



Properties of carbon fibre composites for automotive crash structures

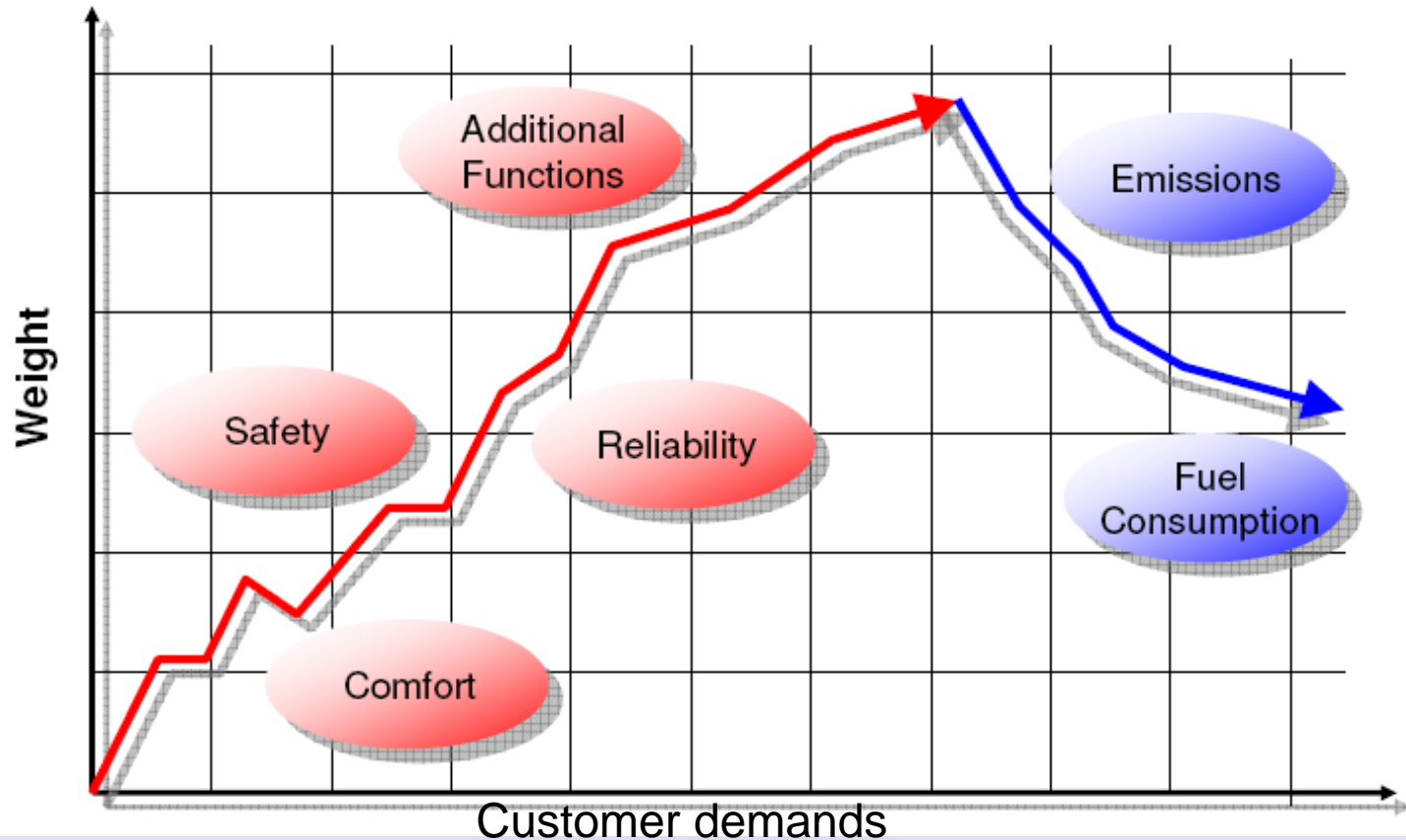
“The light weighting low down” Automotive seminar
17th February 2011

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Centre for material and fibre innovation,
Deakin University

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Dr. Bernard F Rolfe & Dr. Bronwyn L Fox

Why Composites?



Source: Lotus Engineering

Solution ?



Develop light weight materials like composites to replace heavy metal parts.

