FORMA06 - Practical works of the formation “advanced Use”: plate multi-fissured in traction

Summary:

This test 2D plane deformation, into quasi-static, enters within the framework of the validation of postprocessings in linear elastic breaking process. The plate multi-is fissured. The cracks are represented by method X-FEM.

1. Problem of reference

One studies the behavior of a plate multi-fissured in traction. In order not to net the cracks, method X-FEM is used.

One considers an infinite plate in traction, comprising 2 cracks length $2a$ (see Figure 1-1).

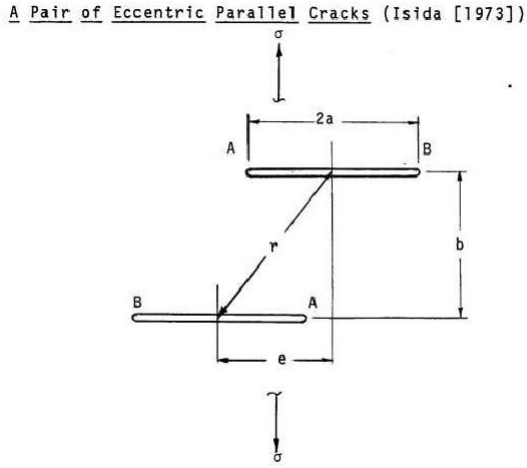

Figure 1-1: geometry of the problem

One proposes to check the abacuses provided by the “Handbook of stress-intensity factors” of G. Sih. The factor of intensity of the constraints K_I at the point A is given by the following formula: $K_I^A = F\left(\frac{2a}{r}, \frac{e}{b}\right)\sigma\sqrt{\pi a}$ where $F\left(\frac{2a}{r}, \frac{e}{b}\right)$ is given by the graphics of Figure 2.1.3-1.

2. Modeling A

2.1. Unfolding of the TP

2.1.1 Geometry and grid with Salomé-Meca

Under Salomé-Méca, carry out the geometry.

One will be able to consider a plate centered in the beginning, of finished size: $2\,m$ of with dimensions.

Carry out the grid. It is pointed out that the cracks are not with a grid, one will be able to thus use a regulated grid of quadrangles sufficiently fine everywhere (algorithm 1D = Wire discretization + algorithm 2D = Quadrangle).

2.1.2 Creation of the command file without postprocessing of the rupture

a) Reading of the healthy grid and definition of the model not enriched

Reading of the grid refined (LIRE_MAILLAGE) with format MED;
Definition of the finite elements used (AFFE_MODELE, MODELISATION='D_PLAN');
Reorientation of the normals to the elements: one will use MODI_MAILLAGE/ORIE_PEAU_ 2 D in the same way to direct all the elements, with a turned normal towards outside for the faces to which one

applies the loading;

b) Definition of the crack and elements X-FEM

Definition of only one fissures horizontal length $2a=0,3\,m$ (DEFI_FISS_XFEM): Utilisez the catalogue of cracks preferably (FORM_FISS= ' SEGMENT')
Modification of the model to take into account elements X-FEM (MODI_MODELE_XFEM),

c) Definition of material, the conditions and resolution of the mechanical problem

Definition and assignment of material (DEFI_MATERIAU and AFFE_MATERIAU);
Definition of the limiting conditions and loadings (AFFE_CHAR_MECA) on the enriched model : • Blocking of the rigid modes (DDL_IMPO onS GROUP_NO 'N_A','N_B'); • Application of traction (1 MPa) on 'M_haut' and 'M_bas'(PRES_REP)
Resolution of the elastic problem (MECA_STATIQUE) on the enriched model.

d) Postprocessing of displacements and the constraints with X-FEM and visualization with Paravis

Creation of a grid of visualization (POST_MAIL_XFEM);
Creation of a model for visualization (AFFE_MODELE) on the grid created for visualization;
Creation of a field of results on the grid of visualization X-FEM (POST_CHAM_XFEM);
Impression of the results to format MED (IMPR_RESU).

Supplement the command file realized by taking of account 2 cracks, in the case of figure according to:
$a=0,15$ and $b=0,4$ (either $2a/b=0,75$)
$e=0$

One is reminded that each call DEFI_FISS_XFEM product a crack. For 2 cracks, this order should be called twice .

2.1.3 Addition of the postprocessing of the rupture to the command file

a) Calculation of K with CALC_G

To calculate the factor of intensity of the constraints (K1) (OPTION=' CALC_K_G') .

To use the result of MECA_STATIQUE (RESULT).

To supplement information at once THETA :

- bottom of crack, by specifying the number of the bottom (in your case there are 2 funds of crack A and B)
- rays of the crown of the field theta (R_INF , R_SUP), to define according to the grid used.

