FleXcrash

Flexible and hybrid manufacturing of green aluminium to produce tailored adaptive crash-tolerant structures

PRESENTER NAME: Sergi Parareda & Andoni Agirre
DATE: 06 / 10 / 2023

Index

Flexcrash general overview

Flexible and hybrid manufacturing of green aluminium to produce tailored adaptive crash-tolerant structures

- European project funded under the topic: *HORIZON-RIA CL5-2021-D6-01-10 - Testing safe lightweight vehicles and improved safe human-technology interaction in the future traffic system*
- **4 years** duration, from 1/09/2022 to 31/08/2026
- **Budget**: 3,9M€ funded by the EC
- **10 partners** from **5** different **European countries**
- Coordinated by **Eurecat**, RTO
- **Grant agreement ID**: 101069674

Consortium

FleXcrash

10 partners from 5 European countries: Spain, Sweden, Italy, Austria and Germany

3	2	3	1	1
Research centres	Universities	Industrial partners	Industrial research centre	Standardisation body

eurecat

Fraunhofer IWS

virtual vehicle

LULEÅ UNIVERSITY OF TECHNOLOGY

imc KREMS UNIVERSITY OF APPLIED SCIENCES

gemmate technologies

Gestamp

aerobase

STELLANTIS

UNE Normalización Española

About Flexcrash

Towards a new generation of safer, lighter, and circular crash structures production

- The Flexcrash project is focused on the development of a **flexible and hybrid manufacturing technology to produce tailored adaptive crash-tolerant structures made of green aluminium alloys.**

- To achieve this, the project selects vehicle parts and **applies surface patterns onto performed parts** with the objective to **reduce weight, increase safety** and **optimise crash performance of current and future vehicles**.

- Flexcrash solutions are to provide a **general improvement of car safety** with a **reduction of risks and fatalities in crashes**.

Our goal is to radically transform the traditional automotive sector and adapt to the extensive agility, versatility and interoperability needs of the upcoming industry.

The need

Flexcrash contributes to improve European automotive industry and societal challenges

More sustainable & lighter vehicle structures

Flexcrash uses green aluminium alloys and lightweight materials proposing processes more respectful for the planet and leading to a more sustainable automotive sector.

Aligned with European policies

The project contributes to the EC Circular Economy Action Plan “For a cleaner and more competitive Europe”, which is part of the key actions of the European Green Deal.

Support to meet GHG EU emission targets

The Flexcrash project contributes to the EU emission reduction target of 40% of Green House Gases by 2030 through developing circular, safe, and lightweight sustainable materials.

Flexcrash ambition *is to develop a low weight and circular automotive front structure that supports the EU long-term goals on zero emissions mobility and reduction in injuries and fatalities due to crashes.*

Research beyond the state-of-the-art

Flexcrash responds to current and future challenges in modelling and manufacturing for the development of vehicles with improved performance, cost-effectiveness and reduced environmental footprint.

Vehicle lightweighting

Applying a new hybrid manufacturing concept contributing to a more efficient use of resources and a weight reduction.

Passengers' safety

Contributing to achieve a long-term improvement of car safety, allowing a direct reduction of the fatalities' risks in road crashes and passenger's injuries

Expected results

A unique concept with potential to be implemented in the European automotive industry

1

Crash simulation from advanced material to virtual testing

Testing the project's tolerant structures under different crash scenarios to validate the simulation approach.

2

Flexible and hybrid manufacturing technologies

Transforming the traditional automotive sector and adapting to the extensive agility, versatility, interoperability needs of the industry.

3

New crash tolerant structures

Offering the tools to produce and build lighter and safer car structures.

4

Advanced testing on crash, toughness and fatigue

Optimizing the materials and manufacturing parameters and reducing the implementation time.

5

Identification of safety needs for current and future mobility

Identifying and demonstrating future relevant crash scenarios.

Project phases

1. Design of the crash tolerant structures according to the most probable crashes with high risk of passenger's injuries

2. Proposition of the different material and Solutions for the different parts of the front-end structured used as project's demonstrator.

