

Preliminary Sizing Procedure of Rib of an Aircraft

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ABSTRACT

The paper is about the preliminary sizing procedure of rib of an aircraft. This study is to show the sizing and positioning of ribs in aircraft wing. CATIA V5 is used for rib modeling. Web and truss are the main types rib. It acts as a load distributor. I and C shapes are the cross-sectional configuration. Various loads are acting on rib like pressure load, inertia load etc. Riveting and spot welding are the joining methods of skin and ribs.

Keywords

Ribs, Wing, spar, stringers, loads.

1. INTRODUCTION

For aerodynamic reasons the wing contour in the chord direction must be maintained without appreciable distortion. Ribs are used to hold the cover panel to contour shape and also to limit the length of skin – stringer or integrally stiffened panels to an efficient column compressive strength. The other major purposes of Ribs are to act as a transfer or distribute the load. Ribs are composed of caps , stiffener and webs. It also contains lightening holes and beads in its structure. There are many types of rib construction, but in aircraft industry, we generally used shear web ribs because it act as a fuel slash inhibitor. The web provides continuous support for the wing cover panels for internal integral fuel tonic pressure. Truss type ribs generally will be heavier particularly an deep ribs. The truss type is most efficient because it is strong and lightweight, but it is also the most complex to construct. Most manufactured aircrafts have wing ribs made up of solid extruded aluminium. Ribs may be made of metals, wood or composite materials depending on the design criteria of an aircraft. They can be generally classified into different types by their cross-sectional configuration. They may be in the form of I – beam or C – beam.

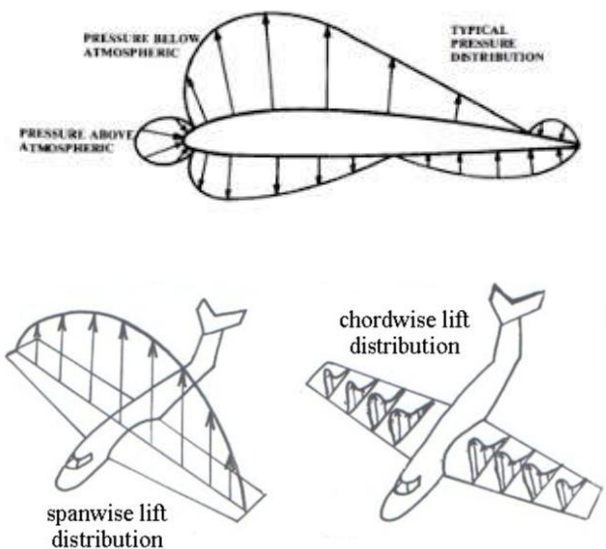
Table 1. Conventional available shape of size:-

S.NO	Material	Shape	Thickness range (mm)
1.	AL2014-T6	I	0.5-2
2.	AL2024-T851	C	0.5-2
3.	AL7075-T6	Z	0.5-2
4.	AL7075-T7351	C	0.5-2

1.1 The various loads acting on the ribs

- The primary loads- acting on a rib are the external air loads and the transfer of them to the spars.
- Inertia loads- fuels, structure, equipment, external stores.
- Crushing loads due to flexure bending- when a wing box is subjected to bending loads, the bending of the box as a whole tends to produce inward acting loads on the wing ribs.
- Redistributes concentrated loads- such as nacelle and landing gear loads to wing spars and cover panels.
- Diagonal tension load from skin- when the wing skin wrinkles in a diagonal tension field the ribs act as compression members.

1.2 Pressure distribution on a rib



1.3 Joining methods of skin and ribs are Riveting and Spot welding

1.3.1 Riveting

Riveting is a process used to join two or more plates or pieces to hold them together in which a metal pin is passed through them. Many type of riveting processes are used for joining. The special type of aluminium alloy is used in the aircraft for riveting.

1.3.2 Spot welding

Spot welding or resistance welding is a process for fastening metallic object together. Metallic object has some level of resistance to flow of electric current. This resistance will cause heat energy as electric current passes through the work piece. This heat energy is used to join the two parts or pieces of metals in aircraft.

