DACOMAT

Deliverable number: D7.6

Project business case workshop 1

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The DACOMAT project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No. 761072

Deliverable details

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Dissemination level	
X	PU = Public
	CO = Confidential, only for members of the consortium (including the EC)
	Classified, information as referred to in Commission Decision 2001/844/EC.
Deliverable type	
	R: Document, report (excluding the periodic and final reports)
	DEM: Demonstrator, pilot, prototype, plan designs
X	DEC: Websites, patents filing, press & media actions, videos, etc.
	ORDP: Open Research Data Pilot
	OTHER: Software, technical diagram, etc.

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1. Introduction

The goal of Deliverable 7.6 is to present the results of the first project workshop.
This report describes the activity carried out during the workshop, as well as its organization procedures. The workshop is part of the Grant Agreement of the project. It was organized by Ayming with the help of SINTEF and the speakers. The goal of the workshop was to provide the attendants with a broad overview of the DACOMAT developments and get feedback about how stakeholders can make use of them.

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2. Preparation of the Workshop

1 Context and objectives

Two workshops have been planned within the DACOMAT framework, to support and enhance the DACOMAT exploitation strategy, namely:

- Project Business case Workshop 1 (M36)
- Project Business case Workshop 2 (M48)

However, due to lack of advanced results regarding business cases that have started later in the project, it has been decided during DACOMAT's general assembly in M24 to propose another structure for these workshops. The first workshop reported in this deliverable address damage tolerant and damage controlled composite materials in general. The consortium will organise a final workshop by the end of the project (as planned), gathering both project business case studies (i.e. bridges and wind blades).

A key subject regarding exploitation is the development of **new materials** with improved performances. To have a fruitful workshop, the consortium decided to target the following objectives:

- Dissemination of the results / knowledge
- To get feedback from the invited participants
- Assessing adequate scopes of potential DACOMAT follow-up projects in order to further exploit the DACOMAT results.

Hence the theme and titles became: ***Damage tolerant composites: Why and how?***

As we wanted to discuss with the attendees, the participation was limited. The consortium did not advertise the workshop widely, but instead invited selected key composite experts and stakeholders (including some of those identified in deliverable 7.2).

A list of nearly 40 relevant stakeholders has been developed with the partners:

- Application-oriented composites research centre
- Industrial
- Composite business
- Contributors to standards
- glass fibre and fabric producer
- blade designer
- wind blade OEMs
- Research centres / universities

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- Material manufacturers
- Research centre
- Industrial in other applications…

2 Date and Location

The workshop took place on Monday the 08th of March 2021 online (Teams web conference).

3 Schedule

To allow discussion, and not display any confidential or sensitive information, speakers focused on the question of the characteristics of materials and fostering their implementation in the industry.

The invitation was shared directly by the consortium:

The project Damage Controlled Composite Materials (DACOMAT) is a research and innovation project funded by the European Commission. DACOMAT aims to develop more damage tolerant and damage predictable low-cost composite materials, in particular for used in large load carrying constructions like bridges, buildings, wind-turbine blades and offshore structures. Specifically, DACOMAT develops materials and methods to increase the interlaminar fracture resistance.

The DACOMAT consortium is pleased to invite you to our workshop titled "Damage tolerant composites. Why and how?"

Date: 08.03.21
Time: 10.00 – 12.30
Venue: online event

The DACOMAT consortium have visions and ideas about how to increase the use of the concept of damage tolerance in composite structures. To succeed in exploiting those, we rely on disseminating them to, and discussing them with stakeholders from composite industry and research.

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The workshop will gather composite experts from research, industry and engineering. The format of the workshop will be a balanced combination of presentation of DACOMAT project results and ideas and facilitated discussions.

Agenda:

- More damage tolerant and damage predictable low-cost composite materials. The DACOMAT goals and approach, *Jens Kjær Jørgensen, SINTEF*
- Discussion: How could your applications benefit from damage tolerant composites?
- Design and materials requirements to achieve damage controlled/tolerant structures, *Bent Sørensen, DTU*
- Q&A session
- DACOMAT developments compared to standard materials, *Reidar Joki, FiReCo*
- Q&A session
- Certification of damage tolerant materials and future Recommended Practice for damage tolerant composite components, *Philippe Noury, DNV GL*
- Discussion: Can damage tolerant composites improve safety and reliability?
  General Q&A session

Registration is open for ***invited stakeholders*** from industry and academia. Attendance is free of charge, but **registration is required**
We have no strict deadline, but please register as soon as possible and before February 15th. If you for sure know that you cannot participate, we appreciate that you let us know by replying to this email.

