To introduce a new modelization into AFFE_MODELE

Summarized:

This document describes what it is necessary to do to introduce a new modelization into operator AFFE_MODELE of *Code_Aster* .

In a few words, it is necessary:

- To introduce a small block of text into the catalog of the phenomena and modelization,
- To write one or more catalogs of elements.
- To write the routines of elementary computations specific to the elements of this new modelization.

The object of this document is only to have the catalog phenomene_modelisation__.catastrophes and general structure of a catalog of type_element.

The rest of the actions to be made is described in the document [D5.02.05] “To introduce a new elementary computation”.

Contents

1 the choice

of the modelization are carried out through operator AFFE_MODELE of Code_Aster . *For example* , the user will write in his command file: KID

```
= AFFE_MODELE (MAILLAGE = MAIL, AFFE=
                      _F (TOUT = "OUI', MODELISATION = "AXIS_JOINT_HMS",
PHENOMENE
                                    = "MECHANICAL")) In
```

the purpose to be able to propose to the user of other modelizations, one will describe in this document a methodology to introduce a new modelization into Code_Aster . *To introduce*

a modelization into Code_Aster *requires* to raise the following questions: In

- which phenomenon I will add my modelization? Which
- are geometrical and topological dimensions of the finite elements? Which
- are meshes concerned with this modelization? Which
- are "principal" and the edge elements the elements? Which
- are the attributes which one can define? Which
- are realizable computations with this modelization? We

will answer these questions in this document. Other

relative questions with the finite elements are treated in other documents: [D5.02

- .01] How to introduce a new quantity or new components (CMP) into an existing quantity? [D5.02
- .02] How to introduce a new type of mesh (type_maille) or a new element of reference (ELREFE)? [D5.02
- .05] How to introduce a new elementary computation? Modification

2 of the catalog of the phenomena and modelizations Catalogues

- to modify: phenomenon _modelisation__.catastrophes Localization
- : ... /catalo /compelem Presentation

2.1 of the catalog phenomenon _modelisation__.catastrophes This catalog

breaks up into 3 parts: a part dedicated to the mechanical phenomenon, another with the thermal phenomenon, and another with the acoustic phenomenon. For

each phenomenon, a block corresponding to each modelization is presented. For example, for modelization "AXIS_JOINT_HMS" of the "MECHANICAL" phenomenon, we have: PHENOMENE

```
__MECHANICAL  CODE_        _"ME"  … MODELISATION
```

```
__"AXIS_JOINT_HMS" DIM    2 2 CODE_   _"JH2" ATTRIBUT
      __THM=OUI  AXIS=  YES MESH
      __QUAD8 ELEMENT    __HM_J_   AXQ8S NETS
      __SEG3 ELEMENT     __HM_J_   AXSE3 We
```

will present the key word of this block: MODELISATION

- __DIM
- CODE_
- _ATTRIBUT
- __MESH
- __ELEMENT
- __Key words:

2.1.1 MODELISATION , DIM , CODE_ _key word

- MODELISATION __provides the name of the modelization. In the example above, it is modelization "AXIS _JOINT_HMS". Key word

- DIM respectively provides topological dimension and geometrical dimension: Geometrical
  - dimension corresponds corresponding to geometrical reference, topological
  - dimension corresponds corresponding to meshes. In

    this example, topological dimension is identical to geometrical dimension, but it is not always the case. For example

  , a modelization "DKT" (thin shells) collects elements whose meshes support are of dimension 2 (triangles, quadrangles), however the nodes of the mesh are expressed in the reference 3D (according to X, Y , Z) . One thus has for this modelization: DIM 2 3 key word

- CODE_ _provide as its name indicates it, a code. It is about a character string of 3 characters making it possible to identify the modelization. For modelization "AXIS _JOINT_HMS", the selected code is "JH2" . This " code" is inevitably different for all the modelizations. It is a form of alias (on 3 characters exactly) of the name of the modelization. ATTRIBUT

2.1.2 __At

the second line, one has the possibility of providing behind the key word one or more attributes optional ATTRIBUT __. Example:

Are ATTRIBUT __THM=OUI AXIS=OUI A what

useful? They make it possible

to provide information in source FORTRAN and to consider processing according to this information. In the example above, attribute AXIS= YES can be questioned in a routine of elementary computation in order to modify the weight of integration of Gauss points. The definition

of the attributes is presented in the form of comments in the catalog phenomenon _modelisation__.catastrophes. One briefly presents some attributes in the table below:
Attributes

Descriptions	ALIAS
8 Character strings	of 8 natures formed by the concatenation of 3 codes (phenomenon, modelization, type of mesh) DIM_TOPO
_MODELI Dimension	topological of the modelization to which belongs element DIM_COOR
_MODELI Dimension	of the space of topological mesh
DIM_TOPO _MAILLE	Dimension of the mesh AXIS
"OUI'	if the element is axisymmetric D_PLAN
"OUI'	if the element is in plane strain C_PLAN
"OUI'	if the element is in plane stress FOURIER
"OUI'	if the element is intended for a study by decomposition in mode of Fourier INCO
"OUI'	if the element is incompressible LUMPE
"OUI'	if the element is lumped PIPE
"OUI'	if it element is a pipe section GRILL
"OUI'	if the element is an element of grid THM "
OUI'	if the element is an element of THM XFEM
Standard	of element XFEM (Heavyside , cracktip, mixed) Table

2.1.2 2.1.2-1 few attributes Note:

the first 4

attributes of this list (ALIAS8, DIM_ REPORT _MODELI, DIM_COOR_MODELI, DIM_TOPO_MAILLE) do not have to be explicitly defined in the catalog. They "are calculated" starting from compulsory information of the catalog: keywords DIM , CODE_ _, … the various

attributes defined in this catalog are assigned to all the type_ element of the modelization. If it is wanted that an attribute is associated only with one type_ element, it is then necessary to define this attribute in heading "ENTETE" of the catalog of type_element. How

to recover the value of the attribute in source FORTRAN? Routines

LTEATT and TEATTR give access the attributes of a type_ element. NET

2.1.3 , ELEMENT In

the following lines, one informs the types of meshes and the element types which one wishes to attach to the modelization. About

the same one line, one informs the type of mesh and the type of associated finite element. In

our example, line: NET

```
__QUAD8 ELEMENT     __HM_J_    AXQ8S means
```

that one allots for this modelization, element of type HM_J_ AXQ8S with the quadrangular mesh with 8 nodes of the type QUAD8 . This element

is known as “the main thing**”** **because** it is about an element whose dimension of the mesh corresponds to the topological dimension of the modelization (equal to 2 for this example). The elements

whose dimension of the mesh is lower than the topological dimension of the modelization are called element “of edge**”** **(or** of skin), i.e. which they border the principal elements. For

this example, element HM_J_ AXSE3 corresponds to the edge element of element principal HM_J_ AXQ8S. Introduction

2.2 of a new modelization into the catalog phenomenon _modelisation__.catastrophes First of all

, it is necessary to be placed in the part corresponding to the phenomenon of your modelization (MECHANICAL, THERMAL or ACOUSTIC). Then core with the writing of the block corresponding to your modelization. You

must start with: to choose

- a name for your modelization (with more the 16 characters), to allot
- a code to your modelization (3 characters exactly), to know
- the topological dimension of your modelization. A this

stage, and while having taken knowledge of paragraph 2.1.1 4 can write the first line (by respecting the indentation): MODELISATION

```
__xxxx  DIM     xxxx  xxxx CODE_    _xxxx  Then
```

, at line following, one gives you the possibility of adding or not attributes to your modelization. You can do some if you think not of needing some in source FORTRAN. The following

stage consists in choosing: the types

- of meshes which you wish to associate with your modelization. You can consult the catalog type_ maille__.catastrophes directory compelem meshes to become acquainted with the types of present in Code_Aster *as well as* their elements of reference, *the name*
- of the type of the finite element which you wish to associate with each type of mesh. You must determine a name of with more the 16 characters which is sufficiently explicit to know the type of its mesh to the reading of its name. You

can thus add the following lines: NET

```
__xxxx  ELEMENT    __xxxx  Us
```

have just answered some questions concerning the new modelization.