2. PRILIMINARY DESIGN

The generative shape design module of CATIA V5 is used to construct the rib. A reference drawing was created for making a rib as shown in fig 1. The dimensions of the computational domain as follows:

Chord length = 1000 mm

Thickness of rib= 1.5 mm

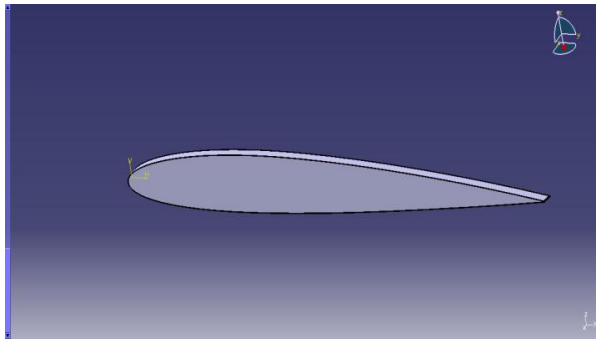


Fig1

In fig 2 rib was attached with front and rear spars.

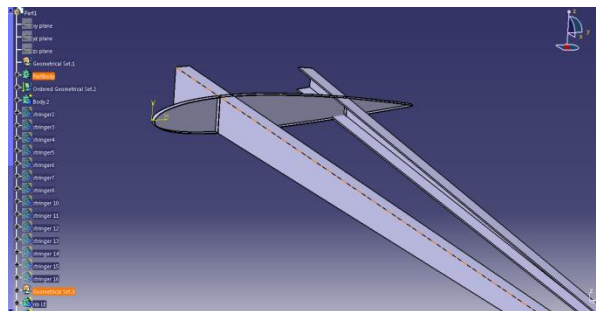


Fig 2

In below fig, rib was divided into 3 parts with the reference of spars.

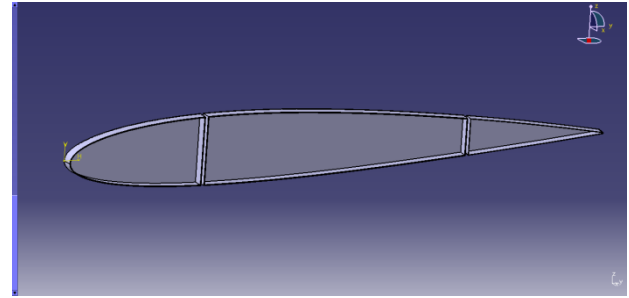


Fig 3

In fig 4 and fig 5 rib was attached with stringers and cut out was made by using pocket command in CATIA.

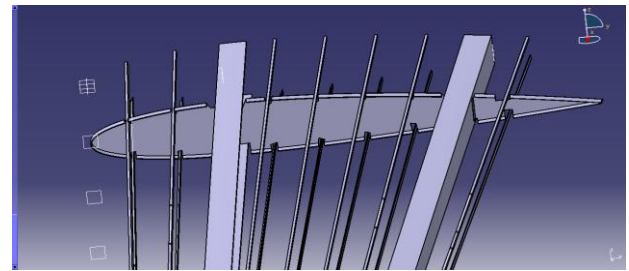


Fig 4

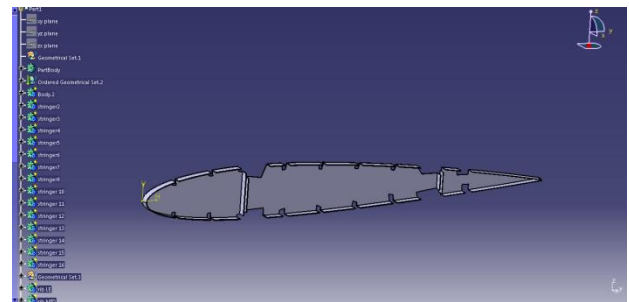


Fig 5

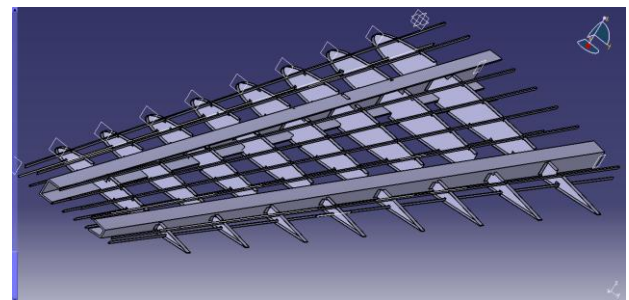


Fig 6

3. CONCLUSION

- The structure of rib was designed in CATIA V5 software.
- The distinct advantages of modeling in CATIA® were found to be accuracy of model and saving both time and reducing costs considerably.

4. FUTURE SCOPE

This study can be extended by discussing rib analysis, detail design of rib etc



5. REFERENCES

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