User Manuel
Booklet U4.4- : Modelling
Document : U4.43.03

Operator AFFE_MATERIAU

1 Aim

To assign materials to the geometric zones of a meshing.

To produce a data structure of type cham_mater.

2 Syntax

```
chm [cham_mater] = AFFE_MATERIAU

        (  ♦  MAILLAGE = ma,                    /          [mesh]
                                                /          [skeleton]
           ◊  MODELE   = mo,                               [model]
           ♦  AFFE = (_F(
                          ♦  /  TOUT     =   'OUI' ,
                             /  MAILLE   =   lma   ,      [mesh]
                             /  GROUP_MA =   lgma  ,      [mesh_group]

                          ♦  MATER =   mat,               [mater]

                          ◊  TEMP_REF =   /  0.    ,      [DEFAULT]
                                          /  tref  ,      [R]
                       ),),
        )
```

3 Operands

The material field is constructed on the meshes of a meshing (or a skeleton) (and not on the elements of a model). This permits for example the definition of the same material field for thermics and mechanics.

3.1 Meshing

♦ MAILLAGE = ma,

Name of the meshing (or the skeleton) that you want to assign to by the material properties.

Remarks :

The assignment operation is the same for the meshes of a skeleton as for the meshes of a meshing. In the rest of the document, we always say meshing for simplification.

When you assign materials to the mesh of a skeleton, it is because you want to calculate stresses (for example) on the post-processing (coarser) mesh.

3.2 Assignment

♦ AFFE

Keyword factor which allows assignment of various materials to “parts” of the meshing.

/ TOUT = ‘OUI’ ,

This keyword allows assignment to all the meshes on the meshing.

/ GROUP_MA = lgma,

This keyword allows assignment to a list of mesh groups on the meshing.

/ MAILLE = lma,

This keyword allows assignment to a list of meshes on the meshing.

A material mat, which is a record produced by one of the operators DEFI_MATERIAU [U4.43.01] of DEFI_COQU_MULT [U4.42.03], is assigned to each mesh group, (keyword GROUP_MA) or each list of meshes (keyword MAILLE), or to the whole meshing (keyword TOUT).

Recall that the DEFI_MATERIAU command [U4.43.01] allows the definition of the parameters of the constitutive relations to use for a mechanical, thermal, or acoustic analysis. The DEFI_COQU_MULT command [U4.42.03] allows the definition of a homogenious material representative of a multi-layered laminate.

If a mesh appears explicitly (or implicitly) in several places of the keyword factor AFFE, the overload rule is applicable: it is the last assignment which precedes [U2.01.08].

3.3 Quantities to assign

3.3.1 Operand MATER

♦ MATER = mat,

Name of the material you want to assign.

3.3.2 Operand TEMP_REF

◊ TEMP_REF = Tref,

The reference temperature T_{ref} introduced by the keyword TEMP_REF is the temperature for which there is no thermal deformation (cf. [R4.08.01]).

If the thermal expansion coefficient α (where the value is introduced in the DEFI_MATERIAU command [U4.43.01]) doesn't depend on the temperature : $\varepsilon^{th}(T) = \alpha\left(T - T_{ref}\right)$.

If the thermal expansion coefficient depends on the temperature, the mathematical expression allowing the calculation of the thermal deformation varies according to the specification of the thermal expansion coefficient function in the DEFI_MATERIAU command:

- The thermal expansion coefficient values (introduced in DEFI_MATERIAU) have to be determined by dilatometry tests carried out at the temperature T_{ref}.

  In this case, the keyword TEMP_DEF_ALPHA must not be specified in the DEFI_MATERIAU command and the thermal deformation is calculated by the expression :

$$\varepsilon^{th}(T) = \alpha(T)\ \left(T - T_{ref}\right) \quad \text{et} \quad \varepsilon^{th}\left(T_{ref}\right) = 0$$

  or $\alpha(T)$ is specified by the keyword ALPHA (or ALPHA_*) in DEFI_MATERIAU.

- The values of the thermal expansion coefficient are determined by dilatometry tests which take place at a temperature T_{def} different to the reference temperature T_{ref}.
  You should carry out a change of reference point in the calculation of the thermal deformation [R4.08.01].

$$\varepsilon^{th}(T) = \varepsilon_m^{th}(T) - \varepsilon_m^{th}\left(T_{ref}\right)$$

where ε_m^{th} is the measured thermal deformation (defined with respect to the temperature T_{def}),

ε^{th} is the calculated thermal deformation (defined with respect to the temperature T_{ref}).

The temperature T_{def} is specified by the keyword TEMP_DEF_ALPHA in DEFI_MATERIAU, and the values of the thermal expansion coefficient (defined with respected to the temperature T_{def}) are specified by the keyword ALPHA or (ALPHA_*) in DEFI_MATERIAU.

4 Example

```
chmat = AFFE_MATERIAU  (   MAILLAGE = ma,
          AFFE = _F (TOUT = 'OUI', MATER = acier),
                    (MAILLE=('ma1','ma2','ma3'),MATER=alu,TEMP_REF=20.),),
                          )
```

The material named acier is assigned to the whole meshing (except the meshes : ma1, ma2, ma3) with the default reference temperature : 0.

The material alu is assigned to the meshes ma1, ma2, ma3 with the reference temperature 20

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