

ZZZZ296 – Validation of the position of the under-points of the pipes

Summary:

This test validates the calculation of the position of the under-points of integration in the total reference mark for one modeling TUYAU_3M. All Lbe coordinated of S under-points are tested.

1 Problem of reference

1.1 Geometry

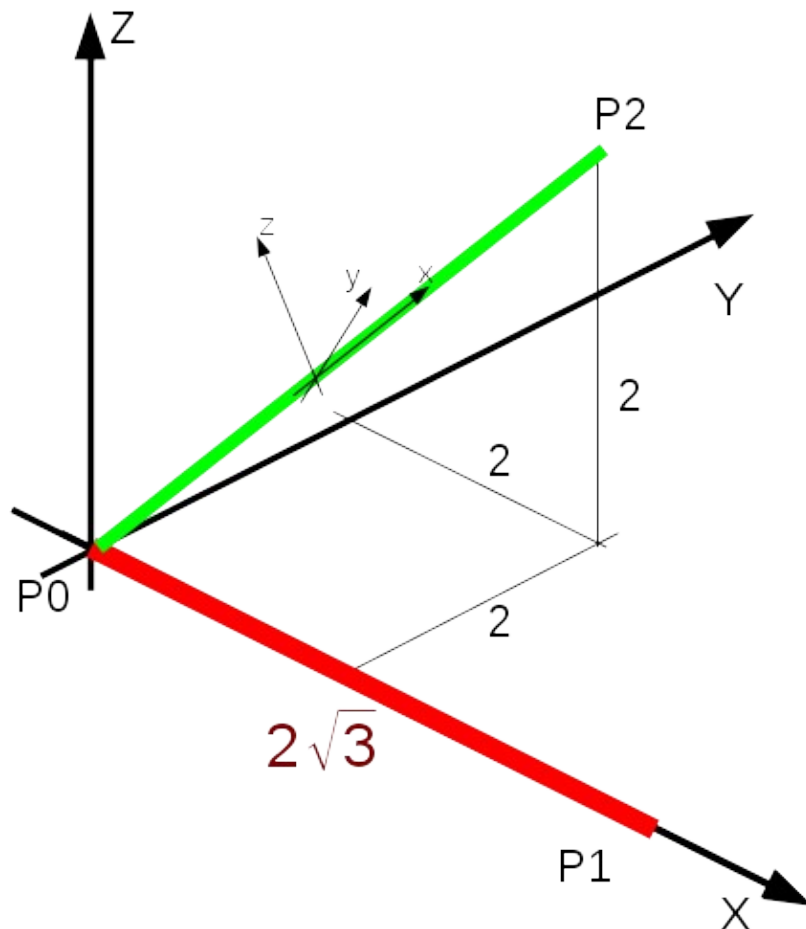


Figure 1.1-a : orientation of the element.

pipeX are directedS in space as indicated on the Figure 1.1-a :
Total coordinates of the points $P0$, $P1$ and $P2$:

$$P0 = (0.0; 0.0; 0.0)$$

$$P1 = (2\sqrt{3}; 0.0; 0.0)$$

$$P2 = (2.0; 2.0; 2.0)$$

2 Reference solution

2.1 Method of calculating

The elements supports of the pipes are SEG3 .

- The position of the points of integration along SEG3 is data in [R3.01.01] "Functions of form and points of integration of the finite elements".

```
# Coordinated of the Points of Gauss on LE long of SEG3
LongPoutre = 2.0*pow(3.0,0.5)
xpg = pow(3.0/5.0, 0.5)
Points= {1: LongPoutre*(1.0- xpg)*0.5,
         2: LongPoutre*0.5,
         3: LongPoutre*(1.0+xpg)*0.5, }
```

- The coordinates of the under-points of integration are functionS amongst layers, amongst sectors and of course of the bore and the thickness.

```
# Coordinated of the Under-Points "Nbfibre = (2*Ncou+1) * (2*Nsect+1)"
def CoordFibre( ifib ):
    Rint = Rext-Ep
    # index of the coordinates
    numAng = ((ifib-1)%(2*Nsect+1))/(2.0*Nsect)
    numCou = ((ifib-1)/(2*Nsect+1))/(2.0*Ncou)
    there = (Rint+Ep*numCou)*NP.cos(2.0*NP.pi*numAng)
    Z = -(Rint+Ep*numCou)*NP.sin(2.0*NP.pi*numAng)
    return there, Z
```