3. Exploration of further weight and crash performance improvements. All the materials, manufacturing technologies and design of crash tolerant structures will be here assessed by crash tests and virtual modelling.

https://www.youtube.com/watch?v=HKIUNMqk1ZY

Future relevant crash scenarios

Future mobility

Mixed traffic environment: human drivers and automated vehicles

Less human errors, but lack of available accident data for automated vehicles

Benchmark: potential reduction of front-to-rear-end collisions by ADS, focus on intersection crashes

*The **ultimate goal** is to predict the types of accidents highly automated vehicles will encounter, crucial for guiding the development of new protection principles for occupants*

Crash Reconstruction Pipeline based on IMC Krems' research to automatically reconstruct car crashes from accident reports with optimization based on Genetic Algorithms

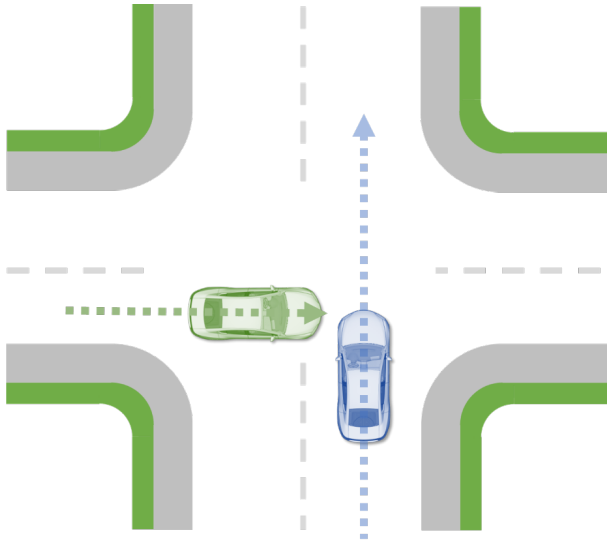
Crash Simulation Generation	Crash Simulation Optimization	Driving Agent Behavior Exploration
Input: crash reports (road geometry, lane markings, etc.) Generate a driving simulation that matches the input reports	Crash reports usually incomplete. Genetic Algorithms evolve the simulated trajectories until compatible with the description reported	Place ADs in crash simulation under different conditions and monitors whether ADs can avoid the crash. Output: relevant collision metrics (Relative Impact angle and velocity, impact location, etc.)

CRP integrates the CommonRoad framework and uses the state-of-the-art, sampling-based motion planner kindly provided by CommonRoad's Principal Investigator, Prof. Matthias Althoff (Technical University of Münich), as reference AD implementation.
simulator: BeamNG.tech is available at https://beamng.tech/

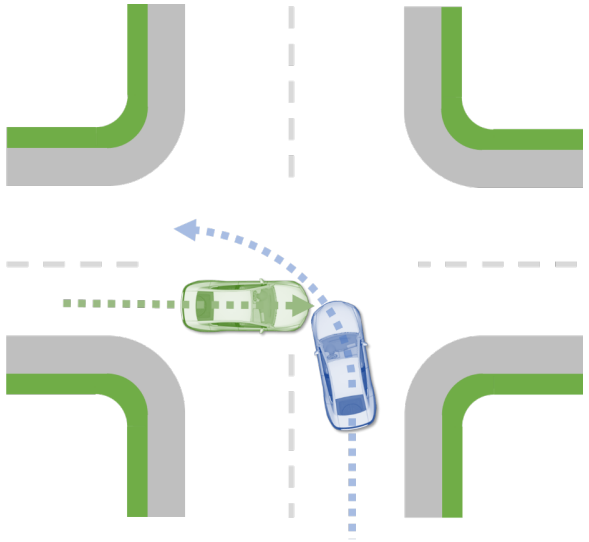
Future relevant crash scenarios

Relevant future scenarios from literature analysis and Flexcrash scenario generator:

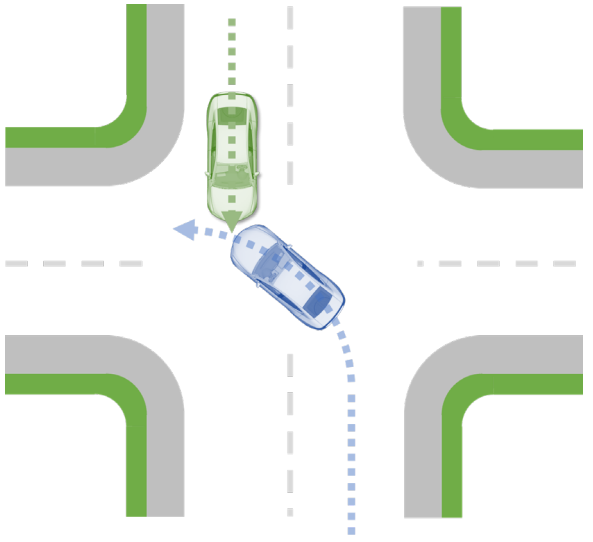
1 SCP-L Crash Scenario



2 LTAP-LD Crash Scenario



3 LTAP-OD Crash Scenario



Active safety crash structure concept

The goal is to **design a structure** that can absorb the energy of a frontal crash and protect the occupants from injury

