

TPLP107 – Method of the solutions manufactured in thermics 2D

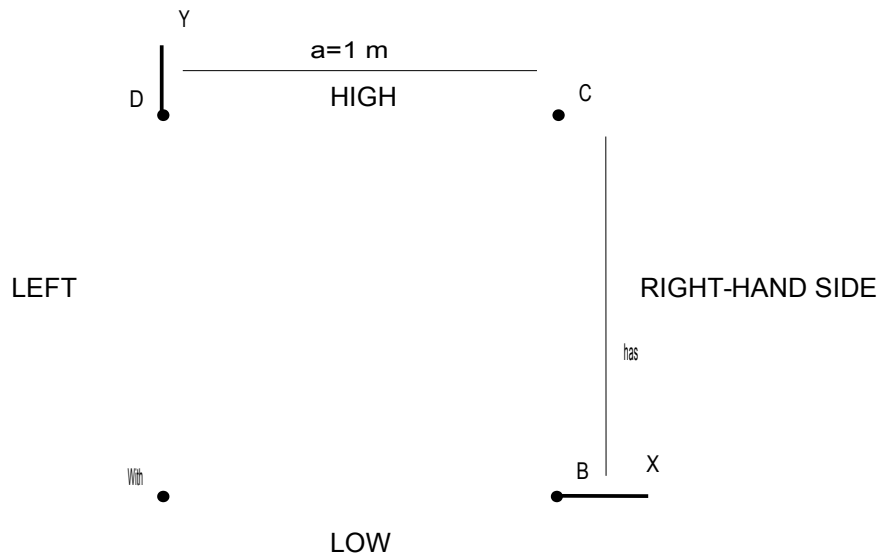
Summary:

The objective of this test is to check thermal modeling 2D thanks to the method of the manufactured solutions [bib1].

1 Problem of reference

1.1 Geometry

One considers a square of with dimensions 1 m .



1.2 Properties of material

$\lambda = 15\text{ W/m}\cdot\text{°C}$ Thermal conductivity

1.3 Boundary conditions and loadings

On the edges GAUCHE, BAS and HAUT, one forces a temperature (see paragraph 2).

On the edge DROITE, one forces a flow (see paragraph 2).

In all the field, one forces a source (see paragraph 2).

1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculating

The analytical reference solution is given by:

$$T = 100 \times (X^6 + Y^6) \quad (1)$$

The conditions of Dirichlet, Neumann and the source term are obtained by the method of the manufactured solutions [bib1].

2.2 Sizes and results of reference

The value of the difference between solutions analytical and calculated on the grid:

$$\sum_{\text{noeuds } n} |T_n^{\text{calc}} - T_n^{\text{ref}}|.$$

In the case of modelings which carry out an analysis of convergence with the smoothness of the grid, the speed of convergence with the smoothness of the grid of the solution calculated towards the analytical solution in standard L_2 , that is to say greatest reality $\alpha > 0$ such as $\|T^{\text{calc}} - T^{\text{ref}}\|_{0,\Omega} < C \times h^\alpha$ where C is independent of h .

2.3 Uncertainties on the solution

None

2.4 Bibliographical references

- 1 U2.08.08 document, Use of the Method of the Solutions Manufactured for the software validation, Documentation U2 de Code_Aster

3 Modeling A

3.1 Characteristics of modeling

A modeling is used PLAN.

3.2 Characteristics of the grid

The grid contains 56 elements of the type SEG3 ET 392 elements of the type TRIA6.

3.3 Sizes tested and results

One tests the sum of the absolute values of the difference between the calculated solution and the analytical solution.

Identification	Type of reference	Value of reference
$\sum_{\text{noeuds } n} T_n^{\text{calc}} - T_n^{\text{ref}} $	'NON_REGRESSION'	0.59734630434863

4 Modeling B

4.1 Characteristics of modeling

A modeling is used PLAN.

4.2 Characteristics of the grid

One carries out a study of convergence with the smoothness of the grid of the solution calculated towards the analytical solution. A succession of grids obtained by uniform refinement using the order MACR_ADAP_MAIL is used:

- grid 0: 4 SEG3, 2 TRIA6
- grid 1: 8 SEG3, 8 TRIA6
- grid 2: 16 SEG3, 32 TRIA6
- grid 3: 32 SEG3, 128 TRIA6

4.3 Sizes tested and results

One tests the speed of convergence with the smoothness of the grid of the solution calculated towards the analytical solution in standard L_2 , that is to say greatest reality $\alpha > 0$ such as $\|T^{\text{calc}} - T^{\text{ref}}\|_{0,\Omega} < C \times h^\alpha$ where C is independent of h .

One tests also the sum of the absolute values of the difference between the calculated solution and the analytical solution.

Identification	Type of reference	Value of reference
$\sum_{\text{noeuds } n} T_n^{\text{calc}} - T_n^{\text{ref}} $	'NON_REGRESSION'	0.59734630434863
α	'ANALYTICAL'	3.0

5 Summary of the results

The results are in very good agreement with the theory.