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Table 1: shows the schedule for the 08 March, 10h to 12h30:

Subject		Speaker	Time	Duration
Presentation	DACOMAT: more damage tolerant and damage predictable low-cost composite materials The challenges of damage tolerant composites	Jens Jørgensen – SINTEF	10:00	00:20
Discussion	How could your applications benefit from damage tolerant composites?	Jens Jørgensen – SINTEF	10:20	00:10
Presentation	Design to achieve damage controlled/tolerant structures	Bent Sørensen – DTU	10:30	00:20
Discussion	Q&A session	Bent Sørensen – DTU	10:50	00:10
Presentation	DACOMAT results towards reference materials	Reidar Joki - FiReCo	11:00	00:20
Discussion	Q&A session	Reidar Joki - FiReCo	11:20	00:10
Break			11:30	00:10
Presentation	Certification of damage tolerant materials and future Recommended Practice for damage tolerant composite components	Philippe Noury – DNV GL	11:40	00:20
Discussion	Can damage tolerant composite improve safety and reliability?	Philippe Noury – DNV GL	12:00	00:20
Discussion	General Q&A session	Jens Jørgensen – SINTEF	12:20	00:10
End of session			**12:30**	

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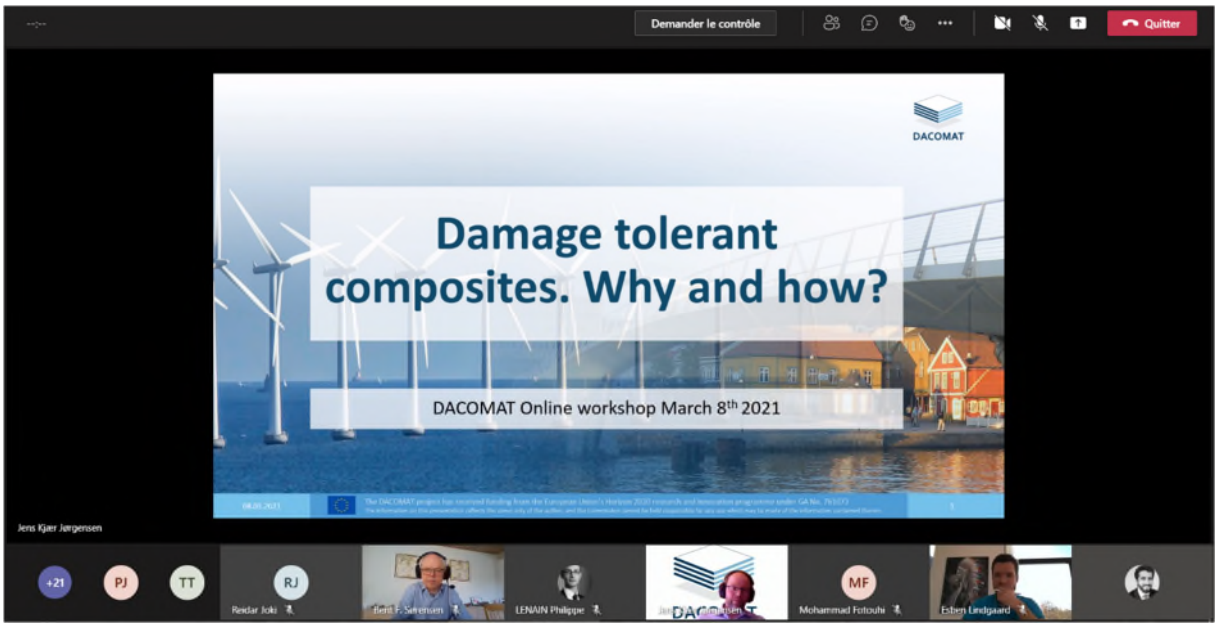
3. Workshop speakers

4 speakers from the DACOMAT partners presented key aspects of the project regarding damage tolerant composites, namely:

- **Jens Jørgensen** – SINTEF, project coordinator, opened the workshop and gave an overview of the project and the challenges of damage tolerant composites.
- **Bent Sørensen** – DTU, talked about the benefits of damage tolerant composites.
- **Reidar Joki** – FiReCo, detailed DACOMAT results on damage predictable low-cost composite materials.
- **Philippe Noury** – DNV insisted on the interest of certification and shared some recommended practices.



4. Workshop Participants

The audience was very heterogeneous with participants both from academia and industry: LM, SGRE, Amiblu, Delft University of Technology FFI, Fraunhofer Institute for Wind Energy Systems, IPC, JCH Industrial Ecology Ltd, NTNU, Samtech SA, Univ Politecnica Madrid etc.
For RGPD and confidentiality reasons, the list of participants cannot be displayed in this public deliverable.

5. Achievements

With more than 40 participants, both from the consortium and stakeholders, industries and academics, the workshop was a success. Each of DACOMAT's speakers, by the end of their presentation, have raised questions to the audience that became the basis for each Q&A session. Hereafter, are summarised key questions that have been raised to favour DACOMAT's exploitation:

- How can your application benefit from damage-controlled composites?
- Are the damage tolerance concepts useable, or too fluffy?
- Where do you see the biggest weakness in damage tolerant design in the future?
- What would be the next steps needed to bring damage tolerant design and damage tolerant materials into industrial use?
- What are your expectations from guidelines or recommended practices? For instance, what should be addressed?
- Would damage tolerance certification of materials be useful?
- Would damage tolerance qualification of component be useful?

