

TPLA300 - Circular plate subjected to a voluminal source of heat

Summary:

This test is resulting from the validation independent of version 3 in linear stationary thermics.

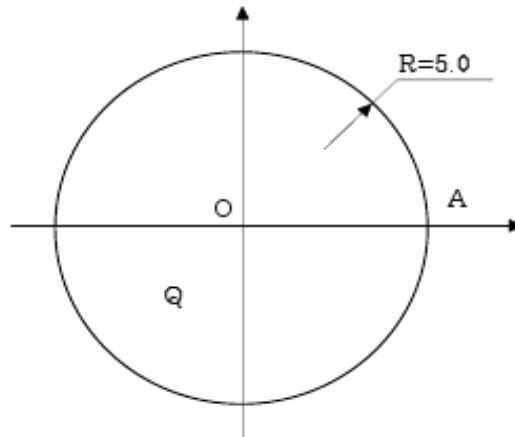
The interest of this case test 2D plan is to validate a thermal element under various boundary conditions (source of heat, imposed temperature).

This case test understands two modelings 2D, one axisymmetric, the other planes.

The results are compared with an analytical solution.

1 Problem of reference

1.1 Geometry



1.2 Properties of material

$\lambda = 0.04 \text{ W/m}^\circ\text{C}$ Thermal conductivity

1.3 Boundary conditions and loadings

- voluminal source of heat $Q = 1 \text{ W/m}^3$,
- temperature imposed on surface outside ($R = 5$) : $T = 0^\circ\text{C}$.

1.4 Initial conditions

Without object.

2 Reference solution

2.1 Method of calculating used for the reference solution

Analytical solution:

$$T(r) = 6.25(25 - r^2)$$

2.2 Results of reference

Temperature for $r = 0., 0.625, 1.25, 1.875, 2.5, 3.125, 3.75, 4.375, 5.$

2.3 Uncertainty on the solution

Analytical solution.

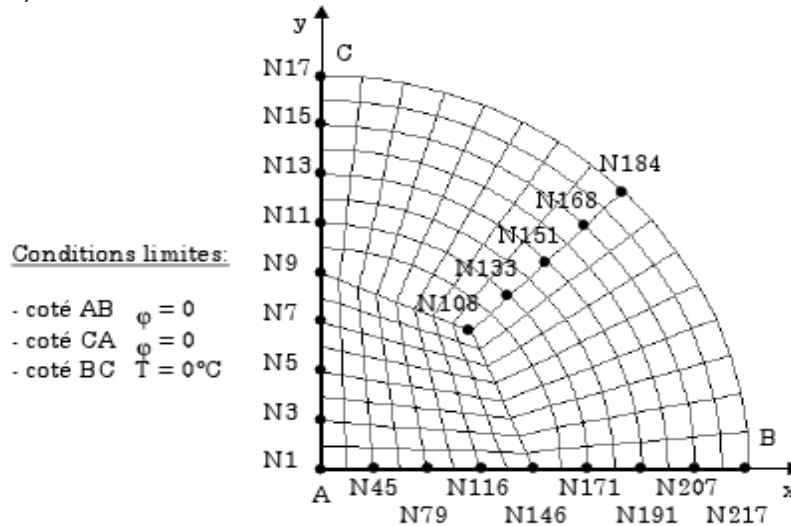
2.4 Bibliographical references

- [1] W.K. Liu, T. Belytschko, "Efficient linear and nonlinear heat conduction with has quadrilateral element", Int. J. num. Meth. Engng, flight 20, n°5, pp 931-948, 1984.

3 Modeling A

3.1 Characteristics of modeling

PLAN (QUAD4)



3.2 Characteristics of the grid

Many nodes: 217
Many meshes and types: 192 QUAD4

3.3 Sizes tested and results

Identification	Reference	Aster	% difference	tolerance
temperatures ($^{\circ}\text{C}$)				
R = 0,000 (N1)	156.25	156.07	-0,114	1%
R = 0,625 (N3)	153.81	153.63	-0,116	1%
R = 0,625 (N45)	153.81	153.63	-0,116	1%
R = 1,250 (N5)	146.48	146.31	-0,117	1%
R = 1,250 (N79)	146.48	146.31	-0,117	1%
R = 1,875 (N7)	134.28	134.10	-0,131	1%
R = 1,875 (N116)	134.28	134.10	-0,131	1%
R = 2,500 (N9)	117.19	116.98	-0,182	1%
R = 2,500 (N108)	117.19	116.82	-0,313	1%
R = 2,500 (N146)	117.19	116.98	-0,182	1%
R = 3,125 (N11)	95.21	95.04	-0,178	1%
R = 3,125 (N133)	95.21	95.00	-0,216	1%
R = 3,125 (N171)	95.21	95.04	-0,178	1%
R = 3,750 (N13)	68.36	68.23	-0,191	1%
R = 3,750 (N151)	68.36	68.21	-0,214	1%
R = 3,750 (N191)	68.36	68.23	-0,191	1%
R = 4,375 (N15)	36.62	36.55	-0,194	1%
R = 4,375 (N168)	36.62	36.54	-0,211	1%
R = 4,375 (N207)	36.62	36.55	-0,194	1%
R = 5,000 (N17)	0.00*	0.00	0.00	1%
R = 5,000 (N217)	0.00*	0.00	0.00	1%
R = 5,000 (N184)	0.00*	0.00	0.00	1%

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Code_Aster

Version
default

Titre : TPLA300 - Plaque circulaire soumise à une source d[...]
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Clé : V4.01.300 Révision :
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* Condition limits

4 Summary of the results

The got results are very satisfactory, the maximum change is of 0.313% .

Among the points of observation, the most important variation is noted with the N108 node which belongs to the element more deformed grid.

The grid used is that proposed in the reference. A radial grid with the same cutting and the same meshes should give better results.

This test made it possible to test the taking into account of a source term within meshes QUAD9 with a modeling AXIS (`AFFE_CHAR_THER` associated with the keyword `SOURCE`).