Aerospace Structures and Materials (ASM)

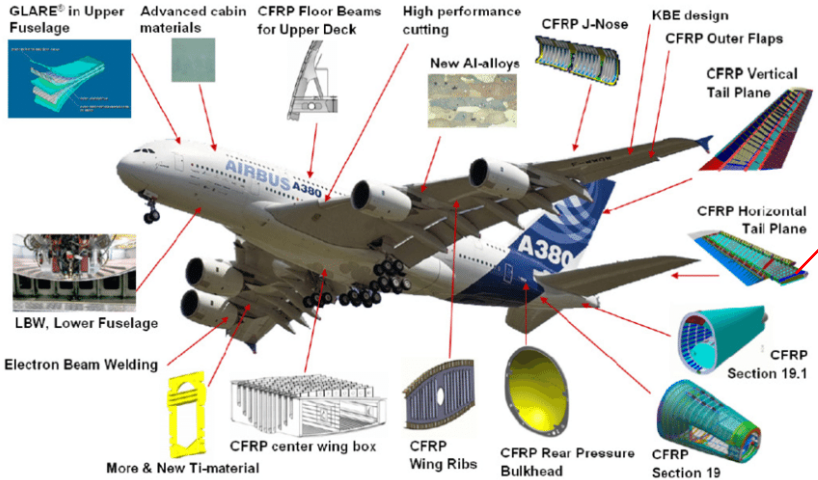
Master Track IV: Innovation in Analysis, Design and Manufacturing

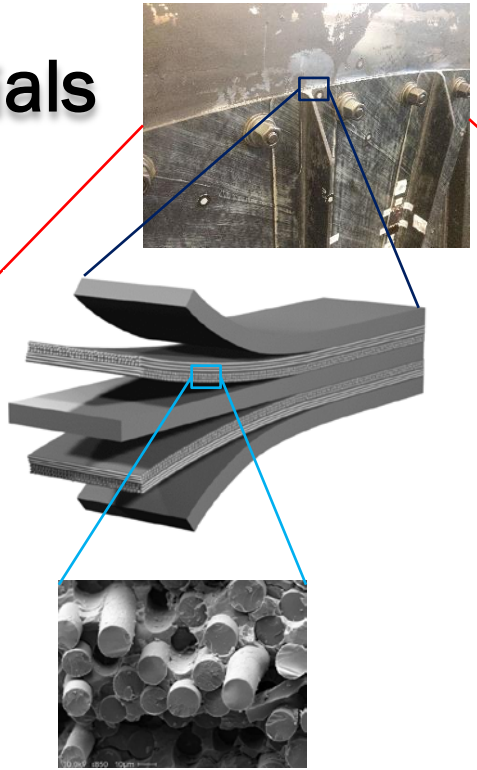
Dr. Sergio Turteltaub

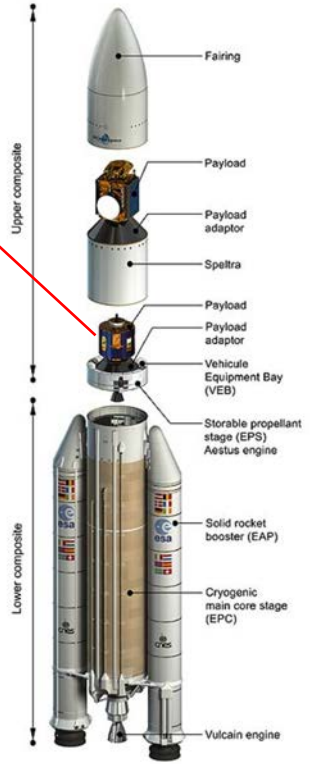
ASM Track Coordinator

ASM: Structures **and** Materials

Big structures that **fly** are made out of **many** small parts...
and each part is made out of many **materials**







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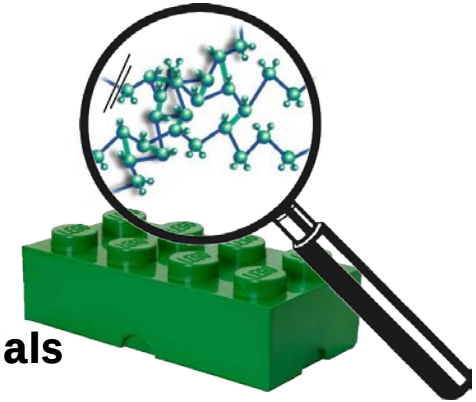
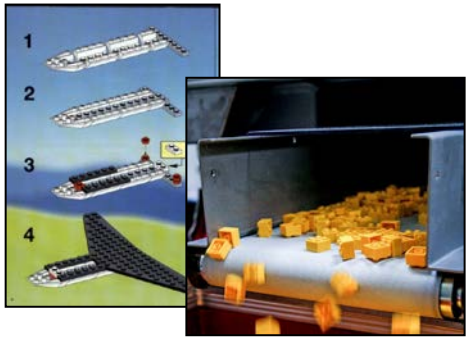
Building Blocks of Aerospace Structures