Presentations generated plenty of interesting discussions and positive feedback from the participants. Additional bilateral discussions are ongoing outside the workshop framework, demonstrating the interest for DACOMAT materials and their further exploitation.

Main discussions were focused on the concept of "damage tolerant composites" and their design practise and certification. Does it make sense to speak about it? Some thoughts have indeed been given regarding this topic from the external stakeholders: "Certainly, materials can be tough and have a high capacity for energy absorption, and thereby be more tolerant of damage. But if we are defining damage tolerant to mean that damage growth in a structure is prevented or arrested, then this is a feature of the "structure", not of the material."

This aspect of the difference between material and structure has already been discussed within DACOMAT, and conclusions were that the guidelines need to address both damage tolerant structures but also damage tolerant materials. Indeed, damage tolerant materials can mean damage tolerant **raw** materials (resin, fibre, fabric or tape) or damage tolerant **laminated** materials (after fabrication or infusion i.e. laminate). There are several reasons for that, among others:

- Raw materials have impact on damage tolerant properties whether at laminate level or structure level.
- Raw materials may have basic strength properties enhanced or reduced for superior damage tolerance, which in turn affects the structural response and ultimate capacity.

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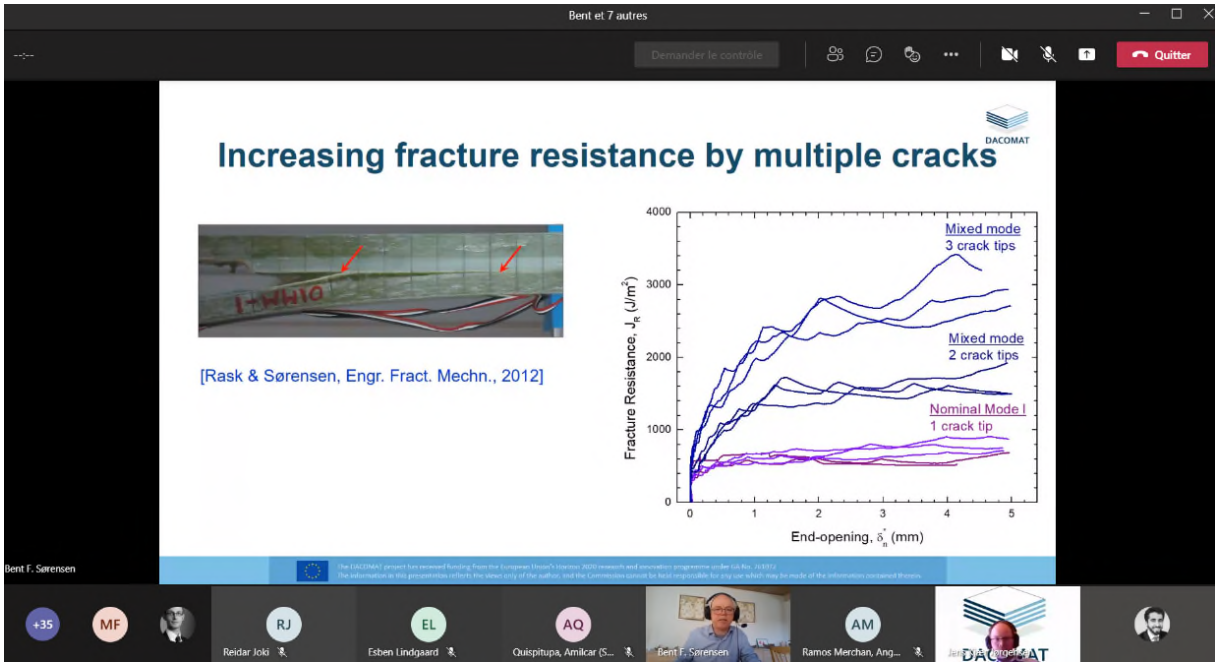
- Laminate specs (orientation, areal weight, stacking sequence etc.) have impact on damage tolerant properties at laminate level and structural level
- Structure specifications and functional requirements (safety factors, load specs. e.g. load controlled or displacement controlled as you mention, single or multiple load paths etc.) have impact on damage tolerant properties of the structure.

A composite layer or a composite laminate is an engineered material where the microstructure is designed and enhanced for given required properties. In that context the differentiation between material and structure is a matter of definition, i.e., whether one is interested in macroscale or microscale properties and phenomena etc.

As a conclusion, damage tolerant behaviour is an inherent coupled material-structure “property”. A key issue in damage tolerance is crack stability. We could define a damage tolerant structure by its ability to have stable crack growth under increasing applied load (i.e., should arrest under fixed load or fixed displacement) for static loading and be able to slow down and arrest under cyclic loading.



The vision of having structures where damage will arrest fully, which would lead to a ‘care-free structure’, is a very interesting goal. It will depend on the material system and structure how feasible it is, but it is a good goal to strive towards. In an aviation context, having a proven ability to arrest cracks in an adhesive bond line would be very helpful to enable certification of adhesive bonding.

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