To go further, it is necessary to write it (or them) catalogues (S) describing the new finite elements of the modelization, as well as routines FORTRAN te00ij.f carrying out their elementary computations. In

the following paragraph, we describe (rather briefly) the catalog of type_element. For

further details on this catalog and the writing of associated routines FORTRAN, one will refer to the document [D5.02.05] “To introduce a new elementary computation” Creation

3 of the catalogs of elements the catalogs

- of elements are localised in… /catalo /typelem They carry
- all (or almost) a name starting by “obstructing”. Presentation

3.1 of a generic catalog of elements gener_xxxx.cata We

will present the broad outlines. For more information, the reader is invited to consult D5.02.05 documentation (“ to introduce *an elementary computation”). We*

will present an extract of the catalog gener_th3d_ 3.catastrophes in order to and the familiarize with the key words of the catalog various parts which composes it. We will propose the computation option FLUX_ELGA which makes it possible to calculate heat flux with Gauss points of the element starting from the field of temperature. We will restrict this option with element principal THER_HEXA20 . GENER_TH3D_

```
3TYPE_GENE__ENTETE
ELEMENT THER_HEXA20 MAILLE HEXA      20ELREFE H20
   GAUSS_  _RIGI       =FPG27  MASS=FPG27  GANO=FPG8ELREFE  __QU8
   GAUSS_  _RIGI       =FPG9  MASS=FPG9MODE   _LOCAL__CMATERC
= ADRSJEVE
    ELEM (I1) CCAMASS   = CAMASS
   ELEM  __(C   ALPHA   BETA  KAPPA  X Y  Z) NGEOMER    = GEOM_R
   ELNO  __IDEN   __(X Y Z) EFLUXPG               = FLUX_R
   ELGA  __RIGI   (FLUX FLUY     FLUZ)     VECTEUR     __MVECTTR
= VTEM_R
    DDL_THERMATRICE__MMATTTR
= MTEM_R
    DDL_THER DDL_THEROPTION__FLUX_ELGA
62
   IN CCAMASS   PCAMASS  NGEOMER PGEOMER  CMATERC PMATERC
                            DDL_THER PTEMPER  CTEMPSR PTEMPSROUT
                            _   _EFLUXPG
                       PFLUX  _RTEXTE  1: Extracted
```

1the catalog gener_th3d_ 3.catastrophes One starts

- by writing the name of the catalog (GENER_TH3D_3) and his type (TYPE_GENE_ _) at line following. For each

- element to be referred in the catalog, it is necessary to write a block ENTETE. In the example describes above, one restricts the catalog with element THER_HEXA20 , from where the presence of only one block ENTETE. One reference in block ENTETE: the type of mesh (MAILLE), elements of reference (ELREFE) and the families of Gauss points (GAUSS) which will be used in elementary computations. The following block

- corresponds to the local modes (MODE_LOCAL): one defines in it the local modes used for all the computation options. It is necessary to specify for each mode_local: quantity and the component as well as the “localization” of field (ELNO, ELGA or ELEM). The last

- block is the block of options (OPTION): one defines in it the options calculated by type_element . For each option, one specifies: the name of the calculated option

(FLUX_ELGA), the number of the routine FORTRAN te00ij which carries out computation (62), the couples (local mode, parameter) of the inputted fields, and the couples (local mode, parameter) of the output fields. Writing of

3.2 a generic catalog of element gener_xxxx.cata You must in general

write 2 catalogs of elements: a first corresponding

- to the principal elements, a second corresponding
- to the edge elements. For example, for

the modelization 3D of the thermal phenomenon, the catalogs of elements are: gener_th3d_3.catastrophes

- for the principal elements, gener_th3d_2.catastrophes
- for the edge elements. The writing of

a catalog of elements breaks up by the following stages: One starts by

- choosing a name to be allotted to your catalog (of prefix "gener_"). It is necessary to be able
- to integrate it into the catalogs of elements present in Code_aster. For the first line of the catalog, it is necessary to write: %& AJOUT TYPELEM After having written
- the name of the catalog and its type, it is necessary to write the blocks of heading. For each principal element or each edge element (defined in the specific catalog phenomene_modelisation __.catastrophes to your modelization), you must write block ENTETE as described in paragraph 3.1. Then 8 writes
- the computation options relative to your modelization behind OPTION, as described in paragraph 3.1. 8