Description of the file of grid of *Code_Aster*

Summary:

This file makes it possible to describe a grid of *Code_Aster*. It can be built by an automatic interface between a maillor and the code, but can also be written with the hand. It contains:

- a possible title,
- a list of nodes with their coordinates,
- lists of meshs, each mesh is described by the list of the nodes which defines its topology, and its orientation,
- groups of nodes and groups of meshs.

Note:

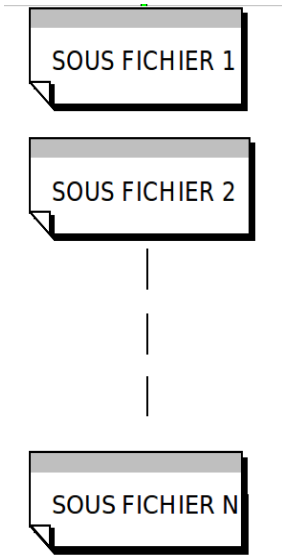
> *A concept of the type `grid`, once read on the file of grid, can be enriched using operators by Code_Aster by information which cannot be currently described in the file of grid. This relates to in particular the static under-structuring. It is of more possible, now, to create groups of nodes or meshs under study.*

Tables of content

1 Structure of the file of grid

The file of grid *Aster* first line until the first occurrence of a line is read begin with the word **END**. This keyword is obligatory.

The file of grid *Aster* consists of a succession of under files of grid, independent.



The file of **grid** *Aster* is a file with format, within the meaning of FORTRAN:

- the length of line is limited to 80 characters (any information starting from column 81 is simply ignored);
- white character ' 'and the comma', 'are only the recognized separators,
- the character % is a character reserved to indicate the beginning, until the end of the line, of a comment,
- the numerical data are interpreted in free format:

```
1  =  1.  =  1.0  =  1.E+0  =  .1E1  =  10.D-1
```

The file **grid** must contain at least:

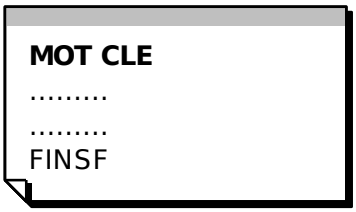
- a subfile of coordinates of nodes `COOR_2D` or `COOR_3D`, defined by 2 or 3 real numbers in a single orthonormal Cartesian reference mark.
- a subfile by type of mesh used.

It can contain, moreover, and that is recommended, a subfile `TITLE`. It is practically essential to define, at the time of the grid, the subfiles of groups of meshs `GROUP_MA` and of the subfiles of groups of nodes `GROUP_NO`.

It will be retained that the assignment of a kind of finite element, can be done only on one mesh (or exceptionally on a node for the discrete elements) described in the file grid. The loadings or the boundary conditions are affected on meshs or nodes according to the cases.

2 Structure of under file

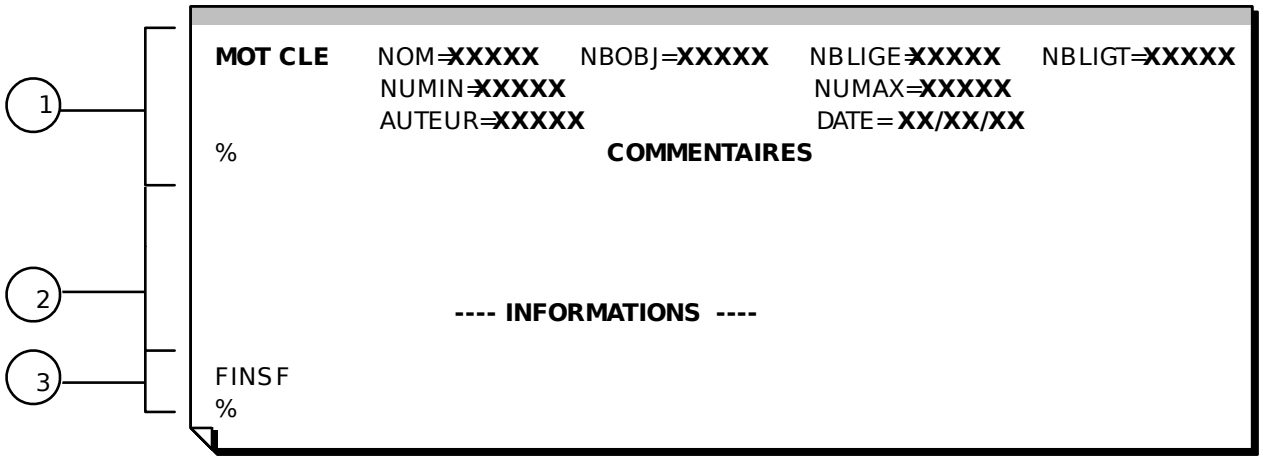
Under file starts with one **keyword** and is finished by the imposed keyword **FINSF** :