Automotive crash rails & Composite tubes

Sectional view of the Audi Q5 body structure



Aston Martin Vanquish composite crash structure*



*Silcock, M., *Composite Crashworthy Structures: Manufacture and Modelling*, in Centre for material and fibre innovation. 2006, Deakin University: Geelong, Australia. p. 285

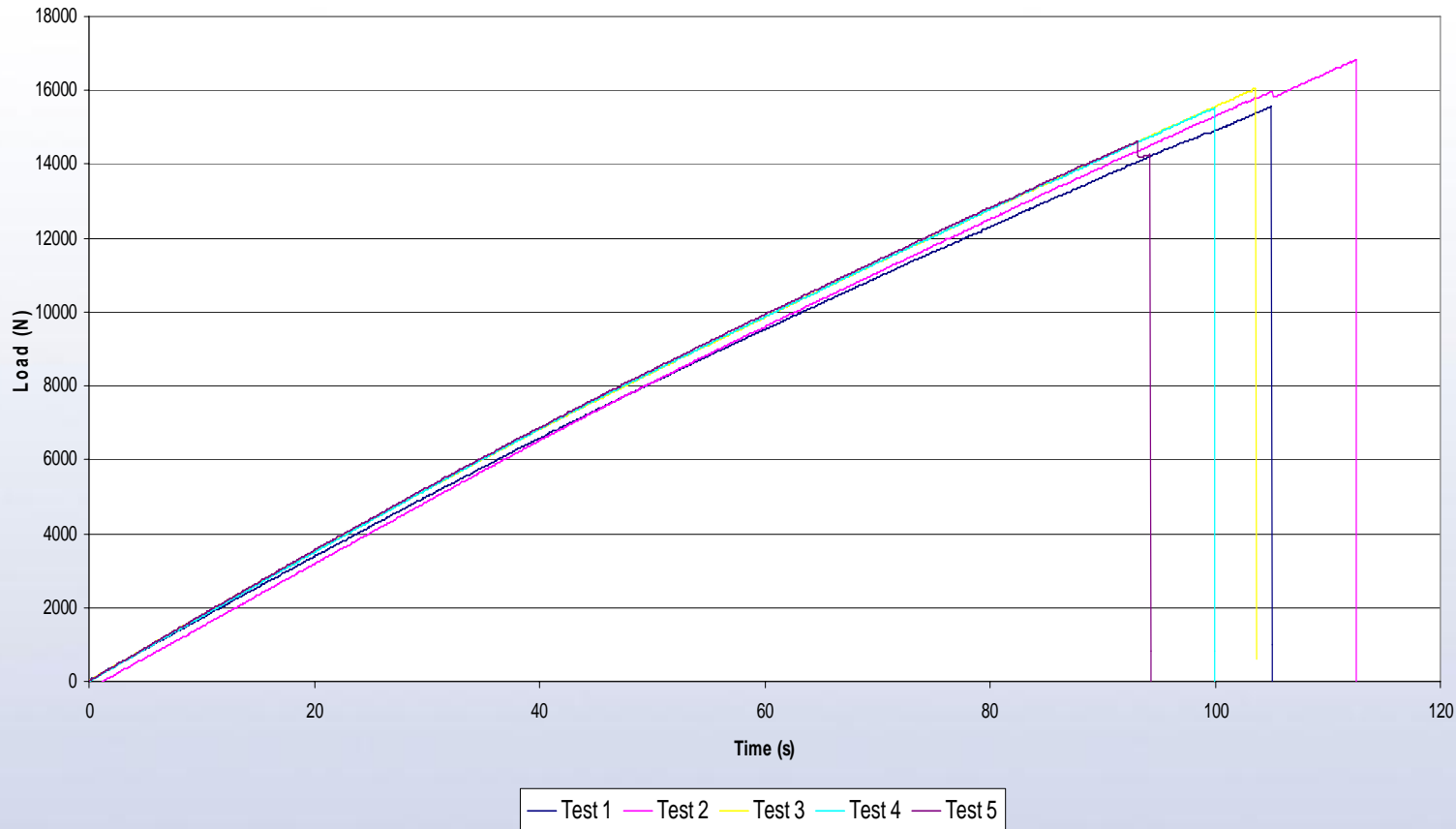
Picture Source: www.theautochannel.com

Overview

1. Tensile behaviour of composite material.
2. Comparison of the axial crushing behaviour of composite and Aluminium tube.
3. Angular impact of composite tubes.
4. Bending of composite and aluminium tubes.