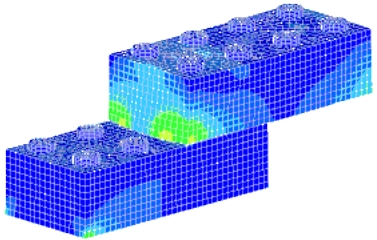


Materials



Production

Safety & Durability



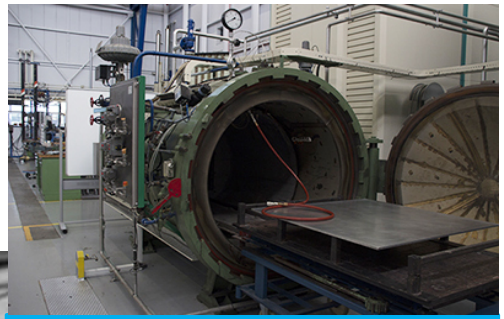
Structures


The things we **MAKE**...
have the potential to **BREAK**

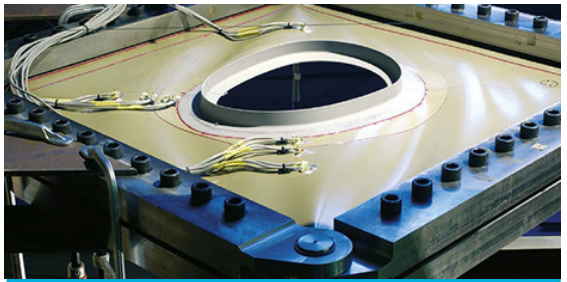
Aerospace Structures and Materials

Four research units and one Lab

Structural Integrity & Composites



Delft ASM Laboratories



Aerospace Structures & Computational Mechanics

Aerospace Manufacturing Technologies

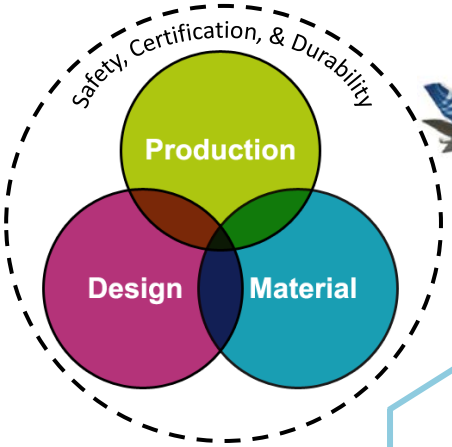
Novel Aerospace Materials

Aerospace Structures and Materials

Master tracks

Faculty of Aerospace Engineering

- Aerodynamics & Wind Energy
- Control & Operations
- Spaceflight
- **Aerospace Structures & Materials**
- Flight Performance & Propulsion
- European Wind Energy Master



Profiles within **track**

- I. **Materials**
- II. **Structures**
- III. **Manufacturing**
- IV. **Durability**

Master **track** IV:

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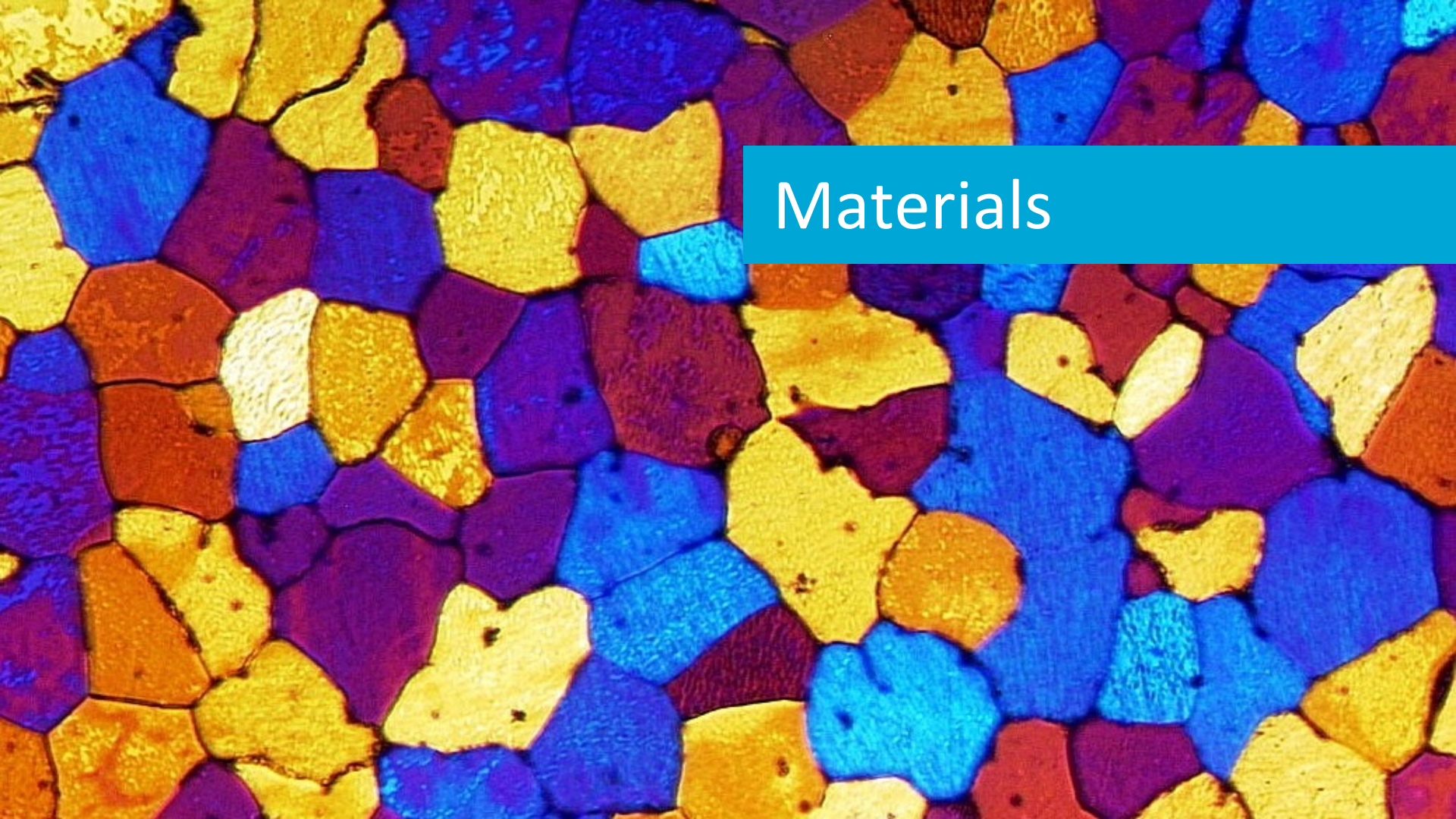
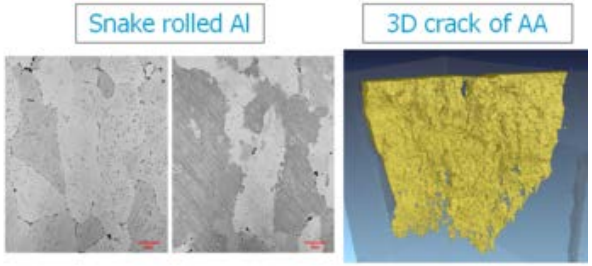
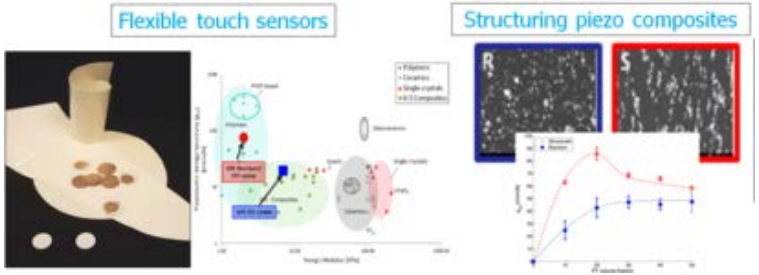


