ZZZZ127 - Validation of the keyword LIAISON_MAIL

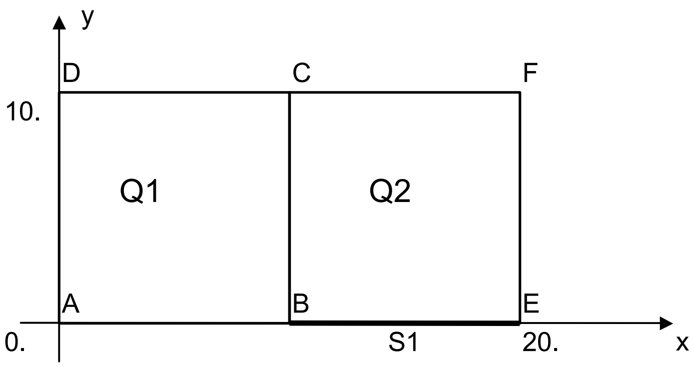
Summary:

This test validates the keyword LIAISON_MAIL orders AFFE_CHAR_MECA and AFFE_CHAR_THER. This keyword generates the linear relations between the degrees of freedom of the nodes of 2 edges which one puts in opposite. The programming is validated in 2D and 3D by intercomparison with a calculation *Aster* similar where the relations between degrees of freedom directly entered by the keyword LIAISON_DDL. One also validates the geometrical transformation (rotation/translation) applied to the one of the edges.

1 Problem of reference

1.1 Geometry

With the dealt problem is plan. The studied structure is 1 rectangle cut out in 2 squares $ABCD$ and $BEFC$.
The solution is established with a network using 2 QUAD4 corresponding to the 2 squares.



1.2 Properties of material

elastic material:

$E=10.0$ units S.I.
$\nu=0.0$

One takes $\nu=0.0$ so that one can deal with this problem plan with a layer of elements 3D by having the plane solution.

1.3 Boundary conditions and loadings

1) One applies a specific force to the point F : $FY=4.0$ u.s.i.

2) Blockings:
   not A : $DX=DY=0.$
   not D : $DX=0.$

3) Linear relations between degrees of freedom:

   loading case: cas1
   $$1.0\,DX(E)-0.5\,DY(D)-0.5\,DY(C)=0.0$$
   $$1.0\,DY(E)+0.5\,DX(D)+0.5\,DX(C)=0.0$$

   loading case: cas2
   $$1.0\,DY(E)+0.5\,DY(D)+0.5\,DY(C)=0.0$$
   $$1.0\,DY(B)+0.5\,DY(C)+0.5\,DY(F)=0.0$$

The initial conditions are of no importance here.

2 Reference solution

2.1 Method of calculating used for the reference solution

In each case, one carries out a preliminary calculation with the keyword `LIAISON_DDL` to introduce the linear relations between degrees of freedom. This calculation is used as reference to calculation with the keyword `LIAISON_MAIL` who generates these linear relations.

To obtain the desired linear relations with `LIAISON_MAIL`, one writes:

Cas1:

```
LIAISON_MAIL: (  NOEUD_2: E           MAILLE_1: Q1
                 CENTER: B            ANGL_NAUT: 90.   TRAN: (-5.  0.)  )
```

What wants to say that one eliminates the 2 degrees of freedom from the node E according to the degrees of freedom of the point E' obtained when one subjects to E a rotation of 90 degrees around B then a translation of vector (– 5.0). E' is thus in the middle of CD. The vector displacement of E is identified (after rotation of 90 degrees) with that of E'. The 2 equations are thus obtained:

```
DX (E) =   DY (E') =  0.5 DY (C) + 0.5 DY (D)
DY (E) = - DX (E') = -0.5 DX (C) - 0.5 DX (D)
```

Cas2:

```
LIAISON_MAIL: (  MAILLE_2: S1     MAILLE_1: (Q1, Q2)
                 DDL_2: 'DNOR'        DDL_1: 'DNOR'
                 CENTER: B            ANGL_NAUT: 180.  TRAN: (+5.  +10.)  )
```

What wants to say that one eliminates normal displacement from the nodes B and E (nodes of the segment $S1$) according to the degrees of freedom of the points B' and E' obtained when one subjects to B and E a rotation of 180 degrees around B then a translation of vector $(+5,+10)$. B' is thus in the middle of CF and E' in the middle of DC. The normal displacement of B is identified (after rotation of 180 degrees) with that of B'. One makes in the same way for B'. The 2 equations then are obtained:

$$DY(E)=-DY(E')=-0.5\,DY(C)-0.5\,DY(D)$$
$$DY(B)=-DY(B')=-0.5\,DY(C)-0.5\,DY(F)$$

2.2 Results of reference

Displacement is observed DY point F :

cas1: $DY(F)=1.4153582447720\text{D}+00$
cas2: $DY(F)=1.0561898652983\text{D}+00$

These displacements are obtained with linear relations enter degrees of freedom introduced by the keyword `LIAISON_DDL`.

2.3 Uncertainties on the solution

No uncertainty.

3 Modeling A

3.1 Characteristics of modeling

The problem is solved with modeling D_PLAN.

3.2 Characteristics of the grid

The grid is made of:

2 QUAD4: $Q1 = ABCD$ and $Q2 = BEFC$
1 SEG2: $S1 = BE$

3.3 Sizes tested and results

Identification	Reference
cas1: $DY(F)$	1.4153582447720D+00
cas2: $DY(F)$	1.0561898652983D+00

4 Modeling B

4.1 Characteristics of modeling

The problem is solved with modeling 3D.

4.2 Characteristics of the grid

The grid is made of:

2 HEXA8: $Q1$ and $Q2$
1 QUAD4: $S1$

4.3 Features tested

The same ones as for modeling A but in 3D.

4.4 Sizes tested and results

Identification	Reference
cas1: $DY(F)$	1.4153582447720D+00
cas2: $DY(F)$	1.0561898652983D+00

5 Summary of the results

The digital results, displacement in a point, are rigorously identical between two calculations *Aster*, with the keyword LIAISON_MAIL, or with the keyword LIAISON_DDL.