



Contact Damage and Remanent Strength of Carbon Fibre/Closed-Cell Aluminium Foam Sandwich Composites System

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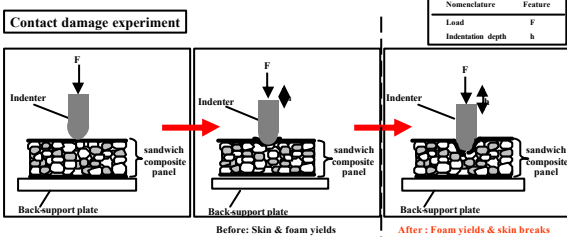
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Introduction

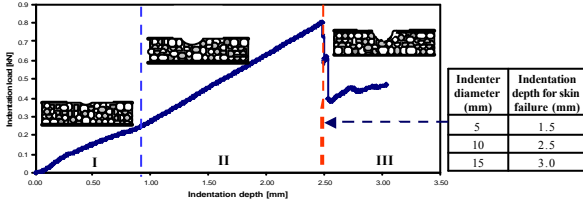
A key motivation for using light metal foams as the core material in a sandwich system construction is not only because of advantageous strength/weight ratios but also their exhibition of very good impact energy absorption. In this research, the sandwich materials are fabricated from carbon fibre skin and closed-cell aluminium foam (ALPORAS) which acted as skin and core, respectively. This study aims to reveal the correlation between contact damage and remanent strength of a carbon fibre/closed-cell aluminium foam sandwich system. Contact damage is induced on the surface of the samples using spherical indenters to indentation depths before the carbon fibre skin breaks. Then, the remanent strength of damaged samples is determined by using a four-point bending test. The behaviour of the damaged samples can be observed from the four-point bending failure modes.

Contact Damage : Quasi-Static Indentation



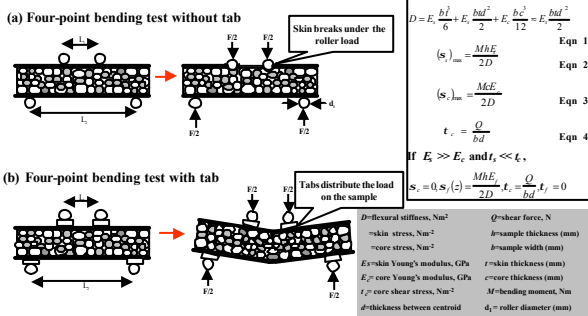
- > Foam thicknesses of 8, 10 and 15 mm were fabricated with carbon fibre composite skin as sandwich samples
- > Spherical indenters of 5, 10 & 15 mm were used to indent samples
- > Indentation depths were varied using similar indenter sizes to all sample thicknesses until the minimum depth was identified before the skin breaks
- > Indentation speed is 0.50 mm/min

Load-Indentation depth curve



- I : Early stage of indentation; the carbon fibre skin and foam start to yield
- II : Indentation load and depth increased; the skin and foam continue yielding
- III: Maximum load; the skin fails

Remanent Strength Measurement : Four-point bending test



Remanent Strength Measurement : Compression & Tension

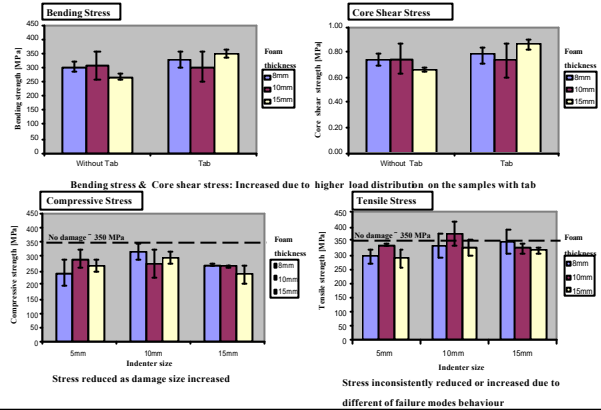
(a) Four-point bending test - Damaged-samples were placed in compression condition



(b) Four-point bending test - Damaged-samples were placed in tension condition



Results : Failure Strength



Failure Modes

Without Tab Failure Mode

Compression Failure Modes

Foam thickness (mm)	Indenter diameter (mm)			Mode	Types of failure
	5	10	15		
8	Mode I	Mode I	Mode I	I	Breaks through the indentation area
10	Mode II	Mode II	Mode II		
15	Mode III	Mode III	Mode III		

Tension Failure Modes

Foam thickness (mm)	Indenter diameter (mm)			Mode	Types of failure
	5	10	15		
8	Mode A	Mode A	Mode A	A	Breaks near to the tab
10	Mode B	Mode B	Mode B		
15	Mode C	Mode C	Mode C		

Conclusions

- Contact damage reduces compression and tensile strength.
- Failure mode is more sensitive to contact damage under compressive loading than tensile loading.
- Stress-distributing tabs must be placed under rollers in four-point bending tests.