

Code Aster

Version
default

Titre : SSNV201 - Bloc avec interface en contact glissière[...]
Responsable : COLOMBO Daniele

Date : 14/10/2011 Page : 1/14
Clé : V6.04.201 Révision :
2a2565c6b803

DY
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DZ
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DY
DY
DZ
DZ

OZ

1.1

3

3.1 Features tested

Orders

| | | | |
|--------------|---------------------|--|--------------------------|
| AFFE_MODELE | AFFE | MODELING | 3D |
| DEFI_CONTACT | FORMULATION ZONE | `XFEM` INTEGRATION CONTACT_INIT SLIDE | `NODE` `NOT` `YES` |

MIN
MIN
MAX
MAX

3.2 Features tested

Orders

| | | | |
|--------------|----------------------------------|---|--------------------------|
| AFFE_MODELE | AFFE | MODELING | 3D |
| DEFI_CONTACT | FORMULATION REAC_GEOM ZONE | `XFEM` `AUTOMATIC` INTEGRATION CONTACT_INIT SLIDE | `NODE` `NOT` `YES` |

DY
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MIN
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MAX
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SSNV201 – Block with interface in contact slide with X-FEM

Summary

The purpose of this CAS-test is to test and validate the features of the option `SLIDE` for the contact with X-FEM. It is mainly a question of proving that for an interface generated by X-FEM, on which one activates the contact with option `SLIDE`, there is not separation of surfaces in contact, they can only slip one compared to the other.

This test brings into play a parallelepipedic block crossed by an interface modelled with X-FEM. The block is subjected to imposed displacements, which would have as a consequence the separation of the structure when the option `SLIDE` is not activated and the slip of the two parts of block, without separation, when this option is activated. Numerically, the activation of this option is made after the contact is established, that is to say initial contact imposed by the user (`CONTACT_INIT=' OUI '`), that is to say natural contact, resulting from the kinematic evolution of the structure.

5 Problem of reference

5.1 Geometry

The structure is a right parallelepiped at rectangular and healthy base. Dimensions of the bar (see [Figure 1.1-1]) are: $LX = 2\text{ m}$, $LY = 4\text{ m}$ and $LZ = 10\text{ m}$.

The interface (Figure 1.1-2) is introduced by functions of level (level set noted normal LN directly in the command file using the operator `DEFI_FISS_XFEM` [U4.82.08]. The interface is defined like a horizontal crack, in the middle of the block according to the direction OZ data by the following function of level:

$$LN = Z - LZ/2$$

éq 1-1

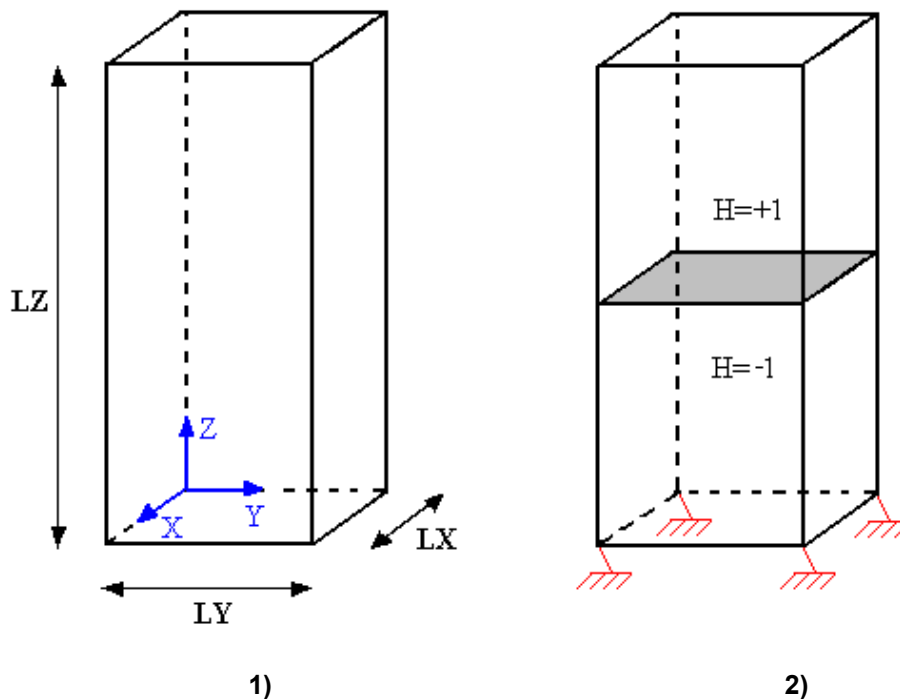


Figure 1.1 Geometry of the block and positioning of the crack

No level set tangential is necessary since the keyword is used `TYPE_DISCONTINUITE='INTERFACE'`, which makes it possible to have the structure completely cut in two parts.

