

## To introduce a new degree of freedom and boundary conditions associated

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### Summary:

What should it be made when one adds a new degree of freedom in one of the sizes `DEPL_R`, `TEMP_R` or `PRES_C` ?

In particular, that must one make so that one can "force" this degree of freedom by dualized linear relations (`AFFE_CHAR_MECA` for example) or eliminated (`AFFE_CHAR_CINE`) ?

## 1 Presentation

When one adds a component to the one of the sizes `DEPL_R`, `TEMP_R` or `PRES_C`, it is frequent that one has to impose boundary conditions kinematics on this new degree of freedom. For example, one wants to be able to block it.

The user wanting to force it degree of freedom will be able to do it, for example, via the following orders and keywords:

| Order                            | Keyword factor                                  |
|----------------------------------|---|
| <code>AFFE_CHAR_MECA (_F)</code> | <code>DDL_IMPO</code><br><code>FACE_IMPO</code> |
| <code>AFFE_CHAR_MECA_C</code>    | <code>DDL_IMPO</code>                           |
| <code>AFFE_CHAR_THER (_F)</code> | <code>TEMP_IMPO</code>                          |
| <code>AFFE_CHAR_ACOU</code>      | <code>PRES_IMPO</code>                          |
| <code>AFFE_CHAR_CINE</code>      | <code>MECA_IMPO</code>                          |
| <code>AFFE_CHAR_CINE</code>      | <code>THER_IMPO</code>                          |

So that the program can force this new degree of freedom, it is necessary to modify/add three types of catalogues. There is no FORTRAN to modify.

- The first stage is the inscription with the catalogue of the sizes this again degree of freedom in size `DEPL_R` in mechanics, in the size `TEMP_R` in thermics, or in the size `PRES_C` in acoustics.
- The second phase consists in putting up to date catalogues of the orders `AFFE_CHAR_XXX`
- The third stage is to create the new element of Lagrange associated with its new degree of freedom. Only difference between these various elements has is the name of degree of freedom, it is almost a recopy).

Note:

The stage number 3 is necessary to be able dualiser the boundary conditions implying the new one degree of freedom. It would be useless if one wished to use only the order `AFFE_CHAR_CINE` (elimination)

In it who relates to the elements of Lagrange, the finite element allowing to introduce conditions on one degree of freedom must have as a name:

|                               |              |
|-------------------------------|--------------|
| <code>D_DEPL_R_nom_ddl</code> | in mechanics |
| <code>D_TEMP_R_nom_ddl</code> | in thermics  |
| <code>D_PRES_C_nom_ddl</code> | in acoustics |

The name of one degree of freedom is thus limited to 7 characters so that the name of the element is limited to 16 characters.

Once these 3 operations carried out, the new one degree of freedom is usable for the boundary conditions.

## 2 Example joining together the three stages to introduce the degree of freedom, GRX (warping of the beams).

### 2.1 Catalogue sizes Commons/physical\_quantities.py

It is enough to add the new component in the tuple:

```
list_cmp_depl= (
    'DX',          'DY',          'DZ',          'DRX',          'DRY MARTINI',
    'DRZ',
    'GRX',         'GLIS',         'NEAR',        'PRE [2]',     'TEMP',        'PHI',
    'DH',          'H1X',         'H1Y',        'H1Z',        'H1PRE1',     'H2X',
```

### 2.2 Modification of the catalogue of element: Elements/d\_depl\_r.py

It is enough to add the new component in the tuple:

```
for cmp in (
    'DH', 'DRX', 'DRY MARTINI', 'DRZ', 'DX', 'DY', 'DZ', 'E1X', 'E1Y', 'E1Z', 'E2X', 'E2Y',
    'E2Z',
    'E3X', 'E3Y', 'E3Z', 'E4X', 'E4Y', 'E4Z', 'GLIS', 'GONF', 'GRX', 'H1PRE1',...
```

### 2.3 Modification of the catalogues of order (AFFE\_CHAR\_XXX/\_C/\_F and AFFE\_CHAR\_CINE/\_F)

Let us take the example of the order AFFE\_CHAR\_MECA. If one wants to allow to block its degree of freedom **GRX**, this name should be added (**GRX**) at various places of the catalogue, as one can see it below.

```
#& MODIFICATION ORDERS  DATE 7/20/2010
...
AFFE_CHAR_MECA=OPER (nom= " AFFE_CHAR_MECA", op= 7, sd_prod=char_meca,
    fr= " Assignment of loads and boundary conditions..
    reentrant=',
...
DDL_IMPO          =FACT (statut=' f', max=' ** \',
...
    regles= (AU_MOINS_UN ('ALL', 'GROUP_MA', 'MESH', 'GROUP_NO', 'NODE'),
    AU_MOINS_UN ('DX', 'DY', 'DZ', 'DRX', 'DRY MARTINI', 'DRZ', 'GRX',
'NEAR', 'PHI',
    'TEMP', 'PRE1', 'PRE2', 'UI2', 'UI3', 'VI2', 'VI3', 'WI2',
...
    DRX          =SIMP (statut=' f', typ=' R'),
    DRZ          =SIMP (statut=' f', typ=' R'),
    GRX          =SIMP (statut=' f', typ=' R'),
...
FACE_IMPO          =FACT (statut=' f', max=' ** \',
...
    regles= (UN_PARMIS ('GROUP_MA', 'MESH',),
```

```

    AU_MOINS_UN ('DX', 'DY', 'DZ', 'DRX', 'DRY MARTINI', 'DRZ', 'GRX',
'NEAR', 'PHI',
                'TEMP', 'PRE1', 'PRE2', 'DNOR', 'DTAN'),
...
DRX           =SIMP (statut=' f', typ=' R'),
DRY MARTINI   =SIMP (statut=' f', typ=' R'),
DRZ           =SIMP (statut=' f', typ=' R'),
DNOR          =SIMP (statut=' f', typ=' R'),
DTAN          =SIMP (statut=' f', typ=' R'),
GRX           =SIMP (statut=' f', typ=' R'),
...

```