Internship offer

Location : ISAE SUPAERO, Toulouse, France

Department : DMSM (Mécanique des Structures et Matériaux)

Supervisor : Éric PAROISSIEN, Frédéric LACHAUD, Mario PLANAS ANDRES

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OFFER DESCRIPTION

Title: Experimental test campaign on thermoplastic-matrix GFRP composite laminates for a recyclable wind turbine blade.

Proposed duration and period: 6 months, S1 2023

Context

Non-recyclable waste generation at the end of life cycle is currently one of the main problems arising from the use of composite materials in many industries: aerospace, automotive, marine…The wind industry is not exempt from this concern, as wind turbine blades are mostly manufactured using composites. Although at the current time there are several methods to recycle these components, and some circular-economy alternatives, redefining the base materials for manufacturing the blades is still one of the most interesting technological solutions for achieving recyclability.

As wind turbine blades are normally made up of several parts that are eventually joined by adhesive bonds, namely two aerodynamic GFRP stiffened shells and a sandwich load-carrying beam enclosed by the firsts, and both the matrix of this composite-based components and the adhesive used to assemble them contain non-recyclable thermosetting resins, one of the most followed solutions is the passage from the use of thermosetting to thermoplastic resins. These not only allow for recycling but also for reducing the mass and the manufacturing costs as some of these resins do not require a hot cure cycle. However, a verification of the structure's integrity against their use must be done, particularly for the adhesively bonded joints, since these are the critical structural areas.

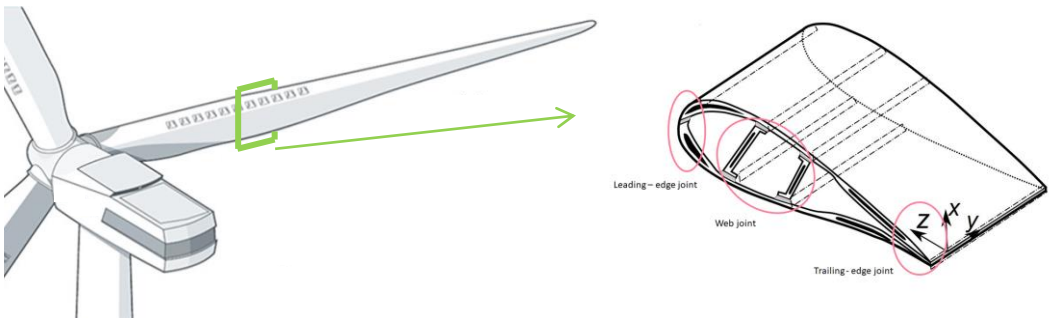
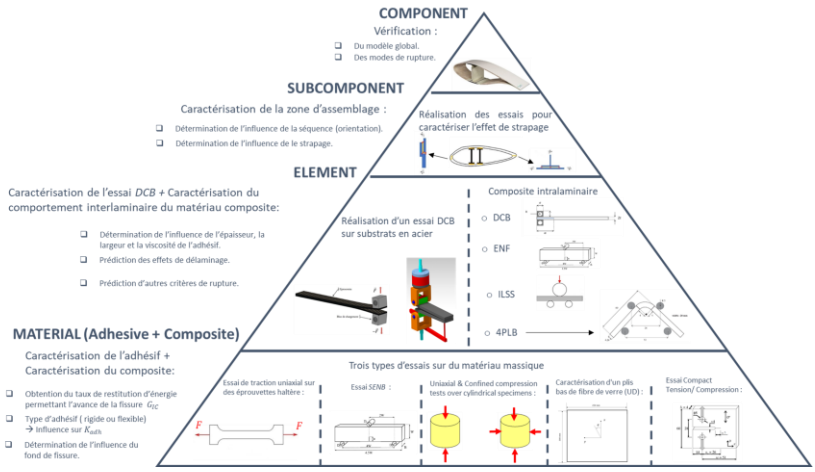


Fig 1. Classical adhesively bonded joints in a wind turbine blade. Adapted from [1].

Within this context, a french company leader in specialty materials has developed a series of new thermoplastic resins for the manufacturing of sustainable wind turbine blades. A PhD is being done at ISAE SUPAERO in collaboration with them in order to characterize the mechanical behavior of this type of resins and their influence on the global response of the structure. This intership appears as a support for this PhD.

Objectives and work	Your mission will be to perform an experimental test campaign to characterize both the mechanical behaviour of the thermoplastic-matrix GFRP assembled components of the blade by their own, and bonded by a thermoplastic-base adhesive. This campaign is part of the designed test pyramid used for the certification of the structure:  Fig 2. Test pyramid for the certification of the structure. We will begin by the base of the pyramid (MATERIAL + ELEMENT), where a series of composite intralaminar & interlaminar characterization tests (Traction, CT/CC, DCB, ENF, ILSS & 4PBL) are expected. These tests will be validated by numerical simulations using the FE method (ABAQUS) and a semi-analytical in-house method, the Macro-element method. Then, we will design the subcomponent tests (ADHESIVE + COMPOSITE SUBCOMPONENT) to characterise the behaviour of the adhesively bonded joints: leading-edge joint, trailing-edge joint and web joint. As a final aim, a design of a reduced blade element test will be proposed to fulfil the test pyramid.
Possibility to continue with a PhD (Yes/No) : TBD	
REQUIRED APPLICANT PROFILE AND SKILLS	
Study level	☐ Undergraduate students (3rd or 4th year) ■ Master students (1st or 2nd year) ☐ PhD students
Required profile and skills	You are a student in the last year of a MSc in Aeronautical or Mechanical Engineering and you have the following qualities: • You have an extensive knowledge in composite materials • You are familiarized with tool handling. • You are familiarized with the FE Method. • You are familiarized with ABAQUS or you are willing to learn. • **Languages:** Advanced English. French is a plus.
Other useful information	Gratification is around 600 €/month depending on working days. Do not hesitate to contact us!
References	[1] J. B. Jørgensen, "Adhesive Joints in Wind Turbine Blades"; 2017.