

1.5.15. EXPERIMENTAL COMPARISON OF INFRARED THERMOGRAPHY, HOLOGRAPHIC INTERFEROMETRY AND ACOUSTO - ULTRASONICS ON A COMPLEX SANDWICH STRUCTURE SAMPLE

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Reinforced plastic honeycomb has traditionally employed glass fabric reinforcement for many whilst other fibers have seldom been used. In the past few years, however, both Kevlar and carbon fiber have become much more common as reinforcing fibers for honeycomb (HC) materials. Carbon fibers are now regularly employed in space vehicles, where constant pressure requirements for lighter structures has led to the use of carbon fiber facings.

Nevertheless, a potential corrosion problem can arise when used in combination to aluminium cores.

This concern for corrosion problems has subsequently led to the adoption of a new class of carbon fiber HC materials for this aircraft and will possibly lead to further use in future designs. Two types of carbon fiber cores are now being produced. One is for purely structural applications, while the other has a requirement for heat transfer through the thickness of the panel. The honeycomb in carbon fiber, used in our complex sample, has a triax structure formed by two layers (0 – 90°) of symmetrically fabric.

One side of the HC has been bonded to a ceramic plate (CM). Although neither of these materials is in large volume production at the moment, the economic impact could be substantial, since these HCs are markedly higher in price than the aluminium and since the ceramic materials have a very complex process of manufacture.

This materials combination would like to simulate the development of new tiles that increases the thermal stability and the conductivity without a meaningful increase of weight or loss of resistance. There is a general trend to inspect products at early manufacturing stages reducing costs for replacing poor-quality works at a later stage.

This trend contributes to the recent growth of non-destructive testing (NDT) methods. Basically, NDT is utilized for two purposes: quality control and maintenance. Three different techniques, Infrared thermography (IT), Holographic Interferometry (HI) and Acousto – Ultrasonics (AU), are used in this work to inspect the sample described below (see fig. 1) and have shown to be interesting alternatives to classical techniques such as conventional ultrasound testing and X-rays commonly used to inspect these structures.

The specimen core, was pierced from two lateral sides (defects A, C – fig. 1 and fig. 2) and broken on a side (defect D – fig. 1 and fig. 2) to simulate a detach (loss of material) after an impact.

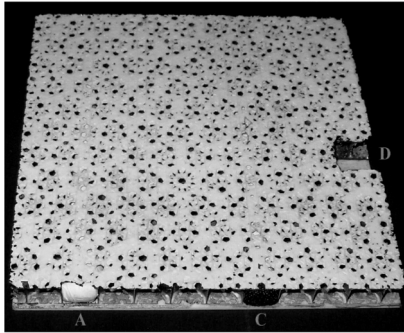


Fig. 1. Side of HC with defects

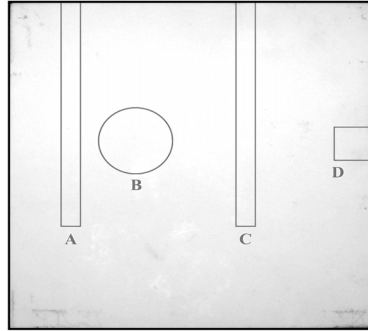


Fig. 2. Side of CM with subsurface defects

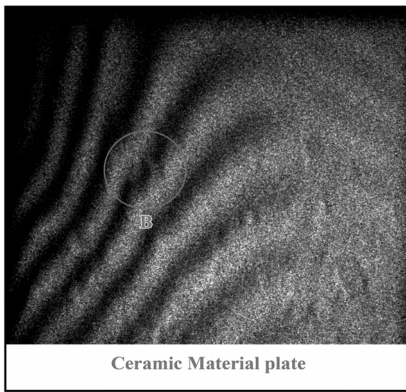


Fig. 3. Result of HI for defect B

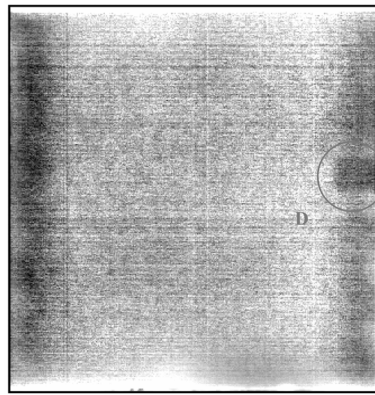


Fig. 4. Result of IRT for defect D

In contrast, defect B (fig. 2 and fig. 3) is inherent in the ceramic material, it has been detected with HI, although it was not artificially fabricated. This defect, is due to structural alterations of the alumina, probably as formation of microvoids.

Defect D (fig. 4) was detected by infrared thermography using flash stimulation from the side of the ceramic. Further testing using lamps and longer heating would be required in order to detect the other defects.

Defects A and C, fabricated through drilling, have been filled with two pieces of sponge conveniently shaped and covered with some Teflon, with the purpose to simulate inclusions of foreign matter.

On a complex structure material, the integration between several techniques is useful with the purpose to identify and to confirm defects of different typology (inclusions, voids and porosity, de-bonds, etc.): this is the main objective of our work.

A comparative experimental investigation is discussed herein to evaluate the performance of HI, IT and AU for the NDT of a honeycomb panel bonded with a ceramic plate and fabricated/not fabricated defects. The main advantages and limitations of the three techniques will be enumerated and discussed in detail during the presentation.