Code_Aster

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Version default

Date : 30/10/2014 Page : 1/8
Clé : U4.43.02 Révision :
c67316b3ce96

Operator `INCLUDE_MATERIAU`

1 Goal

To recover the characteristics of a preset material in the Catalogue Materials of *Code_Aster*.

The files of the Catalogue Materials are located in the sub-directory `material` repertoire of installation.
These catalogues are not diffused in the version of Code_Aster open-source.

Code_Aster

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Version default

Date : 30/10/2014 Page : 2/8
Clé : U4.43.02 Révision :
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Contents

Code_Aster

Version default

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Date : 30/10/2014 Page : 3/8
Clé : U4.43.02 Révision :
c67316b3ce96

2   Syntax

```
chechmate = INCLUDE_MATERIAU (

    ♦  /  ♦  NOM_AFNOR    = nomafnor,                    [KN]

           ♦  TYPE_MODELE    =  /  'Ref.',
                               /  'BY',

           ♦  ALTERNATIVE    =  /  'With' with 'Z',

           ♦  TYPE_VALE    =  /  'NOMI',
                             /  'MAXIMUM',
                             /  'MINI',

       /  ♦  FILE       = 'filename',              [KN]


    ◊  EXTRACTION   = _F (
              ♦  COMPOR     = l_compor,                 [l_K16]
              ♦  TEMP_EVAL   = temp,                    [R]
                    ),
    ◊  UNITE_LONGUEUR  =  /  'Me,                        [DEFECT]
                         /  'MM'   ,

    ◊  PROL_GAUCHE    =  /  'EXCLUDED',                  [DEFECT]
                        /  'CONSTANT',
                        /  'LINEAR',

    ◊  PROL_DROITE    =  /  'EXCLUDED',                  [DEFECT]
                        /  'CONSTANT',
                        /  'LINEAR',

    ◊  INFORMATION          =  /  1,
    [DEFECT]
                            /  2,

             )
```

chechmate is of type [to subdue].

Code_Aster

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Version default

Date : 30/10/2014 Page : 4/8
Clé : U4.43.02 Révision :
c67316b3ce96

3 Catalogue Materials Aster

Code_Aster have a Catalogue Materials whose objectives are:

- to provide the users, the data materials necessary to the realization of digital studies,
- to ensure the perenniality of information,
- to guarantee the reliability and the coherence of the available data,
- and to facilitate and automate the access to the data.

In *Code_Aster*, the material is defined by a set of characteristics necessary to the implementation of a law of behavior, which are introduced by the general order DEFI_MATERIAU.

In the Catalogue Materials, the material is indexed by its designation in standard AFNOR.

The Catalogue Materials distinguishes two types of materials according to the type of study:

- " **material of reference** " for generic studies. It corresponds to a set of products manufactured according to the same well defined specification. It is characterized by values median, minimal and maximum typical of the population concerned. It is this material which it is advised to use if one does not have a perfect description of material to model,
- " **particular material** " for specific studies. It corresponds to a well identified product or a concept of material given. This material is characterized by specific values of its properties, together with extreme values related on the heterogeneity of material and/or uncertainty on the values. This material is finely documented in order to avoid its systematic use without precaution.

In addition, one can index various materials (of reference or individual) corresponding to the same designation AFNOR. The RCC-M distinguishes, for the same designation AFNOR, the characteristics material following the technical specification of reference, the type of product (forged, rolled, tube, sheet,…) and dimensions of the component. In order to take account of this additional dimension, in the Catalogue Materials, one associates with each material a letter of the alphabet.

To summarize, in the Catalogue Materials the materials are indexed by a character string which is composed of the concatenation:

- designation in standard AFNOR,
- word ref. (if material of reference) or BY (if particular material),
- of a letter of the alphabet.

For example: 18MND5_REF_A

The Catalogue Materials is presented in two distinct forms:

- a form "files" usable by *Code_Aster* by the order INCLUDE_MATERIAU. They is a set of files having for name the character string previously described (for example 18MND5_REF_A) and for extension one of the following character strings: NOMI (for the median values), MINIS (for the minimal values) and MAXIMUM (for the maximum values),
- a form "cards", where the user can consult characteristic materials in the form of tables and obtain the origin of the characteristics. This shape of the catalogue is accessible on the site from *Code_Aster* : www.code-aster.org (only in Intranet EDF, in the section Documentation M). Each card material is the object of an independent validation by department MMC.

