SSLS122 - Rectangular isotropic homogeneous plate offset

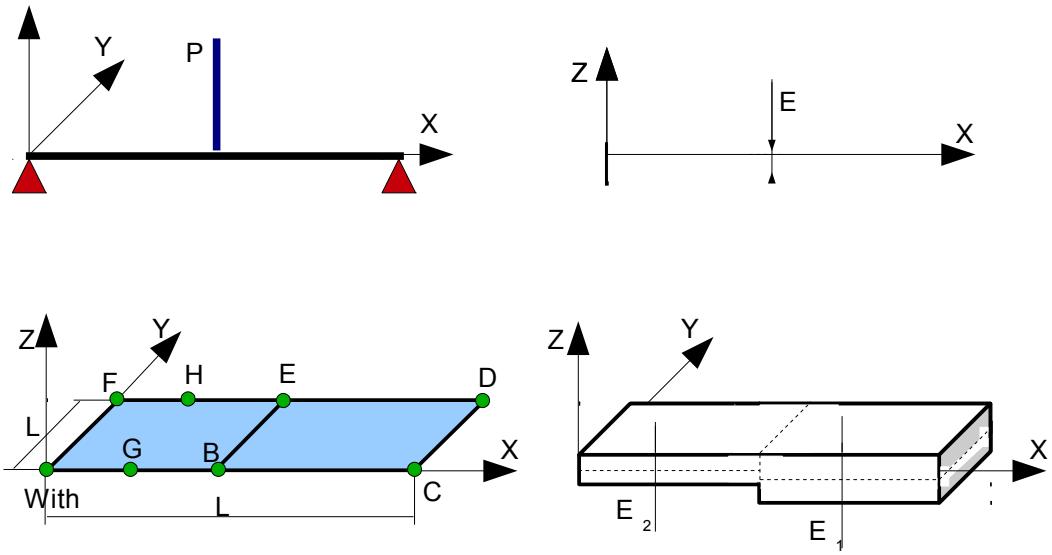
Summary:

This CAS-test makes it possible to test the eccentricity of the plates with modelings DKT and DST.

1 Problem of reference

1.1 Geometry

Inflection 3 points



Characteristics of the plates (m) :

Length: $L=10$

Width: $l=1$

Thickness 1: $e_1=0.1$

Thickness 2: $e_2=0.08$

Offsetting: $e=0.01$

Coordinates of the points (m) :

$A:(0,0)$ $E:(5,1)$

$B:(5,0)$ $F:(0,1)$

$C:(10,0)$ $G:(2.5,0)$

$D:(10,1)$ $H:(2.5,1)$

1.2 Properties of material

Rubber band

- $E=2.1\times10^{11}\,Pa$ Young modulus
- $\nu=0.3$ Poisson's ratio

1.3 Boundary conditions and loadings

Imposed displacement (m) :

- segment AF , CD : $DZ=0$
- segment FA : $DX=0$
- not A : $DX=DY=DRZ=0$

Loading

- Pressure on BE : $p=2.\times10^{5}N/m$ $P=pl$

2 Reference solution

2.1 Method of calculating used for the reference solution

Displacements:

- Points B and E

$$f=\frac{Pl^3}{96\,EI_1}+\frac{Pl^3}{96\,EI_2} \text{ with } I_i=\frac{b\times e_i^3}{12}$$

- Points G and H

$$f=-\frac{Pl^3}{192\,EI_1}(\frac{I_1}{I_2}+\frac{7}{2})$$

- Bending moment:

$$M(x)=\frac{P.x}{2}$$

2.2 Reference variable

- DZ following displacement z at the points B and G.
- MXX bending moment for $x=\frac{L}{2}$ and $x=\frac{L}{4}$

2.3 Size and result of reference

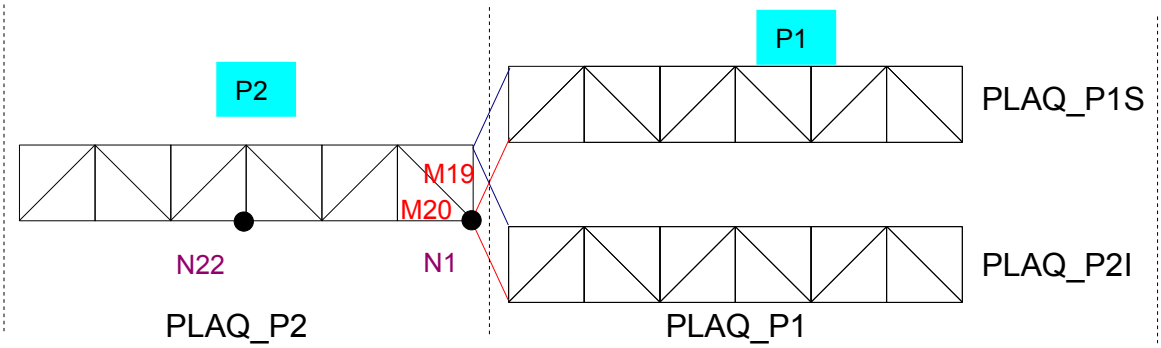
Not	Component	Reference
B	DZ	$0.3515625\,m$
	DRZ	$0.$
	MXX	$-50\times10^4\,m.N$
G	DZ	$-0.2629743\,m$
	DRZ	$0.$
	MXX	$-25.\times10^4\,m.N$

