

**FAILURE INVESTIGATION OF BELL 412 MAIN ROTOR
BLADE TRIM TABS AND STUDY OF SUITABLE ADHESIVE
MATERIAL APPLICATION WITH A NEW TRIM TAB
DESIGN**

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Degree of Master of Science

Department of Materials Science and Engineering

University of Moratuwa

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**This Dissertation submitted in partial fulfillment of the requirements for the Degree of
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Declaration

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the Supervisor: Mr. V Sivahar

Signature of the Supervisor :

Date :

Abstract

The Bell 412 helicopter is a type of aircraft in the Sri Lanka Air Force (SLAF) inventory which is accorded specialty status due to its role in the transportation of VVIPs in Sri Lanka. Over three decades of operation, the failure of trim tabs, a bigger issue of Main Rotor Blades (MRBs) have been identified. MRB is a glass fibre construction and the titanium trim tabs are bonded by manufacturer-recommended adhesives. This failure could hamper the efficient usage of the helicopter operation and may result in the blade being inoperable. This issue currently persists and this research is focused on a study of the failure of the Bell 412 main rotor trim tab and explores the possibility of a suitable adhesive material application with a new trim tab design to resolve the problem. During the initial findings, it has been observed that the prevalent condition is attributed to the failure of the adhesion between the trim tab and the Main Rotor Blade. To identify the root causes, adhesion properties were tested using a modified floating roller peel test (FRPT). Further, the fracture mechanism was observed and Differential Thermal Analysis (DTA) techniques were utilized.

In this study, it was also observed that the original design of the trim tab itself propagates the failure and thus, another area of focus in this research was to optimize the design of the same. In addition, the study proceeds to investigate suitable adhesive material properties which would be better suited to resolve this critical issue.

Keywords: Main Rotor Blade, Helicopter, Trim Tabs, Glass Fibre, Honeycomb, Titanium Alloys, Adhesives, Composite.

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Abbreviations

- OEM - Original Equipment Manufacturer
- SLAF - Sri Lanka Air Force
- MRB - Main Rotor Blade
- DS - Daily Servicing
- FRPT - Floating Roller Peel Test
- DSC - Differential Scanning Calorimetric
- RAT - Rapid Test method
- CPT - Composite Peel Test
- DTA - Differential Thermal Analysis
- T_g - Glass Transition Temperature
- RT - Room Temperature
- SEM - Scanning Electron Microscope
- ASTM - American Society for Testing and Materials