of the results

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For each modeling, DKT, DKQ, DST and DSQ, the results found for the offset plate coincide with the reference solution.