

TPLP300 - Rectangular plate: convection, imposed temperature

Summary:

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

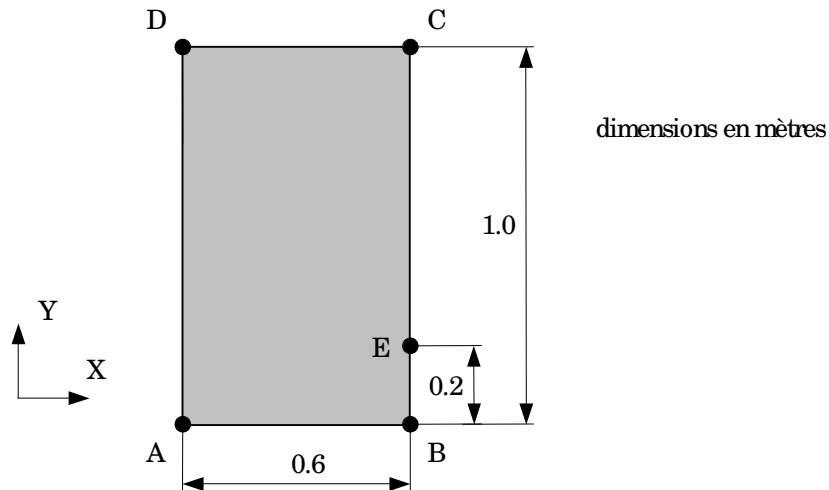
It is about a problem 2D plan represented by only one modeling (plane).

The features tested are the use of thermal elements plans under limiting conditions of imposed temperature and convection.

The results are compared with those provided by NAFEMS.

1 Problem of reference

1.1 Geometry



1.2 Properties of material

$\lambda = 52 \text{ W/m} \cdot ^\circ\text{C}$ Thermal conductivity

1.3 Boundary conditions and loadings

- imposed temperature dimensioned $[AB]$: $T_p = 100^\circ\text{C}$,
- density flux $= 0$ on with dimensions one $[DA]$,
- convection on with dimensions ones $[BC]$ and $[CD]$,
 - $h = 750 \text{ W/m}^2 \cdot ^\circ\text{C}$,
 - $T_{ext} = 0^\circ\text{C}$.

1.4 Initial conditions

Without object.

2 Reference solution

2.1 Method of calculating used for the reference solution

The reference solution is that given in the card "TEST n° T4" of the tests of reference published by NAFEMS.

2.2 Results of reference

Temperature at the point E: $T = 18.3^{\circ}C$

2.3 Uncertainty on the solution

Nonavailable on card NAFEMS

2.4 Bibliographical references

- [1] NAFEMS (the National Agency for Finite Element Methods Standard and (the U.K.)): "Standard The NAFEMS Benchmarcks", TNSB rév 3, October 1990.

3 Modeling A

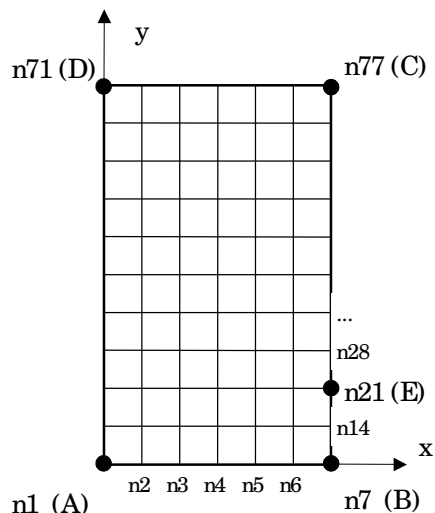
3.1 Characteristics of modeling

PLAN (QUAD4)

Conditions aux limites:

- Coté AB: $T = 100^{\circ}\text{C}$
- Coté BA: $\phi = 0$.
- Coté BC,CD: $T_{\text{ext}} = 0^{\circ}\text{C}$
 $h = 750\text{W/m}^2\text{ }^{\circ}\text{C}$

Points	X	Y	Noeuds
E	0.6	0.2	N21
A	0.0	0.0	N1
B	0.6	0.0	N7
C	0.6	1.0	N77
D	0.0	1.0	N71



3.2 Characteristics of the grid

Many nodes: 77
Many meshes and types: 60 QUAD4 (16 SEG2)

3.3 Sizes tested and results

Identification	Reference	Aster	difference	tolerance
Temperature ($^{\circ}\text{C}$)				
At the point $E : N21$	18.3	17,954	-1.89	1%

4 Summary of the results

Modeling gives a result which exceeds the tolerance fixed initially. The maximum change obtained is of 1.9%, to compare with the tolerance of 1%.

In this test, the heat gradients are more important close to the point B (imposed temperature and convection), a finer grid in this zone would improve quality of the results.

The results are regarded as acceptable taking into account the type of mesh (QUAD4) and the density of the grid used

The interest of this test is its origin NAFEMS.