

## ZZZZ185 - Validation of the command MODI\_MAILLAGE associated with SYMETRIE and of the command PROJ\_CHAMP associated with DISTANCE\_MAX

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### Summarized:

The purpose of this case test is to validate command MODI\_MAILLAGE with the key word SYMETRIE and command PROJ\_CHAMP with key word DISTANCE\_MAX.

- command MODI\_MAILLAGE, with key word SYMETRIE makes it possible to take the symmetric one of a mesh 2D or 3D ,
- command PROJ\_CHAMP with key word DISTANCE\_MAX makes it possible not to project the field on the nodes which do not answer the 2 following criteria:
  - 1) the nodes are not in an element of the 1st mesh,
  - 2) the nodes are beyond DISTANCE\_MAX.

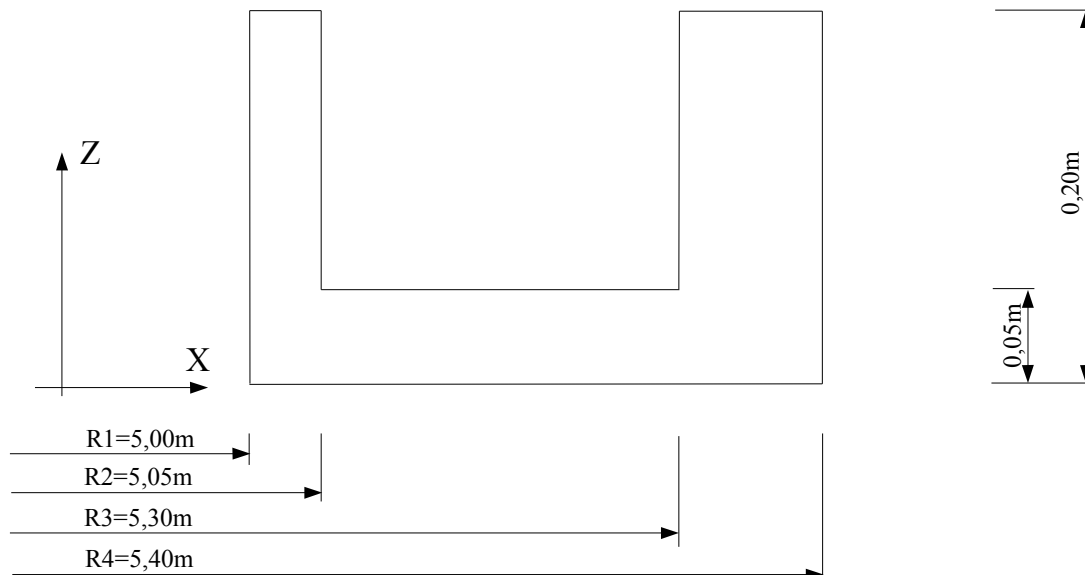
The case test consists in realizing:

- a thermal study on structure 1/8ème,
- the construction of the thermal field on 1/4 of structure by projection of the results got on the structure 1/8ème, with the taking into account of a symmetry plane,
- a thermal study on 1/4 of structure,
- the comparison of the field of temperature obtained by projection and a study on 1/4 of structure.

## 1 Problem of reference

### 1.1 Geometry

the structure is obtained by rotation around the axis Z, of the section represented with [Figure1.1-a].