This description is sufficient for *Aster*. The most complete description is the following one:

- each under file comprises 3 parts:

1) the heading of under file,
2) contents of information,
3) the end mark of under file (FINSF).



- WORD KEY and FINSF (end of under file) are obligatory because they delimit under file inside the file of grid.
- NAME is optional. When the keyword is GROUP_MA or GROUP_NO, if NAME is absent then the first channel of character met after these KEYWORDS it will form NAME GROUP_MA or of GROUP_NO.

By convention any character string which follows the characters % is interpreted like a comment.

2.1 The heading

The role of the heading is to provide total information on the contents of under file:

KEYWORD : besides its role of delimitor of under file it informs about the nature of information which will follow. It must be in 1st line of under file **and tallied on the left.**

NAME : it is used to indicate a set of information. It must be in 1st line of the heading of under file. It is optional.

all the other keywords are currently ignored by the operator LIRE_MAILLAGE [U4.21.01].

2.2 List of information

They are the information resulting from a maillor and written in free format.
Information which this file must contain defines of the classical entities of the finite element method:

- **nodes** : points defined by one **name** and by theirs **Cartesian coordinates** in space **2D** or **3D**,
- **meshs** : topological figures **named** plane or voluminal (not, segment, triangle, quadrangle, tetrahedron,…), defined by the ordered list of the nodes which constitute them and to which will be able to apply various types of finite elements, boundary conditions or loadings. The order of the nodes directs the mesh. This orientation must be scrupulously established because it is in particular used to lay down the direction of the loadings (pressure,…).

One can also define groups of these topological entities.

- **groups of nodes** : named lists of names of nodes,
- **groups of meshs** : named lists of names of meshs.

Systematically, when one has to refer to nodes (or meshs), one will be able to refer to groups of nodes (or groups of meshs).
The interfaces with the mailleurs generate such groups automatically (according to criteria specific to the maillor).
These groups facilitate the assignment of the material characteristics on the grid, of the boundary conditions or the impression of the results. Indeed, at the time of such operations one refers to the nodes or the meshs, which it is interesting to describe by group.
The operator of *Code_Aster* DEFI_GROUP [U4.22.01] allows to create groups a posteriori on any concept of the type grid already read.
It will be noted, that all the entities handled in the code (nodes, meshs, groups of nodes, groups of meshs) are **named** and usable constantly by their name (**8 characters** to the maximum for the meshs and the nodes, **24 characters** maximum for GROUP_MA and GROUP_NO).
The “breakage” of the names is preserved: for example, 'GR_AB' is different from 'gr_ab'. The classification of the entities is never clarified: it is used for only in-house to point on the values of the various associated variables.

2.3 END of subfile

It is reserved’ and obligatory word the ' FINSF who indicates the end of under file, which begin with one WORD KEY.

3 List of the keywords (standard of under files)

TITLE Description of the file grid in documentary matter. The operators of interface with mailleurs build a specific title starting from information to each maillor

/ COOR_3D Description of the nodes by three space coordinates:
- name of the node described (or number interpreted like a name),
- 3 coordinates,

/ COOR_2D Description of the nodes by 2 coordinates :
- name of the node described (or number interpreted like a name),
- 2 coordinates,

/ POI1				points)	
/ SEG2	/ SEG3	/ SEG4		segments)	
/ TRIA3	/ TRIA6	/ TRIA7		triangles)	
/ QUAD4	/ QUAD8	/ QUAD9		quadrangles)	**connectivity**
/ HEXA8	/ HEXA20	/ HEXA27		hexahedrons)	**meshs**
/ PENTA6	/ PENTA15	/ PENTA18		pentahedrons)	
/ TETRA4	/ TETRA10			tetrahedrons)	
/ PYRAM5	/ PYRAM13			pyramids)	

GROUP_MA Group of meshs (attention the name is obligatory)

