UNIVERSITI TEKNOLOGI MARA

THE EFFECT OF TAIL SWEEP ANGLE TO THE AERODYNAMICS AND STABILITY OF A BLENDED WING BODY AIRCRAFT (BASELINE V)

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ABSTRACT

Blended wing body (BWB) aircraft is theoretically designed based on the combination of conventional aircraft and flying wing which is likely to be the future concept of an aircraft. Some of the studies claim that BWB aircraft has higher lift to drag ratio compared to the conventional aircraft. However, by obtaining high lift to drag ratio only does not means that the aircraft has good longitudinal stability. Flight Technology and Test Centre (FTTC), Universiti Teknologi MARA Shah Alam began the research on BWB aircraft in 2005 and found problem related to the stability of the aircraft. Some ideas have been proposed to overcome the BWB's poor flight stability such as having large central elevator, installing canard, designing planform that mimics a bird, and installing long tail boom. Recently, the FTTC has come up with a BWB aircraft design with close-coupled tail known as Baseline V. The Baseline V BWB has been found to have high lift to drag ratio of 32 but its negative value of zero-lift moment hinders it from having favourable trim angle of attack. This research focuses on the tail of Baseline V the tail swept of 0˚, 30˚, 45˚ and 60˚ and the area is maintained. The objective of the research is to determine the best tail sweep angle for Baseline V which will gives the best aerodynamics performances and has good flying quality at trim condition. This research was carried out via wind tunnel experiments conducted at three different wind tunnel locations: Universiti Teknologi Malaysia Skudai, UiTM Shah Alam and Universiti Pertahan Nasional Malaysia Kuala Lumpur using a 1:1 scale full model, a 1:2 scale half model and a 2:7 scale half model respectively. Computational Fluid Dynamic (CFD) is also carried out just to compare with the wind tunnel data. The data obtained were analysed and plotted in term of lift coefficient, drag coefficient, lift to drag ratio and moment coefficients. The pitching angle for all experiments were varied between -10˚ to +17˚. The blockage corrections have been applied to the wind tunnel data. From the analysis, Baseline V shows a decrement of lift coefficient as the tail sweep angle increase. The 0˚ tail sweep angle configuration has the highest lift coefficients with respect to the angle of attack and the then followed by 30˚, 45˚ and 60˚ tail sweep angle configuration. For the drag coefficients, the results obtained does not has trend as it shows that the 60˚ tail configuration has the lowest drag. The 30˚ tail configuration produced the highest drag and subsequently 0˚ and 45˚ tail configurations. It was found that by sweeping the tail sweep angle backward, the moment coefficients increase. The 60˚ recorded the highest C_M and consequently 45˚, 30˚ and 0˚ tail sweep angle configuration. From the results plotted, mathematical relationship with respect to the tail sweep angle was established. At trim condition, the 60˚ tail sweep angle configuration gives the best aerodynamic efficiency and good longitudinal stability.

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