

SSLP117 – Square plate in inflection – variable variation in temperature

Summary:

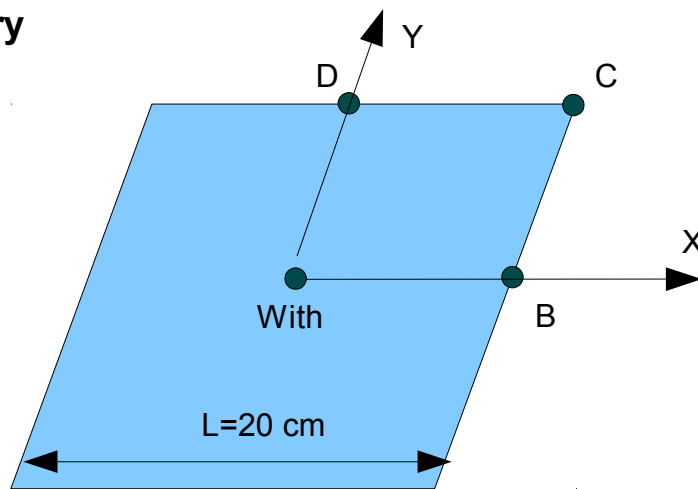
The objective of this test is to validate the calculation of displacements, the moments and the constraints in a square plate, simply supported, in subjected inflection has a variable variation in temperature.

Modelings :

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

1 Problem of reference

1.1 Geometry



Thickness = 0.25cm .

1.2 Properties of material

The material is elastic isotropic whose properties are:

- $E=3.\times 10^6 \text{ N/cm}^2$
- $\nu=0.3$
- $\alpha=6.5\times 10^{-6} / ^\circ\text{C}$

1.3 Boundary conditions and loadings

Boundary conditions:

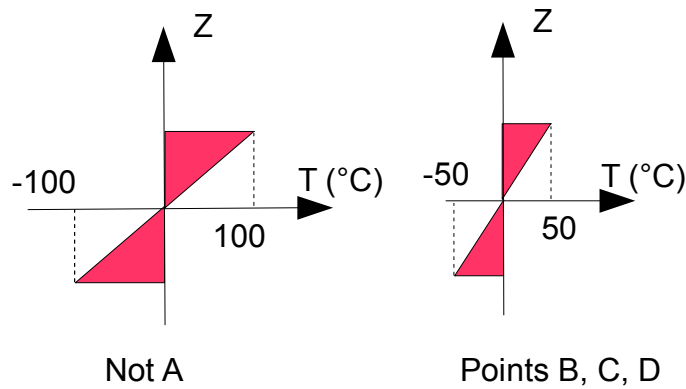
- On the edge AB : $DY = DRX = 0$
- On the edge AD : $DX = DRY = 0$
- On the edge BC and CD : $DZ = 0$

Loading

- The loading applied is a loading of temperature which varies in the following way:

$$\text{Higher skin: } T(x, y) = 100 - 5|x| - 5|y| + \frac{1}{2}|xy|$$

$$\text{Lower skin: } T(x, y) = -100 + 5|x| + 5|y| - \frac{1}{2}|xy|$$



1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculating

The reference solution is a digital solution [1].

2.2 Sizes and results of reference

- Displacement DZ in the center of the plate

Not A : $DZ=0.14712\text{ cm}$

- Moment M_{xx} in the center of the plate

Not A : $M_{xx}=103.80\text{ N}$

2.3 Uncertainties on the solution

Digital solution

2.4 Bibliographical references

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

3 Modeling A

3.1 Characteristics of modeling

A modeling is used DKT.

3.2 Characteristics of the grid

The grid contains 5000 elements of the type TRIA3.

3.3 Sizes tested and results

One tests displacement along the axis Z and moment MXX in the center of the plate (not A).

Identification		Type of reference	Value of reference	Tolerance %
DEPL	$X (cm)$			
DZ	0.0	'SOURCE_EXTERNE'	0.14712	0.1

Identification		Type of reference	Value of reference	Tolerance
EFGE_ELNO	$X (cm)$			
MXX	1.0	'SOURCE_EXTERNE'	103.80	3.5

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

- Lay down n°1: $-0.125cm < Z < -0.0417cm$

Not/Mesh	Sleep	Size	Type of reference	Value of reference	Tolerance
$A(M5200)$	INF	$SIXX$	'NON_DEFINI'	9666.036	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	9664.713	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.662	10^{-6}
	MOY	$SIXX$	'NON_DEFINI'	8285.175	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	8284.039	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.568	10^{-6}
	SUP	$SIXX$	'NON_DEFINI'	6904.313	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	6903.366	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.473	10^{-6}

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

Not/Mesh	Sleep	Size	Type of reference	Value of reference	Tolerance
<i>A(M5200)</i>	<i>INF</i>	<i>SIXX</i>	'NON_DEFINI'	4142.588	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	4142.020	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.284	10^{-6}
	<i>MOY</i>	<i>SIXX</i>	'NON_DEFINI'	2761.725	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	2761.346	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.189	10^{-6}
	<i>SUP</i>	<i>SIXX</i>	'NON_DEFINI'	1380.863	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	1380.673	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.095	10^{-6}

4 Modeling B

4.1 Characteristics of modeling

A modeling is used DKT.

4.2 Characteristics of the grid

The grid contains 2500 elements of the type QUAD4.

4.3 Sizes tested and results

One tests displacement along the axis Z and moment MXX in the center of the plate (not A).

Identification		Type of reference	Value of reference	Tolerance
DEPL	$X (cm)$			
DZ	0.0	'SOURCE_EXTERNE'	0.14712	0.1

Identification		Type of reference	Value of reference	Tolerance
EFGE_ELNO	$X (cm)$			
MXX	1.0	'SOURCE_EXTERNE'	103.80	3.5

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

- Lay down n°1: $-0.125cm < Z < -0.089cm$

Not/Mesh	Sleep	Size	Type of reference	Value of reference	Tolerance
$A(M2700)$	INF	$SIXX$	'NON_DEFINI'	9653.560	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	9653.560	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.064	10^{-6}
	MOY	$SIXX$	'NON_DEFINI'	8274.480	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	8274.480	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.055	10^{-6}
	SUP	$SIXX$	'NON_DEFINI'	6895.400	$10^{-4}\%$
		$SIYY$	'NON_DEFINI'	6895.400	$10^{-4}\%$
		$SIXY$	'NON_DEFINI'	-0.046	10^{-6}

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

Not/Mesh	Sleep	Size	Type of reference	Value of reference	Tolerance
<i>A(M2700)</i>	<i>INF</i>	<i>SIXX</i>	'NON_DEFINI'	-6895.400	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	-6895.400	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.046	10^{-6}
	<i>MOY</i>	<i>SIXX</i>	'NON_DEFINI'	-8274.480	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	-8274.480	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.055	10^{-6}
	<i>SUP</i>	<i>SIXX</i>	'NON_DEFINI'	-9653.560	$10^{-4}\%$
		<i>SIYY</i>	'NON_DEFINI'	-9653.560	$10^{-4}\%$
		<i>SIXY</i>	'NON_DEFINI'	-0.064	10^{-6}

5 Summary of the results

The got results are satisfactory.