

SSLP116 – Square plate in bending – constant variation in temperature

Summarized:

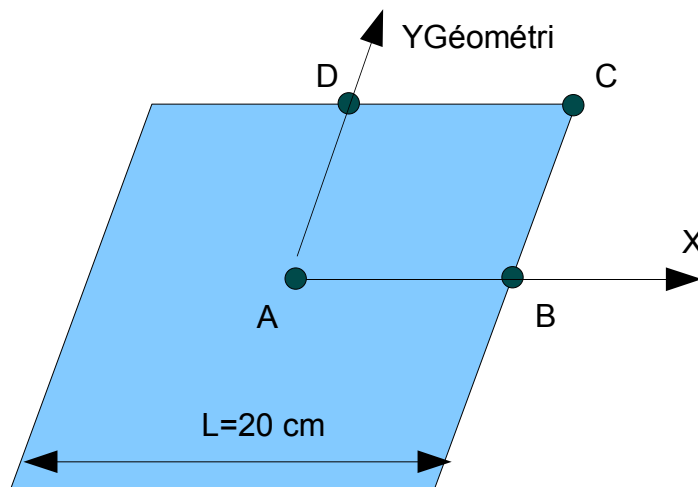
The purpose of this test is to validate the computation of displacements, of the moments and of the stresses in a square plate, simply supported, in subjected bending has a constant variation in temperature.

Modelizations :

- Modelization *A* : DKT with meshes TRIA3
- Modelization *B* : DKT with meshes QUAD4

1 Problem of reference

1.1



Thickness = 0.25cm .

1.2 Properties of the material

the material is elastic isotropic whose properties are:

- $E = 30. \times 10^6 \text{ N/cm}^2$
- $\nu = 0.3$
- $\alpha = 6.5 \times 10^{-6} / ^\circ\text{C}$

1.3 Boundary conditions and loadings

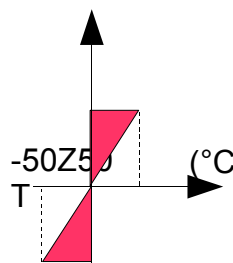
Boundary conditions:

- On edge AB : $DY = DRX = 0$
- On edge AD : $DX = DRY = 0$
- On edge BC and CD : $DZ = 0$

Loading

- the loading applied following way:

is a loading of temperature which varies in the



1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculating

the reference solution is a numerical solution [1].

2.2 Quantities and results of reference

- Displacement following the axis Z along AB

$X (cm)$	$DZ (cm)$
0.0	0.1033
2.0	0.0992
4.0	0.0883
6.0	0.0692
8.0	0.0400
10.0	0.

- Moment M_{XX} along AB

$X (cm)$	$MXX (N)$
1.0	-50.0
3.0	-45.6
5.0	-36.4
7.0	-23.2
9.0	-8.0

2.3 Uncertainties on the numerical

solution Solution

2.4 bibliographical References

- [1] M.H. SADR-LAHIDJANI: "Modelization and analyzes plates and subjected elastic thin shells has fields of temperature", Doctorate UTC, 1984.

3 Modelization A

3.1 Characteristic of the modelization

One uses a modelization `DKT` with 3 layers in the thickness.

3.2 Characteristics of the mesh

The mesh contains 5000 elements of the type `TRIA3`.

3.3 Quantities tested and results

One tests displacement along the axis Z and the moment MXX along AB .

Standard		identification of reference	Value of reference	Tolerance %
DEPL	$X (cm)$			
DZ	0.0	"SOURCE_EXTERNE"	0.1033	4.0
	2.0	"SOURCE_EXTERNE"	0.0992	3.5
	4.0	"SOURCE_EXTERNE"	0.0883	3.
	6.0	"SOURCE_EXTERNE"	0.0692	3.
	8.0	"SOURCE_EXTERNE"	0.0400	2.

Standard		Identification of reference	Value of reference	Tolerance %
EFGE_NOEU	$X (cm)$			
MXX	1.0	"SOURCE_EXTERNE"	-50.0	0.5
	3.0	"SOURCE_EXTERNE"	-45.6	0.2
	5.0	"SOURCE_EXTERNE"	-36.4	1.0
	7.0	"SOURCE_EXTERNE"	-23.2	3.0
	9.0	"SOURCE_EXTERNE"	-8.0	0.5

One tests the stresses on the lower, average and higher skin in 2 layers.