Legal requirements

Pedestrian protection

Different speeds

Different angles

Pylon and small overlap

Compatibility

Economic and ecological factors

Energy to be absorbed

Permissible deformations

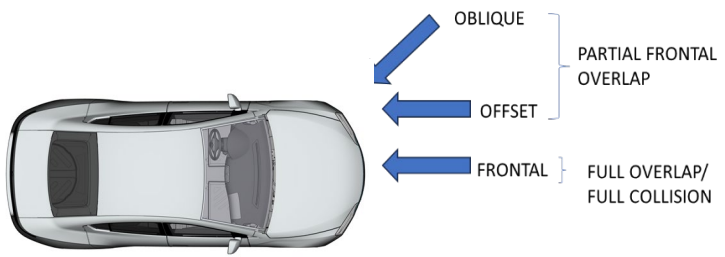
Force levels

Decelerations

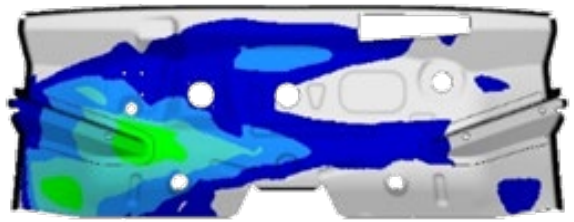
Classique manufacturing technologies (extrusion & die casting)

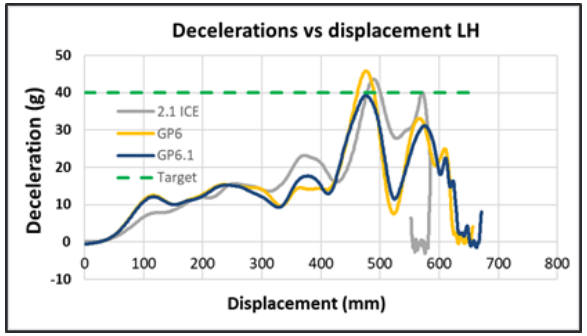
Additive manufacturing (AVFF)

Active systems



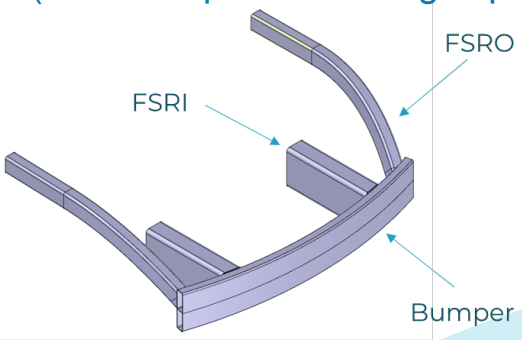
Dashpanel intrusions

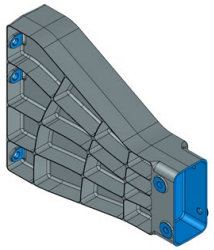




Active safety crash structure concept

Extruded parts based on boundary conditions (SALEMA part and design space)



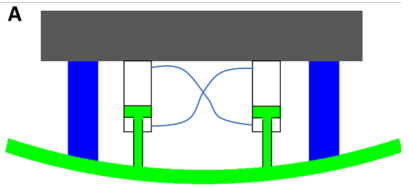


Aluminum die casting parts from SALEMA project

Die casting part

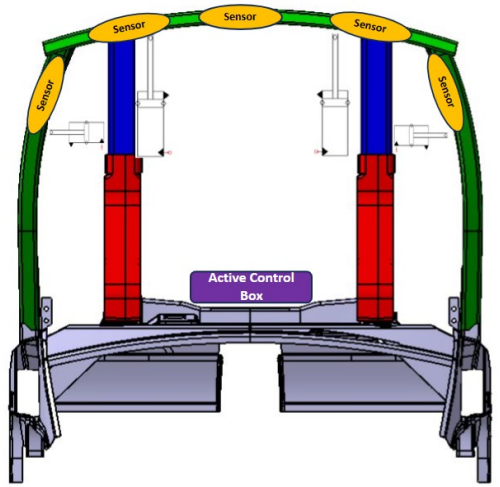
Extruded parts

Active system



Active system with hydraulic actuators

Active safety front-end concept



Active system will include:

- Sensors (speed, overlap ratio, angle...)
- Hydraulic actuators
- Auxiliary hydraulic/circuit elements
- Control Unit
- Connecting/assembling components

Flexcrash demonstrator

Outputs of this project (designs, material modelling...) will be implemented and tested on full crash vehicle level

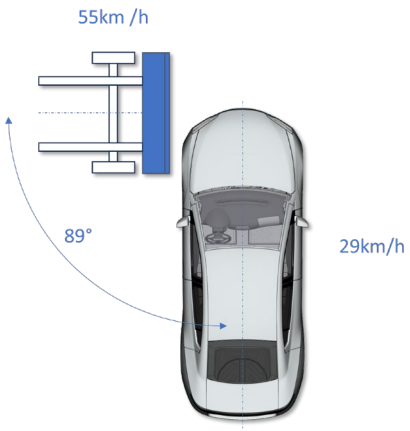
- ✓ *Adapt current G3 front end*
- ✓ *Implement aluminum baseline designs*

GLab G3

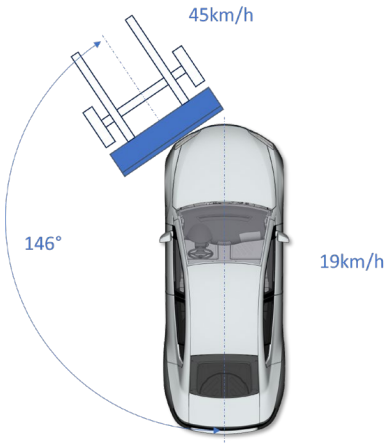
Full-crash virtual model by Gestamp

Relevant crash configurations for Flexcrash:

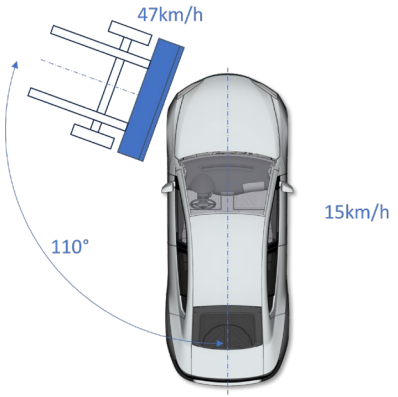
Derived crash configuration SCP-L



Derived crash configuration LTAP-OD



Derived crash configuration LTAP-LD

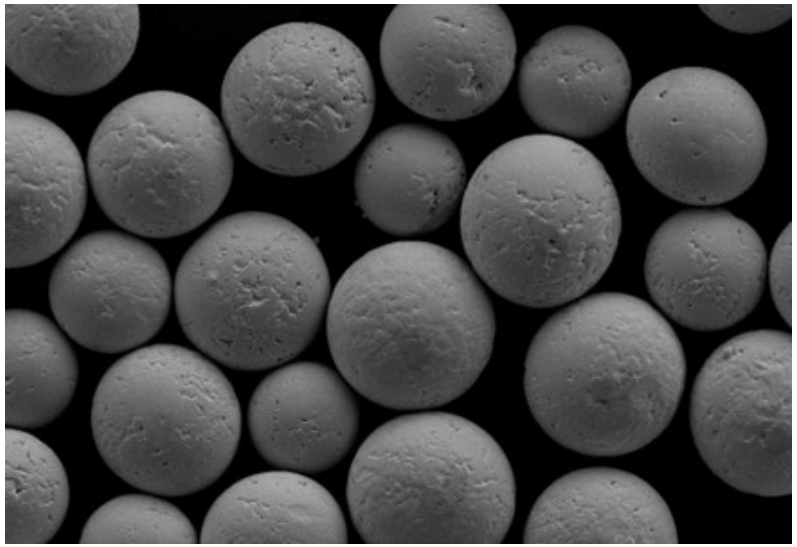


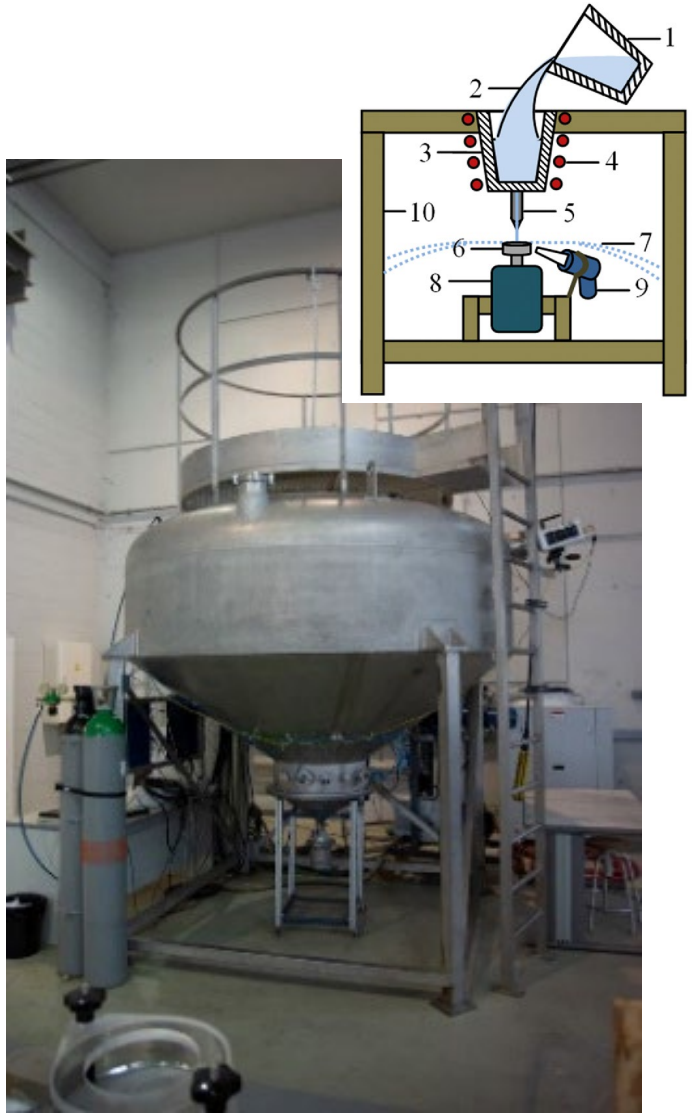
Flexible and hybrid manufacturing technologies

Development of aluminium powders with high amount of recycled aluminium and minimized content of CRMs

