ZZZZ282 – Validation of the definition of a crack on a grid by DEFI_FISS_XFEM

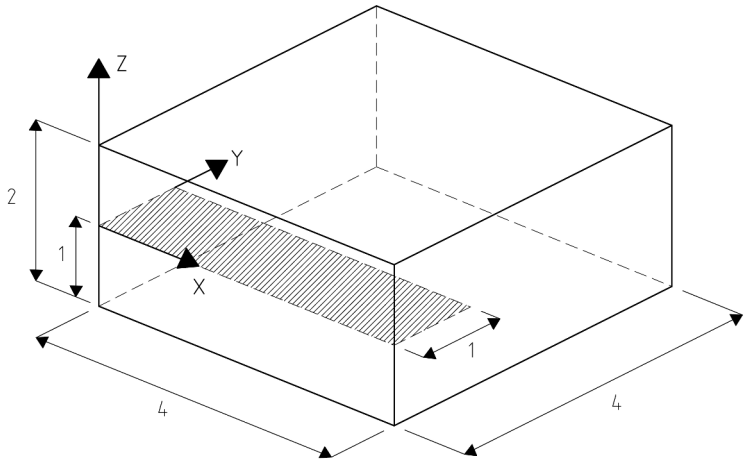
Summary:

This test validates the calculation of the functions of level (level sets) of a crack and an interface X-FEM on a grid for all the methods available in DEFI_FISS_XFEM.

1 Problem of reference

1.1 Geometry

A parallelepiped of dimensions is considered $4\text{x}4\text{x}2\,mm$ with a plane crack:



2 Principle of the test

In DEFI_FISS_XFEM one can define the crack on a grid by four different methods:

- by groups of meshs which form the crack and its bottom. To create these two groups, one uses by simplicity the operator PROPA_FISS (method INITIALIZATION).
- by analytical functions which make it possible to calculate directly both level sets:
  $lsn = Z$
  $lst = Y - 1$
- by a catalogue of preset forms. In this case one uses the form DEMI_PLAN.
- by two fields with the nodes which account for both level sets. By simplicity these two fields are extracted from the crack defined by the catalogue of the preset forms above.

One expects that the fields with the nodes which characterize both level sets of the crack on the grid are the same ones as those which give the level sets on the grid of the structure. So for the grid one uses the same grid as that used for the structure, one expects that the values of the two fields in each node of the grid are the same ones as those with the same node of the grid of the structure. For each method available one thus proceeds in the following way:

- one calculates the level sets on the grid of the structure and the grid by DEFI_FISS_XFEM,
- for each node of the grid of the structure, one calculates the difference between the level set normal z defined and that in the same node of the grid of the grid,
- for each node of the grid of the structure, one calculates the difference between the level set tangent y defined and that in the same node of the grid of the grid,
- it is checked that in each node the two calculated differences are equal to zero.

One makes the same thing for the interfaces with the difference as only one level set (the normal) is used to define an interface.

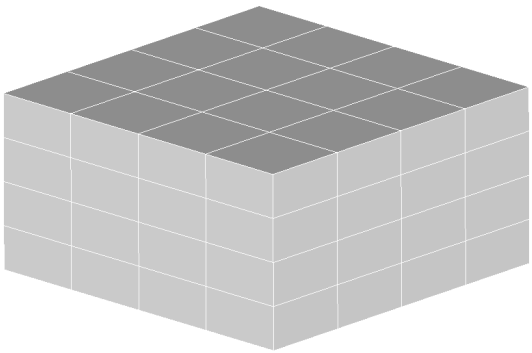
3 Modeling A

3.1 Characteristics of modeling

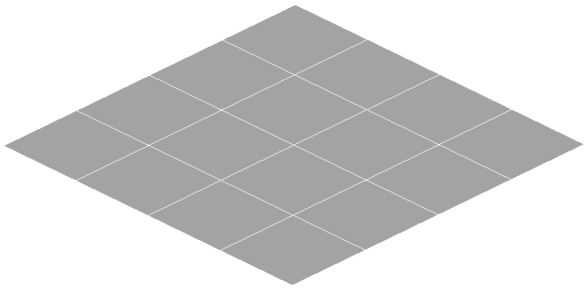
A modeling is used 3D. For an interface and for the only methods “catalogues preset forms” and “fields with the nodes” of DEFI_FISS_XFEM, a modeling is used D_PLAN same geometry limited to the plan (X,Y) because these methods are not available in 3D.

3.2 Characteristics of the grid

Grid 3D contains 64 elements of the type HEXA8 of dimension $1\text{x}1\text{x}0.5\,mm$:



Grid D_PLAN contains 16 elements of the type QUAD4 of dimension $1\text{x}1\,mm$:



The same grid is used at the same time for the structure and the grid.

3.3 Sizes tested and results

One tests in each node the difference between the level set on the grid of the structure and the level set on the grid of the grid. A value exactly equal to zero is obtained everywhere, which makes it possible to check the coincidence of the fields to the nodes between structure and grid.

3.4 Remarks

In the test one is obliged to use a tolerance in TEST_TABLE. One takes this tolerance equalizes to 0.01. That does not affect the results of the test because one tests values which are always exactly equal to zero.

4 Summary of the results

Two fields with the nodes calculated by DEFI_FISS_XFEM, at the same time on the grid of the structure and the resulting grid of the grid, are always coïncidents independently of the selected method for the definition of the crack or the interface.
That makes it possible to conclude that the operator DEFI_FISS_XFEM correctly calculate the level sets on the grid.