Modelling and numerical testing of the interfacial fracture

PARTNERS

INSTITUT CLÉMENT ADER

Key words : modelling, numerical test, adherence, fracture, DCB, 3PB, FE, ME

Department: Department Mechanics of Structures and Materials (DMSM)

JOB DESCRIPTION:

Aircraft structures are designed by the assembly of beams with concentrated caps and of thin plates, from initial design up to the maintenance (repairs). The objective is to set the material where it is needed to maximize the strength-to-mass ratio. The aircraft structural components are mainly assembled thanks joining technologies related to bolting. If bolting joining technologies are well controlled, its main drawback is the local reduction of the strength-to-mass ratio. Indeed, to reduce the local stress level to be transferred, the joining areas are mainly characterized by an increase of the thickness of materials to be assembled. On the contrary, it is acknowledged that the adhesive bonding technology allow for the increase of static and fatigue strength while reducing the mass. As a result, in the frame of the cost reduction, a solution for the design of aircraft structures could have built them by laying up adhesively bonded material sheets, to locally set the material where it is needed while avoiding over thicknesses.

The adhesive layer allows for the transfer of loads between the structural parts. To ensure this function, the adhesive layer must provide both cohesion and adhesion strengths. The topic of this internship is focused on the adhesion strength, called adherence.

Various experimental tests can be used to assess the adherence [1-4]. Among the existing tests, the three-point bending tests (3PBT), see Figure 1, allows for the localization of failure initiation as well as for the assessment of adherence at macroscopic scale [1]. Recently Birro et al. [5-8] suggest a methodology to assess the adherence under static loading, based on the coupling of experimental test and numerical test results at mesoscale involving Finite Fracture Mechanics (FFM) [9] and macro-element (ME) modelling [10-11].

This internship offer is included within a collaborative research project called AMETIST founded by the ANR (Agence Nationale de la Recherche) and is contributing in the TACCOS (Toulouse Adhesion Cohesion Collage Structural) initiative.

MISSIONS:

The objective of this internship is (i) to modelling and numerical testing of the fracture at the interface between an adhesive layer and its metallic adherend and (ii) to compare the numerical test results with experimental ones provided by a partner of the project. The expected work includes:

• literature review

• modelling of experimental tests mased on various specimen such as double cantilever beam (DCB), three-point bending (3PBT)

• numerical testing using analytical, ME modelling and FE modelling: simulation of tests and adherence assessment ability

• correlation between experimental and numerical test

• report and presentation

A verry limited number of experimental tests on DCB could be performed.

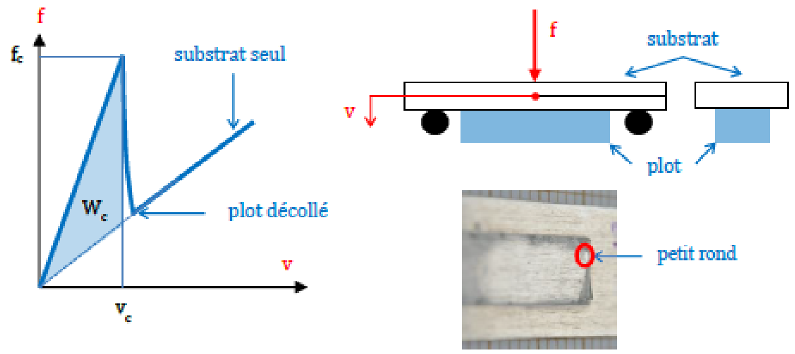

Figure 1 – Three-point bending test.

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REQUIRED PROFILE:

This offer is suitable to students in last year of MSc, MEng in Solids Mechanics, Structures Mechanics. The expected specific skills are:

• fundamentals of strength of materials
• basics on the FE method

COMPENSATION: 4.35 € HEURE

DURATION: 06 MONTS ASAP in 2026

LOCATION: TOULOUSE

RESPONSIBLE OF THE SUBJECT:

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APPLICATION PROCESS: CV + cover letter to be sent to the responsible of the topic.

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