Appear 1.1-a : Cut structure

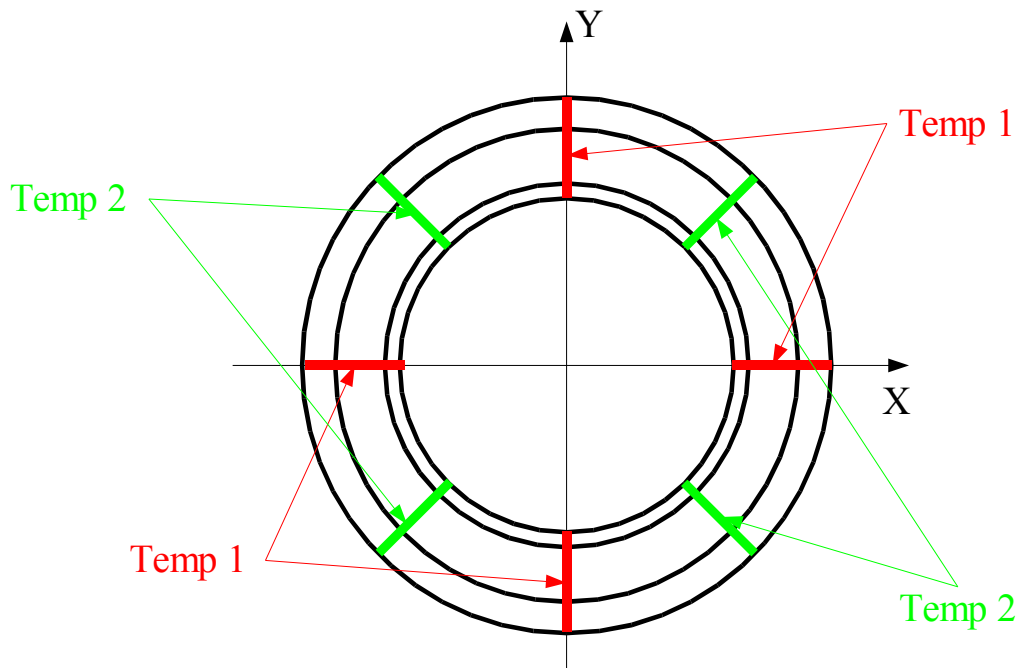
### 1.2 Properties of the material

the study is realized in linear thermal, only the thermal characteristics are necessary to the definition of the materials.

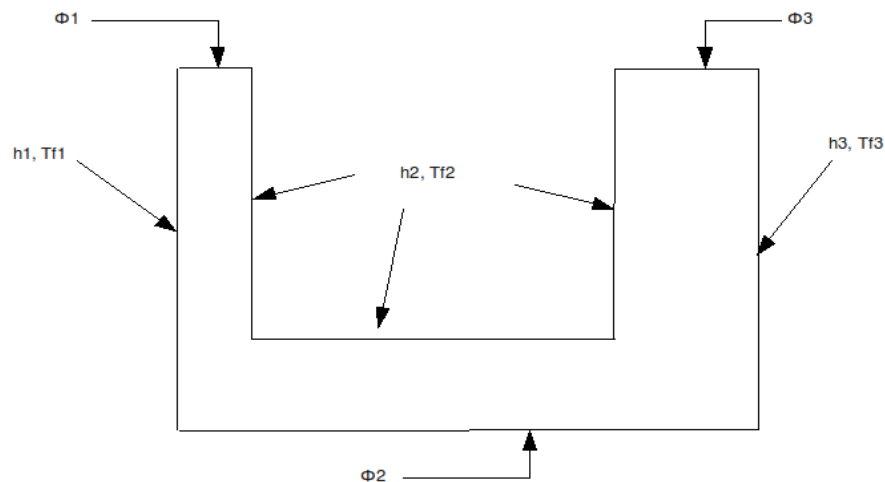
Isotropic thermal conductivity:  $\lambda = 15.0 \text{ W/m.k}$

### 1.3 Boundary conditions and loadings

the study is carried out in linear thermal, the conditions on the imposed temperatures are represented with [Figure1.3-a], the flux conditions and the heat exchange are indicated to [Figure1.3-b].



Appear 1.3-a : Sight of top, with the conditions in imposed temperature.



Appear 1.3-b : Cross-section, with the flux conditions and the heat exchange.

Flux conditions:

$$\phi_1 = 10.0 \text{ W/m}^2$$

$$\phi_2 = 0.0 \text{ W/m}^2$$

$$\phi_3 = 30.0 \text{ W/m}^2$$

Conditions of exchange by convection:

$$h_1 = 350.0 \text{ W/m}^2 \text{ k} \quad tf_1 = 300.0 \text{ }^\circ\text{C}$$

$$h_2 = 400.0 \text{ W/m}^2 \text{ k} \quad tf_2 = 275.0 \text{ }^\circ\text{C}$$

$$h_3 = 600.0 \text{ W/m}^2 \text{ k} \quad tf_3 = 310.0 \text{ }^\circ\text{C}$$