Tensile behaviour of composites

Load Vs Time Curve at 1 mm/min



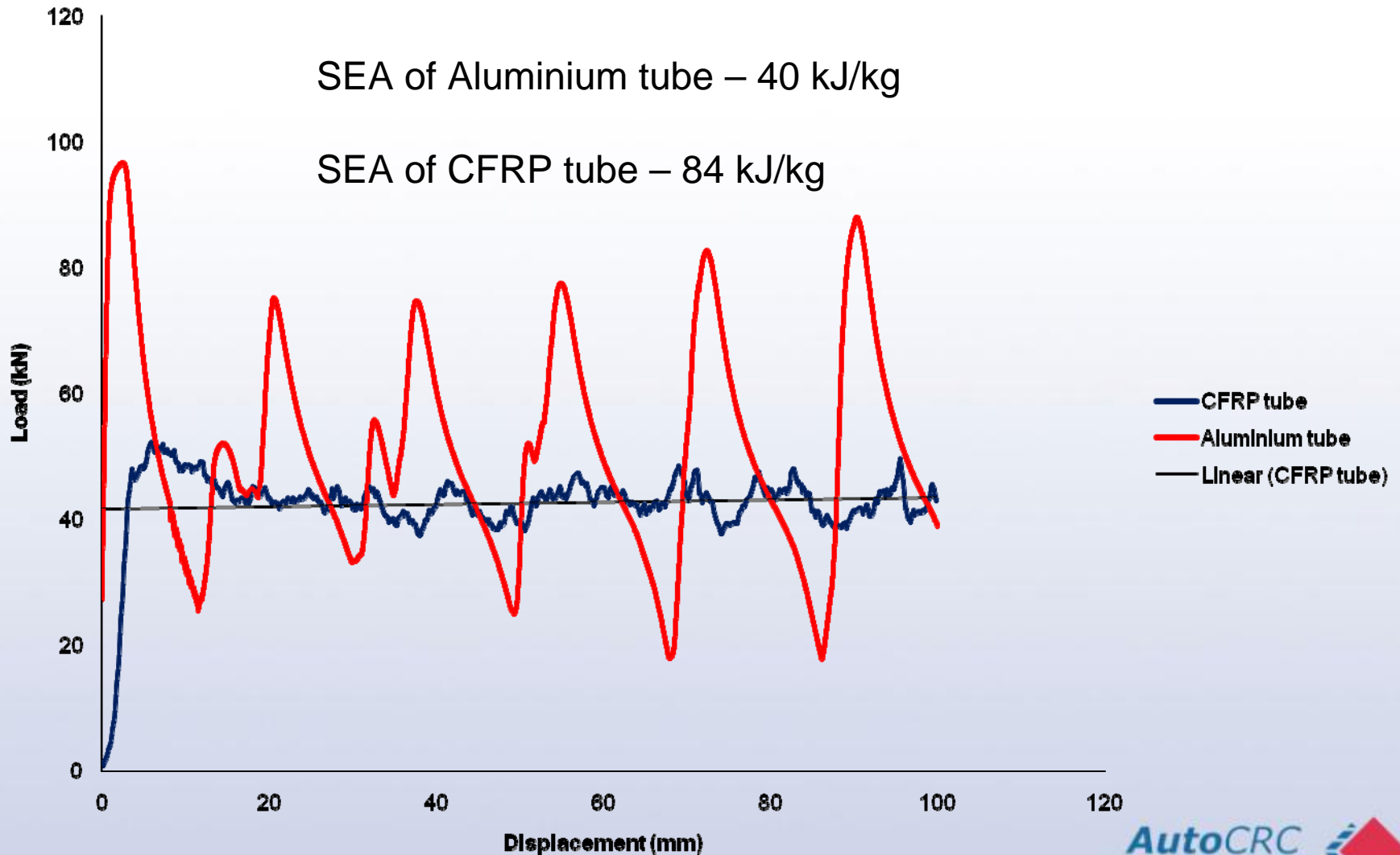
Overview

1. Tensile behaviour of composite material.
2. Comparison of the axial crushing behaviour of composite and Aluminium tube (AA6063-T6).
3. Angular impact of composite tubes.
4. Bending of composite and aluminium tubes.