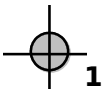
GROUP_NO Group of nodes (attention the name is obligatory)

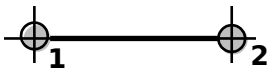
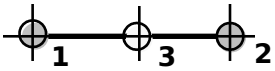
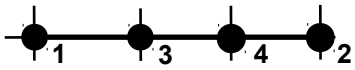
Note:

- *When a keyword was read, there remains interpreted until the appearance of FINSF .*
- *After one FINSF , any keyword not recognized (typing error) is ignored and a message is transmitted.*
- *COOR_2D and COOR_3D are mutually exclusive.*
- *The presence of a frame of reference in universal file IDEAS causes a stop of the IDEAS/Aster interface.*

4 The description of the meshs

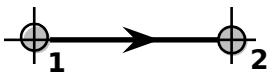
Conventions of description of the topology of the meshs in *Aster* are summarized here. The use of the meshs is given here as an indication, it is necessary to refer to specific documentation to each order.

Mesh associated with **a node** (2D or 3D)	
POI1	

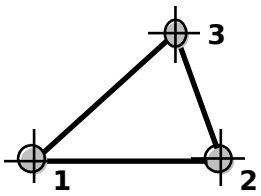
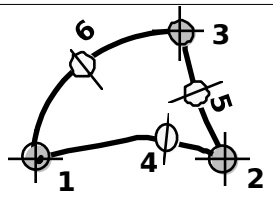
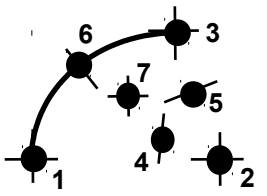
Mesh associated with **a segment** (**2D** or **3D**)	
SEG2	
SEG3	
SEG4	

Orientation :

Down the direction is laid by the order of the nodes tops

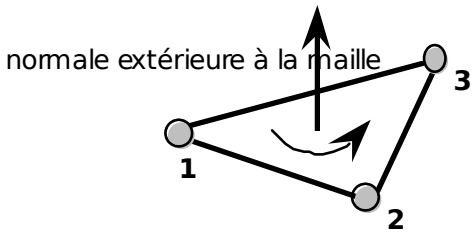


This orientation is possibly supplemented by characteristics given according to the type of affected finite element on the mesh by the keyword factor `ORIENTATION` of the operator `AFFE_CARA_ELEM` [U4.42.01].

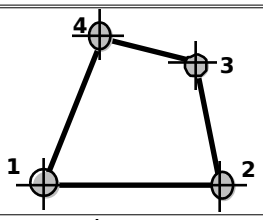
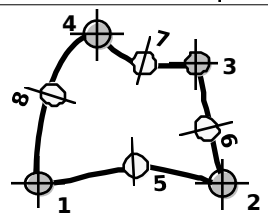
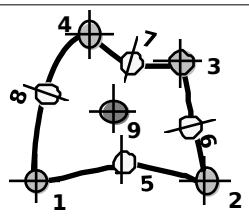
Mesh associated with **a triangle** (**2D** or **3D**)	
TRIA3	
TRIA6	
TRIA7	

Orientation:

Down the direction is laid by the order of the nodes tops which are given to define the direct trigonometrical direction.

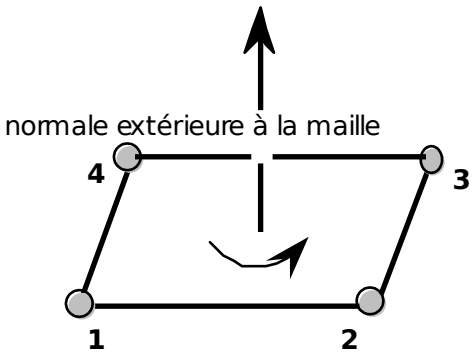


This orientation is possibly supplemented by characteristics given to the elements by the operator AFFE_CARA_ELEM [U4.42.01], in particular for the elements of hull by the keyword factor HULL.