The order CALC_G producing a structure of data of the type counts, one needs I mprimer results in a table with IMPR_TABLE .

b) Calculation of K with POST_K1_K2_K3

To calculate K with POST_K1_K2_K3 :

- to use the result of MECA_STATIQUE (RESULT)

- to inform the bottom of crack
- to inform the parameter ABSC_CURV_MAXI
- to print the results in a table (IMPR_TABLE)

Note: not to take account of alarm in CALC_CHAMP which specifies that EXCIT should be added.

Compare got results with the solution of Handbook.

To go further, one will be able:
- to prolong the abacuses for $2a/r>0.9$ (for example $2a/r=1$),
- to study the smoothness of the grid,
- to make a parametric study for $e=[0\ ;2b]$ (to think of using python),
- to study other configurations (inclined cracks, addition of other cracks…).

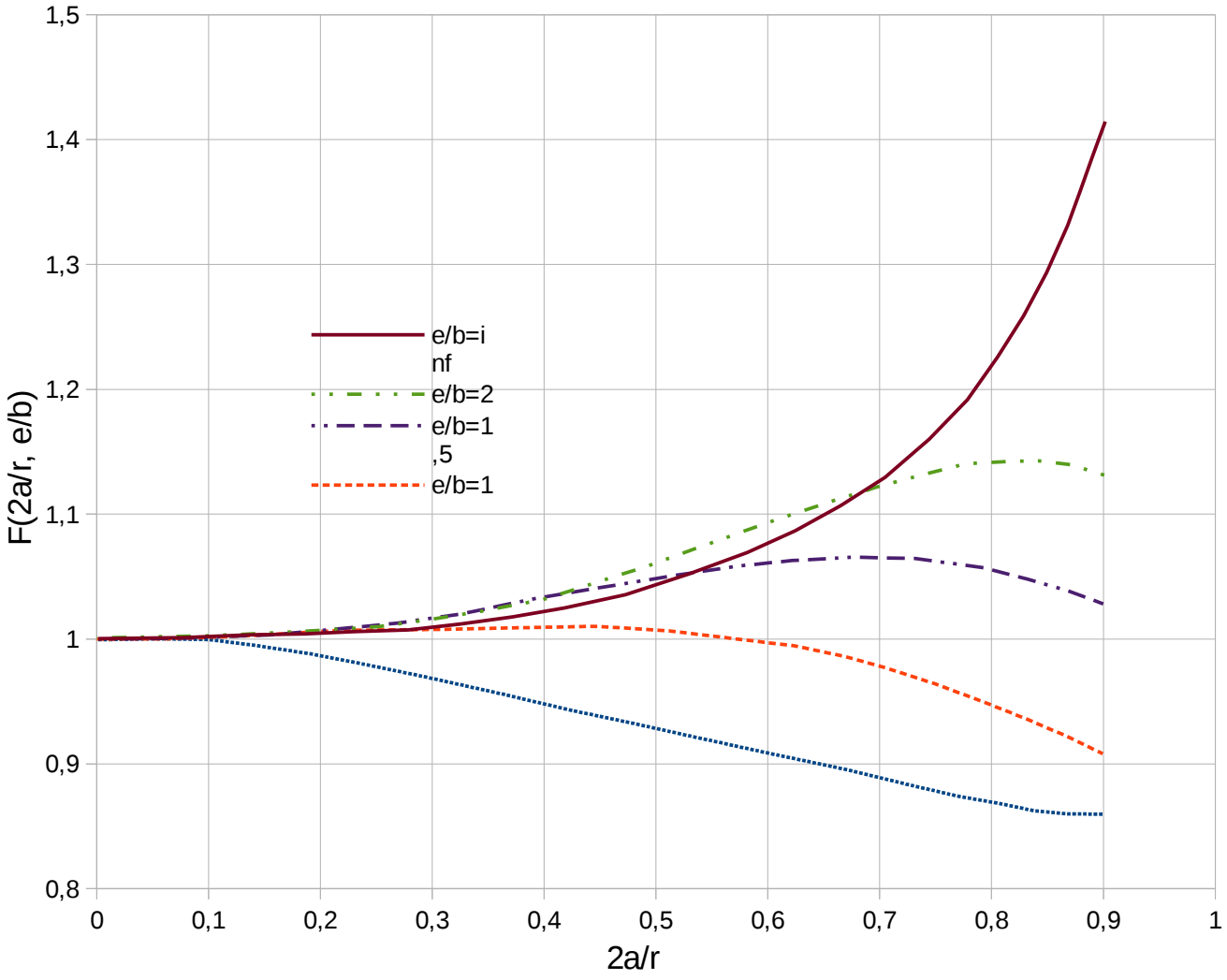

Figure 2.1.3-1: Abacus