Materials

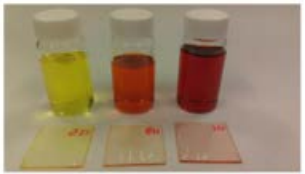
Materials: Research themes



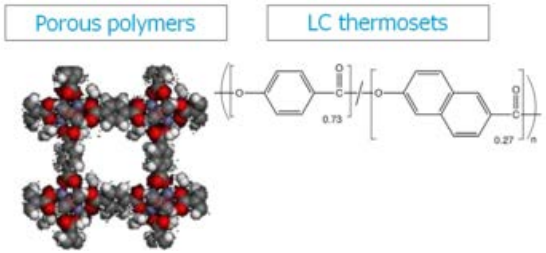
Advanced Metallic Systems



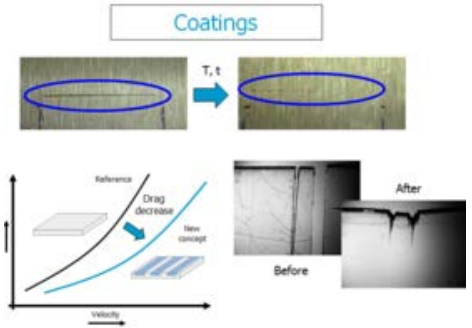
Smart Materials



Organic solar cells



Polymers for high performance applications



Self Healing Materials (SHM) and functional surfaces

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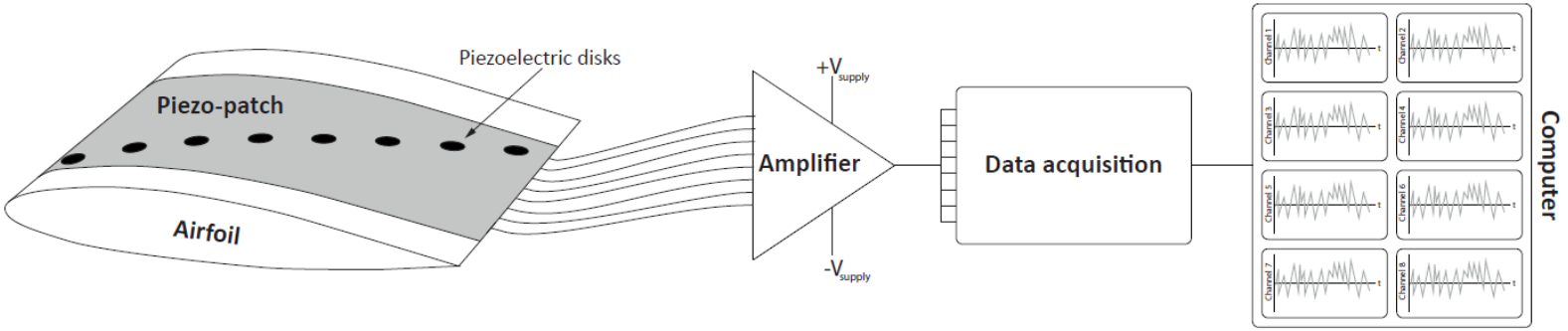
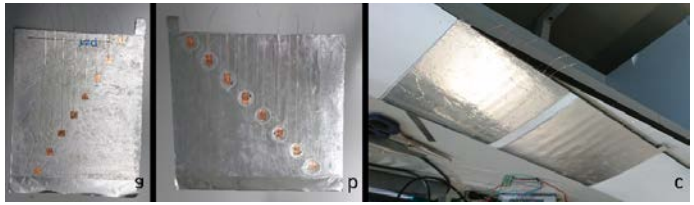
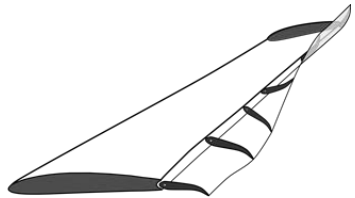
Applications: Smart Wing







SMART STRUCTURES

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Materials Profile: Courses Overview

Key Material Relevant Core Courses
Material Design

Key Material Relevant Electives
Design of Self Healing Materials
Materials Characterization
Materials Selection

Profile Courses	I. Materials	II. Structures	III. Manufacturing	IV. Durability
Polymers	✓		✓	
Advanced Alloys	✓			
Functional Coatings	✓			
Sensor Materials	✓			✓
Trinity Exercise		✓	✓	
Stability & Analysis of Structures I		✓		✓
Polymer Composites Manufacturing		✓	✓	✓
Experimental Techniques & NDT	✓	✓	✓	✓
Design & analysis of Composite Structures I		✓	✓	✓
# EC	17	18	20	17

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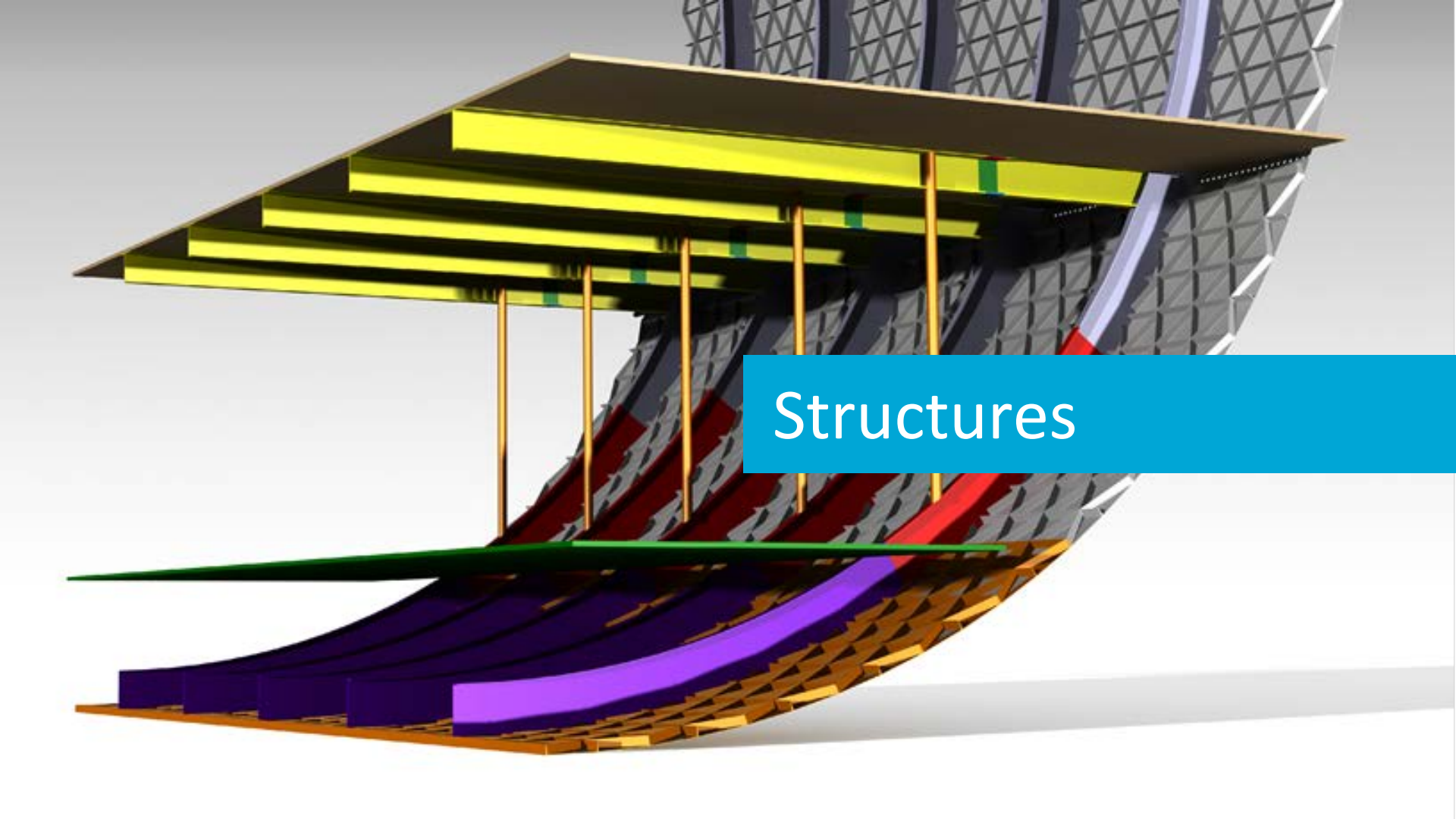
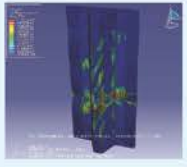
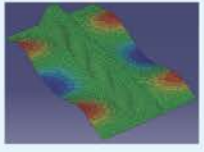


