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Conventional Stress Analysis Of Fuselage Section Of Passenger Aircraft

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ABSTRACT

Aircraft is a highly complex flying structure generally transport aircraft undergoes nominal maneuvering flights. Fuselage is an Aircraft's main body section that holds crew and passengers or cargo. A supersonic fighter plane has a very slender, streamlined fuselage to reduce drag associated with high speed flight. Shape of the fusel -age is normally determined by the mission of the aircraft. There are three types of Fuselage structure's:- Truss, Monocoque, Semi-Monocoque structure. Semi Monocoque is preferred method of constructing an all Aluminium Fuselage. First , a series of frames in the shape of fuselage cross section are held in position on a rigid fixture. These frames are then joined with lightweight longitudinal elements called stringers. These are in turn covered with a skin of sheet Aluminium, attached by rive-ting or by bonding with special adhesive. Because of its stressed skin construction , a semi-monocoque fuselage can withstand damage and still be strong enough to hold together.

1. INTRODUCTION

In Aircraft Construction , a longeron, stringer, stiffener is a thin strip of material to which skin of aircraft is fastened. In fuselage stringers are attached to formers(frames) and run in longitudinal direction of aircraft. They are responsible for transferring the aerodynamics loads acting on skin onto frames. Rivet is a permanent mechanical fastener, it can support tension loads, shear loads but are widely used to support shear loads. Rivets are preferred over nut and bolts as it costs less, easy to repair and can easily be inspected. Stress Analysis Can be done to inspect whether a fuselage structure can bear a load or not and the same is used to describe here to show the behavior of riveted skin, doubler, stringer, filler and frame together. Riveted elements gets deformed when shear load is applied.

2. OBJECTIVE

By calculating the dimensions of fuselage element from 2-D drawing we draw 3-D geometry. Various side view sections of the main structure (fig 1) are A-A, B-B, C-C which are shown in fig2.

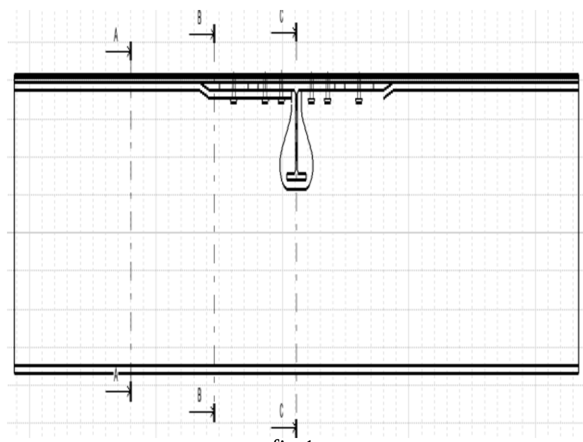

fig.1

section A-A scale 1:1 section B-B scale 1:1 section C-C scale1:1

fig.2

3. 3-DIMENSIONAL MODEL

The attachment of the fuselage elements by rivet in 3-D designed in CATIA-V5 shown below

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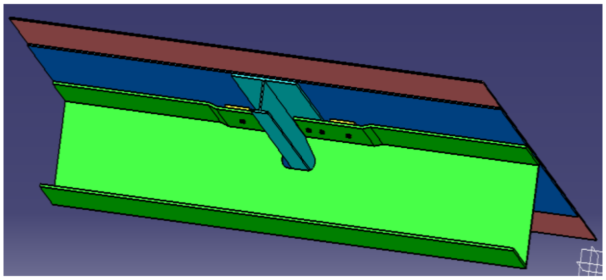


4. MATERIAL SPECIFICATION

Selection of aircraft materials depends upon any consideration, which can in general be categorized as cost and structural performance. Cost includes initial material cost, and maintenance cost. The key material properties that are pertinent to maintenance cost and structural performance are

*density

*stiffness

*strength

*durability

*damage tolerance

*corrosion

Aluminum 2024-T3 clad material is used.

1.2024-T3 use for high strength tensile application.it has best fracture toughness and slow crack growth rate and good fatigue life.

2. It is non-magnetic and heat treatable.

5. LOADS AND CALCULATION

To perform the actual stress analysis solution both axial and bending stress distribution that arenormally present across an exposed cross-sectional area of a beam are replaced by equivalent member forces designated at specific elements areas. Mathematically this is accomplished by multiplying the average stress level of an element by its corresponding element area.

P = f*A

LOADS: M=3000 in-lb (compression skin side)

