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

SSLS116 - Membrane loading of an offset plate

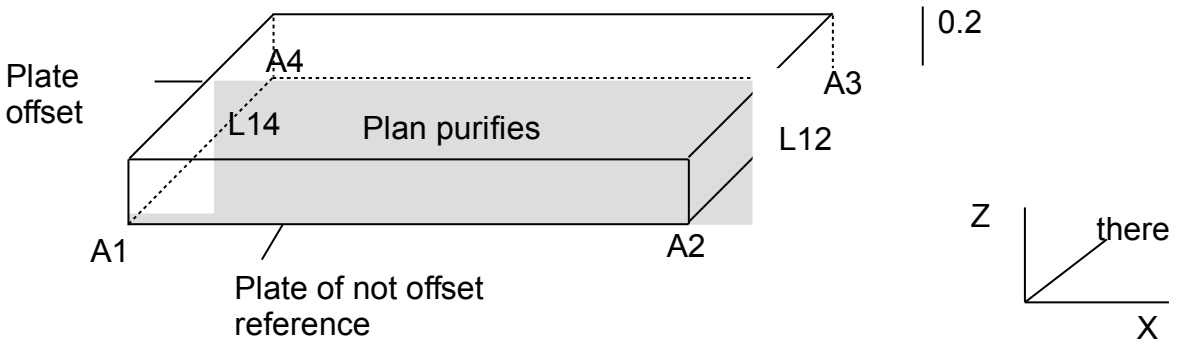
Summary:

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:

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

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 $L12$

$FX=1000.\text{N}\quad MY=100.\text{N.m}$	on the offset plate
$FX=1000.\text{N}$	on the not offset plate

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

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 $N1$ and $N16$ (for DKQ and it DSQ) and of the calculation of the frequencies of the first 4 modes.

2.3 Uncertainty on the solution

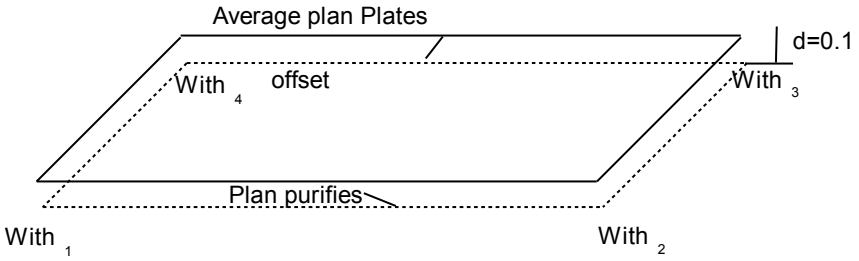
Uncertainty is worthless since it is the same calculation carried out by two different ways.

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 meshs DKT (TRIA3)

3.3 Features tested

Orders	Keyword factor
AFFE_CARA_ELEM	OFFSETTING
AFFE_CHAR_MECA	FORCE_ARETE

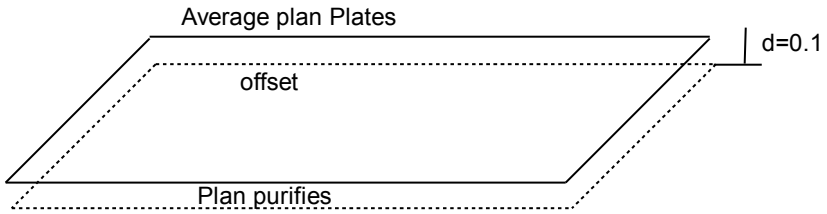
4 Results of modeling A

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 er mode	1.4439E-03Hz	1.4465 E-03	0,182
Frequency 2ème mode	3.71554 E-03	3.7984 E-03	2,231
Frequency 3ème mode	9.01537 E-03	9.1305 E-03	1,277
Frequency 4ème 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 meshs DKQ (QUAD4)

5.3 Features tested

Orders	Keyword factor
AFFE_CARA_ELEM	OFFSETTING
AFFE_CHAR_MECA	FORCE_ARETE

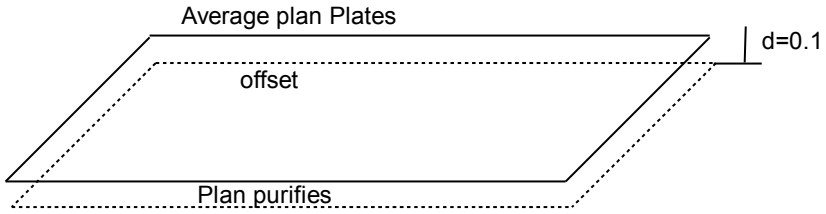
6 Results of modeling B

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 er mode	1.44474E-03 Hz	1.446841 E-03	0,145
Frequency 2ème mode	3.69339 E-03	3.703038 E-03	0,261
Frequency 3ème mode	9.04773 E-03	9.14141 E-03	1,023
Frequency 4ème 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 meshs DKT (TRIA3)

7.3 Features tested

Orders	Keyword factor
AFFE_CARA_ELEM	OFFSETTING
AFFE_CHAR_MECA	FORCE_ARETE

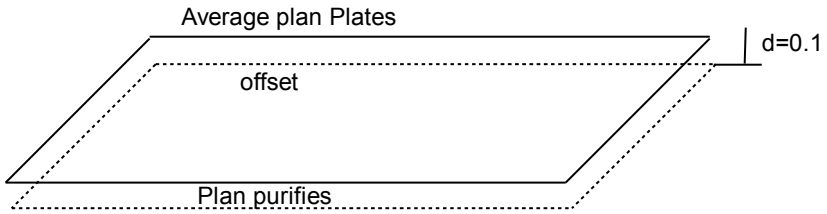
8 Results of modeling C

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 er mode	1.4439E-03	1.4465 E-03	0,182
Frequency 2ème mode	3.71554 E-03	3.7984 E-03	2,231
Frequency 3ème mode	9.01537 E-03	9.1305 E-03	1,277
Frequency 4ème 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 meshs 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 er mode	1.44474E-03	1.446841 E-03	0,145
Frequency 2ème mode	3.69339 E-03	3.703038 E-03	0,261
Frequency 3ème mode	9.04773 E-03	9.14141 E-03	1,023
Frequency 4ème mode	1.33393 E-02	1.34463 E-02	0,802

11 Summary of the results

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