ISSN (O): 2393-8609

International Journal of Aerospace and Mechanical Engineering

Volume 5 – No.4, August 2018

ANALYTICAL APPROACH TO DETERMINE THE DIMENSION OF STRINGERS THAT CAN BE USED IN A CARGO AIRCRAFT DOOR

Umang Rawal
B.Tech in Aerospace Engineering
UPES, Dehradun-248001
Uttarakhand, India
umangrawal1296@gmail.com

Mohit Sharma
B.Tech in Aerospace Engineering
UPES, Dehradun-248001
Uttarakhand, India
mht.shrm15@gmail.com

ABSTRACT
This paper presents an analytical approach to determine the dimension of the stringers that can be used in the door of a cargo Aircraft. In the development of an aircraft, components are designed in a way that gives maximum efficiency to the aircraft but also cost is optimized. The current work follows the iterative approach to find the optimum dimension of stringers. This is achieved by calculating the bending moment using different dimensions in a Z shape stringer and then selecting the one who's bending moment is close to 450mpa.

General Terms

Stringer, Shape, Cargo, Aircraft, Aluminum 2024 T6

Keywords
Analytical Approach, Dimension, Stringer, Aircraft

1. INTRODUCTION
The design and manufacture of aircraft door expect thoughtfulness regarding a few special basic structural requests. High strength and light weight are two essential functional requirements to be considered in selecting the material and the shape of components used to construct the aircraft door. Traditionally the structural components used in an aircraft door are Stringers, Ribs, Spars and Skin. Each of these components are responsible to withstand certain load acting on the door.

Stringer is a solidifying part which supports a section of load carrying skin, to avoid buckling under pressure or shear loads. Stringers shield the skin from bending. They are fundamentally in charge of transferring the aerodynamic loads following up on the skin onto the framed formers. It additionally transfers the bending loads acting on the wings onto the ribs and spars.

The paper follows an iterative approach to find out the optimum dimension of the stringers used in the door of a Cargo Aircraft. This is achieved by assuming different dimensions of a Z shape stringer and calculating the subsequent moment and moment of Inertia to find out the bending stress.

2. MATERIAL SPECIFICATION
Mostly aluminum-2024-T6 is utilized for skin-stringers and edges. Airframe designers still request solid, hardened material at an adequate weight and cost .So composites of aluminum, steel and titanium will likely utilized for airframe outline. Other aluminum composites i.e. aluminum-press molybdenum-zirconium, work all around ok at high temperature to be aggressive with titanium up to close to 600ºF.

3. METHODOLOGY
To determine the optimum dimension of a stringer to be used in a Door of a Cargo Aircraft, an iterative approach will be used. The steps of which are as follows.

STEP I
Choose a shape of the stringer according to the base structure so that the attachment can be done with ease. Stringers can be of different shapes, a few of them are shown below.

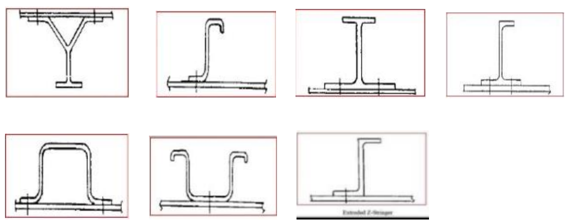

Fig 1: Types of Stringers

We choose Z shape stringer because of two major factors:

- Manufacturability of this shape
- The ease with which riveting can be done on it.

Once the desired shape is selected, our aim is to obtain maximum retention of stress with less minimum weight.

ISSN (O): 2393-8609
International Journal of Aerospace and Mechanical Engineering
Volume 5 – No.4, August 2018

STEP II

Consider the general dimensions of stringer and assume a value of thickness and at that thickness calculate value of bending stress i.e. σ

$$\sigma = \frac{M\,Y}{I}$$

Where M = Moment experienced by the Z shaped stringer

Y = position of center of gravity

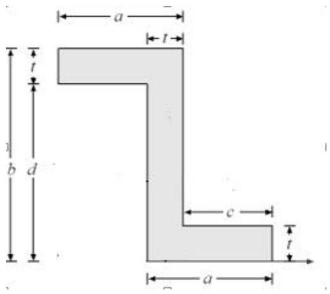

Fig 2: Selected stringer

The method is to calculate the amount of bending stress produces by the Z shaped stringer when 5.57 psi pressure is applied on it.

Assume thickness = t

And calculate Moment of Inertia i.e. I

$$I = \frac{b(a+c)^3 - 2c^3 d - 6a^2 cd}{12}$$

Using the values, Moment of Inertia is calculated.

STEP III

To calculate value of Moment, M

$$M = \frac{Wl^2}{8}$$

The pressure should be converted in the form of acting force.

$$W = \frac{F}{L}$$

And we know

$$F = PXA$$

Where p = pressure

A = Area, area here chosen is the largest area on the panel

A = l x a dimensions of that largest segment.

Using these equations,

$$W = PXa$$

Final equation for M is

$$M = \frac{Pal^2}{8}$$

Now we know value of M

Value of y is fixed

Y = 35/2 = 17.5

STEP IV

Substitute the values to obtain bending stress, σ. If this value is less than 450 MPa then it is feasible and the dimensions obtained are appropriate.

4. CONCLUSION

The iterative approach is one of the basic but an effective analytical approach to determine the dimension of a stringer which can be used in a door of a cargo aircraft. By following the above four steps one can easily determine the optimum dimension of a stringer which can withstand the acting load.

5. REFRENCES

[1] Airframe Stress Analysis and Sizing, Niu, 1999.

[2] A. J. Morris. MOB A European Distributed Multi-Disciplinary Design and Optimization Project. AIAA Paper 2002-5444, Sept. 2002.

[3] Analysis and Design of Flight Vehicle Structures, E.F. Bruhn, 1965.

[4] Baolin Chen.Theory and algorithm of optimization[M].Beijing:TsinghuaUniversity Press,2004.