

Summarized Procedure

MACR_ECREVISSE:

The purpose of macro-command `MACR_ECREVISSE` is calculating the fluid flow (air/vapor/liquidates) through one (or several) fissures (S) crossing (S) in a structure modelled in 2 dimensions. It carries out for that, with each time step, the sequence of two codes:

- `Code_Aster` which makes it possible to know the thermomechanical state of the Ecrevisse
- structure which carries out the thermohydraulic flow computation through crack.

In practice, the macro-command is given the responsibility to carry out successively for all time step:

- a linear thermal computation
- a quasi-static mechanical computation
- to call the macro-command `CALC_ECREVISSE`, which it will be in load:
 1. to recover the profile of crack
 2. to call a third macro-command `MACR_ECRE_CALC` which will generate the command file and will launch Ecrevisse
 3. to extract and copy the results
 4. checking the imposed criteria are checked and if need be redécouper time step.

The principal concept of output is the data structure result of mechanical computation (`evol_noli`). It is also possible to obtain the data structure results of thermal computation, like 2 arrays, one containing the flows at every moment, the other recapitulating the data relating to cracks. By creating a directory of output in the profile of study, one will be able to recover all the outputs there relating to Ecrevisse.

It is possible to carry out poursuites of computation.

Notice

It is necessary to specify key word `DEBUG=_F` (`HIST_ETAPE=' OUI'`) in `debut` or `POURSUITE` to use `MACR_ECREVISSE`.

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1 Drank

This command allows the sequence of Code_Aster with the ECREVISSE software. The principle rests for each time step, with a successive call to:

- THER_LINEAIRE to obtain the thermal state of structure
- STAT_NON_LINE to obtain the mechanical state of structure
- to the ECREVISSE code to know the flow conditions of the fluid.

Notice

It is necessary to specify key word `DEBUG=_F (HIST_ETAPE=' OUI')` in `debut` or `POURSUITE` to use `MACR_ECREVISSE`.

2 Syntax

```
MACR_ECREVISSE (

# OUTGOING CONCEPTS
  ◇ ARRAY          = CO ("array")          [CO]
  ◇ DEBIT           = CO ("flow")          [CO]
  ◇ TEMPER=        CO ("temp")            [CO]

# ETAT_INITIAL
  ◇ ETAT_INIT=     _F (
    ◆ EVOL_NOLI=   evol_noli              [evol_noli]
    ◆ EVOL_THER=   evol_ther              [evol_ther]
    ◆ NUME_ORDRE=  nume_ordre             [I]
  ),

# MODEL THERMOMECHANICAL
    ◆ MODELE_MECA=      m_meca              [modele_sdaster]
    ◆ MODELE_THER=      m_ther              [modele_sdaster]

# LISTE Of TIMES
  ◆ LIST_INST = list_inst                  [listr8]

# DONNEES FOR STAT_NON_LINE AND THER_LINEAIRE
  ◆ CHAM_MATER=chmat          [cham_mater]
  ◇ CARA_ELEM=                carac        [cara_elem]
  ◆ EXCIT_MECA   = _F (
    ◆ CHARGE     = chi          [char_meca]
    ◇ FONC_MULT=  fi           [function]
    ◇ TYPE_CHARGE = "FIXE_CSTE" [DEFAULT]
                          /"SUIV"
                          /"DIDI"
  )
  ◆ CONTACT=      char_contact
[char_contact]
  ◆ EXCIT_THER=   _F (
    ◆ CHARGE=     chi          [char_ther]
    ◇ FONC_MULT=  fi           [function]
  )
  ◆ COMP_INCR=    _F (see the document [U4.51.11])
  ◇ NEWTON=       _F (see the document [U4.51.03])
  ◇ CONVERGENCE=  _F (see the document [U4.51.03])
```

