User Manual
Booklet U4.4- : Modelling
Document : U4.41.01

Operator AFFE_MODELE

1 Aim

To define the physical phenomenon to be modelled (mechanical, chemical…) and the type of finite elements.

This operator allows the assignment of models over all or part of the mesh, which defines :

- The degrees of freedom of the nodes (and the equation or the associated equations of conservation)
- the types of finite elements in the meshes
- possibly:
  - interpolation functions in the meshes.
  - GAUSS integration points in these meshes.*

The range of assignable finite elements are described in the [U3] booklets.

The mesh types are described in document [U1.03.02].

To produce a data-structure of the type `modele`.

2 Syntax

```
mo [modele] = AFFE_MODELE    (
                [assign model]
      ♦ MAILLAGE =               ma ,                  /  [mesh]
                                                       /  [skelton]
      ◊ INFO =    /  1                                    [DEFAULT]
                  /  2  ,

      ◊ VERIF =   |  'MAILLE'
                  |  'NOEUD'  ,

      ♦ |  AFFE = _F (
                        ♦ /  TOUT      =  'OUI',
                          /  MAILLE    =  mail,           [l_maille]
                          /  NOEUD     =  noeu,           [l_noeud]
                          /  GROUP_MA  =  g_mail,         [l_gr_maille]
                          /  GROUP_NO  =  g_noeu,         [l_gr_noeud]

                        ♦ /  ♦ PHENOMENE =     'MECANIQUE',
                             ♦ MODELISATION=# 3D continuum
                                              /  '3D',
                                              /  '3D_SI',
                                            # 3D thermo-hydromechanics
                                              /  '3D_THM',
                                              /  '3D_THH',
                                              /  '3D_HM',
                                              /  '3D_HHM',
                                              /  '3D_THHM',
                                              /  '3D_HHMD',
                                              /  '3D_HMD',
                                              /  '3D_THHD',
                                              /  '3D_THHMD',
                                              /  '3D_THVD',
                                              /  '3D_THMD',
                                              /  '3D_JOINT_CT',
                                            # 3D_quasi_incompressible
                                              /  '3D_INCO',
                                            # 3D fluid-structure
                                              /  '3D_FLUIDE'
                                              /  '3D_FAISCEAU',
                                            # 3D porous boundary
                                              /  '3D_ABSO',
                                              /  '3D_FLUI_ABSO',
                                            # 3D non-local
                                              /  '3D_GRAD_EPSI',
                                              /  '3D_GRAD_VARI',
                                            # elastic support
                                              /  'APPUI_REP',

                                            # 2D continuum
                                              /  'D_PLAN',
                                              /  'C_PLAN',
                                              /  'AXIS',
                                              /  'AXIS_SI',
                                              /  'AXIS_FOURIER',
                                              /  'AXIS_INCO',
                                              /  'D_PLAN_INCO',
                                              /  'C_PLAN_SI',
                                              /  'D_PLAN_SI',
                                            # 2D thermo-hydromechanics
                                              /  'AXIS_HHMD',
                                              /  'AXIS_HH2MD',
                                              /  'AXIS_HMD',
                                              /  'AXIS_HHM',
                                              /  'AXIS_HM',
                                              /  'AXIS_THH',
                                              /  'AXIS_THHM',
```

```
                                    /   'AXIS_THM',
                                    /   'AXIS_THHD',
                                    /   'AXIS_THH2D',
                                    /   'AXIS_THHMD',
                                    /   'AXIS_THH2MD',
                                    /   'AXIS_THMD',
                                    /   'D_PLAN_THM',
                                    /   'D_PLAN_THH',
                                    /   'D_PLAN_HM',
                                    /   'D_PLAN_HHM',
                                    /   'D_PLAN_THHM',
                                    /   'D_PLAN_HHMD',
                                    /   'D_PLAN_HH2MD',
                                    /   'D_PLAN_HMD',
                                    /   'D_PLAN_THHD',
                                    /   'D_PLAN_THH2D',
                                    /   'D_PLAN_THHMD',
                                    /   'D_PLAN_THH2MD',
                                    /   'D_PLAN_THMD',

                                  # 2D non-local
                                    /   'D_PLAN_GRAD_EPSI',
                                    /   'C_PLAN_GRAD_EPSI',
                                    /   'D_PLAN_GRAD_VARI',
                                    /   'C_PLAN_GRAD_VARI',

                  # contact elements for crack propogation
                  crack propogation
                                    /   'AXIS_GRAD_VARI',
                                  # 'AXIS_FISSURE'
                                    /   'PLAN_FISSURE',
                                  # 2D fluide-structure
                                    /   '2D_FLUI_ABSO',
                                    /   'D_PLAN_ABSO',
                                    /   '2D_FLUIDE',
                                    /   '2D_FLUI_STRU',
                                    /   '2D_FLUI_PESA',
                                    /   'AXIS_FLUIDE',
                                    /   'AXIS_FLUI_STRU',

                                  # 3D plates and shells
                                    /   'DKT',
                                    /   'DST',
                                    /   'Q4G',
                                    /   'COQUE_3D',
                                  #   large-shell element
                                    SHB8
                                    /       'SHB8',
                                  #   concrete-reinforcing
                                    grills
                                    /   'GRILLE',
                                    /   'GRILLE_MEMBRANE',
                                  # assembled grills
                    combustible
                    homogeneous
                                    /   'ASSE_GRIL',
                                  # 2D plates and shells
                                    /   'COQUE_AXIS',
                                    /   'COQUE_C_PLAN',
                                    /   'COQUE_D_PLAN',
                                  # 3D bars and cables
                                    /   'BARRE',
                                    /   '2D_BARRE',
                                    /   'CABLE',
                                    /   'CABLE_POULIE',
                                  # 2D discrete elements
                                    /   '2D_DIS_T',
                                    /   '2D_DIS_TR',
                                  # 3D discrete elements
                                    /   'DIS_T',
```

```
                                                    /   'DIS_TR',
                                                # 3D beams
                                                    /   'POU_D_E',
                                                    /   'POU_D_EM',
                                                    /   'POU_D_T',
                                                    /   'POU_C_T',
                                                    /   'POU_D_TG',
                                                    /   'POU_D_TGM',
                                                    /   'POU_D_T_GD',
                                                    /   'FLUI_STRU',
                                                # pipes
                                                    /   'TUYAU_3M',
                                                    /   'TUYAU_6M',

                                  /   ♦  PHENOMENE :      'THERMIQUE'
                                      ♦  MODELISATION :# 3D continuum
                                                    /   '3D',
                                                    /   '3D_DIAG',
                                                # 2D continuum
                                                    /   'PLAN',
                                                    /   'AXIS',
                                                    /   'AXIS_DIAG',
                                                    /   'AXIS_FOURIER',
                                                    /   'PLAN_DIAG',
                                                # 3D shell
                                                    /   'COQUE',
                                                # 2D shell
                                                    /   'COQUE_AXIS',
                                                    /   'COQUE_PLAN',

                                  /   ♦  PHENOMENE :      'ACOUSTIQUE',
                                      ♦  MODELISATION : # 3D continuum
                                                          '3D',
                                                        # 2D continuum
                                                          'PLAN',

                          )
                |  AFFE_SOUS_STRUC :   (
                          ♦  /   TOUT   =  'OUI',
                             /   MAILLE =  l_mail,            [l_maille]
                                 )
                          )  ;
```