- ✓ *AlSi10Mg + 1% Zr*
- ✓ *AlSi8Mg + 1% Zr*

Al powder particles from 50 to 100 µm

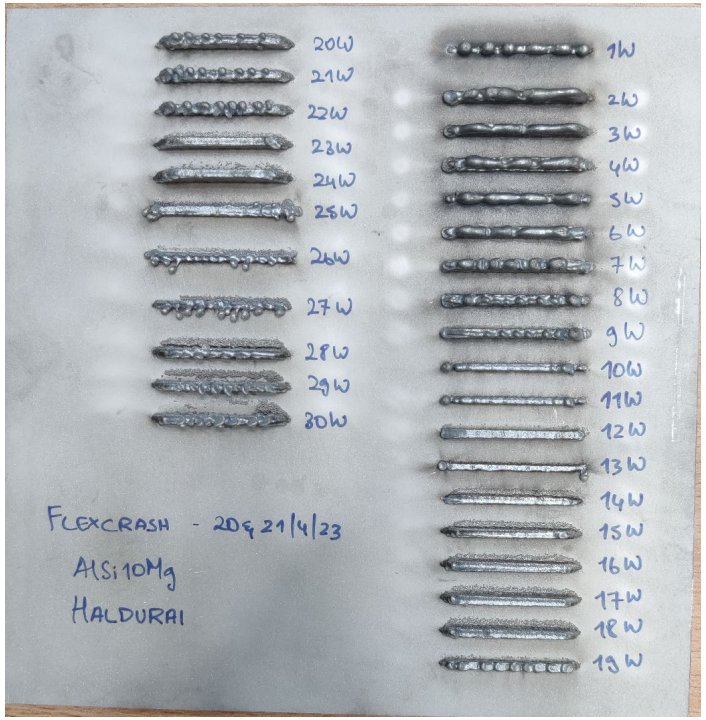


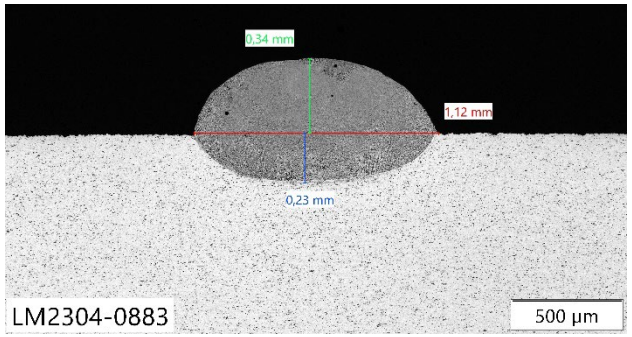


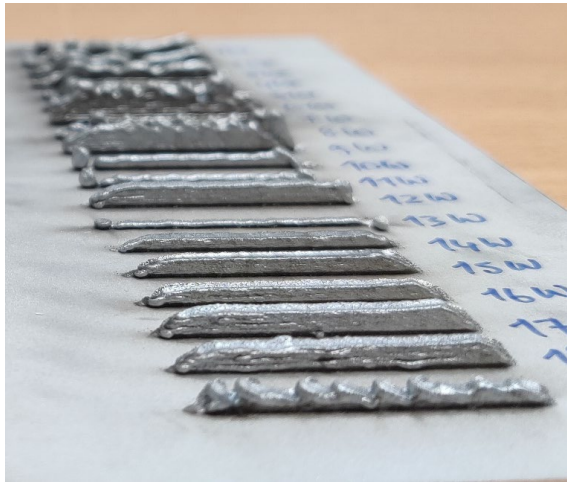
Centrifugal atomization

Flexible and hybrid manufacturing technologies

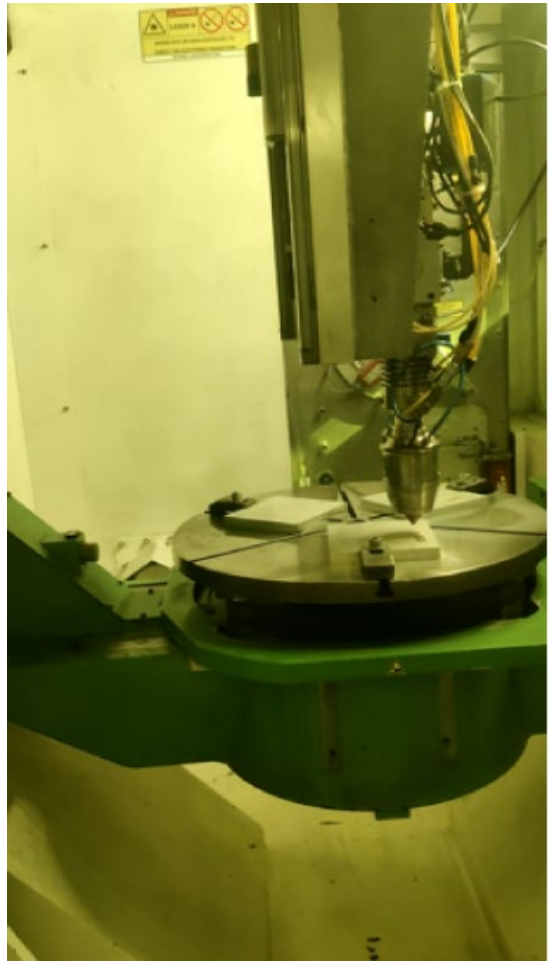
Development of process parameters for high material quality and low thermal input







Small scale 3D structures
Adding-Value Functional Features (AVFF)