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

```

    ◇ PARM_THETA=      theta      [DEFAULT=0.57]                [R]

# DONNEES GEOMETRICAL RELATING TO the CRACK
  ◆ FISSURE=          _F (
    ◆ GROUP_MA=gma                [grma]
    ◆ GROUP_NO_ORIG=ogno           [grno]
    ◆ GROUP_NO_EXTR=egno          [grno]
    ◆ SECTION=              /"ELLIPSE"
                              /"RECTANGLE"
    ◇ LISTE_COTES_BL=          / (0, max (abs_curv))          [DEFAULT]
                              /lcb1                          [listr8]
    ◆ LISTE_VAL_BL=            lvbl                            [listr8]
    ◆ ZETA = zeta                [R]
    ◆ RUGOSITE = eps              [R]
    ◆ OUVERT_REMANENTE = ouv_rem  [R]
    ◇ TORTUOSITE=              /1                              [DEFAULT]
                              /wrong                         [R]
    ◇ PREFIXE_FICHER=/          "FISSURE1"                   [DEFAULT]
                              /"prefix"                     [kN]
  ),
# DONNEES RELATING To the ECOULEMENT
  ◆ ECOULEMENT=          _F (
    ◆/ PRES_ENTREE=          EP                [R]
      /PRES_ENTREE_FO=      fpe                / [function]
      /                      /                 / [three-
dimensions function]
      /                      /                 / [formula]
    ◆/ PRES_SORTIE=          PS                [R]
      /PRES_SORTIE_FO=      fps/              [function]
      /                      /                 / [three-
dimensions function]
      /                      /                 / [formula]
    ◆ FLUIDE_ENTREE =/1      ,
      /2,
      /3,
      /4,
      /5,
      /6
    # if FLUIDE_ENTREE = 1,3,4 or 6
    ◆/TEMP_ENTREE=te        [R]
      /TEMP_ENTREE_FO=fte/  [function]
      /                      /                 / [three-
dimensions function]
      /                      /                 / [formula]
    # if FLUIDE_ENTREE = 2 or 5
    ◆/TITR_MASS=xe          [R]
      /TITR_MASS_FO=fxe/
[function]
      /                      /                 / [three-
dimensions function]
      /                      /                 / [formula]
    # if FLUIDE_ENTREE = 4 or 5
    ◆/PRES_PART=pae        [R]
      /PRES_PART_FO=fpae/  [function]
      /                      /                 / [three-
dimensions function]
      /                      /                 / [formula]
  ),

```

```
# CHOICE OF the MODELS FOR ECREVISSE
  ◆ MODELE_ECRE=      _F (
    ◇ IVENAC=/                0,                [DEFAULT]
                                /1,
    ◆ ECOULEMENT=      /"SATURATION",
                                /"GELE",
    # if ECOULEMENT= "GELE"
    ◆ PRESS_EBULLITION=  peb,                [R]

    ◆ FROTTEMENT=/                -14,
                                /-12,
                                /-11,
                                /-4,
                                /-3,
                                /-2,
                                /-1,
                                /0,
                                /1,
                                /2,
                                /3,
                                /4,
                                /11,
                                /12,
                                /14,
    # if FROTTEMENT negative
    ◆ REYNOLDS_LIM=relim                [R]
    ◆ FROTTEMENT_LIM=frtlim                [R]
    ◆ TRANSFERT_CHAL=/                -12,
                                /-11,
                                /-2,
                                /-1,
                                /0,
                                /1,
                                /2,
                                /11,
                                /12,
    # if TRANSFERT_CHAL negative
    ◆ XMINCH=                xminch                [R]
    ◆ XMAXCH=                xmaxch                [R]

# Convergence criterion MACRO-COMMAND
  ◆ CONV_CRITERE=      _F (
    ◆ TEMP_REF=                tref                [R]
    ◆ PRES_REF=                pref                [R]

    ◆ CRITERE=/                "TEMP_PRESS"                [DEFAULT]
                                /"TEMP"
                                /"PRESS"
                                /"EXPLICITE"
    # if CRITERE different from EXPLICITE
    ◇ NUME_ORDRE_MIN=n                [I]
    ◇ PREC_CRIT=prec                [R]
    ◇ SUBD_NIVEAU=nb                [I]
    ◇ SUBD_PAS_MINI=nbpas                [R]
  ),
# CONVERGENCE DIGITAL OF ECREVISSE
  ◇ CONVERGENCE_ECREVISSE=      _F (
    ◇ KGTEST=/                kgtest                [R]
                                /0.5                [DEFAULT]
```

Titre : Procédure MACR_ECREVISSE
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```

        ◇ ITER_GLOB_MAX=/          itnmax          [ I ]
                                   /400             [ DEFAULT ]
        ◇ CRIT_CONV_DEBI=/         precdb          [ I ]
                                   /1.E-5           [ DEFAULT ]
    ),
# GENERAL
◇ COURBES=/          "AUCUNE"          [ DEFAULT ]
                                   /"POSTSCRIPT"     [ kN ]
                                   /"INTERACTIF"     [ kN ]
◆/ LOGICIEL=logiciel          [ kN ]
   /          VERSION=' 3.2.1'       [ kN ]

◇ ENTETE=titer
◇ IMPRESSION=/          "NON"          [ DEFAULT ]
                                   /"OUI '
◇ INFO=/              1              [ DEFAULT ]
                                   /2)
```

3 Operands

3.1 Operands COUNT/TEMPER/DEBIT

```
◇ TEMPER= CO ("temp")
◇ ARRAY  = CO ("array")
◇ DEBIT  = CO ("flow")
```

These key words make it possible to give the name of the concepts leaving the macro-command, namely

- **ARRAY** : an array of 7 columns giving for each time step: the dimension z , flux, stagnation pressure (Pa), the temperature of the fluid ($^{\circ}C$), the coefficient of heat exchange by convection ($W.m^{-2}.^{\circ}C^{-1}$), the name of crack.
- **TEMPER** : the data structure result of thermal computation
- **DEBIT** : the value of the flow ($kg.s^{-1}$) to each time step and for each crack

Note:

- *all the concepts of output are optional; it nevertheless is highly advised to inform has minimum **TEMPER**, if not it is impossible to control the fields of temperature in structure and to make a poursuite*
- *if the concept is reentrant, key word **TEMPER** should not be here indicated but under the key word **ETAT_INIT**, operand **EVOL_THER**.*

3.2 Key word ETAT_INIT