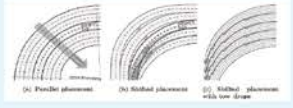
Structures

Structures: Research themes

Single-Stringer compression specimen damage tolerance

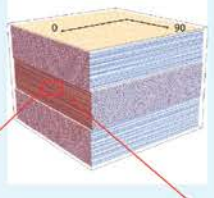




Making the composite meet local structural requirements

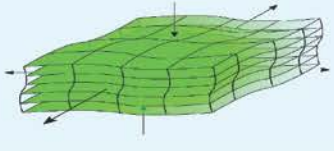
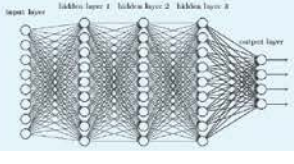



Multifidelity aeroelastic loads and stability calculation methods

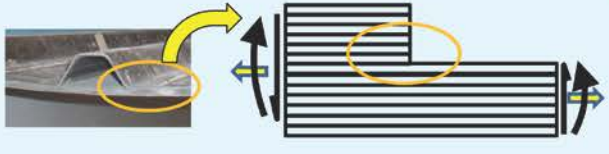
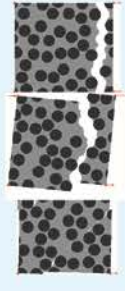

Understanding fracture from a multiscale perspective



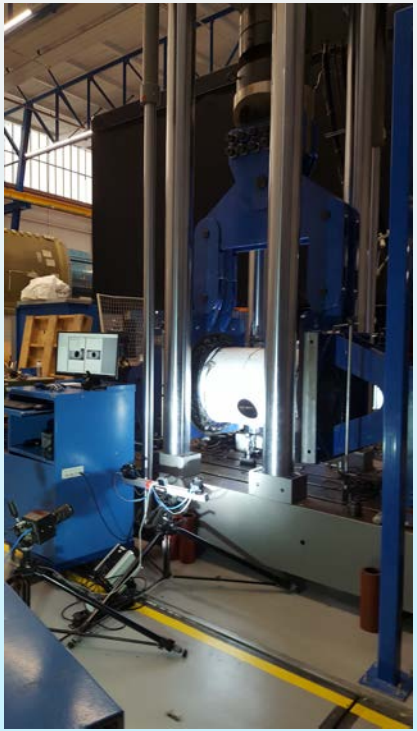

Deep learning on finite element analysis

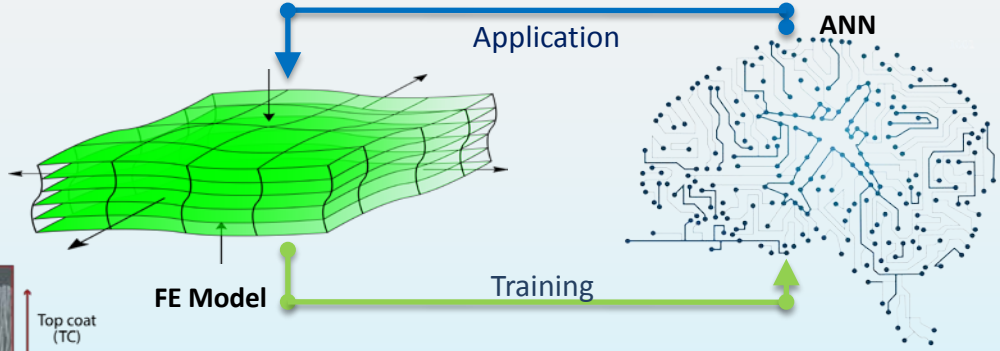
Composites design and engineering

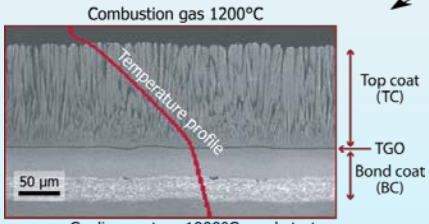



Structures: simulations and experiments

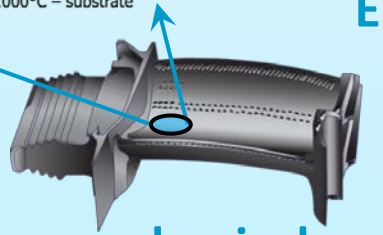


Buckling: Testing structural limits

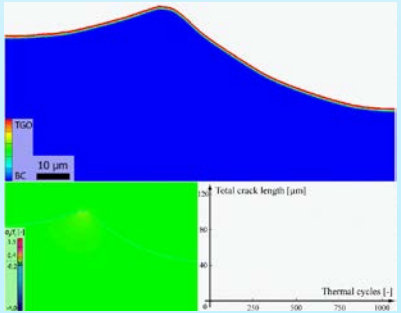




Machine learning on Finite Element Analysis



Thermomechanical analysis of structures at high temperature



Structures Profile: Courses Overview

Key Structures Relevant Core Courses
Design of Light-weight Structures
Linear Modelling
Key Structures Relevant Electives
Aeroelasticity
Non-linear Modelling
Spacecraft & Launcher Structures
Stability & Analysis of Structures II
Design & Analysis of Composite Structures II

