

Commande COMBINATION_LOAD

1 Goal

This order allows of, to calculate combinations between mechanical loadings (in the field of linear elasticity and in statics) and thermal expansion, by superimposing the answers of the structure to each individual loading.

2 Syntax

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COMBINAISON_CHARGE (

♦  MODELE_MECA      =      Mo,                [model]
◇  MODELE_THER      =      mo_ther,          [model]
♦  CHAM_MATER_MECA =      chmat ,            [cham_mater]
♦  CARA_ELEM_MECA  =      carac ,            [cara_elem]
◇  CARA_ELEM_THER  =      carac_ther ,       [cara_elem]
♦  BLOCK            =      tank ,            [char_meca]
◇  BLOC_THER        =      char2 ,           [char_meca]
♦  EXCIT_MECA       =      _F (
  ♦  CHAR_MECA      =      CHari ,           [char_meca]
  ♦  NOM_CHAR        =      name ,           [K16]
  ),
◇  EXCIT_THER       =      _F (
  ♦  CHAM_MATER_THER =      chmat_ther ,     [cham_mater]
  ♦  NOM_CHAR        =      nameHT ,         [K16]
  ),
◇  LIST_INST_THER   =      list ,            [listr8]/[list_inst]
◇  BEHAVIOR          =      _F (
  ♦  / ALL           =      ' OUI' ,
  / GROUP_MA        =      g_mail ,          [l_gr_maille]
  ♦  RELATION        =      / 'ELAS' ,       [DEFECT]
  / 'MULTIFIBRE',
  / 'CABLE',
  ),
♦  TABLE_COEF      =      matable ,         [table_sdaster]
♦  CHAM_RESU        =      _F (
  ♦  NOM_CHAM        =      chpsymbo ,       [KN]
  ♦  NOM_CMP         =      lcmp ,           [l_Kn]
  ),
♦  TABLE_RESU      =      _F (
  ◇  UNIT            =      links ,          [I]
  ♦  OPTION          =      / ' COEF_COMB' ,
  / ' CALC_COMB' ,
  / ' EXTREMA' ,
  ♦  TABLE          =      tabresu ,        [table_sdaster]
  if OPTIONG = ' EXTREMA'
  ◇  CRIT_COMP       =      / 'TOUT',        [DEFECT]
  / 'MAXI',
  / ' MAXI_ABS',
  / 'MINI',
  / 'MINI_ABS',
  ),
◇  IMPRESSION       =      / 'NON' ,         [DEFECT]
  / 'YES',
  if IMPRESSION = ' YES '
  ♦  UNIT            =      links med ,      [ I ]

```

3 Principle

The order makes it possible to calculate the combinations of the mechanical loadings and thermics by superimposing the results linearly ofS loadingS individual, with elements in 3D and most elements of structure: DKT, COQUE_3D, BAR, 2D_BARRE, POU_D_T/E/EM/TGM, MEMBRANE, GRILLE_MEMBRANE/EXCENTRE, DIS_T/TR, CABLE.

Mechanical loadings pouvant to be taken into account by COMBINAISON_CHARGE are the following :

- Voluminal effort
- Nodal effort
- Effort distributed
- Variable pressure in space
- Imposed displacements

loadingS thermicsS taken into account correspond to thermal dilation, via a field of the type `cham_mater` exit of `AFFE_MATERIAL / AFFE_VARC` by affecting a field of temperature or a structure of data of the type `sd_resultat` (several fields of temperature with a list of the moments).

With each thermal loading in the order, one calculates mechanical results with `MECA_STATIQUE` or `STAT_NON_LINE`, and one creates two fields of envelope, maximum and minimal, in order to superimpose with the results of other loadings in the combinations.

Note:

The thermal calculation of the elements `MEMBRANE` beT approximated by elements `DKT`.

4 Operands

4.1 Operand **MODELE_MECA/CHAM_MATER_MECA/CARA_ELEM_MECA**

◆ `MODELE_MECA = Mo`

Name of model for mechanical calculations.

◆ `CHAM_MATER_MECA = chmat`

Name of the affected material field on the model `Mo` .

◆ `CARA_ELEM_MECA = carac`

Name of the characteristics (`carac`) elements of structure (hull, beam, pipe, bar, cable, elements discrete, etc) affected on the model `Mo`. This keyword is obligatory: it is supposed that this order is always used with elements of structure.

4.2 Operand **BLOCK**

◆ `BLOCK = tank ,`

Name of the mechanical loading to block the rigid movement of body of the structure. This loading will be present for all the combinations.

4.3 Operand **MODELE_THER / CARA_ELEM_THER/ BLOC_THER**

These three keyword are optional and they are necessary only when there exist thermal loadings for elements of structure `MEMBRANE`. Indeed elements `MEMBRANE` are not compatible with the variables of order. The order thus proposes to make an approximation by replacing them by elements `DKT` pour thermal loadings. Consequently, calculation requires a new mechanical model, where `DKT` replace `MEMBRANE`, as well as characteristics of the elements and the loading of blocking assigned to this model.

◆ `MODELE_THER = mo_ther ,`

Name of model **mechanics** for calculations with `DKT` to replace them `MEMBRANE`.

◆ `CARA_ELEM_THER = carac_ther ,`

Name of the characteristics (`carac`) elements of structure affected on the model `mo_ther` .

◆ `BLOCK_THER = chaR2 ,`