```
◇ ETAT_INIT=      _F (
  ◆ EVOL_NOLI=    evol_noli
  ◆ EVOL_THER=    evol_ther
  ◆ NUME_ORDRE=   nume_ordre
```

Key word allowing to define the initial state in the frame of a poursuite of the macro-command.

3.2.1 Operand EVOL_NOLI

Name of the concept of the `evol_noli` type from where will be extracted the mechanical state.

3.2.2 Operand EVOL_THER

Name of the concept of the `evol_ther` type from where will be extracted the thermal state. This concept will be enriched during computation.

3.2.3 Operand NUME_ORDRE

the initial state to continue computation will be defined starting from the number of archilage `NUME_ORDRE` for `evol_noli` and `evol_ther`.

3.3 Operands MODELE_MECA/MODELE_THER

```
◆ MODELE_MECA=   m_meca
◆ MODELE_THER=   m_ther
```

These key words make it possible to inform the name of the model (`m_meca`) whose elements are the object of mechanical computation and the name of the model (`m_ther`) whose elements are the object of thermal computation.

3.4 Operand LIST_INST

◆ LIST_INST = list_inst

List of time step which corresponds to imposed times of computation. In the event of recutting, times are inserted in this list.

3.5 Operand CHAM_MATER

◆ CHAM_MATER=chmat

Name of the affected material field to the mesh. Attention, this field must understand the data associated with the structural mechanics behavior and the thermal behavior (key word THER of DEFI_MATERIAU). It is also necessary to have defined the reference temperature under AFFE_VARC.

3.6 Operand CARA_ELEM

◇ CARA_ELEM= carac

This key word makes it possible to inform, the characteristics of the beam elements, bars, shell, pipe, discrete element, when they are present in the model. Attention, this key word is used only for mechanical computation but is not transmitted for the operator of thermal (to avoid any problem with the bars).

3.7 Key word EXCIT_MECA

```
◆ EXCIT_MECA=           _F (
◆ CHARGE=               chi
◇ FONC_MULT=            fi
◇ TYPE_CHARGE         =   /"FIXE_CSTE"
                         /"SUIV"
                         /"DIDI"
                         )
```

It acts here to inform the boundary conditions of the mechanical problem, as well as the possible mechanical loadings which apply to structure. Syntax is identical to that of key word EXCIT of STAT_NON_LINE but it is not possible to control a loading. See the document [U4.51.03].

3.8 Key word CONTACT

◆ CONTACT =char_contact

One informs here the conditions of contact between the lips of crack, which can be closed during computation. The goal of this key word is that to avoid the interpenetration of the lips which can occur under the effect of the flow of the fluid.

3.9 Key word EXCIT_THER

