SSNP166 - Beam notched in inflection three points

Summary:

The study of this problem makes it possible to characterize energy necessary to the propagation of a crack in a concrete beam. It makes it possible to validate the law of behavior CZM_EXP_MIX by comparison with the experiment of the total behavior Force-displacement of a beam notched on two supports simple.

It corresponds to the one of the experimental tests of the thesis of Per-Erik Peterson [bib1].

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1 Problem of reference

1.1 Geometry

To validate the cohesive law CZM_EXP_MIX more specific to quasi-fragile materials, one models a beam notched out of concrete subjected to inflection 3 points, while being based on the experimental data of the thesis of P. - E. Peterson [bib1]. This test indeed is part of the experimental references most frequent to validate the models of surface or voluminal damage of the concrete.

A beam length $2\,m$, height $200\,mm$ and thickness $50\,mm$, notched in its medium on $100\,mm$ (half the height of the beam) is in simple support on its two ends.

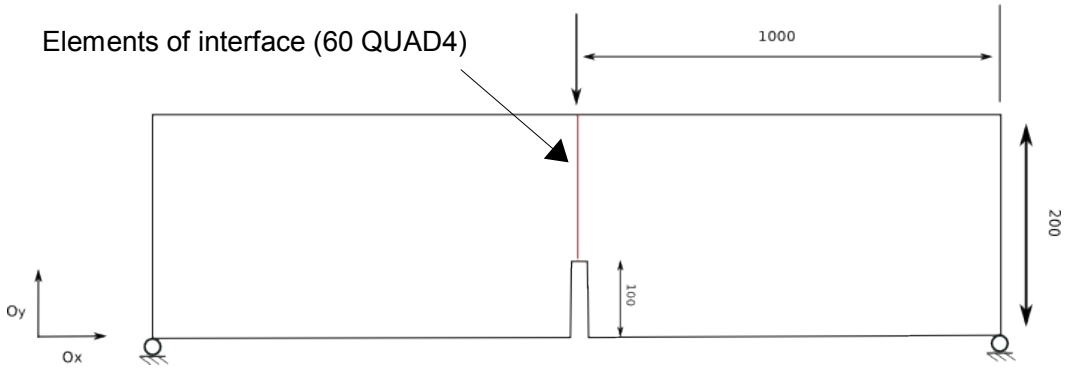

Figure 1: Representation of the Beam in inflection 3 points. The thickness is of $50\,mm$

1.2 Properties of material

The law used is the law CZM_EXP_MIX.
The parameters materials are defined under the keyword RUPT_FRAG or RUPT_FRAG_FO

Young modulus: $E=30\,GPa$
Poisson's ratio $\nu=0.2$

Density of critical energy of surface G_c :	**GC** = 137 N/m
critical stress σ_c :	**SIGM_C** = 3.3 MPa
Penalization of the Lagrangian one	PENA_LAGR= 300
Rigidity of the slip	RIGI_GLIS= 10 (value by default)

1.3 Boundary conditions and loadings

Embedding : The displacements imposed according to OY are worthless at the 2 fulcrums (GROUP_NO: CL1 and CL2). One blocks following displacement 0x on one of the two supports.

Displacement: One applies a displacement imposed according to OY to the top of the crack (GROUP_NO: DpL).

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2 Reference solution

2.1 Experimental result

The reference solution is the experimental curve resulting from the thesis of Peterson [1] visible on Figure 2. It is the force exerted on the beam according to the displacement of the center of the beam along axis OY

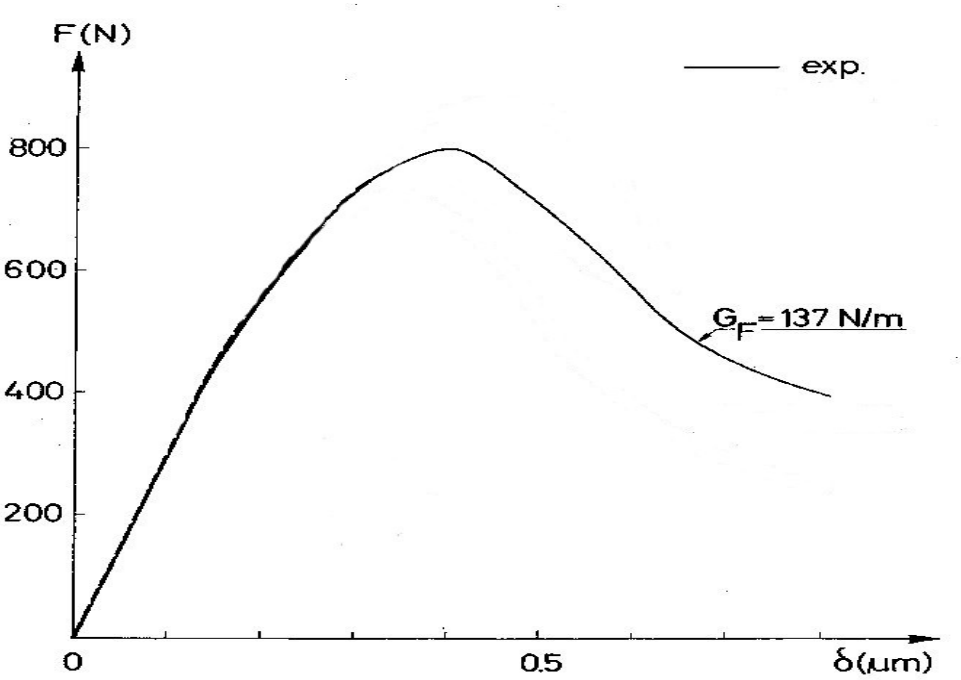

Figure 2: Experimental results for two types of concrete [1]

Note:

Figure 2 is a graph extracted the Thesis of EP. Petersson. It comprises an error on the scale in displacement. The opening is in millimetre and not out of micrometer.

2.2 Bibliographical reference

[1] Thesis of Per-Eric Petersson: “Ace growth and development of concrete fracture zones in lime pit and similar materials”

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3 Modeling A

3.1 Characteristics of modeling

Modeling in plane deformations D_PLAN for the elastic element and PLAN_INTERFACE for the elements of interface

Figure 3: Grid the beam

3.2 Characteristics of the grid

Many nodes: 3000
1400 TRIA3
67 QUAD4

3.3 Sizes tested and results

One tests the force resulting and the opening from the crack at two moments: increment 9 close to the peak and increment 15 in the zone post-peak.

Size tested	Reference	Tolerance (%)
Force with increment 9	7,78D+02	0.46
Ouv with increment 9	3.65D-01	6th-3
Force with increment 15	5.92D+02	1.08
Ouv with increment 15	6.07D-01	0.08

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4 Summary of the results

The exponential law makes it possible to find the peak of the experimental test with an error lower than 2 % as well as the curved post-peak contrary with a linear cohesive law.

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