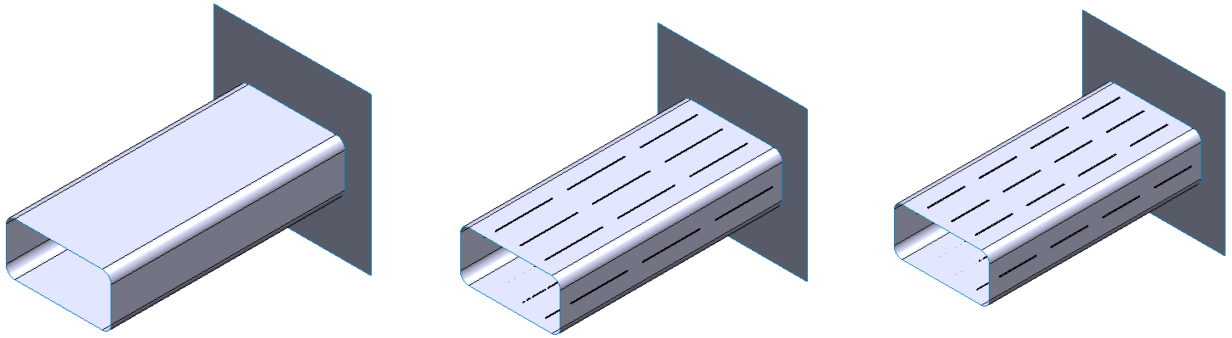


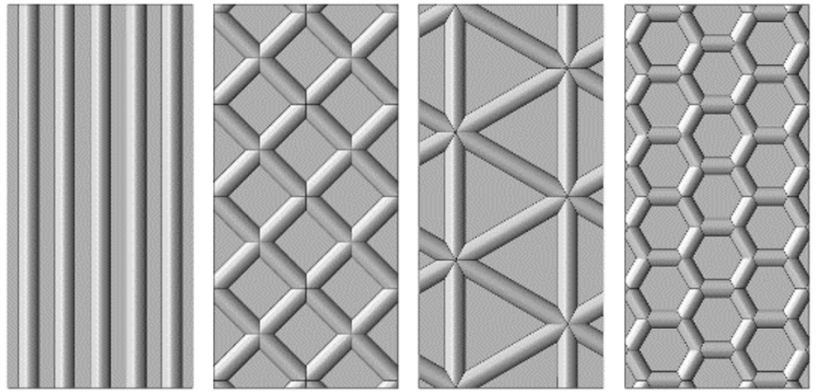
Laser Metal Deposition (LMD)

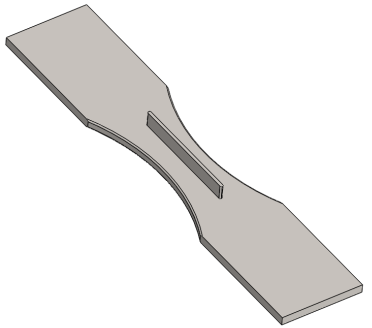
Flexible and hybrid manufacturing technologies