```
◆ EXCIT_THER     = _F (
      ◆ CHARGE         = chi
      ◇ FONC_MULT=     fi
                         )
```

It acts here to inform the boundary conditions of the thermal problem as well as the possible thermal loadings. Syntax is identical to that of key word EXCIT of THER_LINEAIRE.

See the document [U4.54.01].

3.10 Key word COMP_INCR

It acts here to inform the constitutive law which will be used to solve the mechanical problem. See the document [U4.51.03].

3.11 Key word NEWTON

It acts here to inform the parameters of the algorithm of Newton to solve the mechanical problem. This key word is identical to that of STAT_NON_LINE, it is thus appropriate to refer to the document [U4.51.03].

3.12 Key word CONVERGENCE

It acts here to inform the convergence criteria for mechanical computation. Syntax corresponds to that of STAT_NON_LINE (see the document [U4.51.03]).

Note: it can be necessary to use RESI_GLOB_MAXI rather than RESI_GLOB_RELA, when there is no mechanical loading (if not, null force, therefore RESI_GLOB_RELA indefinite).

3.13 Operand PARM_THETA

It acts here to inform the value of the parameter θ characteristic of the theta-diagram used to solve the thermal problem. See the document [U4.54.01].

3.14 Key word FISSURES

◆ CRACK

This key word makes it possible to define all the parameters having milked in a crack. Several occurrences of this key word are possible if there are several cracks.

3.14.1 Operand GROUP_MA

◆ GROUP_MA = gma

Groups of meshes defining the lips of crack. One gives the group of the lower lip and higher.

3.14.2 Operands GROUP_NO_ORIG and GROUP_NO_EXTR

◆ GROUP_NO_ORIG = ogno

◆ GROUP_NO_EXTR = egno

Makes it possible to define the two nodes groups which define the two ends of cracks in order to direct it.

3.14.3 Operand SECTION

◆ SECTION= /"ELLIPSE" /"RECTANGLE"

It acts here to define the bypass section of flow (plane perpendicular with the plane of modelization). This one can be elliptic or rectangular. One of dimensions of this section corresponds in keeping with crack in the plane of the modelization. This one is at every moment given by the macro-command. Other dimension corresponds in keeping with crack out of plane of modelization. This one is fixed during all computation and must be indicated thanks to operands LISTE_COTES_BL and LIST_VAL_BL.

3.14.4 Operands LISTE_COTES_BL/LISTE_VAL_BL

◆ LISTE_COTES_BL = lcb1

◆ LISTE_VAL_BL = lvb1

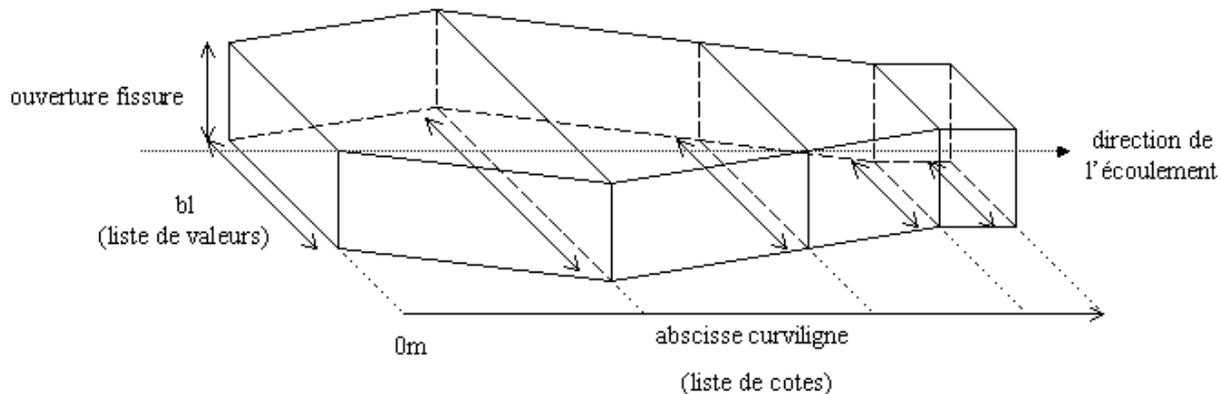


Figure 3.14.4-a: Representation of crack

to characterize the size of crack in the plane not modelled, it is necessary to provide the value of the "small" axis of the elliptic section or the width of the rectangular section at least in 2 points.

LISTE_COTES_BL makes it possible to inform the curvilinear abscisses where the dimension of crack is given and LIST_VAL_BL makes it possible to give dimension. If LISTE_COTES_BL is not indicated, LISTE_VAL_BL must contain the width of crack at the entry and the exit of crack.

3.14.5 Operand RUGOSITE

◆ RUGOSITE = eps

absolute Roughness of the wall (in meters). This value influences result only if friction is calculated by Ecrevisse (operand FROTTEMENT >0) and if flow is not laminar any more

3.14.6 Operand ZETA

◆ ZETA = zeta

Ratio loss of singular load at the entry (without dimension).

3.14.7 Operand OUVERT_REMANENTE

◆ OUVERT_REMANENTE = ouv_rem

Value of the remanent opening (in meters) for Ecrevisse computation corresponding to the real hydraulic opening of crack when the two lips are with the contact. This translated the fact that, even when the crack is closed, a small amount of fluid will forward, in particular because of roughness. This parameter depends on the material: for example, it is about $10 \mu m$ for the concrete.

This key word is thus taken into account thus during hydraulic computation (Ecrevisse), but not by Code_Aster : it can thus happen well that hydraulic computation is carried out with the remanent opening, is that the contact is activated in mechanical computation.

3.14.8 Operand TORTUOSITE

◆ TORTUOSITE = wrong

If the crack is tortuous, one can admit that, seen fluid, the length of crack is higher than the thickness of the crossed wall. This coefficient, which by default is worth 1, makes it possible to take into

account this phenomenon. The length of crack will be thus equal to $\frac{L}{tort}$ with $tort \leq 1$

3.14.9 Operand PREFIXE_FICHER

◆ PREFIXE_FICHER= prefix

Makes it possible to define the name of the textual file and output files Ecrevisse in file REPE_OUT (curved), and thus to distinguish the files associated with each crack.

3.15 Key word ECOULEMENT

◆ ECOULEMENT

It acts in this key word to define the nature of the fluid and its characteristics.

3.15.1 Operands PRES_ENTREE/PRES_ENTREE_FO

◆/ PRES_ENTREE =pe
/PRES_ENTREE_FO=fpe

This operand makes it possible to give the stagnation pressure (Pa) or its evolution in the course of time, upstream of crack. It must be understood enters $215 \cdot 10^5 Pa$ and $10^5 Pa$.

3.15.2 Operands PRES_SORTIE/PRES_SORTIE_FO

◆/ PRES_SORTIE = EP
/PRES_SORTIE_FO= fpe

This operand makes it possible to give the stagnation pressure (Pa) or its evolution in the course of time, in output of crack. It must be understood enters $215 \cdot 10^5 Pa$ and $10^5 Pa$ being higher than the pressure of entry (if not, there is no flow and computation stops).

3.15.3 Operand FLUIDE_ENTREE

◆ FLUIDE_ENTREE =1,2,3,4,5 or 6

This operand makes it possible to define the state of the fluid at the entrance of crack:

- 1: Supercooled or saturated water;
- 2: Diphasic fluid;
- 3: Saturated or overheated vapor;
- 4: Air + overheated vapor;
- 5: Air + saturated vapor;
- 6: Air alone.

According to the situation of the fluid, only some of the following characteristics are with being informed.

3.15.4 Operands TEMP_ENTREE/TEMP_ENTREE_FO

◆/ TEMP_ENTREE=te
/TEMP_ENTREE_FO=fte

This operand makes it possible to inform the temperature ($^{\circ}C$) or its evolution in the course of time, upstream of crack. It must be indicated if the fluid at the entry is "supercooled or saturated Water", "saturated or overheated Vapor", "Air + overheated vapor" or "Air alone".
(operand FLUIDE_ENTREE = 1,3,4, or 6).

3.15.5 Operands TITR_MASS/TITR_MASS_FO

◆/ TITR_MASS =xe
/TITR_MASS_FO =fxe

This operand makes it possible to inform the mass vapor title, or its evolution in the course of time, upstream of crack. It corresponds to the relationship between the mass of vapor and the mass of water liquid and vapor. It must be indicated if the fluid at the entry is "Fluid diphasic" or "Air + saturated vapor" (operand FLUIDE_ENTREE = 2 or 5).

3.15.6 Operands PRES_PART/PRES_PART_FO

◆/ PRES_PART= pae
/PRES_PART_FO= fpae

This operand makes it possible to inform the partial pressure of air (Pa) or its evolution in the course of time, upstream of crack. It must be indicated if the fluid at the entry is "Air + overheated vapor" or "Air + saturated vapor" (operand `FLUIDE_ENTREE=4` or `5`).

3.16 Key word `MODELE_ECRE`

◆ `MODELE_ECRE`

This key word makes it possible to inform the models which will be used by Ecrevisse to compute: the flow of the fluid.

3.16.1 Operand `IVENAC`

◇ `IVENAC=` 0 or 1,

When this operand is activated (`IVENAC=1`), ECREVISSE computation is carried out with taking into account of the vena contracted (pressure loss in entry). If not (case by default), computation will be carried out without this option of modelization.

3.16.2 Operand `ECOULEMENT`

◆ `ECOULEMENT=` /"SATURATION",
/"GELE"

In the absence of air and in the presence of water (operand `FLUIDE_ENTREE=1` or `2`), this operand makes it possible to choose between the model homogeneous with the equilibrium and the model of flow "GELE" characterized by a non-zero fraction of metastable fluid.

3.16.3 Operand `PRESS_EBULLITION`

Pressure of boiling (Pa) to the model providing only for cold flow.

3.16.4 Operand `FROTTEMENT`

It acts here to define how friction is calculated. The valid values are:
-14, -12, -11, -4, -3, -2, -1, 0, 1, 2, 3, 4, 11, 12, 14 .

Value 0 corresponds to a computation without friction.

For the negative values, the user fixes the value of the coefficient of kinetic friction for the turbulent flows. For the positive values, friction in turbulent flow is calculated starting from the coefficient of roughness. Moreover, for the values superiors to 10, the model used for the laminar flow is connected with that in turbulent flow. Otherwise, a discontinuity is present.

According to the value used, the computation of dynamic viscosity is done differently (important for diphasic flows), cf Ecrevisse documentation.

3.16.5 Operands `REYNOLDS_LIM/FROTTEMENT_LIM`

limiting Coefficient of Reynolds and coefficient of kinetic friction imposed for a limiting Reynolds higher than Reynolds.

A to provide only if `FROTTEMENT < 0`.

3.16.6 Operand `TRANSFERT_CHAL`

This operand makes it possible to determine whether one wants or not to take into account the heat transfer by convection between the fluid and the wall. The valid values are:
-12, -11, -2, -1, 0, 1, 2, 11, 12 .

Value 0 corresponds to a computation without heat transfer (adiabatic).

The other values correspond to various options for the computation of the convection coefficient (differences only for the laminar mode). To refer to Ecrevisse documentation.

3.16.7 Operands `XMINCH/XMAXCH`

This operator has meaning only in the diphasic cases, if `TRANSFERT_CHAL < 0`. He makes it possible to inform the value of the mass gas titles delimiting the zone of transition between the models from computation from the convection coefficient, cf Ecrevisse documentation.

3.17 Key word `CONV_CRITERE`

the macro-command calculates three criteria at every moment making it possible to thus estimate the importance of the changes occurred between two time step and the validity of the sequence carried out. To compute: these criteria, the user must define values of reference for the pressure and the temperature, allowing to quantify the acceptable variation.

$$e_T = \frac{\text{Max}(T_t - T_{t-1})}{T_{\text{REF}}}$$
$$e_P = \frac{\text{Max}(P_t - P_{t-1})}{P_{\text{ref}}}$$
$$e_G = \sqrt{e_T^2 + e_P^2}$$

Then, it can activate if it wishes it the recutting of time step if the value of the criterion is lower than a given value.

The gained experience watch however that it is to better try to optimize the list of time to count on the recutting of time step, because Ecrevisse computations are relatively long

3.17.1 Operand `CRITERE`

Makes it possible to define the nature of the criterion used to manage time step in the macro-command. The possible values are:

- `EXPLICITE` : no recutting some is the value of indicators
- `TEMP` : there will be recutting according to the value of e_T
- `PRES` : there will be recutting according to the value of e_P
- `TEMP_PRES` : there will be recutting according to the value of e_G

3.17.2 Operand `TEMP_REF`

Reference temperature for the computation of the criterion in temperature of the macro-command.

3.17.3 Operand `PRES_REF`

Pressure of reference for the computation of the criterion in pressure of the macro-command.

3.17.4 Operand `PREC_CRIT`

Value with which one compares the error obtained to activate or not the recutting of time step (1 per default). For example for the temperature: $e_T < \text{PREC_CRIT}$

3.17.5 Operand `NUME_ORDRE_MIN`

Sequence number from which the criterion of error is taken into account. Convergence is forced on the lower sequence numbers. One often uses this operand time step to start the activation of the criterion of error starting from the second and to force convergence on the first step which is often delicate with treating, since one imposes brutal loadings on initial time.

3.17.6 Operand `SUBD_NIVEAU`

Number of recutting of time step authorized. Beyond this value, one redécoupe more and one leave the macro-command.

3.17.7 Operand `SUBD_PAS_MINI`

Time step in lower part of which one does not cut out any more.

3.18 Key word CONVERGENCE_ECREVISSE

3.18.1 Operand KGTEST

Parameter of the iterative algorithm of Ecrevisse.

Must be understood enters 0 and 1. Fixed by default at 0.5, one can have to so put a slightly lower value difficulties of convergence on the flow are observed.

3.18.2 Maximum operand

ITER_GLOB_MAXI Number of iterations authorized for the computation of the flow (400 per default).

3.18.3 Operand CRIT_CONV_DEBI

Accuracy used for the convergence of the computation of the flow. It is the value compared to which Ecrevisse tests the flow max and min in its process of computation.

$$\frac{G_{max} - G_{min}}{G} \leq \text{CRIT_CONV_DEBI}$$

By default with 10^{-5} , of the values until 10^{-2} improves the computing time without losing much accuracy.

3.19 Operand COURBES