5.2 Properties of material

Young modulus: $E = 100\text{ MPa}$

Poisson's ratio: $\nu = 0.0$

Density: $\rho = 7800\text{ kg/m}^3$

5.3 Boundary conditions and loading

The nodes of the lower surface of the block are embedded (see Figures 1.1-1) by applying to the group of nodes of surface a loading in imposed displacements:

$$ENCASTR : DX = 0 , DY = 0 \text{ and } DZ = 0 .$$

Two other loadings in imposed displacements, are applied to the group of nodes of the upper surface of the block:

$$CHZ : DZ = DEPZ \text{ and } DX = 0 ;$$

$$CHY : DY = DEPY .$$

The values of imposed displacements are: $DEPY = DEPZ = 1 \cdot 10^{-3} m$. The loadings are applied in three stages by using the functions presented to [Figure 5.3-1].

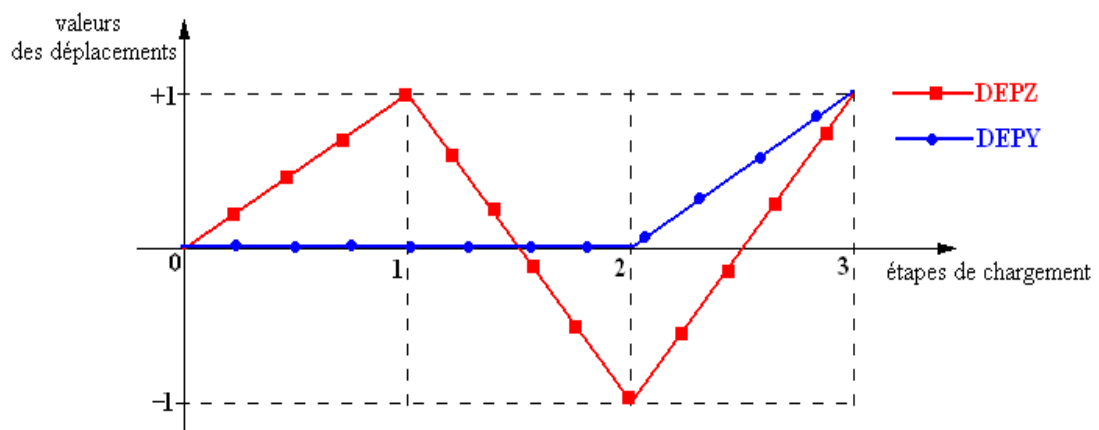


Figure 5.3-1: Variations of the loadings in imposed displacements

By imposing this kinematics of displacements to the upper part of the block, one wishes to show the dealing of the option `SLIDE`. In an initial state, the contact is not affected on the lips of the crack (`CONTACT_INI = 'NON'`) and thus the two parts of the block will separate following the first stage from loading ($DZ = DEPZ$). They come to be restuck in the second phase when they are brought closer ($DZ = -DEPZ$). Once returned in contact, the option `SLIDE` activate yourself and prevents separation according to the normal direction (OZ) during the third stage, in spite of imposed displacement ($DZ = DEPZ$), the tangential slip on the level of the interface remains possible ($DY = DEPY$).

6 Reference solution

6.1 Sizes and results of reference

The solution of such a problem is of course obvious.

Stage 1:

Both partS structure are detached: the lower part has a null displacement and the upper part has an overall movement equal to the displacement imposed on the top of the structure.

Stage 2:

There is no horizontal displacement. Vertically, the two parts of the structure are dependent and behave like only one block in compression. Displacement with the interface is equal to moist displacement at the top of the structure and the jump of displacement is null.

Stage 3:

Horizontally, the lower part has a null displacement and the upper part has an overall movement equal to the displacement imposed on the top of the structure. Vertically, the two parts of the structure are dependent and behave like only one block in traction. Displacement with the interface is equal to moist displacement at the top of the structure and the jump of vertical displacement is null.

7 Modeling A

7.1 Characteristics of modeling

A modeling is considered 3D X-FEM with taking into account of the contact. The interface is introduced into the healthy grid by the operator `DEFI_FISS_XFEM`.