10 to 20% weight reduction through topological optimization and Al alloys

Front rail crash optimization



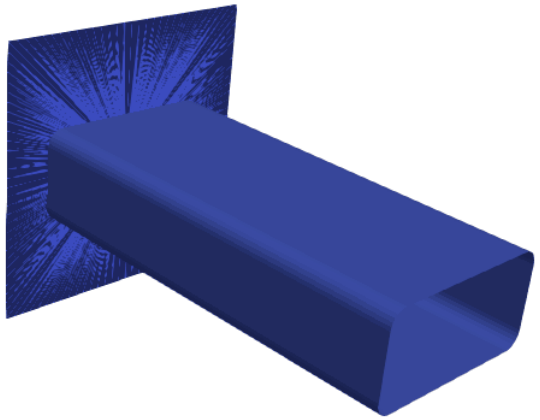


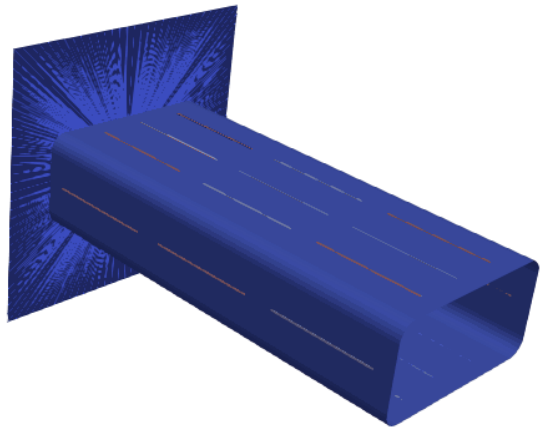


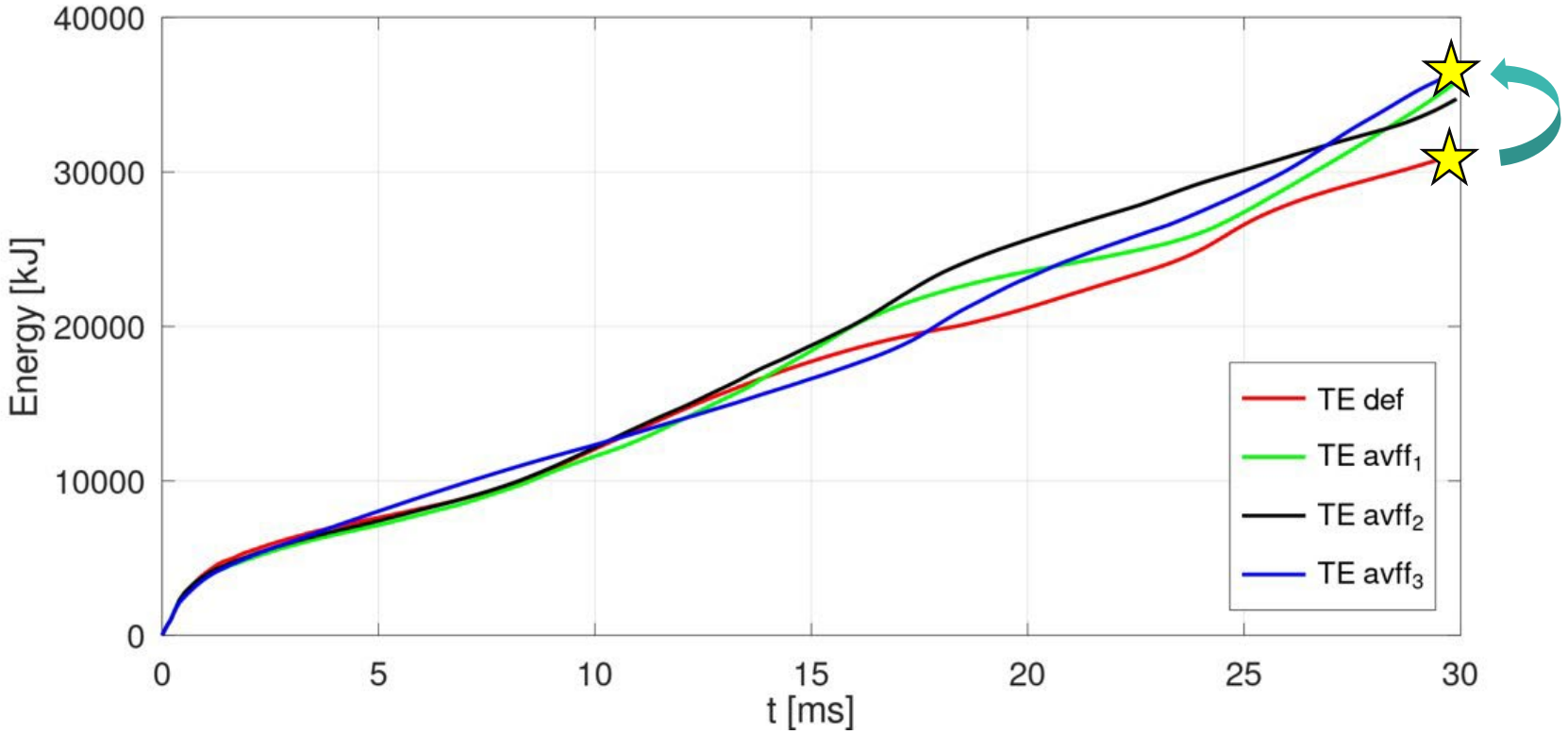
- Bending tests
- Compression tests
- Torsion tests
- Fatigue tests

New tests to estimate crashworthiness and durability

Flexible and hybrid manufacturing technologies







50% reduction of passenger injuries and fatalities

Coordinated by:
eurecat

FleXcrash

Flexible and hybrid manufacturing of green aluminium to produce tailored adaptive crash-tolerant structures

Thank you!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101069674. This document reflects only Flexcrash consortium view and neither the European Commission or any associated parties are responsible for any use that may be made of the information it contains