```
◇ COURBES=/ "AUCUNE" [DEFAULT]
             /"POSTSCRIPT"
             /"INTERACTIF"
```

Makes it possible to generate or not the curves of output of Ecrevisse. If the curves are generated, they are stored in file REPE_OUT with the format postscript (all times are in the same file postscript). In interactive mode, the curves are displayed for each time step.

3.20 Operand LOGICIEL

Makes it possible to specify "into tough" the path to find the executable one of Ecrevisse. Now, only versions 3.2 and 3.2.1 are compatible with the MACR_ECREVISSE. It is necessary obligatorily to inform this operand or alternatively operand VERSION.

3.21 Operand VERSION

Indicates the version of Ecrevisse used in the coupling. It is necessary obligatorily to inform this operand or alternatively operand LOGICIEL. Now, version 3.2.1 is used. It is the only one that one can inform under operand VERSION. If one wishes to use version 3.2, this one must be indicated under operand LOGICIEL.

3.22 Operand ENTETE

Is used to give a title to Ecrevisse computation.

3.23 Operand PRINTING

When the operand is worth "OUI", the macro one prints a summary array of the results of Ecrevisse along the curvilinear abscisse (temperature, pressure, flux, velocity, convection coefficient,...).

3.24 Operand INFO

INFO=1 : almost no display.

INFO=2 : display information concerning the convergence criterion.

4 Operation of the coupling

4.1 Principle

This macro-command was developed in a precise frame: to estimate the flows of a crack in a concrete block modelled in 2D, possibly containing the steels modelled in the form of bar (not taken into account in thermal computation). The use in any other frame must thus be done with the greatest precaution. However, it in fact 3 macro-command imbricated there, which can make it possible to use only part of the features.

The algorithm is the following:

```
Beginning of the macro
  Loop on the list of times
  MACR_ECREVISSE.py thermal
  Recovery loading and mechanical Execution
  of THER_LINEAIRE Projection
  of the thermal loading and definition of the loadings coming from Ecrevisse
  Exécutionde
  STAT_NON_LINE Entered
  CALC_ECREVISSE.py Recovery
    of the opening of crack (POST_RELEVE_T) Recovery
    of the temperature out of crack edge Entered
  MACR_ECRE_CALC.py Execution
    of ECREVISSE Recovery
    of the calculated flow and the arrays of results Extraction
  and copy of the outgoing data (CL, thermal, result Ecrevisse...) Evaluating
  of the convergence criterion (error in temperature and/or pressure) possible
  Recutting of time step the even stop following the conditions Recovery
  of information and concepts (loading,...) The detail
```

of the intermediate macro-commands, CALC_ECREVISSE and MACR_ECRE_CALC, is given in appendix. Units

4.2 One can

usually do without the units in Code_Aster *while remaining* coherent. However, for the needs for Ecrevisse, it is important to respect the international system of units here (IF), in particular for the lengths (m), the pressures (Pa), and the temperatures ($^{\circ}C$).

4.3 advice of use The mesh

must be in 2 dimensions, and the crack with a grid explicitly. So that computation is of good quality, it is necessary to optimize the mesh so that it is compatible with the phenomena which one wants to represent: mechanical loadings, thermal loadings but also the flow of the fluid. It is thus important sufficiently to refine the mesh with edges of crack if one wants to see to warm up the material. As starter of cracks, the thermal and hydraulic phenomena are fast, it is thus necessary there too to refine the mesh sufficiently. The discretization in time is also very important and must be sufficiently fine, under penalty of having important variations in the responses. It is better to try to optimize this list of times rather than to rest only on the criteria for redécouper because this strategy is much more expensive in time. The macro-command

can be réentrante. The thermal and mechanical results will be well enriched, on the other hand of new arrays of output will be created for the new list of time step. Note:

the loadings

are destroyed with each time step, as well as the material field, possible postprocessings are in fact restricted (displacement, stress and local variables with Gauss points). Example

5 use See test

zzzz218a, B and C. Référence

6 Ecrevisse Notes H-I

- 1 86-2004-00741-FR, air/water flow Simulation/vapor through a crack: software ECREVISSE version 3.0 Notes principle, HERVOUET Chantal. H-I81-2008
- 2 - 03647-FR, Modifications made to the software ECREVISSE version 3.1 to obtain ECREVISSE version 3.1.1, HERVOUET Chantal. H-I81-2009
- 3 - 00243-FR, air/water flow Simulation/vapor through a crack: software ECREVISSE version 3.1.1 User's manual, HERVOUET Chantal. Appendices

7 Syntax

7.1 of procedure CALC_ECREVISSE CALC_ECREVISSE