Axial crushing of Carbon fiber & Aluminium Tube (AA6063-T6)



Comparison of force displacement Curves

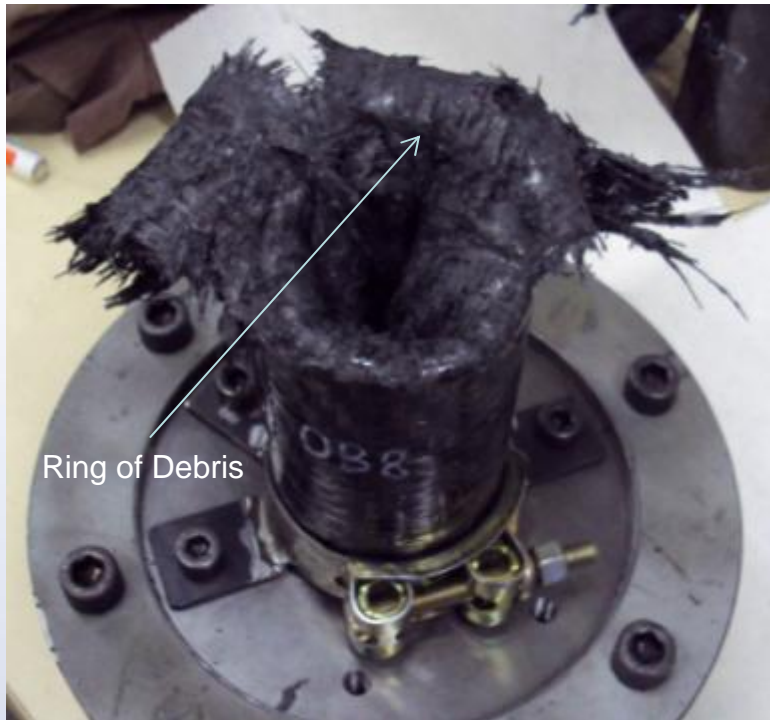


Overview

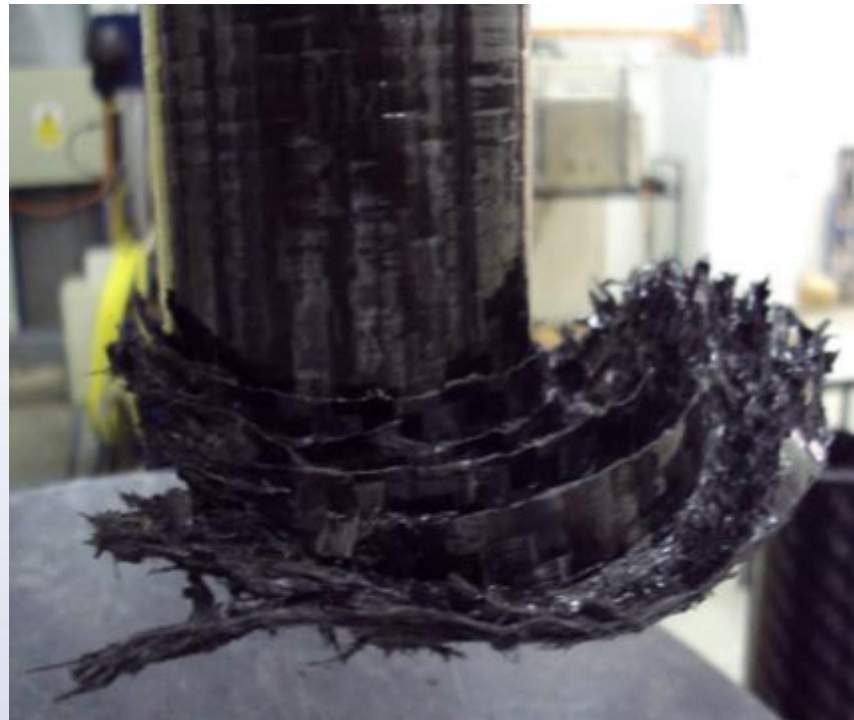
1. Tensile behaviour of composite material.
2. Comparison of the axial crushing behaviour of composite and Aluminium tubes.
3. Angular impact of composite tubes.
4. Indentation of composite and aluminium tubes.