Profile Courses	I. Materials	II. Structures	III. Manufacturing	IV. Durability
Polymers	✓		✓	
Advanced Alloys	✓			
Functional Coatings	✓			
Sensor Materials	✓			✓
Trinity Exercise		✓	✓	
Stability & Analysis of Structures I		✓		✓
Polymer Composites Manufacturing		✓	✓	✓
Experimental Techniques & NDT	✓	✓	✓	✓
Design & analysis of Composite Structures I		✓	✓	✓
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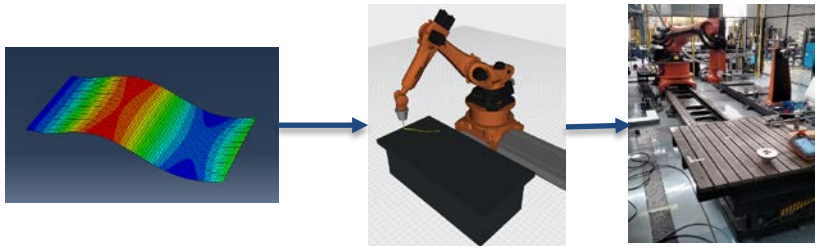
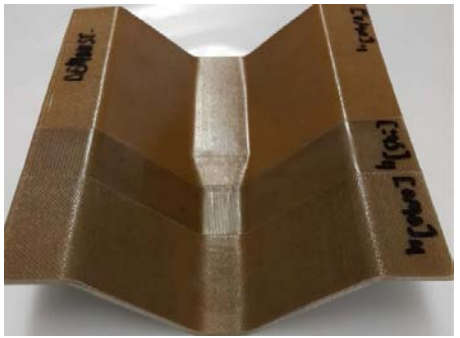
Manufacturing

Manufacturing: Research themes

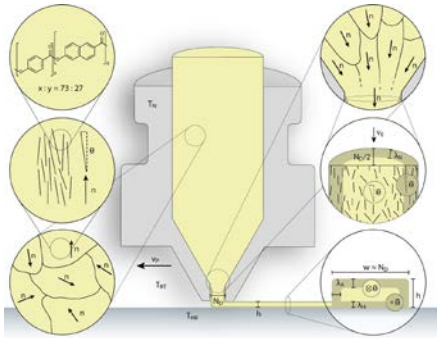
From design to robot language



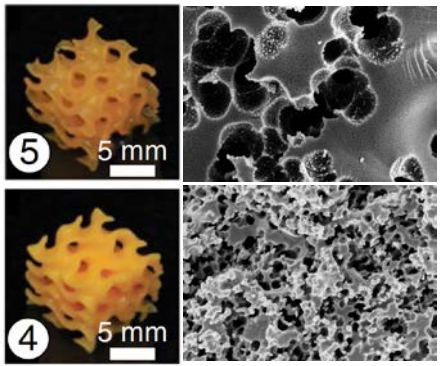
Press forming FPRC

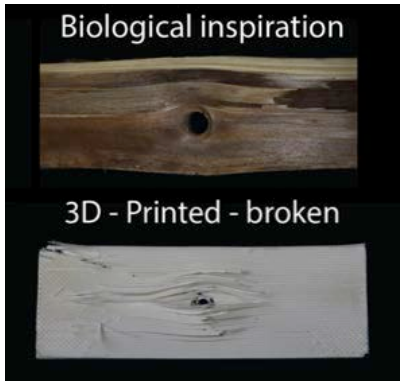


Hierarchical structure of the LCP polymer



Bioinspiration: hierarchical architectures





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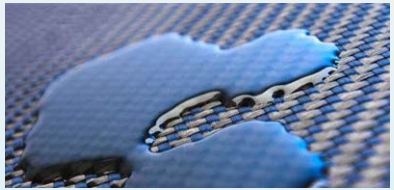
Manufacturing: emerging topics

Life Cycle of composites

Footprint

End of Life

Recycling



Manufacturing Profile: Courses Overview

Key Manufacturing Relevant Core Courses
Manufacturing of Aerospace Struct. & Mat.
Design of lightweight structures I
Key Manufacturing Relevant Electives
Aircraft Manufacturing Laboratory
Industrial Composite Manufacturing
Sheet Metal Forming
Design of lightweight structures II

Profile Courses	I. Materials	II. Structures	III. Manufacturing	IV. Durability
Polymers	✓		✓	
Advanced Alloys	✓			
Functional Coatings	✓			
Sensor Materials	✓			✓
Trinity Exercise		✓	✓	
Stability & Analysis of Structures I		✓		✓
Polymer Composites Manufacturing		✓	✓	✓
Experimental Techniques & NDT	✓	✓	✓	✓
Design & analysis of Composite Structures I		✓	✓	✓
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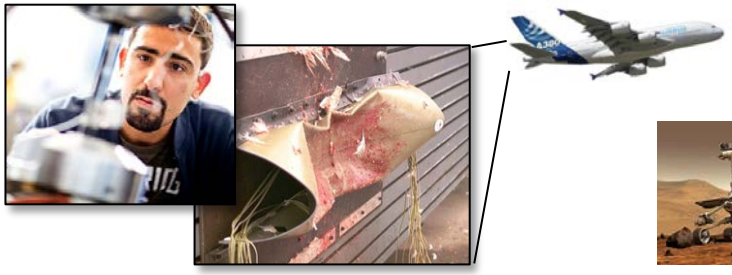
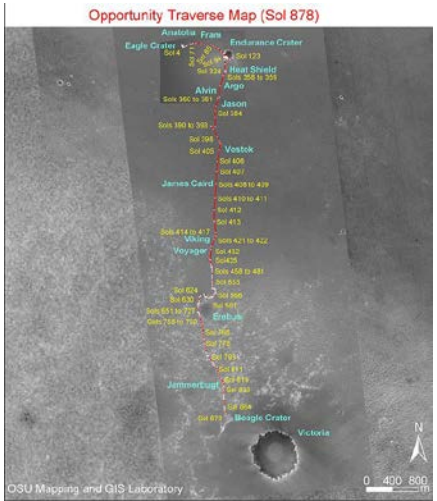
Durability