```

= (# CONCEPT

LEAVING ♦ CHARGE
  _MECA= CO ("char_meca      ") [CO] ♦          CHARGE
  _THER1= CO ("char_ther ") [CO] ♦          CHARGE
  _THER2= CO ("char_ther ") [CO] ♦          ARRAY
  = CO ("array      ") [CO] ♦          DEBIT
  = CO ("flow      ") [CO] # MODEL

MECHANICAL ♦ MODELS
  _MECA= m_meca [      model]          ♦ MODELS
  _THER= m_ther [      model]          # DONNEES

GEOMETRICAL RELATING TO the RESULTS ♦ RESULTAT
  = _F (♦          MECHANICAL
    = rmeca [result          ] ♦ THERMAL
    = rther [result          ] /♦ NUMERICAL
    _ORDRE= nume_ordre          [I] ♦ INST
    = urgent          [R]), #          DONNEES

GEOMETRICAL RELATING TO the CRACK ♦ CRACK
  = _F (♦          GROUP
    _MA= gma [grma          ] ♦          GROUP
    _NO_ORIG= ogno [grno          ] ♦          GROUP
    _NO_EXTR= egno [grno          ] ♦          ZETA
    = zeta [R]          ♦ RUGOSITE
    = rug [R]          ♦ OUVERT
    _REMANENTE= ouv_rem [R] ♦ PREFIXE
    _FICHIER="/FISSURE1      ", [DEFAULT] /prefix
    ♦ TORTUOSITE
    = wrong [R]          ♦ SECTION
    = "ELLIPSE          "/"RECTANGLE
    " ♦ LISTE
    _COTES_BL=/(0, max          (abs_curv)) [DEFAULT] /lcb1
    [listr8]          ♦ LISTE
    _VAL_BL= lvbl [ listr 8]          ), # DONNEES

RELATING To the ECOULEMENT ♦ ECOULEMENT
  =... idem      MACR
    _ECREVISSE /ECOULEMENT ♦ idem

  MODELS _ECRE=...      MACR
    _ECREVISSE/MODELE_ECRE # DONNEES

RELATING TO the DIGITAL CONVERGENCE ♦ CONVERGENCE_ECREVISSE
  =... idem      GENERAL
    MACR _ECREVISSE/CONVERGENCE_ECREVISSE #