Lastly, the order INCLUDE_MATERIAU allows to use files out of Catalogue Materials and thus out of qualified field.

Code_Aster

Version
default

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Date : 30/10/2014   Page : 5/8
Clé : U4.43.02   Révision :
c67316b3ce96

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4   Operands
NOM_AFNOR/TYPE_MODELE/ALTERNATIVE/TYPE_VALE   or FILE

The classical use of the Catalogue Materials consists in using the first 4 keywords.

These operands make it possible to choose material to be used and thus to define its name according to the rule presented to the preceding paragraph.

♦   NOM_AFNOR   = nomafnor,   [KN]

Allows to specify the designation of material in standard AFNOR (for example: 18MND5).

♦   TYPE_MODELE   = / 'Ref.',
                         / 'BY',

Allows to specify if they are the characteristics of material of reference or those of the particular material which one wishes to use.

♦   ALTERNATIVE   = / 'With',
                         ......
                         / 'Z',

Allows to specify the alternative of the material which one wishes to use (the characteristics are in general different according to the thickness or the diameter and this for the same designation in standard AFNOR). The paragraph of description of material of the card material makes it possible to know the alternative interesting the user.

♦   TYPE_VALE   = / 'NOMI',
                       / 'MAXIMUM',
                       / 'MINI',

Allows to specify if one wants to use the median values, minimal or maximum.

The keyword FILE allows as for him to include the values of properties materials stored in an unspecified file out of Catalogue Materials and thus out of qualified perimeter.
One provides to this keyword the complete name of the file (in absolute or relative) to include.

5   Keyword EXTRACTION

The values of characteristics material contained in the Catalogue Materials are generally tables of values depending on the temperature. So one informed in the Catalogue Materials only certain keywords ratios control DEFI_MATERIAU : those for which the operands are defined by functions (for example: ELAS_FO, THER_NL,…). On the other hand, the keywords factors for which the operands are defined by realities (for example: ELAS,…) in the various files composing the form "files" of the Catalogue Materials are not indicated.
One can however generate these keywords in the order DEFI_MATERIAU by the keyword EXTRACTION by specifying the behavior or the behaviors which one wishes to generate and by specifying the value of the temperature to which one wishes to extract the values from the function.

5.1   Operand COMPOR

♦   COMPOR   = l_compor   [l_K16]

Code_Aster

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Version default

Date : 30/10/2014 Page : 6/8
Clé : U4.43.02   Révision :
c67316b3ce96

Indicate the name of the keywords factors of DEFI_MATERIAU who will be extracted. For example, 'ELAS' or 'THER'.

5.2 Operand TEMP_EVAL

♦ TEMP_EVAL = temp   [R]

Temperature to which, one wishes to extract the values from characteristic materials. For example, one creates in the order DEFI_MATERIAU the operand $E = E_0$ under the keyword factor ELAS by interpolating the value with T_0 operand $E = E (T)$ defined in the catalogue. The type of interpolation is determined by the corresponding function of the catalogue. In general, the interpolation is linear, prohibited extrapolations.

6 Operand UNITE_LONGUEUR

◊ UNITE_LONGUEUR = / 'Me ,   [DEFECT]
                  / 'MM' ,

Allows to use the data of the catalogue material with the millimetre like unit of length.

The values indicated in the catalogue material are and remain in meters. If the user specifies UNITE_LONGUEUR = 'MM' in the order INCLUDE_MATERIAU, that means that the user wishes to handle units of length in millimetres, and orders it INCLUDE_MATERIAU carry out the transformation of the units.

