

UNIVERSITI TEKNOLOGI MARA

**STRESS ANALYSIS OF RIVETED AND BONDED
PATCH REPAIRS ON A STIFFENED PANEL**

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ABSTRACT

There are a few thousands commercial aircrafts operating today. Many of those aircrafts are considered old or aging and will experience damages whether little or large. Damages in aircraft structures are classified as negligible and intolerable. Since commercial aircrafts are constructed to be in Damage Tolerant Design (DTD), negligible damage is not threatening and the aircraft can still operate under some limitations. Intolerable damage however, should be repaired to prevent growth of the damage and to maintain airworthiness of the aircraft. One of the damages that is covered in this research is a crack damage and the repair on it. The damage location in this research is on the skin next to the top hat stringer section on a stiffened panel. The case study simulated the rear fuselage stiffened panel of a Boeing 737. Most damage repair methods and procedures are prescribed in the Structural Repair Manual (SRM). The SRM provides details procedures of repair using bolts and rivets. The damage case in this research is not part of the SRM. Even though extensive stress analysis has been done by the manufacturer before the repair procedure is documented, however, there is no strength analysis reported in the SRM. This research conducted a stress analysis on the structure before damaged, after damaged, and after repaired conditions, in which riveted patch was used in one case, and bonded patch in the other. Two methods of analyses were conducted namely finite element analysis using ANSYS software, and experimental method using strain gages and Universal Testing Machine. The stress distributions of all conditions were compared between the finite element and the experimental methods. In addition to the above, theoretical analysis was used to predict the static strength of the structure all four conditions. The static strengths of all conditions were compared between theoretical and experimental methods. It was expected that both repair methods would restore the original strength of the structure. Based on the comparison between FEA and experimental results, there were agreements on the graph pattern. However, there were extreme values in the readings of the strain gages near the jigs or load application points. This was mainly due to the setting of the jigs which produced local effect high stress area. Based on the static strength analysis, it was found that the riveted patch repair was weaker than the original condition by 15%. The bonded patch repair failed at more than 20% less than the original strength. This was due to the limited resources of bonding repair facilities which made the bonding process not properly done so that the patch was not perfectly bonded to the skin.

Keywords: Stiffened panel stress analysis, crack damage, riveted patch repair, bonded patch repair, finite element analysis, experimental analysis, static strength.

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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