Où:

- Rext and Ep are respectively the ray external and the thickness of the pipe, well informed in the order AFFE_CARA_ELEM.
- Nsect and Ncou are respectively the number of sector and layer, well informed in the order AFFE_CARA_ELEM.

```
CARA = AFFE_CARA_ELEM (
    MODELE=MODEL,
    POUTRE=_F (GROUP_MA=('BEAM', 'POUTRE0'),
              SECTION='CIRCLE', CARA=('R', 'EP'), VALE=(10.0,1.0),
              TUYAU_NSEC = 4, TUYAU_NCOU = 2, )
)
```

- The matrix of passage of the pipe POP1 with the pipe POP2 allows to calculate the coordinates of the under-points of the pipe POP2 starting from the preceding formulas.

```
# Stamps Axe_X passage towards Trisecting
un3 = 1.0/pow(3.0,0.5); un2 = 1.0/pow(2.0,0.5); un6 = 1.0/pow(6.0,0.5)
MatPass = NP.array( [[un3, -un2, -un6],
                    [un3, un2, -un6],
                    [un3, 0.0, 2.0*un6]] )
```

For the pipe POP1 coordinates (x, y, z) fibre 'ifib' for the point 'ipt' are given by:

```
X = Points [ipt]
there, Z = CoordFibre( ifib )
```

For the pipe POP2 coordinates (x_t, y_t, z_t) fibre 'ifib' for the point 'ipt' are given by:

```
# According to the Trisecting one
xx = Points [ipt]
yy, zz = CoordFibre ( ifib )
xxt, yyt, zzt = NP.dot ( MatPass, NP.array ( [xx, yy, zz] ) )
```

2.2 Sizes and results of reference

The coordinates of all the under-points are tested.

To obtain the coordinates oneE table is generated starting from a stress field built at the under-points.

```
CSIEF=CRÉA_CHAMP (TYPE_CHAM='ELGA_SIEF_R', OPERATION="AFFE",
                 MODELE=MODEL,
                 AFFE_SP=_F ( CARA_ELEM = CARA, ), PROL_ZERO='YES',
                 AFFE=_F (TOUT="YES", NOM_CMP=('SIXX',), VALE= ( 0.0, ),),
)

RESU=CRÉA_RESU (TYPE_RESU = "EVOL_NOLI", OPERATION = "AFFE",
               NOM_CHAM='SIEF_ELGA',
               AFFE=_F (CHAM_GD = CSIEF, MODEL = MODEL, CARA_ELEM =CARA,
                       INST =0.0, ),
               )
```

The coordinates are then tested using TEST_TABLE.

For example for the coordinate 'X' pipe POP1 :

```
TEST_TABLE (REFERENCE= 'ANALYTICAL' ,
            VALE_CALC=xx, VALE_REFE=xx, NOM_PARA='COOR_X', TABLE=TBEPS0,
            FILTRE=( _F (NOM_PARA='NOT', VALE_I= ipt, ),
                    _F (NOM_PARA='SOUS_POINT', VALE_I= ifib, ), ),
            )
```

2.3 Uncertainties on the solution

No, exact solution.

3 Modeling A

3.1 Characteristics of the grid

The maillage Dbe pipeX is composed of a standard mesh SEG3.

3.2 Characteristics of modeling

Definition of the model:

```
MODEL=AFFE_MODELE (  
  MAILLAGE=MAPOU,  
  AFFE=_F (TOUT='YES', PHENOMENE='MECHANICAL',  
           MODELISATION='TUYAU_3M',),  
)
```

Assignment of the characteristics:

- Ray and thickness of the pipe
- Number of sector and number of layer

```
CARA=AFFE_CARA_ELEM (  
  MODELE=MODEL,  
  POUTRE=_F (GROUP_MA=('BEAM', 'POUTRE0'),  
            SECTION='CIRCLE', CARA=('R', 'EP'), VALE=(10.0, 1.0),  
            TUYAU_NSEC = 4, TUYAU_NCOU = 2, ),  
)
```

3.3 Values tested and results

All the coordinates of the under-points for the 2 pipes are tested.

4 Summary of the results

The purpose of this test is to check that the positions of the under-points of integration of modeling TUYAU_3M are well calculated.