7.2 Characteristics of the grid

One discretizes the structure using the finite elements `HEXA8`. According to the three directions of the frame of reference chosen, one has $2 \times 4 \times 9$ elements thus a total of 72 finite elements (see [Figure 7.2-1])

The interface will be introduced in the middle of the fifth stage of elements according to the direction *OZ*.

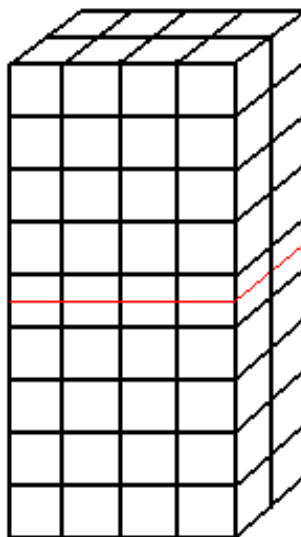


Figure 7.2-1: Maillage of modeling A

7.3 Sizes tested and results

The operator `POST_MAIL_XFEM` allows to net the cracks represented by method X-FEM. The operator `POST_CHAM_XFEM` then allows to export results X-FEM on this new grid. These two operators are to be used only in a posterior way with calculation at sights of postprocessing. They make it possible to generate nodes right in lower part and with the top of the interface and to display their displacements.

The values of displacement are thus tested just in lower part and with the top of the interface after convergence of the iterations of the operator `STAT_NON_LINE`. The following table is obtained:

| Not | Identification | Reference | Tolerance |
|-----|---|-----------|-----------|
| 1 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 1 | <i>DY</i> for all the nodes right with the top of the interface | 0.00 | 1.0E-16 |
| 1 | <i>DZ</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 1 | <i>DZ</i> for all the nodes right with the top of the interface | 1.0E-03 | 1.0E-09% |
| 2 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 2 | <i>DY</i> for all the nodes right with the top of the interface | 0.00 | 1.0E-16 |
| 2 | <i>DZ</i> for all the nodes right below the interface | -5.0E-4 | 1.0E-09% |
| 2 | <i>DZ</i> for all the nodes right with the top of the interface | -5.0E-4 | 1.0E-09% |
| 3 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 3 | <i>DY</i> for all the nodes right with the top of the interface | 1.0E-03 | 1.0E-09% |
| 3 | <i>DZ</i> for all the nodes right below the interface | 5.0E-4 | 1.0E-09% |
| 3 | <i>DZ</i> for all the nodes right with the top of the interface | 5.0E-4 | 1.0E-09% |

To test all the nodes in only once, it is tested minimum and it maximum column.

8 Modeling B

8.1 Characteristics of modeling

It is acted of the same modeling as modeling A, but as great slips.

8.2 Characteristics of the grid

It is the same grid as that of modeling A (see [Figure 7.2-1])

8.3 Sizes tested and results

The values of displacement are thus tested just in lower part and with the top of the interface after convergence of the iterations of the operator `STAT_NON_LINE`. The following table is obtained:

| Not | Identification | Reference | Tolerance |
|-----|---|-----------|-----------|
| 1 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 1 | <i>DY</i> for all the nodes right with the top of the interface | 0.00 | 1.0E-16 |
| 1 | <i>DZ</i> for all the nodes right below the interface | 0.00 | 1.0E-16 |
| 1 | <i>DZ</i> for all the nodes right with the top of the interface | 1.0E-03 | 1.0E-09% |
| 2 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-15 |
| 2 | <i>DY</i> for all the nodes right with the top of the interface | 0.00 | 1.0E-15 |
| 2 | <i>DZ</i> for all the nodes right below the interface | -5.0E-4 | 1.0E-09% |
| 2 | <i>DZ</i> for all the nodes right with the top of the interface | -5.0E-4 | 1.0E-09% |
| 3 | <i>DY</i> for all the nodes right below the interface | 0.00 | 1.0E-6 |
| 3 | <i>DY</i> for all the nodes right with the top of the interface | 1.0E-03 | 1.0E-01% |
| 3 | <i>DZ</i> for all the nodes right below the interface | 5.0E-4 | 1.0E-01% |
| 3 | <i>DZ</i> for all the nodes right with the top of the interface | 5.0E-4 | 1.0E-01% |

To test all the nodes in only once, it is tested minimum and it maximum column.

9 Summary of the results

It is noticed that the activation of the option `SLIDE` had the effect envisaged, once the contact established at stage 2, i.e. the absence of separation following the direction OZ at stage 3, in spite of the imposition of a displacement following this direction, with a structure in traction. Discontinuity according to OZ , on the level of the interface, is worthless at the end of stages 2 and 3 and the upper part of the block slips according to the direction OY with the specified value.