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A REVIEW REPORT ON EMPENNAGE OF AIRCRAFT

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ABSTRACT
The objective is to study about the empennage i.e. tail structure of an aircraft and to optimize the weight of aircraft.

Keywords
Empennage, stabilizers, V-tail, T-tail, carbon fibre, aluminum.

1. INTRODUCTION
The empennage i.e. the tail structure of an aircraft comprising of stabilizer, elevator, vertical and rudder. Most aircraft feature an empennage incorporating vertical and horizontal stabilizing surface which stabilize the flight dynamics of yaw and pitch as well as control surface. Many earlier aircraft that lacked a stabilizing empennage were virtually unflyable. That's why it is called “tailless aircraft” usually have a tail fin (vertical stabilizer).Structurally, the empennage consist of the entire tail assembly, including the tailfin, the tailplane and the part of the fuselage to which these are attached. The rear section is called the Elevator, and is usually hinged to the horizontal stabilizer. The elevator is a movable airfoil that controls change in pitch, the up and down motion of the aircraft’s nose. The rear section of the vertical fin is the Rudder, a movable airfoil that is used to turn the aircraft’s nose to one side or the other .For weight optimization the use of composite materials in the primary structure of aircraft is becoming more common, the industry demand for predicting and minimizing the product and maintenance cost is rising .However, the selection for the design and associated manufacturing process in the early design stage is so far largely experience and knowledge based and partly a political decision which create a high cost. There is, therefore, a need to develop an approach for the optimal design of a minimum weight composite wing box structure , to design requirement and design goal for the empennage of a light weight aircraft which is generally fuselage mounted type. The empennage has been design for performing various stability control function . In order to maintain a high efficiency model, endeavors were made to make empennage as light as possible as well as with a high structural strength to weight criteria .The proposed methodology was considered for minimum weight empennage mode under applied the loading condition. The material is organized around the major task in empennage design:

- Empennage configuration (structure characteristics and dimensions as related to the aircraft requirement are considered and compared from the previous light weight aircraft model);
- Material selection (structural loading , ultimate strength mode of failure , fatigue, configuration, environmental effects and light weight);
- Empennage modeling and analysis (safety factor, applied load, structural analysis).

The critical aspects of the structural ,performance , and physical boundary requirements that the structural design must satisfied are presented and the detail procedure for modeling the empennage structure is also presented .The model is then exported into the analysis software to conducted the analysis. The analysis of the empennage model is conducted representing that the model when an advance material such as carbon fibre is considered inspite of aluminum is suitable for optimizing the weight and proved to be effective.

2. ABOUT EMPENNAGE STRUCTURE
There are three types of empennage configuration :T-tail, V-tail, and Convectional tail. The most commonly used empennage configuration is a T-tail where engine are positions on the rear of the fuselage or on high-wing aircraft when the horizontal stabilizer may be located in the wing wake. The demerits of T-tails are that it needs large structural components resulting increased weight and complexity undesirable rolling moment in the opposite direction of the desired turn. They are scarcely used. SO they are only two surfaces instead of three.

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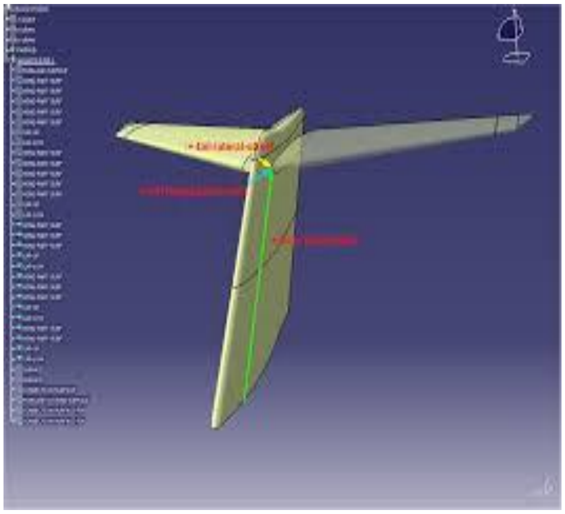

1.1 T-tail configuration

The Vertical tail assembly is a light weight and stiff structure that maintains proper airfoil shapes under the applied proper loads. The aerodynamic loads distributed on the skin of the aircraft to produce shear torsion and bending moment at the fuselage interface.It reduce aerodynamic sideslip and provide direction stability .Generally navigational radio or airband receivers antinas are located on or inside the vertical tail.

1.2 V-tail configuration

The aircraft having three jets engine houses central engine in the vertical tail. There are two type of vertical stabilizer single conventional tail where vertical stabilizer is located vertical and horizontal stabilizer to the rear of the fuselage; T-tail where horizontal stabilizer is placed at the top of the vertical stabilizer. T-tail often used in the fuselage mounted engine configuration so that horizontal stabilizer remains away from the engine exhaust.

1.3 Conventional tail

The conventional horizontal stabilizer assembly consist of left and right out put sections attached to a centre section or torque box within the fuselage. The horizontal tail is moved by hydraulic actuators in response to control pitch.

3. SCOPE

The research aims at optimizing the weight of an empennage structural assembly that will tolerate the different loads – operational loads, aerodynamic loads. The objective is to provide simply yet durable light weight structure that can be distribute the aerodynamic forces produce by the tail structure to the airframe through the most efficient load path. The analysis on the empennage model is conducted using ANSYS 10.0 tools representing that the model design when an advanced material such as carbon fibre is consider inspite of aluminum is suitable for reducing the structural weight and increasing the strength and hence optimizing the overall weight of empennage structure.

4. CONCLUSION

In the competitive environment of aircraft industry it becomes absolutely necessary to improve the efficiency , performance of aircraft .Metallic (aluminum) structure is partially superior to composite (carbon fiber) strength cost aspects. Composite (carbon fibre) structure is superior to metallic (aluminum) structure in weight aspect which will influence in airplane performance. The advantage of the carbon fibre provides the structure of the empennage with the greater strength hence the weight of the structures can be optimized by replacing the existing material aluminum with the carbon fibre.

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