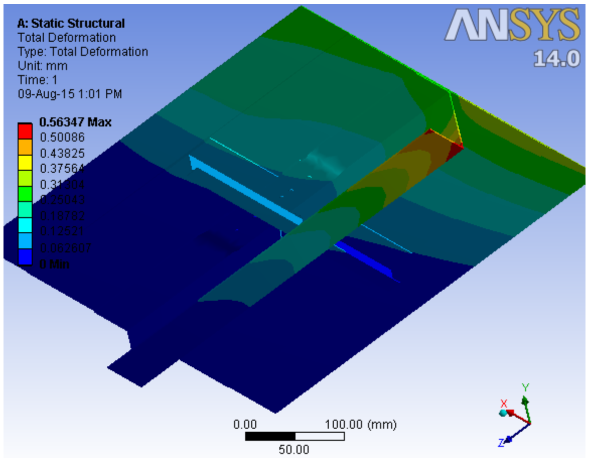
P=0, V=0, f=Mc/Ina

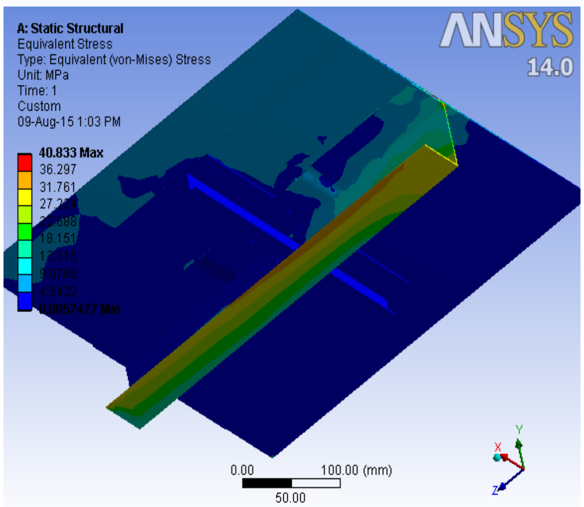
section A-A	b	h	y	A	Ay	Ay2	Io
1	50.8	2.03	1.015	103.124	104.6709	106.2409	35.41364
2	2.03	72.14	38.1	146.4442	5579.524	212579.9	63510.16
3	50.8	2.03	75.185	103.124	7753.378	582937.7	35.41364
4	38.1	1.27	76.835	48.387	3717.815	285658.3	6.503616
5	30.6	1.02	77.98	31.212	2433.912	189796.4	2.70608
				432.2912	19589.3	1271079	63590.2
	Ycg=	45.31506	in	Yna=Ycg=	45.31506		
	Icg=	446978.6		Icg=Ina=	446978.6		
		M=	3000				
MEMBER FORCES							
Element	Member	b	h	A	c	f*	P*
1	skin	30.6	1.02	31.212	32.6644	-0.21923	-6.84275
2	frame	38.1	1.27	48.387	31.5194	-0.21155	-10.2363
3	outer flange	50.8	2.03	103.124	29.8694	-0.20048	-20.6738
4	portion of web	2.03	25.91	52.5973	15.8994	-0.10671	-5.61279
5	web above the neutral axis	2.03	2.9444	5.977132	1.47	-0.00987	-0.05897
6	web below the neutral axis	2.03	43.2856	87.86977	21.6428	0.145261	12.76402
7	inner frame flange	50.8	2.03	103.124	43.38	0.291155	30.02506

section B-B	b	h	y	A	Ay	Ay2	Io
1	50.8	2.03	1.015	103.124	104.6709	106.2409	35.41364
2	2.03	70.1	37.08	142.303	5276.595	195656.2	58273.2
3	50.8	2.03	73.145	103.124	7543.005	551733.1	35.41364
4	38.1	1.27	76.835	48.387	3717.815	285658.3	6.503616
5	30.6	1.02	77.98	31.212	2433.912	189796.4	2.70608
				428.15	19076	1222950	58353.23
	Ycg=	44.55447	in	Yna=Ycg=	44.55447		
	Icg=	431382.4		Icg=Ina=	431382.4		
		M=	3000				
MEMBER FORCES							
Element	Member	b	h	A	c	f*	P*
1	skin	30.6	1.02	31.212	33.40553	-0.23231	-7.25101
2	frame	38.1	1.27	48.387	32.27053	-0.22442	-10.8591
3	outer flange	50.8	2.03	103.124	28.59053	-0.19883	-20.5041
4	portion of web	2.03	23.88	48.4764	15.63553	-0.10874	-5.27111
5	web above the neutral axis	2.03	3.69553	7.501926	1.847765	-0.01285	-0.0964
6	web below the neutral axis	2.03	42.52447	86.32467	21.26224	0.147866	12.76447
7	inner frame flange	50.8	2.03	103.124	43.53947	0.30279	31.22495

section C-C	b	h	y	A	Ay	Ay2	Io
1	50.8	2.03	1.015	103.124	104.6709	106.2409	35.41364
2	2.03	46.23	25.145	93.8469	2359.78	59336.68	16714.23
3	38.1	1.27	76.835	48.387	3717.815	285658.3	6.503616
4	30.6	1.02	77.98	31.212	2433.912	189796.4	2.70608
				276.5699	8616.178	534897.7	16758.86
	Ycg=	31.15371	in	Yna=Ycg=	31.15371		
	Icg=	283230.6		Icg=Ina=	283230.6		
		M=	3000				
MEMBER FORCES							
Element	Member	b	h	A	c	f*	P*
1	skin	30.6	1.02	31.212	46.82629	-0.49599	-15.4808
2	frame	38.1	1.27	48.387	45.68129	-0.48386	-23.4125
3	web above the neutral axis	2.03	17.10629	34.72577	8.553145	-0.0906	-3.146
4	web below the neutral axis	2.03	29.12371	59.12113	14.56186	0.15424	9.118858
5	inner frame flange	50.8	2.03	103.124	30.13871	0.319231	32.92042

Stress analysis is done by using ANSYS workbench





6. ACKNOWLEDGMENTS

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