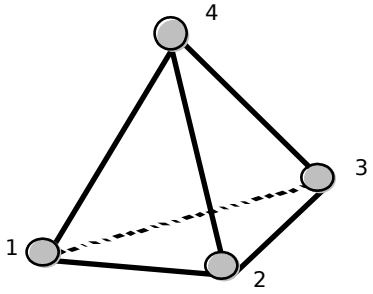
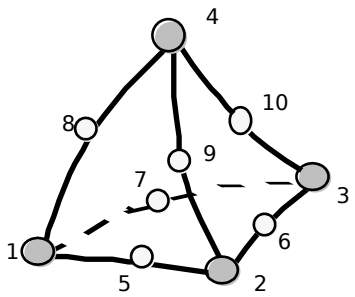
Mesh associated with **a quadrangle** (2D or 3D)	
QUAD4	
QUAD8	
QUAD9	

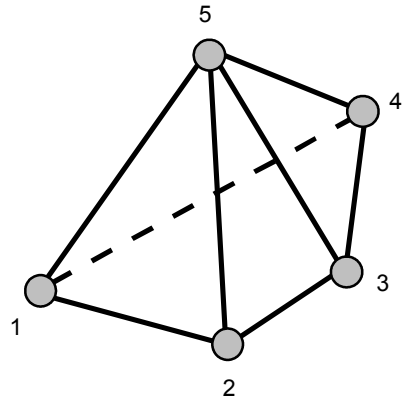
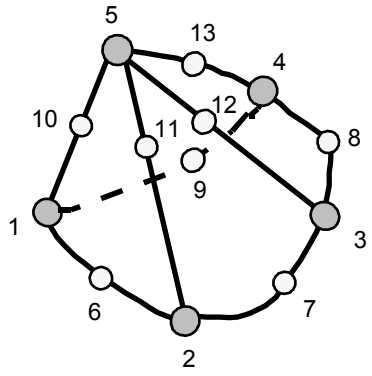
Orientation:

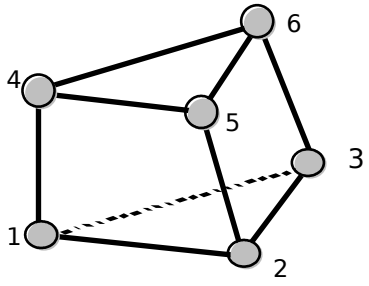
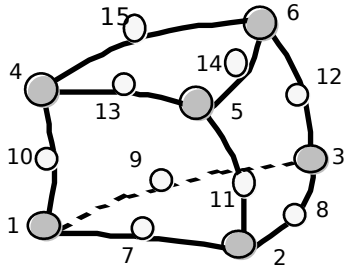
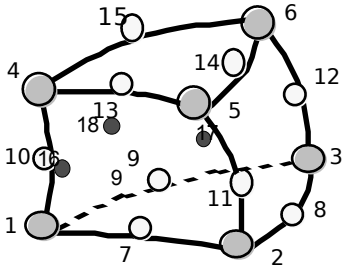
Down the direction is laid by the order of the nodes tops which are given to define the direct trigonometrical direction

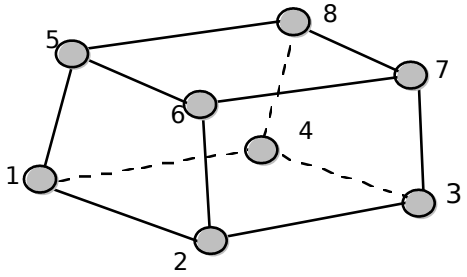
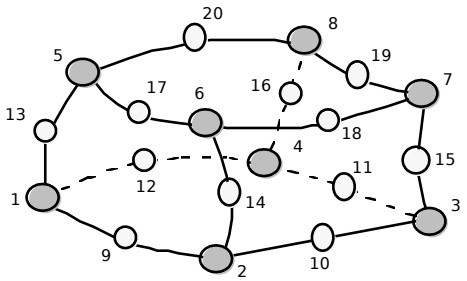
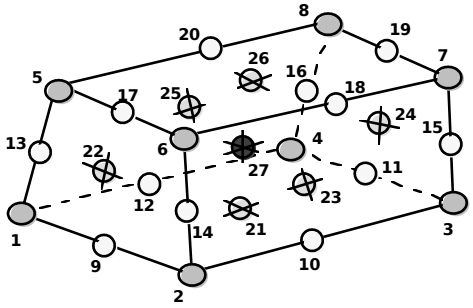
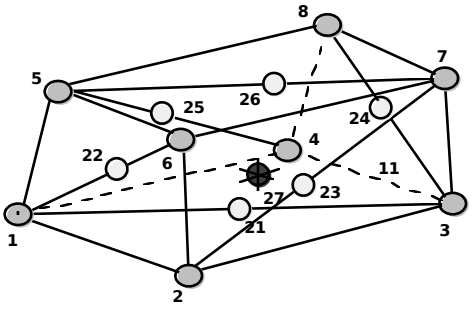


This orientation is possibly supplemented by characteristics given to the elements by the operator AFFE_CARA_ELEM [U4.42.01], in particular for the elements of hull by the keyword factor HULL.

