

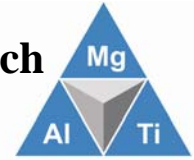


Contact Damage Response of Foam-Based Sandwich Panels to Quasi-Static and Impact Indentation

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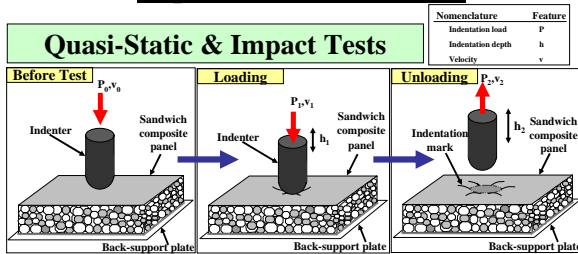


ARC Centre of Excellence Design in Light Metals

Introduction

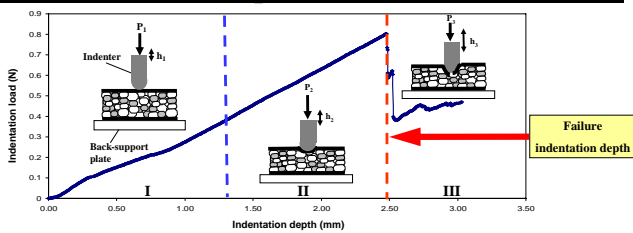
Foam-based sandwich panels laminated with carbon-fibre-reinforced fabric skins were studied to investigate local contact damage. The damage was simulated experimentally by indentation with hemispherical indenters of various sizes, under quasi-static and impact conditions. It was found that the damage under the quasi-static loading was dependent on the indenter size but independent of the sample thickness, while the impact loading induced a velocity-dependent and indenter-size dependent damage. The failure of the sandwich panels in both cases was triggered by skin failure, however, the failure depth was more pronounced under the quasi-static indentation.

Experimental Procedures



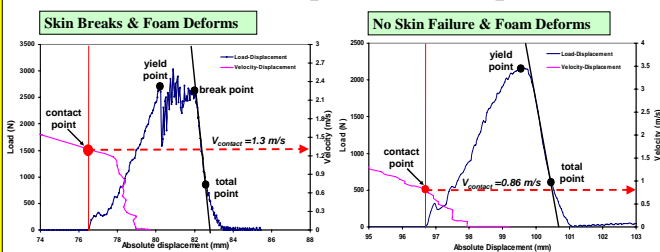
- Indenter: hemispherical indenters of 5 (for quasi-static only), 10, 15 & 20 mm
- Panel thickness: 8, 10 and 15 mm
- Quasi-static test: constant indentation velocity of 0.50 mm/min, indentation depths were varied; depths at skin failure were identified
- Impact test: critical velocity is changed to indent the panel without failure

Load-Indentation Depth Curve: Quasi-Static Test

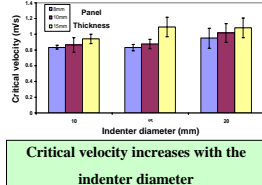


- I : Early stage of indentation; carbon fibre skin and foam start to yield
- II : Indentation load and depth increase; skin and foam continue yielding
- III : Maximum load; skin fails

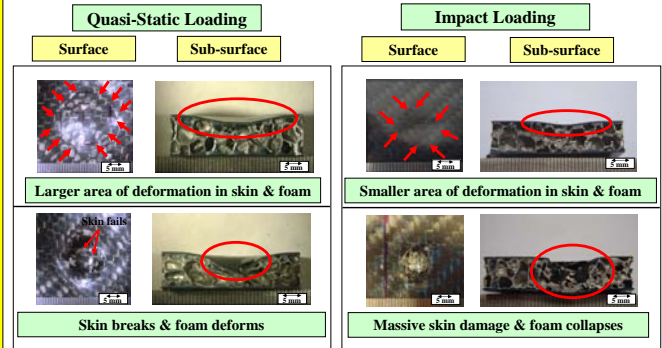
Load-Indentation Depth Curve: Impact Test



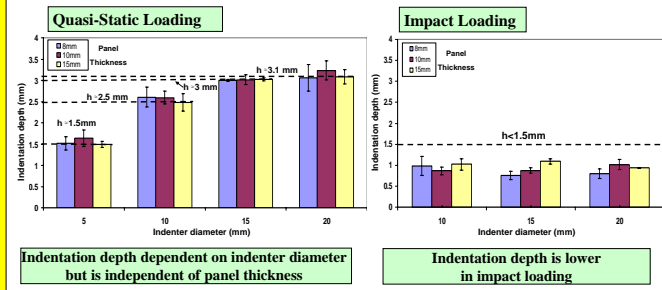
- Contact point identified when indenter first hits the panel
- Yield point (at visible dent or cracks) - recognised at maximum load, dependent on applied velocity
- Break point occurred when failure is completed
- The end of the test determined by 'total point' (in the figure)



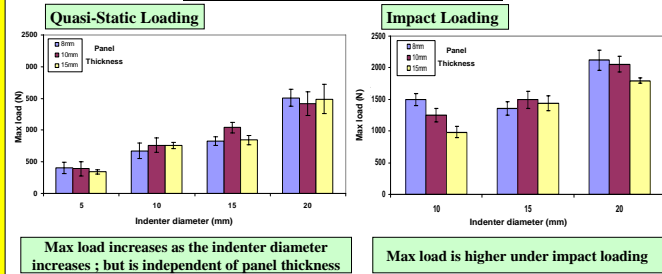
Failure Modes Analysis



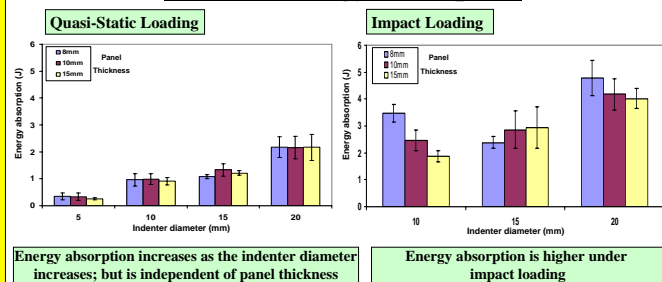
Results: Indentation Depth



Results: Maximum Load



Results: Energy Absorption



Conclusions

- Quasi-Static test: Contact damage is dependent on indenter diameter but independent of panel thickness
- Impact test: Contact damage is dependent on velocity and indenter size
- Surface and sub-surface failure modes are different under quasi-static and impact loading conditions