3 Modeling A

3.1 Characteristics of modeling A

The grid of the plate is composed in two parts:

- $P1$, constituted of a nonexcentré grid
- $P2$, constituted by two superimposed grids:
  - $PLAQ\_P1S$ excentré of 0.015m
  - $PLAQ\_P1I$ excentré of -0.035m



Modeling DKT:

Many nodes 26

Many meshs 39 That is to say: SEG2 3, TRIA3 36

Group of nodes:

- A, B, C, D, E, F, G, H

Group of meshs:

- $PLAQUE$: surface $ACDF$
- $PLAQ\_P1$: surface $BCDE$
- $PLAQ\_P2$: surface $ABEF$
- CD : segment CD
- FA : segment FA
- BE : segment BE

3.2 Result of modeling A

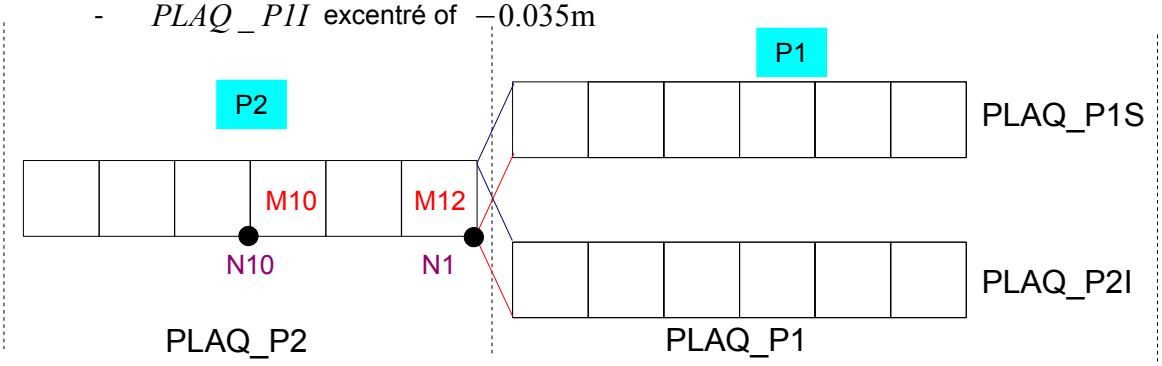
Not	Mesh	node	Component	Reference	Tolerance (%)
B		$N1$	DZ	$0.3515625\,m$	1.
		$N1$	DRZ	0.	0.1
	$M19$	$N1$	MXX	$-500\,000.\,m.N$	3.
	$M20$	$N1$	MXX	$-500\,000.\,m.N$	5.
G		$N22$	DZ	$-0.2629743\,m$	1.
		$N22$	DRZ	0.	0.1

4 Modeling B

4.1 Characteristics of modeling B

The grid of the plate is composed in two parts:

- $P1$, constituted of a nonexcentré grid
- $P2$, constituted by two superimposed grids:
  - $PLAQ\_P1S$ excentré of 0.015m
  - $PLAQ\_P1I$ excentré of -0.035m



Modeling DKT:

Many nodes 26

Many meshs 21 That is to say: SEG3 3, QUAD4 18

Group of nodes:

- A, B, C, D, E, F, G, H

Group of meshs:

- $PLAQUE$: surface $ACDF$
- $PLAQ\_P1$: surface $BCDE$
- $PLAQ\_P2$: surface $ABEF$
- CD : segment CD
- FA : segment FA
- BE : segment BE

One tests in this modeling COEF_RIGI_DRZ negative. In this case, the ddl DRZ has a physical direction of " drilling rotation " or rotation around the normal.