Conditions of imposed temperature:

$$Temp_1 = 250.0 \text{ }^\circ\text{C}$$

$$Temp_2 = 160.0 \text{ }^\circ\text{C}$$

## 1.4 Initial conditions

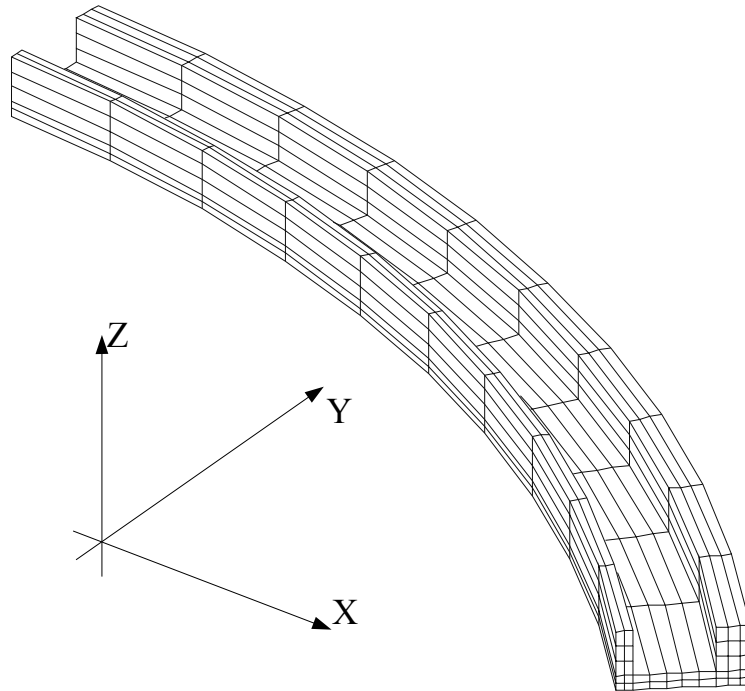
Without object.

## 2 Reference solution

### 2.1 Method of calculating

For this case test, 2 studies are carried out.

- The first study is carried out on 1/8ème structure. The computation is a linear thermal analysis, with the boundary conditions described with [§1.2].
- The second study is carried out on 1/4 of structure. The computation is a linear thermal analysis, with the boundary conditions described with [§1.2].



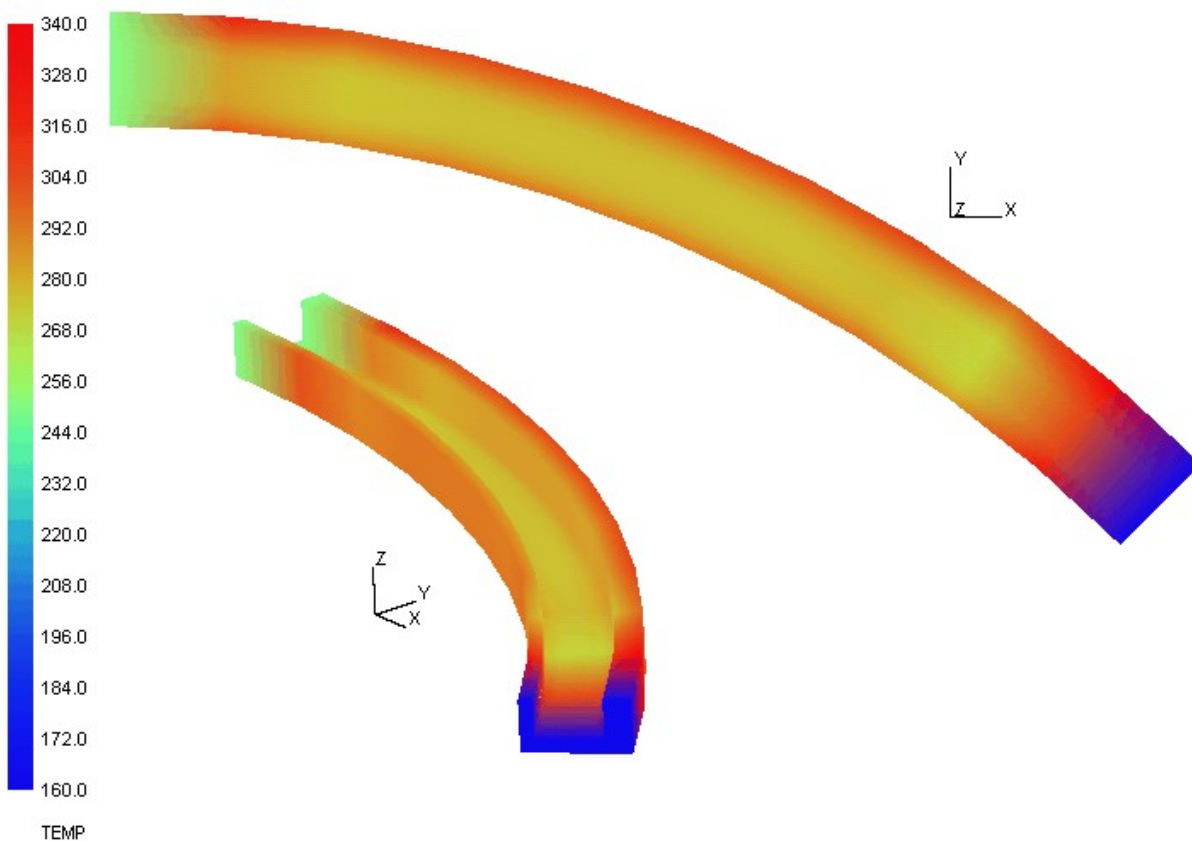
Appear 2.1-a : Mesh of structure 1/8ème.