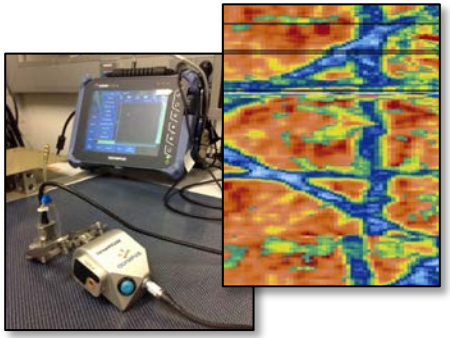
A380 full scale fatigue test - Airbus

Durability: Research themes



Fatigue & Durability



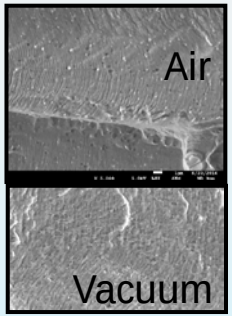


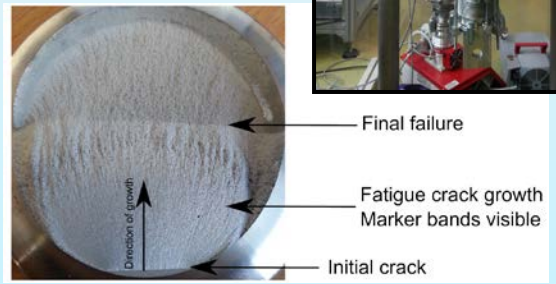
NDT/SHM

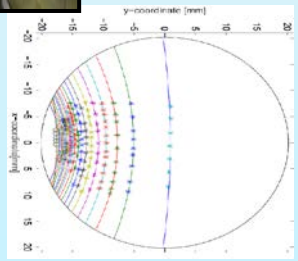
Safety & Certification

Durability: safety first

Environmental effect of fatigue crack growth

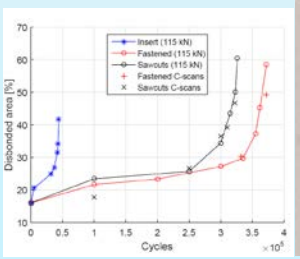


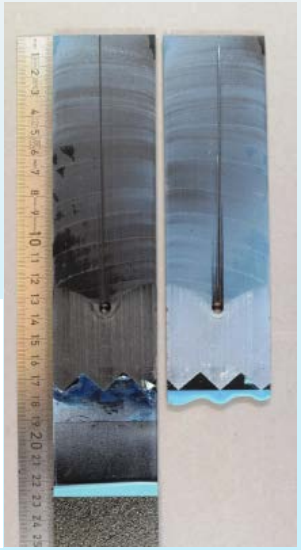




Challenging the notion of crack closure as an explanation for mean-stress effects on fatigue crack growth in metals

Disbond Arresting Features





Enabling certification of bonded joints through use of design features that arrest incidental damage growth under fatigue

Forensic Engineering

Santa Crash
FORENSIC * ENGINEERING
AEROSPACE ENGINEERING

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Durability Profile: Courses Overview

Key Durability Relevant Core Courses
Fatigue of Structures & Materials
Design of lightweight structures I
Key Durability Relevant Electives
Structural Integrity & Maintenance
Forensic Engineering
Design & Analysis of Composite Structures II
Design of Self Healing Materials

Profile Courses	I. Materials	II. Structures	III. Manufacturing	IV. Durability
Polymers	✓		✓	
Advanced Alloys	✓			
Functional Coatings	✓			
Sensor Materials	✓			✓
Trinity Exercise		✓	✓	
Stability & Analysis of Structures I		✓		✓
Polymer Composites Manufacturing		✓	✓	✓
Experimental Techniques & NDT	✓	✓	✓	✓
Design & analysis of Composite Structures I		✓	✓	✓
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New: Space Profile

Increased interest in Space: Early announcement:

- **New** profile with **space**-related courses and projects
- Combination of topics from ASM and Space Track
- New courses from ASM already being developed and implemented
- Details **TBA**

Courses on Spacecraft and Launcher Structures

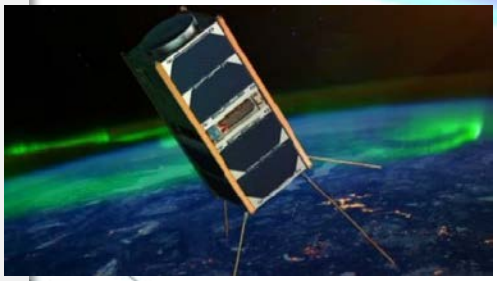
Falcon Heavy: Reusable

AE4-ASM-523

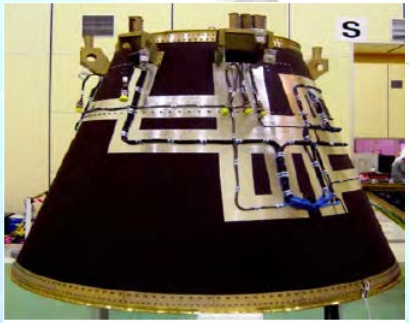
Design of Spacecraft and Launcher Structures

AE4-ASM-524

Advanced Design, Development and Verification of Spacecraft and Launcher Structures



CubeSat



Payload Launcher Adapter

ESA – Vega Launcher

Aerospace Structures & Materials

The people behind ASM


We pursue research that will help enable the aerospace products of tomorrow meet the ever rising demands on performance, and do so for the entire life of the product.
Rinze Benedictus


Our research is both explorative and fundamental in nature but successful concepts are developed up to a level suitable for absorption by the industry.
Sybrand van der Zwaag
Pim Groen
TU Delft

Roeland De Breuker

Typically, our research projects combine engineering expertise with the use of advanced computational tools in order to develop design solutions relevant to societal needs. The final product of the research can be a **prototype** of an innovative technology or **design methodology** for use in industry.

Chiara Bisagni

Clemens Dransfeld

There are simulation methods that are very accurate, but that last for days or weeks. But I prefer a fast prediction of 80% reliability in three hours than a solution of 100% accuracy in a week. The industry is often willing to take that risk

Aerospace Manufacturing requires an interdisciplinary approach between materials science, engineering and manufacturing.