Angular Impact of Carbon fiber tubes

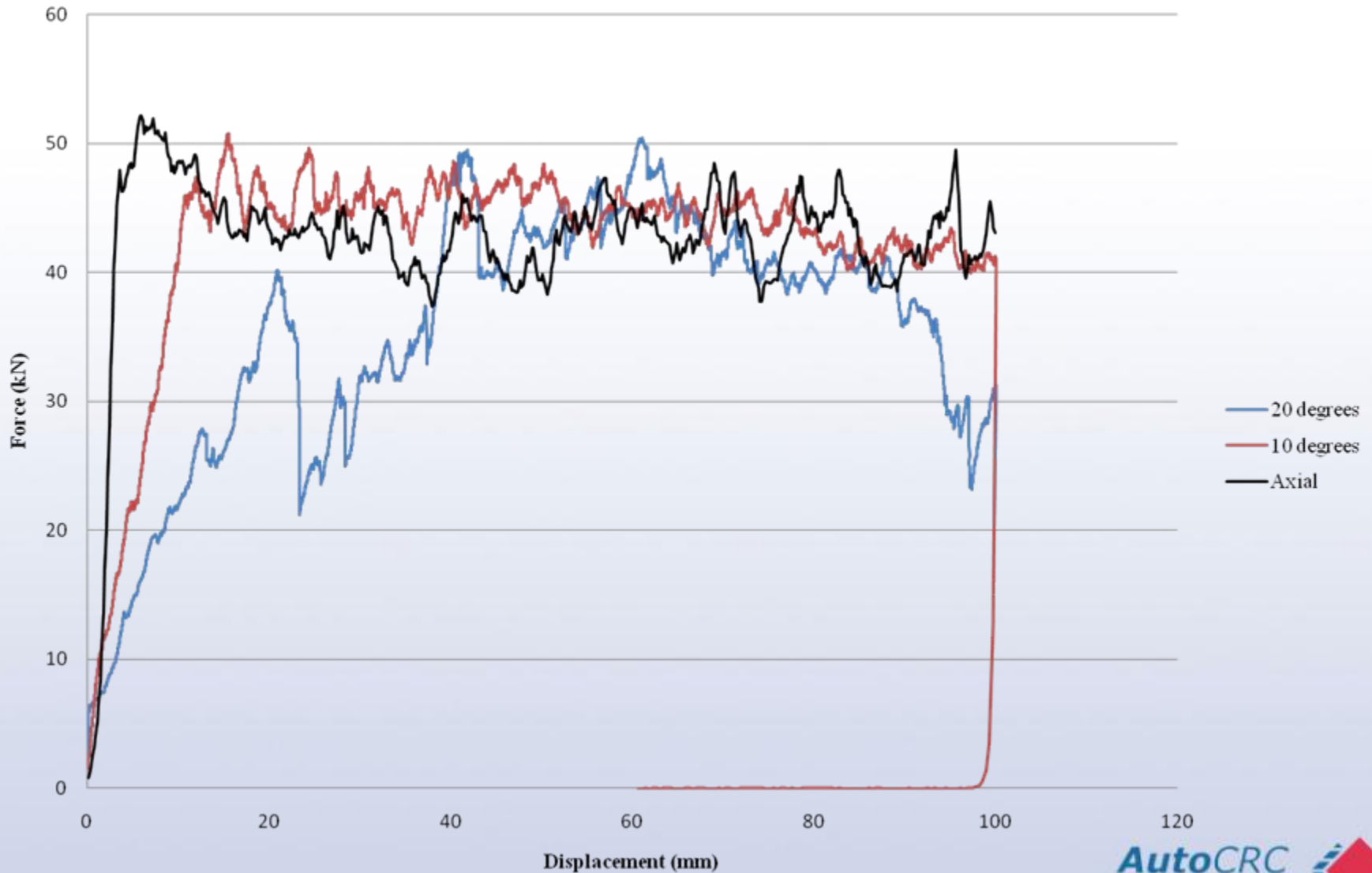
10 degrees impact



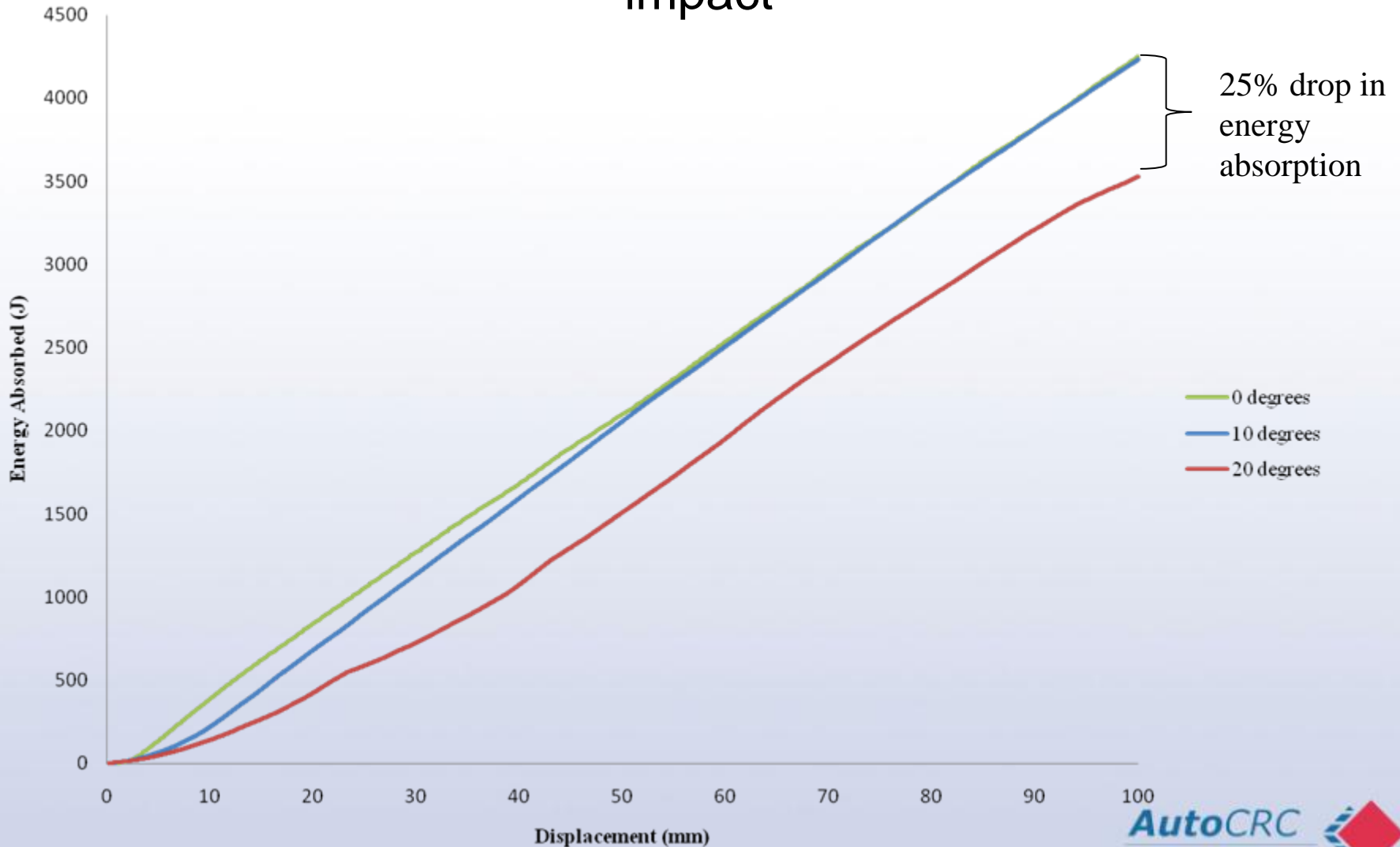
20 degrees impact



Force-Displacement Curves



Comparison of energy absorbed at various angles of impact



Overview

1. Tensile behaviour of composite material.
2. Comparison of the axial crushing behaviour of composite and Aluminium tubes.
3. Angular impact of composite tubes.
4. Bending of composite and aluminium tubes.