3 Operands

3.1 Operand MAILLAGE

♦ MAILLAGE = ma

Name of the associated mesh on which the elements are assigned.

Comments :

For axisymmetrical models, the axis of revolution is the Y-axis on the mesh. The whole structure must be meshed with $X \geq 0$.

3.2 Keyword AFFE

♦ | AFFE

Defines the entities in the mesh and the types of elements which will be assigned to them. For each case, we can introduce a list of models. The overload rule applies between different models, from left to right.

For example :
```
AFFE=_F(
TOUT='OUI',PHENOMENE='MECANIQUE',MODELISATION=('AXIS','AXIS_SI'),
```

The different models "overload" each other: AXIS_SI overloads AXIS onr the mesh where AXIS_SI exists.

Comment :

The code stops with an <F> error if the models in the list are not all of the same dimension (for example MODELISATION=('3D', 'D_PLAN'). Moreover, in the case of AFFE, the specified meshes with the same order of dimension as the model must all be assigned. Otherwise, the code gives off an <A>larm warning. This warning protects a user using models with holes . If, for example, only the AXIS_SI model is used with a mesh that does not contain TRIA6.

The entities within the mesh are specified by these operands :

Operand :	Content / Meaning :
TOUT	Assignment to the whole of the mesh (but not the nodes !)
GROUP_MA	Assignment to a list of grouped meshes
GROUP_NO	Assignment to a list of grouped nodes (see comment)
MAILLE	Assignment to a list of meshes*
NOEUD	Assignment to a list of nodes (see comment)

Comment :

Use of elements that are assigned only to nodes does not allow the assignment of materials via AFFE_MATERIAU. Because of this, these elements cannot be used in either STAT_NON_LINE [U4.51.03] or DYNA_NON_LINE [U4.53.01]. In this case, it is necessary to make a preliminary mesh. POI1 using keyword CREA_POI1 in CREA_MAILLAGE [U4.23.02].

Using such elements is thus reserved for linear calculations on discrete elements, of which all properties are assigned by AFFE_CARA_ELEM.