Christos Kassapoglou

The ASM department: research staff

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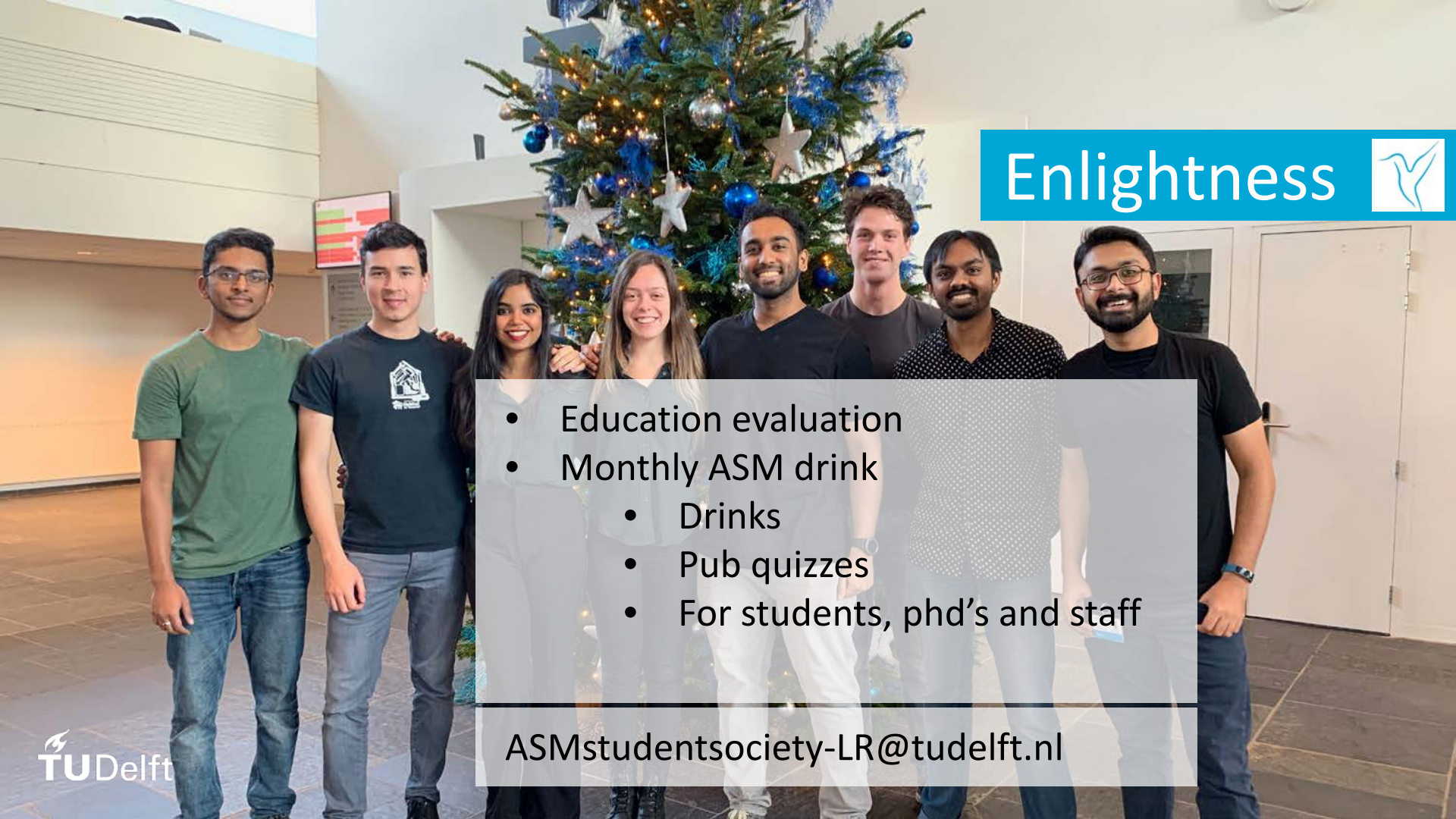

Enlightness

- Education evaluation
- Monthly ASM drink
  - Drinks
  - Pub quizzes
  - For students, phd’s and staff

ASMstudentsociety-LR@tudelft.nl

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Enlightness

- Company event
  - Potential jobs & internships

TEIJIN DAMEN Airborne

ATG europe KLM nlr

ASMstudentsociety-LR@tudelft.nl

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- Excursions & guest lectures

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The Structures and Materials Track may be a good choice for you if you find many things that you like:

- When you like **real-life aircraft** and **space structures**
- When you like to think about **new aerospace concepts**
- When you like **mechanics** and **simulations**
- When you like creating **new materials** and **innovate** existing ones
- When you like **experimental** work in a **real** laboratory
- When you are interested in **mathematical complexity**
- When you like **science** as much as **engineering**
- When you care about **safety**
- When you like making **real** objects
- When you like robot **control** and **automation**
- When you want to provide **new tools** to the **industry**