- Lay down n°1: $-0.125\text{cm} < Z < -0.0417\text{cm}$

/Mesh	Lay down	Standard size	of reference	Value of reference	Tolerance
A(M5200)	INF	SIXX	"NON_DEFINI"	4880.375	$10^{-4}\%$
		SIYY	"NON_DEFINI"	4880.125	$10^{-4}\%$
		SIXY	"NON_DEFINI"	-0.125	10^{-6}
	MOY	SIXX	"NON_DEFINI"	3225.583	$10^{-4}\%$
		SIYY	"NON_DEFINI"	3253.417	$10^{-4}\%$
		SIXY	"NON_DEFINI"	-0.083	10^{-6}
	SUP	SIXX	"NON_DEFINI"	1626.712	$10^{-4}\%$
		SIYY	"NON_DEFINI"	1626.708	$10^{-4}\%$
		SIXY	"NON_DEFINI"	-0.042	10^{-6}

- Lay down n°3: $0.0417\text{cm} < Z < 0.125\text{cm}$

/Mesh	Lay down	Standard size	of reference	Value of reference	Tolerance
A(M5200)	INF	SIXX	"NON_DEFINI"	-1626.792	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-1626.708	$10^{-4}\%$
		SIXY	"NON_DEFINI"	0.042	10^{-6}
	MOY	SIXX	"NON_DEFINI"	-3252.583	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-3252.416	$10^{-4}\%$
		SIXY	"NON_DEFINI"	0.083	10^{-6}
	SUP	SIXX	"NON_DEFINI"	-4880.375	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-4880.125	$10^{-4}\%$
		SIXY	"NON_DEFINI"	0.125	10^{-6}

4 Modelization B

4.1 Characteristic of the modelization

One uses a modelization `DKT` with 7 layers in the thickness.

4.2 Characteristics of the mesh

The mesh contains 2500 elements of the type `QUAD4`.

4.3 Quantities tested and results

One tests displacement along the axis Z and the moment MXX along AB .

Standard		identification of reference	Value of reference	Tolerance
DEPL	$X (cm)$			
DZ	0.0	"SOURCE_EXTERNE"	0.1033	4.0
	2.0	"SOURCE_EXTERNE"	0.0992	3.5
	4.0	"SOURCE_EXTERNE"	0.0883	3.0
	6.0	"SOURCE_EXTERNE"	0.0692	3.0
	8.0	"SOURCE_EXTERNE"	0.0400	2.0

Standard		Identification of reference	Value of reference	Tolerance
EFGE_NOEU	$X (cm)$			
MXX	1.0	"SOURCE_EXTERNE"	-50.0	1.0
	3.0	"SOURCE_EXTERNE"	-45.6	0.75
	5.0	"SOURCE_EXTERNE"	-36.4	2.0
	7.0	"SOURCE_EXTERNE"	-23.2	5.0
	9.0	"SOURCE_EXTERNE"	-8.0	6.0

One tests the stresses on the lower, average and higher skin in 2 layers.

- Lay down n°1: $-0.125\text{cm} < Z < -0.089\text{cm}$

/Mesh	Lay down	Standard size	of reference	Value of reference	Tolerance
A(M2700)	INF	SIXX	"NON_DEFINI"	4875.116	$10^{-4}\%$
		SIYY	"NON_DEFINI"	4875.116	$10^{-4}\%$
		SIXY	"NON_DEFINI"	7.47×10^{-9}	10^{-6}
	MOY	SIXX	"NON_DEFINI"	4178.671	$10^{-4}\%$
		SIYY	"NON_DEFINI"	4178.671	$10^{-4}\%$
		SIXY	"NON_DEFINI"	6.4×10^{-9}	10^{-6}
	SUP	SIXX	"NON_DEFINI"	3482.225	$10^{-4}\%$
		SIYY	"NON_DEFINI"	3482.225	$10^{-4}\%$
		SIXY	"NON_DEFINI"	5.3×10^{-9}	10^{-6}

- Lay down n°7: $0.089\text{cm} < Z < 0.125\text{cm}$

Not/Mesh	Lays down	Standard size	of reference	Value of reference	Tolerance
A(M2700)	INF	SIXX	"NON_DEFINI"	-3482.225	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-3482.225	$10^{-4}\%$
		SIXY	"NON_DEFINI"	5.3×10^{-9}	10^{-6}
	MOY	SIXX	"NON_DEFINI"	-4178.670	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-4178.670	$10^{-4}\%$
		SIXY	"NON_DEFINI"	-6.4×10^{-9}	10^{-6}
	SUP	SIXX	"NON_DEFINI"	-4875.116	$10^{-4}\%$
		SIYY	"NON_DEFINI"	-4875.116	$10^{-4}\%$
		SIXY	"NON_DEFINI"	7.5×10^{-9}	10^{-6}

5 Summary of the results

the got results are satisfactory.