Mesh associated with **a tetrahedron** (**3D**)	
TETRA4	
TETRA10	

Mesh associated with **a pyramid** (**3D**)	
PYRAM5	
PYRAM13	

Mesh associated with **a pentahedron** (**3D**)	
PENTA6	
PENTA15	
PENTA18	

Mesh associated with **a hexahedron** (**3D**)	
HEXA8	
HEXA20	
HEXA27	 

5 List of the formats of description

We will describe the format of description of information by a continuation of items.

5.1 Correspondence Item - Standard FORTRAN

```
NOM_DE_NOEUD
   CHARACTER*8
NOM_DE_MAILLE
    CHARACTER*8
Coordinate
   REAL*8
LIGNE_DE_TEXTE
   CHARACTER*80
```

5.2 FORMAT of reading associated with the keyword

FORMATS recognized by *Aster*	keyword
(1*NOM_DE_NOEUD, 3*COORDONNÉE)	COOR_3D
(1*NOM_DE_NOEUD, 2*COORDONNÉE)	COOR_2D
(1*NOM_DE_MAILLE, 1*NOM_DE_NOEUD)	POI1
(1*NOM_DE_MAILLE, 2*NOM_DE_NOEUD)	SEG2
(1*NOM_DE_MAILLE, 3*NOM_DE_NOEUD)	SEG3, TRIA3
(1*NOM_DE_MAILLE, 4*NOM_DE_NOEUD)	QUAD4, TETRA4, SEG4
(1*NOM_DE_MAILLE, 5*NOM_DE_NOEUD)	PYRAM5
(1*NOM_DE_MAILLE, 6*NOM_DE_NOEUD)	TRIA6, PENTA6
(1*NOM_DE_MAILLE, 7*NOM_DE_NOEUD)	TRIA7
(1*NOM_DE_MAILLE, 8*NOM_DE_NOEUD)	QUAD8, HEXA8
(1*NOM_DE_MAILLE, 9*NOM_DE_NOEUD)	QUAD9
(1*NOM_DE_MAILLE, 10*NOM_DE_NOEUD)	TETRA10
(1*NOM_DE_MAILLE, 13*NOM_DE_NOEUD)	PYRAM13
(1*NOM_DE_MAILLE, 15*NOM_DE_NOEUD)	PENTA15
(1*NOM_DE_MAILLE, 18*NOM_DE_NOEUD)	PENTA18
(1*NOM_DE_MAILLE, 20*NOM_DE_NOEUD)	HEXA20
(1*NOM_DE_MAILLE, 27*NOM_DE_NOEUD)	HEXA27
(1*NOM_DE_NOEUD)	GROUP_NO
(1*NOM_DE_MAILLE)	GROUP_MA
(LIGNE_DE_TEXTE)	TITLE

5.3 Repetition of the Format

- Any repetition of the format must start at the beginning of line.

Examples:

Is **ILLICIT** :

```
COOR_2D
N1   1.          2.        N2       1.
   3.
FINSF
```

Is **LICIT** :

```
COOR_2D
N1   1.
   2.
N2   1.
```

```
    3.
FINSF
```

6 Examples of under file

Examples of under files describing the space coordinates of 5 nodes expressed in the basic Cartesian total reference mark. Here the contents of information is the same one for the 2 pennies files, it is the mode of representation which differs.