7 Prolongation of the field of definition

The properties materials are defined in the absence of keyword EXTRACTION by functions of the temperature whose field of definition is strict (equivalent to a prolongation EXCLUDED).
It happens sometimes that during iterations of the resolution of the problem (in the case of thermal shock for example), the properties are evaluated out of this field. That led to the stop of calculation.
The user can then choose to authorize the prolongation, constant or linear, of the functions on the left and/or on the right of field of definition. He must then make sure that the results are valid and in particular that the values of the temperature with convergence are well in the initial terminals.

PROL_GAUCHE (resp. PROL_DROITE) the type of prolongation on the left (resp makes it possible to define. on the right), i.e. for the lower values (resp. higher) than the field of definition.

8 Operand INFORMATION

◊ INFORMATION =/ 1,   [DEFECT]
           / 2,

1   pas d' impression of the contents of the file included,
2   impression of the contents of the file included, in the file 'MESSAGE'.

Code_Aster

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

*Version
default*

Date : 30/10/2014 Page : 7/8
Clé : U4.43.02   Révision :
c67316b3ce96

9   Example of use

```
BEGINNING ()

    ….      ….      .....      ….

MAT3 = INCLUDE_MATERIAU(   NOM_AFNOR    = '18MND5',
                           TYPE_MODELE  = 'ref.',
                           ALTERNATIVE    = 'with'       ,
                           TYPE_VALE    = 'NOMI',
                           INFORMATION      = 2 )

chmat3 = AFFE_MATERIAU (   GRID = my,
                 AFFE=_F (   GROUP_MA= ('STRIA1'. , 'SQUA'),
                             MATER=MAT3))

END ()
```

10   To define its own material

> *This paragraph is halfway between the use and the development. One uses a not qualified overload which is responsibility for the user/developer.*

One approaches here the definition of a catalogue for a material given by a user.
The catalogue thus developed will be able to integrate the catalogue managed in configuration after the required qualification, but in the meantime it can be used in overload.
For that, it is enough to define a particular repertoire where the new catalogue will be stored, and to use the argument – rep_mat [name of the repertoire] in the launching of the study (*cf.* [u1.04.00]).

10.1   Management of the unit of length of the grid

To manage the change of unit, one has the function coef_unit.
coef_unit (N) 1 is worth. if UNITE_LONGUEUR is worth 'Me, and is worth 10^n if UNITE_LONGUEUR is worth 'MM'.
For example, for a size in MPa, one will write:

```
E = 2.1e11 * coef_unit (- 6)
```

10.2   Extraction and evaluation according to the temperature

In the writing of the catalogue, it is necessary to determine which are the keywords turned over in the presence ofEXTRACTION and those which are not it.

Example: If one does not request the extraction from a given temperature, one wishes to obtain the elastic properties depending on the temperature, keyword ELAS_FO. Whereas if one requests these properties from 20°C, one wishes to obtain the keyword factor ELAS.

One will write extraction=True (in the catalogue) to indicate that the keyword factor must be preserved if EXTRACTION is present (in the command set), extraction=False to indicate that it should be preserved if EXTRACTION is absent. If extraction is not informed, the keyword is preserved in both cases.

One indicates which function must be evaluated according to the temperature (only variable of currently supported order) by using the function temp_eval :

Code_Aster

Version default

Titre : Procédure INCLUDE_MATERIAU
Responsable : COURTOIS Mathieu

Date : 30/10/2014 Page : 8/8
Clé : U4.43.02   Révision :
c67316b3ce96

`E = temp_eval (_A2)` where `_A2` is a function defined before.

10.2.1 Syntax, words reserved

The catalogue does not call `DEFI_MATERIAU` itself, it defines only the list of the keywords.
For that, the function should be used `defi_motscles` and to name `keywords` the result of this function:

        keywords = defi_motscles (…)

A catalogue material is not an macro-order. However, he obeys the same rules concerning the naming of the intermediate concepts (functions of the properties depending on the temperature in particular). In order not to cause conflicts with the concepts of the command set of the user, it is necessary to take care to prefix the intermediate concepts of the catalogue with one '*_*' (*cf.* [d5.01.02]) and to destroy the concepts which can the being.

Lastly, a limited number of orders are usable in a catalogue: those which primarily handle the functions (to consult the file `Macro bibpyt//include_materiau_ops.py` to have the exhaustive list).