Thaninee Pimton 2010: Internal Structure Design and Analysis of Straight Wing and Aerodynamical Optimized Wing. Master of Engineering (Aerospace Engineering), Major Field: Aerospace Engineering, Department of Aerospace Engineering. Thesis Advisor: Squadron Leader Chamnan Pedchote, Ph.D. 91 pages.

Since the structure of the aircraft wing is important for the aerodynamic lift force, this research aims to study and analyze the design of the aircraft wing's internal structure. Two wing models, straight wing and aerodynamical optimized wing, were investigated in this study. The wing strength was analyzed under specified structural criteria and aircraft load.

Shear stress and displacement of the square plate model were evaluated by using finite element simulations with an S4R four-node shell element model. For the aerodynamical analysis of the wing structures, the wing shape was determined to have i) a sweep angle of 0 degree with taper ratio of 1 or 0.3 and ii) a sweep angle of 42 degree with taper ratio of 1 or 0.3. The wing structure was consisted of wing spars, wing ribs and wing skin. The structure was assigned as a thin square plate which was then subdivided into elements. The material property of the wing was determined as a composite material. The aerodynamical load of the wing was obtained from the computation. Moreover, the effect of the number of wing ribs (0, 30, 40 and 50 ribs) on the aerodynamics of two models (straight wing and aerodynamic optimized wing) was investigated. Finally, the results of the analysis of both wing models were compared by using the von Mises stress and the deflection of the front spar in order to establish an optimized wing.

Results from the analysis of both wing models have shown that wings with sweep angle of 42 degree and taper ratio of 0.3 are the strongest. Moreover, the aerodynamical optimized wing was found to have lower von Mises stress and lower front spar deflection than the straight wing. In addition, the aerodynamic properties of the aerodynamical optimized wing found in this study were similar to the wings that are currently used with the new commercial aircrafts.

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