### 2.2 Quantities and results of reference

result of reference is the field of temperature.

Result of the study on structure 1/8ème and its mesh are saved in a file with format "MED". The projected fields will be then compared with those obtained by the study carried out on 1/4 of structure.

[Figure2.2-a] the field of temperature gives obtained on structure 1/8ème.



Appear 2.2-a : Field of temperature calculated on 1/8ème of structure.

## 2.3 Uncertainties on the solution

No meaning in this case.

The goal of the case test is to check that the symmetry of the mesh and that projections of the field of temperature are correctly made.

## 2.4 Bibliographical references

Without use.

## 3 Modelization A

### 3.1 Characteristic of the modelization

the goal of this modelization is to obtain the solution with the thermal problem starting from the computation carried out on 1/8ème of structure.

The case test proceeds the following way:

- reading of the mesh, structure 1/8ème, starting from the file with format "MED", LIRE\_MAILLAGE orders.
- reading of the field of temperature starting from the file with format "MED", LIRE\_CHAMP orders.
- creation of one result starting from the field previously read, command CREA\_RESU.
- creation of a model starting from the mesh previously read, command AFFE\_MODELE .
- creation of a model for the mesh groups which belong to the symmetry plane, command AFFE\_MODELE (cf notices n°1).
- reading of the mesh, structure 1/8ème, starting from the file with the format "MED" and modification of the mesh by symmetry compared to the plane ( $\pi_{sym}$ ) defined by:
- AXE\_1 = (1.0, 1.0, 0.0), AXE\_2 = (0.0, 0.0, -1.0), POINT = (0.0, 0.0, 0.0)

commands LIRE\_MAILLAGE and MODI\_MAILLAGE.

- reading of the field of temperature starting from the file with format "MED", LIRE\_CHAMP orders.
- creation of one result starting from the field previously read, command CREA\_RESU.
- creation of a model starting from the symmetric mesh, command AFFE\_MODELE .
- reading of the mesh accounting for 1/4 of structure, orders LIRE\_MAILLAGE.
- creation of a model starting from the mesh previously read, command AFFE\_MODELE .
- projection of the 3 results created from the solution calculated on 1/8ème of structure, command PROJ\_CHAMP with key word DISTANCE\_MAX.
- extraction of the fields of temperature of the 3 results resulting from projection, orders CREA\_CHAMP.
- creation of a null field on the model built on 1/4 of structure, orders CREA\_CHAMP (cf notices n°2).
- combination of all the fields, orders CREA\_CHAMP/OPERATION=' ASSE '.
- creation of one result from the combination of the fields, CREA\_RESU.