Name loading **mechanics** to block the rigid movement of body.

4.4 Keyword **EXCIT_MECA**

◆ `EXCIT_MECA = _F () ,`

This keyword factor makes it possible to describe with each occurrence a mechanical loading and its name in the table of the coefficients (see §4.6).

4.4.1 Operands **CHAR_MECA**

◆ CHAR_MECA = chari ,

chari is Chargement mechanical individual coming from the order AFFE_CHAR_MECA for the combinations.

4.4.2 Operands NOM_CHAR

◆ NOM_CHAR = name ,

Name of the loading. It must be coherent with the name indicated in the table of the coefficients (see § 4.6).

4.5 Keyword EXCIT_THER

◇ EXCIT_THER = _F () ,

This keyword factor makes it possible to describe with each occurrence a thermal loading, and possibly its name in the table of the coefficients.

The thermal loadings are taken into account under format DE cham_mater while affecting one or more fields of temperature (AFFE_VARC).

4.5.1 Operands CHAM_MATER_THER

◆ CHAM_MATER_THER = CHmat_ther ,

Name of the material field to affect thermal loadings.

Caution:

CHmat_ther comes from the order AFFE_MATERIAU but ON requires to make the assignment on grid and not it model, because thermal calculation can use two models different when there are thermal loadings for MEMBRANE.

4.5.2 Operands NOM_CHAR

◆ NOM_CHAR = nameHT ,

Name of the loading. It must be coherent with the name indicated in the table of the coefficients.

4.6 Operand TABLE_COEFF

◆ TABLE_COEF = matable ,

Name table with the coefficients of the combinations for all them loadingS.

Each column must represent a loading with a name, which is coherent with the name indicated in EXCIT_MECA/ EXCIT_THER. The table can contain more loadings than those in calculation.

Each line must represent a combination. Each coefficient will be used to multiply the loading in the corresponding combination.

4.7 Operand LIST_INST_THER

◇ LIST_INST_THER = list ,

This operand makes it possible to define a list of moments for the thermal loadings. It is necessary at the time of the presence of the thermal loadings.

4.8 Keyword BEHAVIOR

◇ BEHAVIOR = _F () ,

This keyword factor makes it possible to define the relation for specific elements. By default, ELAS for all the structure.

Although calculations of the combinations are in the elastic range, of the elements need to define explicitly specific relations:

- MULTIFIBRE for modelings POU_D_TGM , POU_D_EM
- CABLE for modeling CABLE

4.8.1 Operands ALL/GROUP_MA

◇ / ALL = ' OUI' ,
/ GROUPE_MA = g_mail,

That makes it possible to specify the elements to affect for the behavior.

4.8.2 Operands RELATION

◆ RELATION = 'ELAS' / 'MULTIFIBRE' / 'CABLE'

Relation for the elements. Prear defect all is elastic.

4.9 Keyword CHAM_RESU

◆ CHAM_RESU = _F () ,

This keyword factor makes it possible to define the fields and the components desired for postprocessings.

4.9.1 Operands NOM_CHAM

◆ NOM_CHAM = CHpsymbo ,

Name of the field desired for postprocessings.

4.9.2 Operands NOM_CMP

◆ NOM_CMP = lcmp ,

List of the names of the components of the field chpsymbo wished. It is obligatory because the components of certain fields are different for the elements of structure.

4.10 Operand TABLE_RESU

◆ TABLE_RESU = _F () ,

This keyword factor makes it possible to define the tables of postprocessings and to print them.

4.10.1 Operands TABLE

◆ TABLE = tabresu ,

Name of the table.

4.10.2 Operands OPTION/CRIT_COMP

◆ OPTION = 'COEF_COMB'/'CALC_COMB'/'EXTREMA' ,

◇ CRIT_COMP = 'TOUT'/'MAXIMUM'/'MINI'/'MAXI_ABS'/'MINI_ABS' ,

The operand OPTION allows to choose Lbe tableS of exit:

- 'COEF_COMB' for the lists of combinations and their coefficients. Each line of the table is one combination, named "COMB_i" (them I first combinations correspond to I individual loadings). Each column corresponds to an individual loading with their names like parameters (indicated in EXCIT_MECA / THER). Note: for a thermal loading, there are two columns, nom_MAX and nom_MIN. This table is practical to check the calculated combinations.
- 'CALC_COMB' for results of envelope (MAXIMUM, MINI) of all the components of the fields requested of each combination.
- 'EXTREMA' for the results of envelope of all the combinations. One can specify the choice with CRIT_CMP.

4.10.3 Operands UNIT

◇ UNIT = unittab ,

Print unit if one wishes to print the table. If absent, it is not printed.

4.11 Operand IMPRESSION/UNIT

◇ IMPRESSION = / 'NOT' , [DEFECT]
/ 'YES' ,

◆ UNIT = unitmed ,

IMPRESSION allows to print results of the fields under format MED. The file can be very heavy, therefore this operand is equalize with 'NOT' by default. If one wishes to print it, it is necessary to define UNIT.

5 Example

See the cases tests sslx300.