Bending of carbon fiber and Aluminium tubes

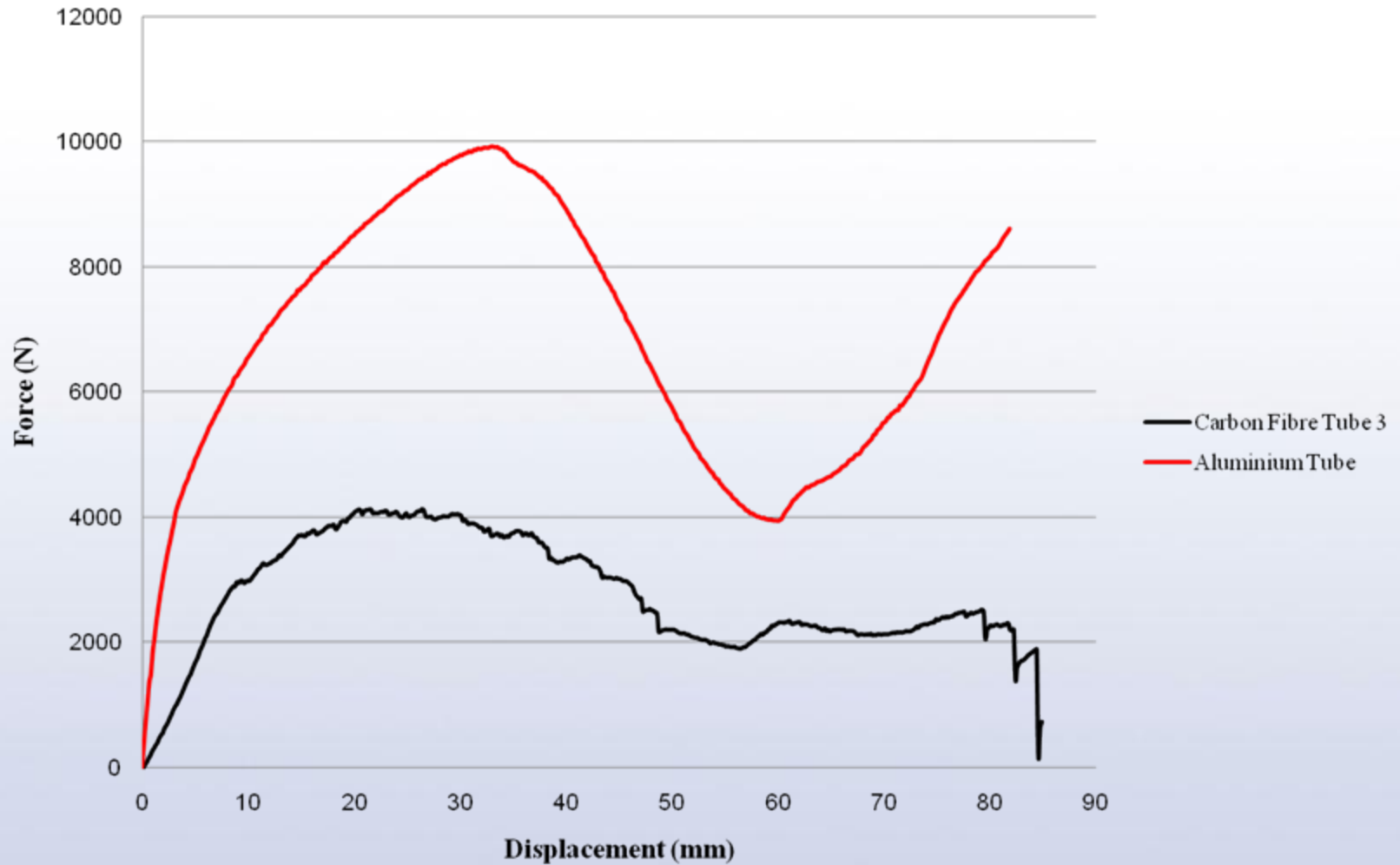
Deformed carbon fibre Tube



Deformed Aluminium Tube



Force Vs Displacement Curves



Conclusions

1. Composites are brittle in nature as seen from their tensile behavior.
2. Composites have very good energy absorption per unit weight when compared to metals during compression.
3. During axial compression, they absorb energy by fiber fracturing and matrix tearing, splitting the structure into alternative folds inside and out.
4. During oblique impact, up to 10 degrees their energy absorption is identical to axial loading.
5. When impacted beyond 10 degrees, they undergo transverse shearing due to bending.
6. Composites lack structural integrity and absorb very less energy in bending. This is one of the reasons why they are still not used as side intrusion beams.