#### Notice n°1:

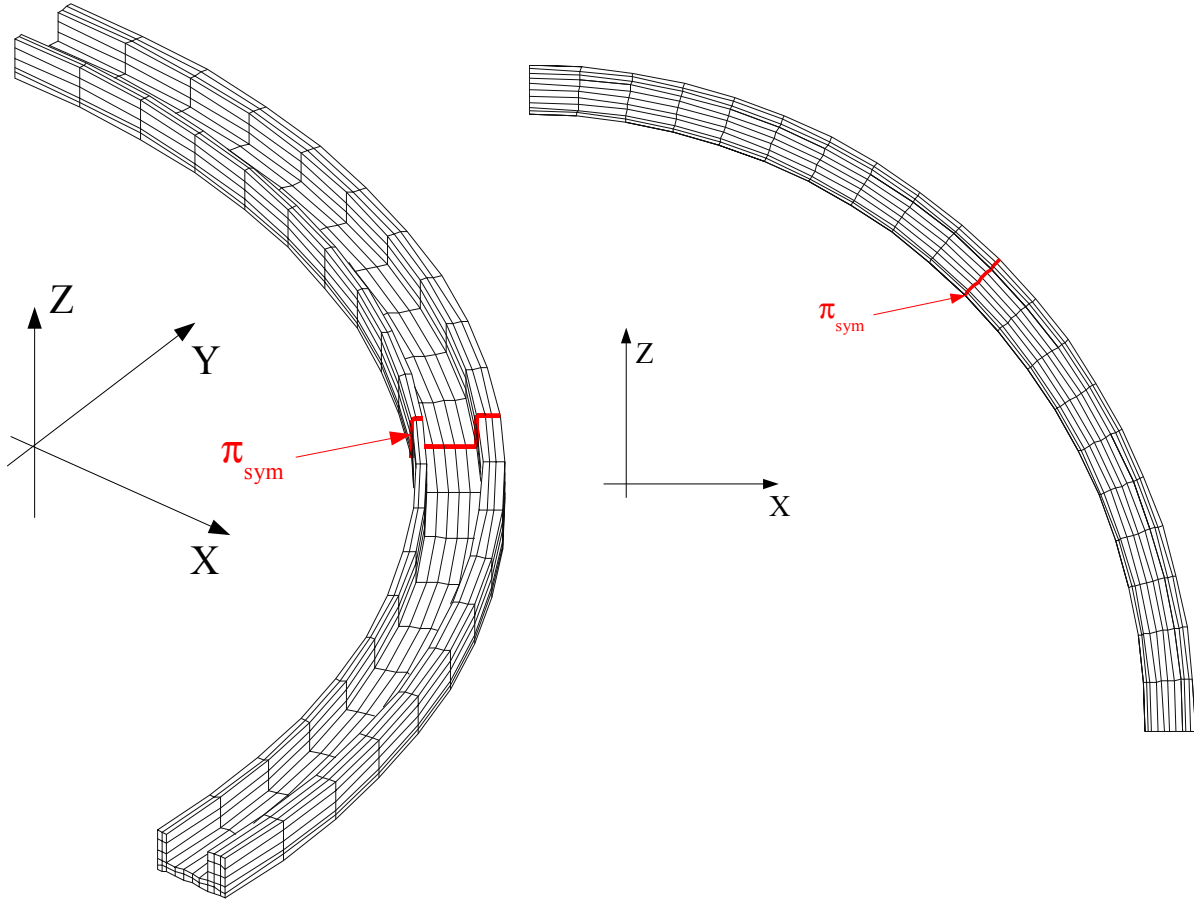
*In this case test, nodes of the mesh, [Figure3.2-a ], belong to the symmetry plane  $\pi_{sym}$  . For these nodes, the projection of the field of temperature will thus be entered 2 times. To avoid once cumulating the field of temperature of too, a solution is to create a model containing only these nodes and to carry out projection on the complete mesh. This field project will be then withdrawn using command CREA\_CHAMP/OPERATION=' ASSE ' .*

#### Notice n°2:

*The projection of the fields using command PROJ\_CHAMP and key word DISTANCE\_MAX makes it possible not to create a field on the nodes which are not contained in one of the elements of the initial mesh and which are at a distance higher than DISTANCE\_MAX of the element nearest. When one combines fields using command CREA\_CHAMP/OPERATION=' ASSE ', it is the first field at nodes which is taken as reference. If the field is incomplete, as in our case, the combination will not give result discounted. The solution is thus to create a null field on all the model and to make use of it like reference field.*

## 3.2 Characteristics of the mesh

the projection of the field of temperature calculated on structure 1/8ème (mesh of [Figure 1.1-a]) is project on the model built starting from the mesh of the 1/4 of structure [Figure 3.2-a)].



Appear 3.2-a : Mesh of the 1/4 of structure.