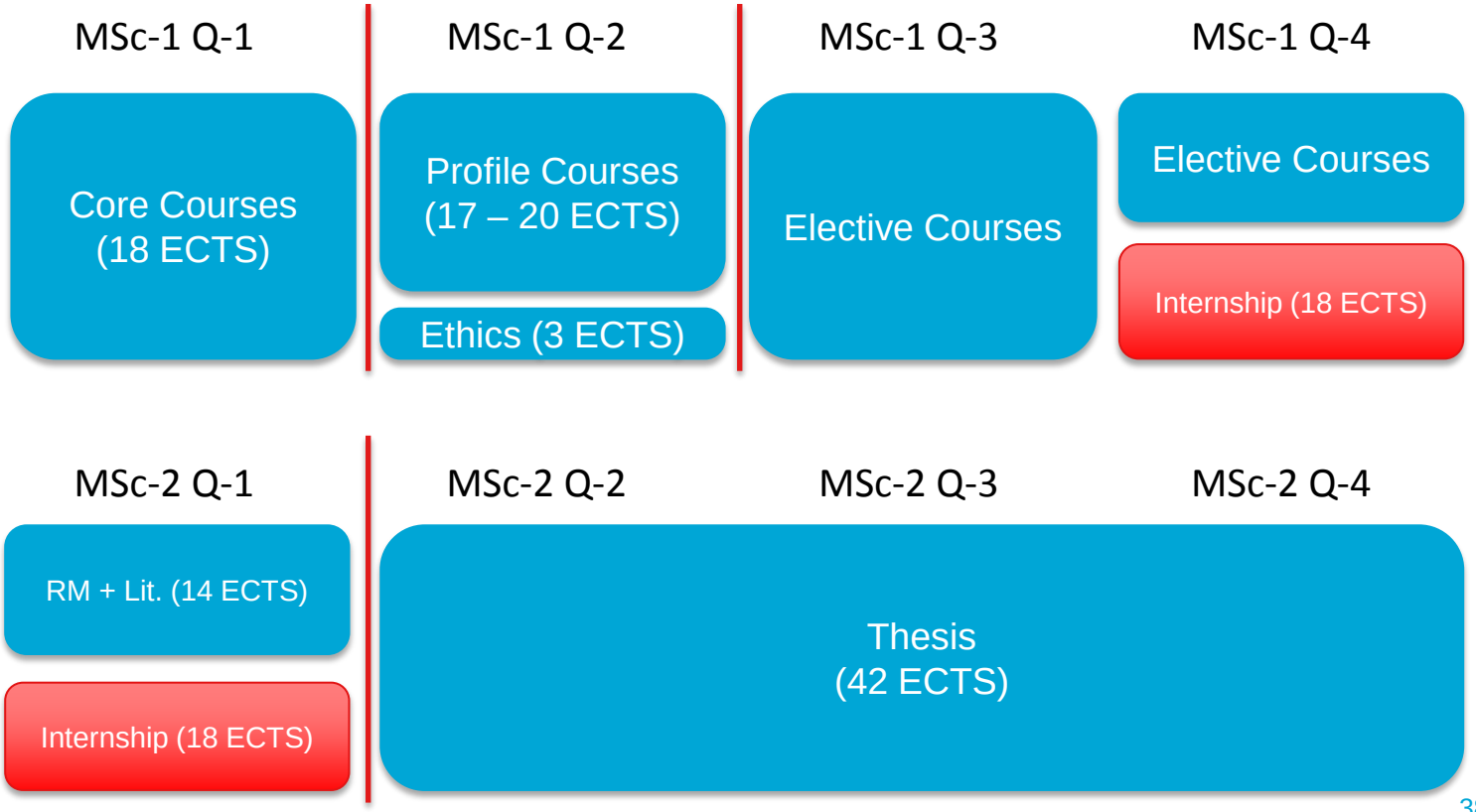
Aerospace Structures & Materials

Practical Information

ASM MSc programme

- Flexible profile and elective choice
- Hands on supervision
- Thriving MSc Student Society
- Many industry contacts

Outline ASM MSc programme

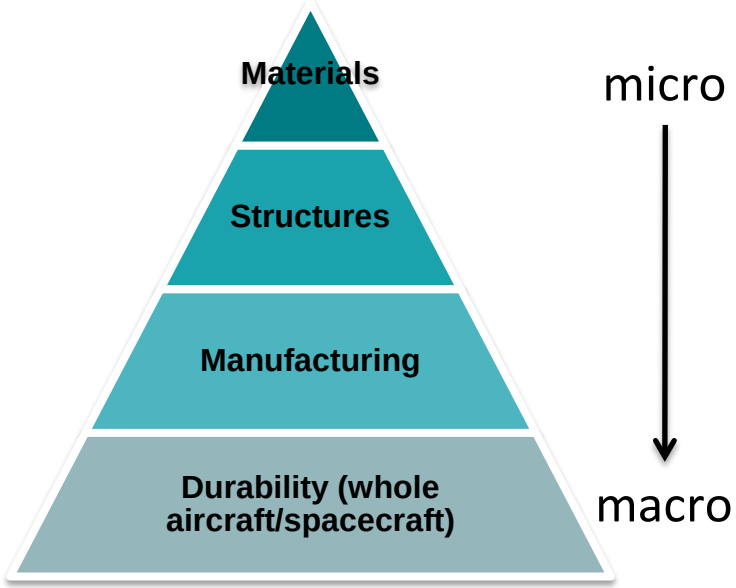


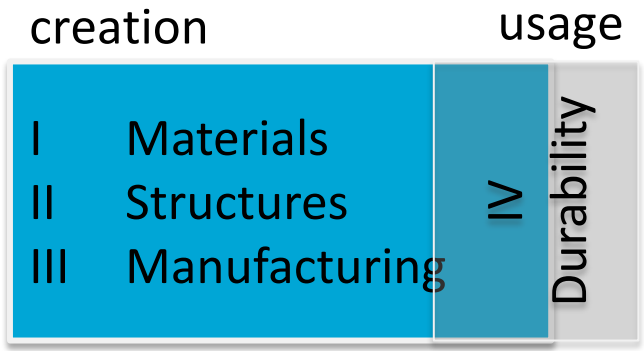
ASM Track Design

EDIT / DELETE SLIDE

1 Common core of 15 ECTS in 1st period

Followed by a choice of 4 thematic profiles:





ASM Core Programme (all in period 1)

AE4ASM001 Design of Lightweight Structures I: Composites & Metals

AE4ASM002 Designing Materials with Aerospace Specific Properties

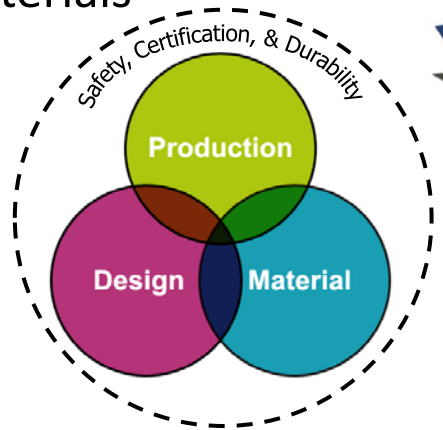
AE4ASM003 Linear Modeling (using F.E.M.)

AE4ASM004 Manufacturing of Aerospace Structures & Materials

AE4ASM005 Fatigue of Structures & Materials

Ethics (in period 2)

WM0324LR



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ASM Core Module

- The core module of the new ASM MSc curriculum has been designed to cover all aspects of structures and materials for the development of an aircraft wing.
- Core topics span from creation and design to analysis, manufacturing and life-time durability monitoring.

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Interaction

September — Introduction

October — Profile coordinators

MSc Track coordinator → Profile s

November — Speed dating event

December — MSc Track coordinator → Elective s

February — Company event

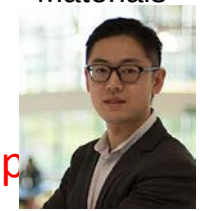
MSc Track coordinator → Thesis top selection

Thesis supervisor


Manufacturing


Durability


Materials


Structures

We Work Well With Others

So why ASM ?

- We maintain strict supervision to help you finish in time
- You can apply for the aircraft construction course
- You are part of a lively MSc student body
- You can play in the best labs of the faculty
- All our student find a job soon after graduating

Contact

ASM MSc Track Coordinator

Faculty of Aerospace Engineering, TU Delft

E-Mail: MScCoordinator-ASM@tudelft.nl

lr.tudelft.nl/asm


We’re looking forward to seeing you in September!
TU Delft