COURBES,
  LOGICIEL, VERSION... =... idem      MACR
    _ECREVISSE/GENERAL ♦ INFO
  = 1 [DEFAULT      ]          /2/3
    ) Operands

```

7.2 specific to CALC_ECREVISSE Operand

7.2.1 CHARGE_MECA outgoing

Concept containing the mechanical loading provided by Ecrevisse. Operands

7.2.2 CHARG_THER 1 and CHARG_THER 2 outgoing

Concepts containing the thermal loadings provided by Ecrevisse. MECHANICAL

7.2.3 key word RESULTAT

7.2.3.1 Operand Contains

result THERMAL STAT_NON_LINE

7.2.3.2 Operand Contains

result THER_LINEAIRE Operand

7.2.3.3 NUME_ORDRE Sequence number

of time step of computation in progress. Operand

7.2.3.4 INST Value of

the time (in seconds) of time step of computation in progress. Syntax

7.3 of procedure MACR_ECRE_CALC MACR_ECRE

```
_CALC = (# CONCEPT

LEAVING ♦ ARRAY
    = CO ("array ") [CO] ♦ DEBIT
    = CO ("flow ") [CO] # DONNEES

GEOMETRICAL RELATING TO the CRACK ♦ CRACK
    = _F (♦ LONGUEUR
        = long [ R ] ♦ RUGOSITE
        = rug [R ] ♦ ANGLE
        = alpha [R] ♦ ZETA
        = zeta [ R ] ♦ SECTION
        = "ELLIPSE" "/" "RECTANGLE"
        "♦ LISTE
        _COTES_BL=/(0, max (abs_curv)) [DEFAULT] /lcb1
        [listr8] ♦ LISTE
        _VAL_BL= lvbl [ listr 8] ), # DONNEES

RELATING To the ECOULEMENT ♦ ECOULEMENT
    = idem MACR _ECREVISSE/ECOULEMENT # DONNEES

RELATING TO the PROFIL OF TEMPERATURE THROUGH the WALL ♦ TEMPERATURE
    = _F (/ ♦ GRADIENT
        = " FOURNI" ♦ LISTE
        _COTES_TEMP=lct [R] ♦ LISTE
        _VAL_TEMP=lvt [R]/ ♦ GRADIENT
```

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

```

= " IMPOSE"
1=tm1 [R] ♦
2=tm2 [R]/
= " CALCULE "
  _PAROI=epp [R] ♦
  _AMONT=alphe [R] ♦
  _AVAL=alphs [R]
=lambd [R]
  _FLUIDE_AVAL=ts [R]), #
♦ TEMP
TEMP
♦
♦ THICKNESS
CONVECTION
♦ CONVECTION
♦ LAMBDA
♦ TEMP
#
GRADIENT
DONNEES

RELATING To the ECOULEMENT ♦ ECOULEMENT
=... idem MACR
  _ECREVISSE /ECOULEMENT ♦ idem

MODEL _ECRE=... MACR
  _ECREVISSE/MODELE_ECCE # DONNEES

RELATING TO the DIGITAL CONVERGENCE ◊ CONVERGENCE_ECCE
=... idem GENERAL
  MACR _ECREVISSE/CONVERGENCE_ECCE #

COURBES,
  LOGICIEL, VERSION... =... idem MACR
  _ECREVISSE/GENERAL) Operands
```

7.4 specific to MACR_ECCE_CALC Key word

7.4.1 FISSURES Operand

7.4.1.1 ANGLE Angle of

flow compared to the ascending vertical (degrees). Operand

7.4.1.2 LONGUEUR Defines

the real length of crack (taking account of its tortuosity) Operand

7.4.1.3 LISTE_COTES_AH According to

the value of operand SECTION : ELLIPSE

: List dimensions of the points defining the main roads of the section; RECTANGLE
: List dimensions of the points defining the length of the section. Operand

7.4.1.4 LISTE_VAL_AH According to

the value of operand SECTION : ELLIPSE

: List values of the points defining the main roads of the section; RECTANGLE
: List values of the points defining the length of the section. Key word

7.4.2 TEMPERATURE Operand

7.4.2.1 GRADIENT Models

variation in temperature: Provided:

Distribution of provided temperature; Imposed
: Imposed distribution of temperature; Calculated
: Profile of temperature calculated; Operand

7.4.2.2 LISTE_COTES_TEMP Lists

dimensions for the temperatures. Operand

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

7.4.2.3 LISTE_VAL_TEMP Lists

values of temperature. Operand

7.4.2.4 TEMP1 Variation

in temperature of the wall along flow. Operand

7.4.2.5 TEMP2 Temperature

of the wall at the entry. Operand

7.4.2.6 EPAISSEUR_PAROI Thickness

of the wall (). Operand m

7.4.2.7 CONVECTION_AMONT Convection coefficient

on the surface of the wall with dimensions upstream. Operand

7.4.2.8 CONVECTION_AVAL Convection coefficient

on the surface of the wall with dimensions downstream. Operand

7.4.2.9 LAMBDA Thermal conduction

of the wall. Operand

7.4.2.10 TEMP_FLUIDE_AVAL Temperature

of the fluid with dimensions downstream.