AFFRIC

Australian Future Fibres Research & Innovation Centre





Core Elements of AFFRIC

- **Co-locate CSIRO Fibre Research Facility Belmont at the Geelong Technology Precinct (GTP)**
 - Development of GTP space to accommodate CSIRO Belmont staff (@ 80 -95) & laboratories
 - CSIRO Fibre Process Building
- **Establish world 1st independent Carbon Fibre R&D Pilot Plant**
 - Dedicated building housing the CF furnace (120m long 15m high furnace) with associated labs/offices.
- **Expand laboratory, office and service facilities in GTP for Deakin researchers**



AFFRIC Research

- Four Research Themes
 - Carbon Fibre Manufacture and Materials Technology
 - Nano-Fibre Discovery, Characterization and Application
 - Green Natural Fibres
 - Smart and Functional Fibrous Materials



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Carbon Fibre- Futures Conference

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CARBON FIBRE - FUTURE DIRECTIONS

Understanding carbon fibre in future
manufacturing through targeted research

WHEN FEBRUARY 27 - MARCH 4, 2011

WHERE FOUR POINTS SHERATON HOTEL,
GEELONG WATERFRONT.

Hosted by the Australian Carbon Fibre Research Facility.

An initiative of Deakin University, VCAMM and the Victorian State Government.

The conference is timed to coincide with the Australian International Airshow at Avalon Airport, Victoria. Visit: www.airshow.net.au

While here, you can take in the attractions of the GEELONG and GREAT OCEAN ROAD regions including THE TWELVE APOSTLES and the local world-class, cool climate WINERIES. Numbers are strictly limited.

Contact Liesl Freeman for more information at liesl.freeman@deakin.edu.au

[Click Here For News Story: Deakin taking off as a carbon fibre leader](#)



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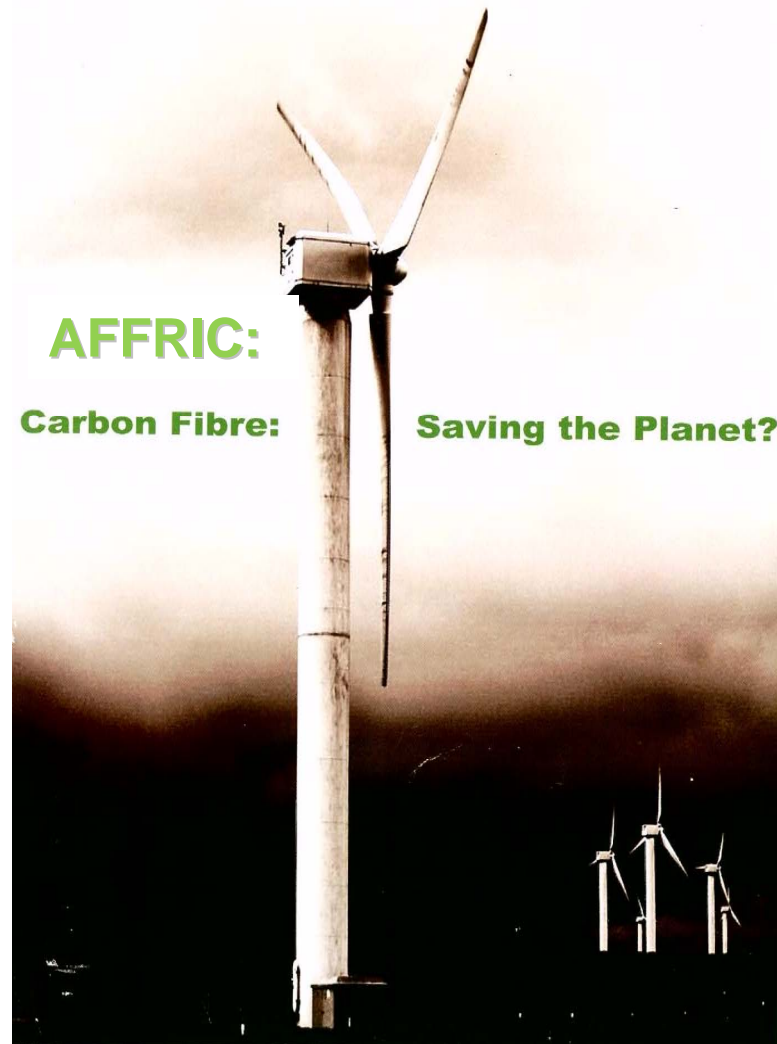


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TTNA Carbon Fibre Program

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Carbon Fibre:

Saving the Planet?

Technical Textiles & Nonwoven Association

Thank you for your attention.



Any Questions ??