4.2 Result of modeling B

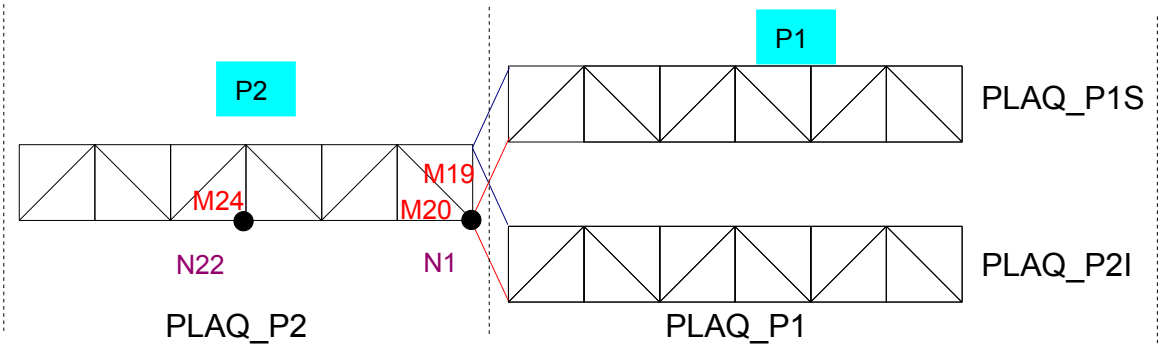
Not	Mesh	node	Component	Reference	Tolerance (%)
B		$N1$	DZ	$0.3515625\,m$	1.
		$N1$	DRZ	0.	0.1
	$M12$	$N1$	MXX	$-500\,000.\,m.N$	0.1
G		$N10$	DZ	$-0.2629743\,m$	1.
		$N10$	DRZ	0.	0.1
	$M10$	$N10$	MXX	$-250\,000.\,m.N$	0.1

5 Modeling C

5.1 Characteristics of modeling C

The grid of the plate is composed in two parts:

- $P1$, constituted of a nonexcentré grid
- $P2$, constituted by two superimposed grids:
  - $PLAQ\_P1S$ excentré of 0.015m
  - $PLAQ\_P1I$ excentré of -0.035m



Modeling DST:

Many nodes 26

Many meshs 39 That is to say: SEG3 3, TRIA3 36

Group of nodes:

- A, B, C, D, E, F, G, H

Group of meshs:

- $PLAQUE$: surface $ACDF$
- $PLAQ\_P1$: surface $BCDE$
- $PLAQ\_P2$: surface $ABEF$
- CD : segment CD
- FA : segment FA
- BE : segment BE

5.2 Result of modeling C

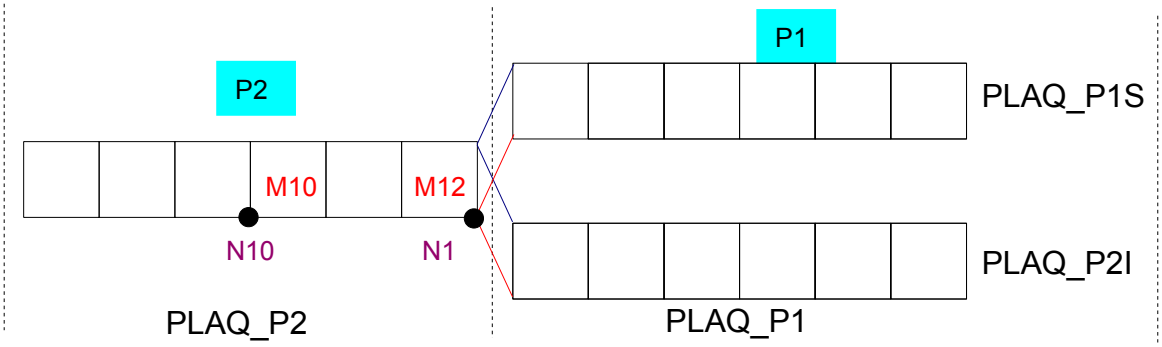
Not	Mesh	node	Component	Reference	Tolerance (%)
B		$N1$	DZ	$0.3515625\,m$	0.5
		$N1$	DRZ	0.	0.1
	$M19$	$N1$	MXX	$-500\,000.\,m.N$	2.
G		$N22$	DZ	$-0.2629743\,m$	0.5
		$N22$	DRZ	0.	0.1
	$M22$	$N22$	MXX	$-250\,000.\,m.N$	13.

6 Modeling D

6.1 Characteristics of modeling D

The grid of the plate is composed in two parts:

- $P1$, constituted of a nonexcentré grid
- $P2$, constituted by two superimposed grids:
  - $PLAQ\_P1S$ excentré of 0.015m
  - $PLAQ\_P1I$ excentré of -0.035m



Modeling DST :

Many nodes 26

Many meshs 21 That is to say: SEG3 3

QUAD4 18

Group of nodes:

- A, B, C, D, E, F, G, H

Group of meshs:

- $PLAQUE$: surface $ACDF$
- $PLAQ\_P1$: surface $BCDE$
- $PLAQ\_P2$: surface $ABEF$
- CD : segment CD
- FA : segment FA
- BE : segment BE

6.2 Result of modeling D

Not	Mesh	node	Component	Reference	Tolerance (%)
B		$N1$	DZ	$0.3515625\,m$	0.4
		$N1$	DRZ	0.	0.1
	$M12$	$N1$	MXX	$-500\,000.\,m.N$	0.1
G		$N10$	DZ	$-0.2629743\,m$	0.4
		$N10$	DRZ	0.	0.1

	M10	N10	MXX	$-250\,000.m.N$	0.1

7 Summary of the results

The got results are satisfactory.