6.1 File resulting from interface IDEAS-*Aster*

```
COOR_3D   NOM=MAILLAGE1       NBOBJ=5          NBLIGE=5     NBLIGT=12
          NUMIN=4             NUMAX=14
          AUTEUR=INTERF_ST/TF           DATE= 11/27/89
%         XMAX=10.0     YMAX=20.0     ZMAX=0.0
%         XMIN=0.0      YMIN=0.0      ZMIN=0.0

%FORMAT= (1*NOM_DE_NOEUD, 3*COORDONNÉE)
  NO4     0.0    0.0       0.0
  NO7     5.0    0.0       0.0
  NO8     5.0    5.0       0.0
  NO10    10.0   20.0      0.0
  NO14    5.0    10.0      0.0

FINSF
```

6.2 Example illustrating the possible formats of writing

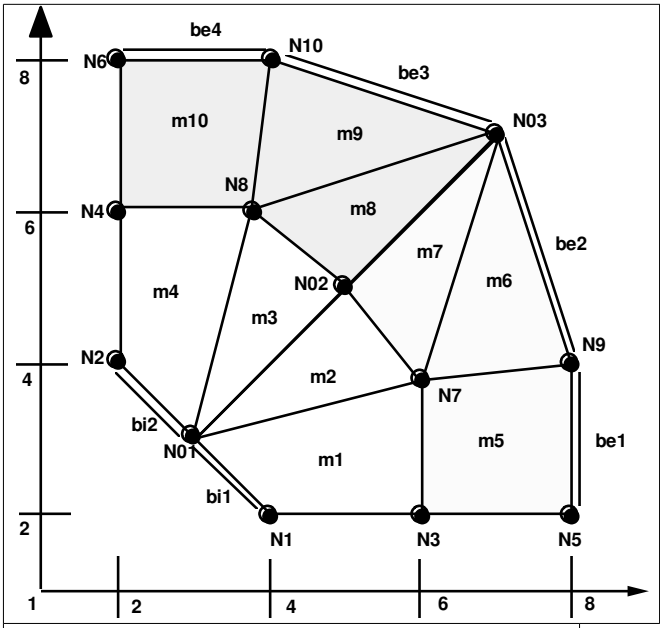
```
TITLE                      % it is the title
THAT IT IS BEAUTIFUL MY FILE GRID   % self-satisfaction
FINSF

COOR_2D             % coordinated 2D
                    % presentation sells by auction but not very advisable
   NOEUD1 0            0.0
   NOEUD2 1            1.D+0
   NOEUD3 2.213564     2.32E+00
                                                FINSF
SEG2                                          % some meshs
                MAILLE1   NOEUD1    NOEUD2    % which suits me
                MAILLE3   NOEUD2    NOEUD3
FINSF
POI1
                MAILLE2   NOEUD2
FINSF
GROUP_MA                                      % groups meshs
                GROUP1    MAILLE1   MAILLE3
FINSF
GROUP_NO        NAME = GROUP2
                NOEUD1    NOEUD2
FINSF
END                    % obligatory
```

6.3 Example illustrating the assignment by groups made up

This example is, obviously, schematic to describe the principal rules of assignment.

Grid 2D : a quarter of a plan field



For the assignment of

- loadings on the edges interior and outside:

  groups of meshs
  BORD_EXT and BORD_INT

- boundary conditions:

  groups of nodes SYME1 and SYME2

- materials:

  groups of meshs
  mail1 and mail2

```
COOR_2D
    N1  4.    2.
    N2  2.    4.
    N3  6.    2.
    N4  2.    6.
    N5  8.    2.
    N6  2.    8.
    N7  6.    3.8
    N8  3.8   6.
    N9  8.    4.
    N10 4.    8.
    N01 3.    3.
    N02 5.    5.
    N03 7.    7.
FINSF
GROUP_MA name = BORD_INT
    bi1   bi2
FINSF
GROUP_MA name = BORD_EXT
   be1 be2 be3 be4
FINSF
GROUP_NO name = SYME1
   N1 N3 N5
FINSF
GROUP_NO name = SYME2
   N2 N4 N6
FINSF
GROUP_MA name = mail1
   m5 m6 m7
FINSF
GROUP_MA name = mail2
   m8 m9 m10
FINSF
```

```
TRIA3
 m2 N01 N7   N02
 m3 N01 N02  N8
 m6 N7  N9   N03
 m7 N7  N03  N02
 m8 N8  N02  N03
 m9 N8  N03  N10
FINSF

QUAD4
 m1   N1  N3  N7   N01
 m5   N3  N5  N9   N7
 m4   N2  N01 N8   N4
 m10  N4  N8  N10  N6
FINSF

SEG2  name = B_INT
 bi1  N1   N01
 bi2  N01  N2
FINSF

SEG2  name = B_EXT
 be1  N5   N9
 be2  N9   N03
 be3  N03  N10
 be4  N10  N6
FINSF

END
```