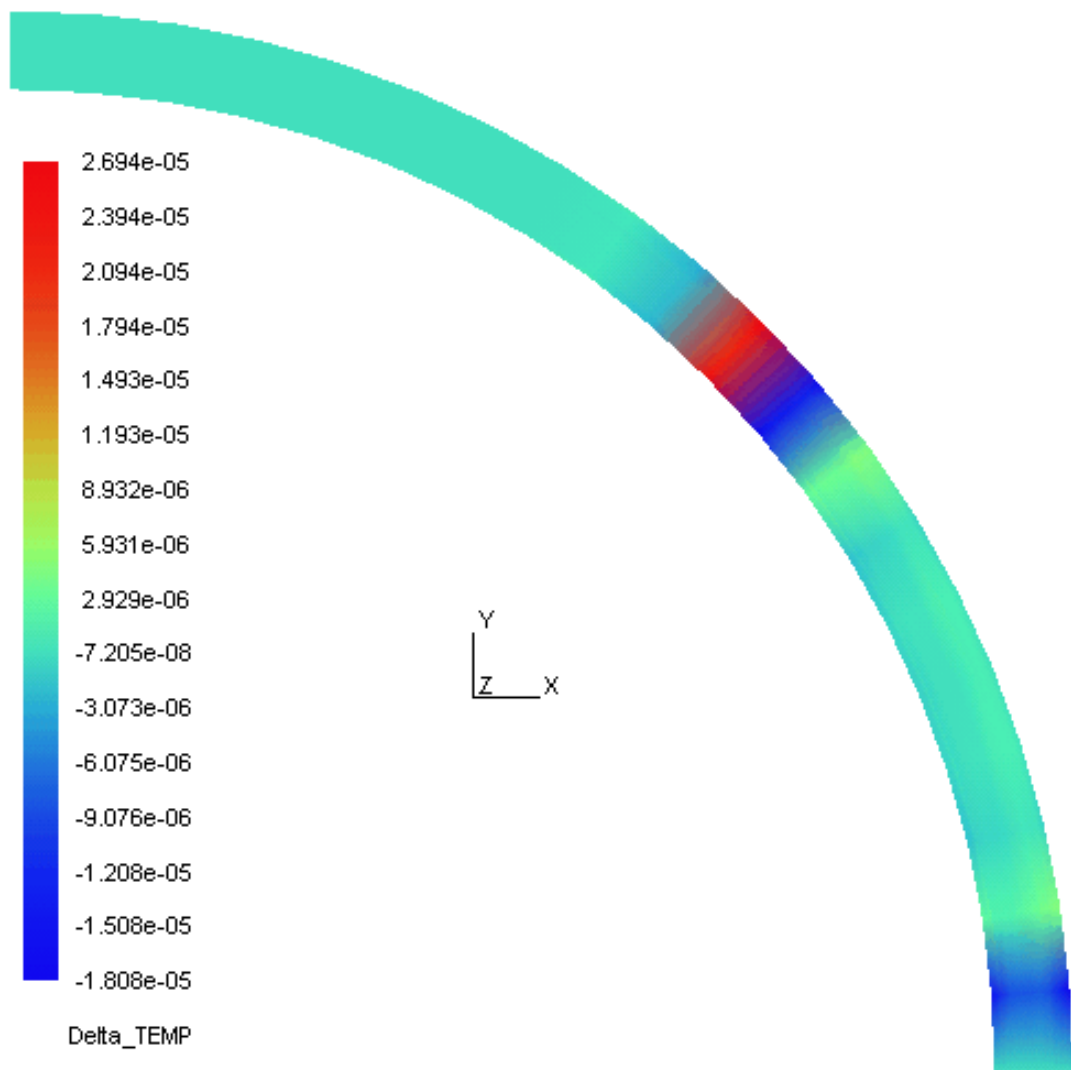
### 3.3 Quantities tested and results

the test is carried out on the field of temperature.

Result obtained by projection and combination on 1/4 of structure the field is extracted from temperature TEMP1. Result calculated on 1/4 of structure the 2nd field is extracted from temperature TEMP2. These 2 fields are withdrawn using command CREA\_CHAMP/OPERATION='ASSE', and the test is carried out on the maximum and minimal value resulting field. In all points of structure, one must have TEMP1 = TEMP2, the field resulting of the command CREA\_CHAMP/OPERATION='ASSE' must thus be null in all points.

Values tested	Reference	Code_Aster	Maximum
Accuracy	0.0	2.694E-05	1.0E-4
Minimum	0.0	-1.808E-05	1.0E-4

It [Figure3.3-a] gives the card of the differences between the two fields of temperature obtained during this case test.



Appear 3.3-a : Card of the differences in temperature.

## 4 Summary of the results

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This case test makes it possible to validate:

- command MODI\_MAILLAGE associated with key word SYMETRIE,
- command PROJ\_CHAMP associated with key word DISTANCE\_MAX.

The validation is done on all the field of temperature and not only on some points.

When the 2 commands are associated, it should be taken account owing to the fact that the fields supported by nodes which belong to the symmetry plane can be entered 2 times.

During the combination of the fields using the command CREA\_CHAMP/OPERATION='ASSE', it is the structure of the first CHAM\_NO which is used as structure of reference. If the structure is incomplete, it is thus necessary to create a CHAM\_NO of reference.