A STUDY ON INDENTATION TEST METHODOLOGY OF AIRCRAFT FLOOR HONEYCOMB CORE SANDWICH COMPOSITE PANELS

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ABSTRACT

The indentation behavior of aircraft floor panel (honeycomb sandwich structures) was investigated from the viewpoints of test methodology, effects of panel layout, and failure mechanisms. The aim is to achieve a design procedure for aircraft floor panels. Due to their high stiffness and strength to weight ratios, composite sandwich structures have proven their usefulness in a large number of applications in various technical fields, especially in aeronautics, automotive and civil engineering[1]. One of the main drawbacks of sandwich structures is the loss of load carrying capacity due to indentation damages.

An indentation test method using a simply-supported plate was developed which can more accurately replicate observed in-use failure modes. The localization and type of damage induced with this test method correlated well with damage present in panels returned from airline. Such damages in real conditions are mainly due to highly concentrated loads [2].

This paper presents the results of experimental investigation on one type of civil Aircraft floor panels with sandwich composite construction. First, the BOEING Company procedure for indentation testing of floor panels are explained. Next, a modified procedure will be presented, and the obtained results will be compared with those reported by Boeing procedure. The effects of varying parameters such as core material and density, and skin layer quantity on indentation test results are investigated.

Some of the panels used in this study are manufactured, assembled and bonded at HESA while others are produced at HEXCEL Company. The tested panels are:

woven fiberglass (7781)/epoxy skins with nomex core and density 48, 96, 123(kg/m^3).

Ready-made panel (from HEXCEL Company): 2 cross ply of undirectional S-glass/epoxy skins with nomex core density 139 kg/m^3.

Ready-made panel (from HEXCEL Company). (2100 grade 2 & 3) manufactured from 2 cross ply of undirectional glass/carbon skins with nomex core density 64 kg/m^3 for grade 2 and 123 kg/m^3 for grade 3.

Indentation tests performed in this study used a cylindrical steel indenter with a flat bottom face and chamfered edges with a diameter of 10 mm. Test panel samples dimension are 150 by 150 mm, with simply supported along the edges.

Figure 1 shows the results of indentation tests on type 2100 grade 2 for the same three sampels. As it can be seen force for top skin crushing is 1592 N.

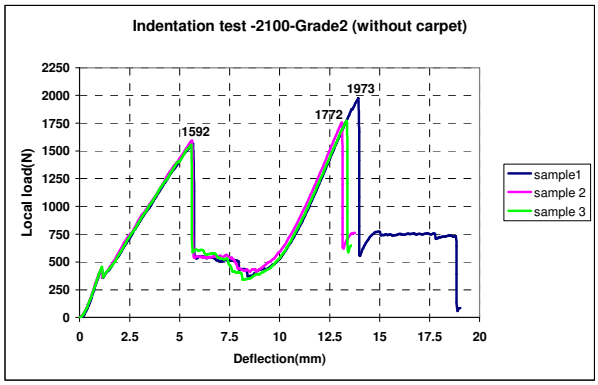

Figure 1: Indentation test -2100-Grade2 (without carpet)

Figure 2 depicts the effect of number of layers on load carrying capacity of type "woven fiberglass (7781)/epoxy skins with nomex core and density 96" panel. The test results indicate that by increasing the number of top layers from 2 to 3 increases the load capacity by about 10%.

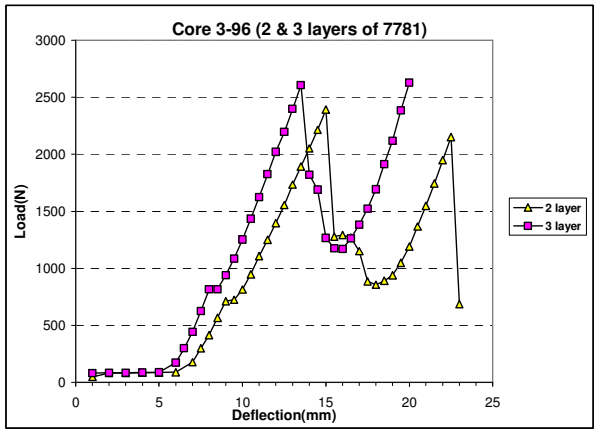

Figure 2 : Effect of layers quantity (20 kgf for one additional layer)

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