Research project offer

Location : ISAE SUPAERO, Toulouse, France

Department : DMSM

Research group : "Joining" transversal axis [MSC and MS2M]

Supervisor : Frédéric LACHAUD and Éric PAROISSIEN

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OFFER DESCRIPTION

Title : Modelling and simulation of the mechanical behavior of bonded repairs

Proposed duration and period : 6 months, S1 2021

Context

A structural repair consists mainly in removing material around the damaged area (fatigue crack, impact, corrosion) then in adding healthy material. The addition of healthy material passes by a joining phase. The classical joining techniques are bolting, adhesive bonding and hybrid bolting / bonding. The adding material can be made in a different material from the parent one leading to the multimaterial interfaces (composite, metal).

Nowadays, the civil aviation does not use adhesive bonding for structural repairs on aircraft, due to the damage tolerance requirements applied to primary structures. One remaining lock is the ability the sizing of adhesive bonding joints **[1-2]**.

Objectives and work

Experimental test were performed on technological specimen representative for bonded repairs using a stepped patch. The objective is to simulate these experimental tests. Several modelling will be developed involving various sets of hypotheses of graded complexities.The modelling of progressive failure of matrix and fibers make use of a dedicated methodology, which has been developed for more than 20 years at ICA **[4]**. At the simplified stage, the macro-element (ME) modelling will be used. The ME modelling of bonded joints is developed at Institut Clément Ader (ICA) since 2004 **[4-5]** (Figure 1).

References

[1] Feuille de route nationale. Vers la maîtrise des Assemblages Collés Structuraux. Aerospace Valley, Astech, Pégase, EMC2 (2014).

[2] CERTBOND, COST Action, CA18120, https://www.cost.eu/actions/CA18120/#tabs|Name:management-committee

[3] Montagne, B., Lachaud, F., Paroissien, E., Martini, D., Congourdeau, F., 2020. Failure analysis of single lap composite laminate bolted joints: comparison of experimental and numerical tests. Composite Structures, 238, 111949 [DOI: 10.1016/j.compstruct.2020.111949]

[4] Paroissien, E., 2006. Contribution aux assemblages hybrides (boulonnés/collés) – Application aux jonctions aéronautiques. PhD Dissertation, University of Toulouse III, November 2006, 286 p., on line http://thesesups.ups-tlse.fr/3/

[5] Ordonneau, B., Paroissien, E., Salaün, M., Malrieu, J., Guigue, A., Schwartz, S., 2020. A methodology for the computation of the macro-element stiffness matrix for the stress analysis of a lap joint with functionally graded adhesive properties. International Journal of Adhesion and Adhesives, 97, 102505 [DOI: 10.1016/j.ijadhadh.2019.102505]

adhesive properties. International Journal of Adhesion and Adhesives, 97, 102505.

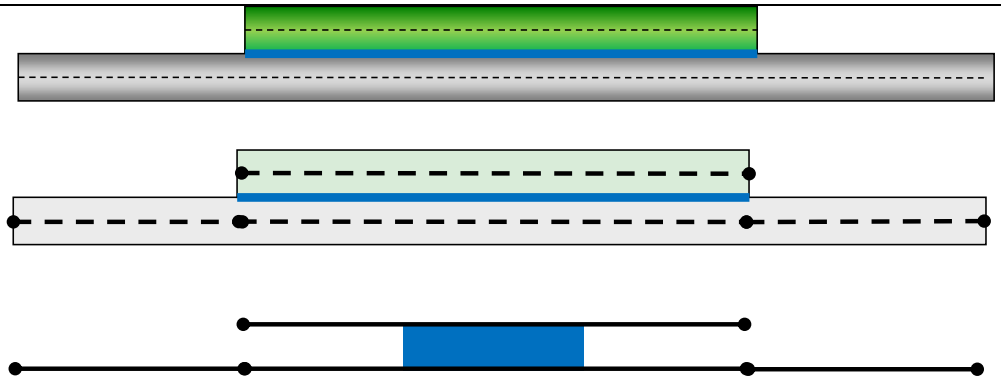

Figure 1. ME modelling

Possibility to continue with a PhD (Yes/No) : TBD	
REQUIRED APPLICANT PROFILE AND SKILLS	
Study level (tick possible choices)	☐ Undergraduate students (3rd or 4th year) ■ Master students (1st or 2nd year) ☐ PhD students
Required profile and skills	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 and CAD
Other useful information	Feel free to take contact