The element typs is specified by these operands :

Operand :	Content / Meaning
PHENOMENE	Physical phenomenon modelled (associated equation of conservation)
MODELISATION	Type of interpolation or discretization

3.2.1 Operands PHENOMENE and MODELISATION

- / - PHENOMENE
- MODELISATION

Are obligatory for each occurrence of the keyword factor AFFE. These two keywords define the one-to-one way in which the element type is assigned to a mesh type. The models are described in these documents :

U3.11.01-D Models POU_D_T, POU_D_E, POU_C_T, BARRE
U3.11.02-D Models DIS_T, DIS_TR
U3.11.03-D Models CABLE and CABLE_POULIE
U3.11.04-D Models POU_D_TG, POU_D_TGM
U3.11.05-B Model POU_D_T_GD
U3.11.06-B Models TUYAU_3M et TUYAU_6M
U3.11.07-A Model POU_D_EM
U3.12.01-C Models DKT - DST - Q4G
U3.12.02-C Models COQUE_C_PLAN, COQUE_D_PLAN, COQUE_AXIS
U3.12.05-A Model SHB8
U3.12.03-C Model COQUE_3D
U3.12.04-B Model GRILLE
U3.13.01-C Models AXIS, D_PLAN, C_PLAN
U3.13.02-E Model AXIS_FOURIER mechanical
U3.13.03-C Models 2D_FLUIDE, 2D_FLUI_STRU, AXIS_FLUIDE, AXIS_FLUI_STRU
U3.13.04-B Model 2D_CONTACT
U3.13.05-B Models AXIS_SI, D_PLAN_SI, C_PLAN_SI
U3.13.06-A Models D_PLAN_GRAD_EPSI, C_PLAN_GRAD_EPSI
U3.13.07-C Models AXIS_INCO, D_PLAN_INCO
U3.13.08-C Models D_PLAN_HM, D_PLAN_HHM, D_PLAN_THM, D_PLAN_THH, D_PLAN_THHM, AXIS_HHM, AXIS_THM, AXIS_THH, AXIS_THHM
U3.13.09-A Models 2D_DIST et 2D_DIST_R
U3.13.12-B Model D_PLAN_ABSO
U3.13.13-A Model 2D_FLUI_ABSO
U3.14.01-D Model 3D and 3D_SI (mechanical)
U3.14.02-C Models 3D_FLUIDE, FLUI_STRU, 2D_FLUI_PESA
U3.14.03-B Model 3D_CONTACT
U3.14.06-C Model 3D_INCO
U3.14.07-C Model 3D_HM, 3D_HHM, 3D_THM, 3D_THH, 3D_THHM
U3.14.09-B Model 3D_ABSO
U3.14.10-B Model 3D_FLUI_ABSO
U3.14.11-A Model 3D_GRAD_EPSI
U3.22.01-D Models COQUE, COQUE_PLAN, COQUE_AXIS – THERMIQUE phenomenon
U3.23.01-D Models AXIS, PLAN, AXIS_DIAG and PLAN_DIAG
U3.23.02-D Model AXIS_FOURIER (thermal)
U3.24.01-D Model 3D and 3D_DIAG (thermal)
U3.33.01-D Models 3D and PLAN of some ACOUSTIQUE phenomenon

3.3 Keyword AFFE_SOUS_STRUC

♦ | AFFE_SOUS_STRUC

Is only usable for a model utilising static sub-structures. [U1.01.04].

♦ / MAILLE : l_mail

l_mail is the list of supermeshes which one wants to assign in the model. As with finite elements, it is not compulsory to assign all the meshes in the mesh. It is AFFE_MODELE that confirms which substructures will be used in the model. The difference with classical finite elements is that on the supermeshes, neither the MODELISATION nor the PHENOMENE is chosen because the macro-element (constructed by the operator MACR_ELEM_STAT [U4.62.01])will be assigned on the supermesh which has its own model and its own phenomenon (those which were used to calculate it).

/ TOUT : 'OUI'
All the (super) meshes are assigned..

3.4 Operand VERIF

◊ VERIF:

Value	Content / Meaning
'MAILLE'	Verifies the assignment to all the requested meshes unless an error occurs
'NOEUD'	Verifies the assignment to all the requested nodes unless an error occurs.

Default : no verification is applied.

4 Execution Phases

From the keywords PHENOMENE and MODELISATION, one creates a data-structure specifying the element type attached to each mesh. There is a possibility of the creating supplementary meshes of the type POI1 when assignments are made on nodes or groups of nodes. This is why it is necessary to use CREA_MAILLAGE [U4.23.02] to create POI1 meshes that are usable in the command file (for STAT_NON_LINE for example).

A brief reminder of the assignments is systematically printed in the message file.

5 Example

```
mo = AFFE_MODELE    (   MAILLAGE =   ma,
                        VERIF =      (   'MAILLE', 'NOEUD'),
                        AFFE  = (_F  (   GROUP_MA     =   gma,
                                         PHENOMENE    =   'MECANIQUE',
                                         MODELISATION =   '3D'   ),
                                 _F  (   GROUP_NO     =   gno,
                                         PHENOMENE    =   'MECANIQUE',
                                         MODELISATION =   'DIS_T'   ),
                        ) )
```

For a model with phenomenon 'MECANIQUE', one assigns:

- 3D iso-parametric elements to the mesh group gma
- discrete elements with 3 dof of translation to the node group gno.