SSND116 - Law of behavior DIS_CHOC in statics

Summary:

This test validates the use of the law of behavior `DIS_CHOC` for contact-friction on the discrete ones in statics.

1 Problem of reference

1.1 Geometry

Two discrete, the first rubber band, the second with DIS_CHOC.

1.2 Properties of materials

Stiffness of the discrete rubber band K_T_D_L, in the reference mark TOTAL : (K_{el} , K_{el} , 0) with $K_{el}=1$

For the discrete one DIS_CHOC

RIGI_NOR K_n	1
RIGI_TAN K_t	0.5
COULOMB μ	0.5
DIST_1	0.5
DIST_2	0

Table 1.2-1: Parameters materials of discrete of shock

1.3 Boundary conditions and loadings

An end is embedded.
The other end:
$DZ=0$,
$FX=-1$,
$FY=2$.
Loadings FX and FY are affected following functions of time:

Time	Function affecting FX	Function affecting FY
0	0	0
1	1	0
1.5	1	1
2	1	0

Table 1.3-1: Multiplying functions of the loading

2 Reference solution

2.1 Results of reference

For following displacement X, it is given by the “normal” part of discrete in parallel, which gives:
$F_x = K_{el} u_x + K_n (u_x + DIST_1)$ if $u_x < -DIST_1$,

$F_x = K_{el} u_x$ if not.

One obtains:

Time	u_x
0.5	-0.5
1	-0.75
2	-0.75

Table 2.1-1: Reference solution

For there following displacement, it is given by the “tangential” part of discrete in parallel, which gives:

$$F_y = k_t (u_y - \delta_y^0) + k_{el} u_y \quad \delta = \delta^0 \quad \text{if } |k_t| (u_y - \delta^0) \leq \mu |F_x| ,$$

$$F_y = \mu |F_x| sgn(u_y - \delta^0) + k_{el} u_y \quad \delta = u - sgn(u_y - \delta^0) \mu K_n (u_x + DIST_1) / K_t \quad \text{if not.}$$

One noted the function “signs” sgn.

One obtains:

Time	u_y
1.05	0.1333333
1.5	1.875
1.55	1.74166666
2	0.125

Table 2.1-2: Reference solution

2.2 Uncertainty on the solution

No uncertainty (analytical solution).

3 Modeling A

3.1 Characteristics of modeling

A first calculation is done with the springs represented by the discrete ones resting on SEG2, the embedded node is with [0,0,0], the other node is with [1,0,0]. The second calculation is carried out by using the discrete ones resting on POI1.

3.2 Sizes tested and results

The first calculation (SEG2).

Identification	Type of reference	Value of reference	Tolerance
Not Vertex_2 – DEPL DX - INST=0.5	'ANALYTICAL'	-0.5	0,1%
Not Vertex_2 – DEPL DX - INST=1.0	'ANALYTICAL'	-0.75	0,1%
Not Vertex_2 – DEPL DX - INST=2.0	'ANALYTICAL'	-0.75	0,1%
Not Vertex_2 – DEPL DY - INST=1.05	'ANALYTICAL'	0.1333333	0,1%
Not Vertex_2 – DEPL DY - INST=1.5	'ANALYTICAL'	1.875	0,1%
Not Vertex_2 – DEPL DY - INST=1.55	'ANALYTICAL'	1.74166666	0,1%
Not Vertex_2 – DEPL DY - INST=2.0	'ANALYTICAL'	0.125	0,1%

The second calculation (POI1).

Identification	Type of reference	Value of reference	Tolerance
Not Vertex_1 – DEPL DX - INST=0.5	'ANALYTICAL'	-0.5	0,1%
Not Vertex_1 – DEPL DX - INST=1.0	'ANALYTICAL'	-0.75	0,1%
Not Vertex_1 – DEPL DX - INST=2.0	'ANALYTICAL'	-0.75	0,1%
Not Vertex_1 – DEPL DY - INST=1.05	'ANALYTICAL'	0.1333333	0,1%
Not Vertex_1 – DEPL DY - INST=1.5	'ANALYTICAL'	1.875	0,1%
Not Vertex_1 – DEPL DY - INST=1.55	'ANALYTICAL'	1.74166666	0,1%
Not Vertex_1 – DEPL DY - INST=2.0	'ANALYTICAL'	0.125	0,1%

4 Summary of the results

The analytical results exactly are found.