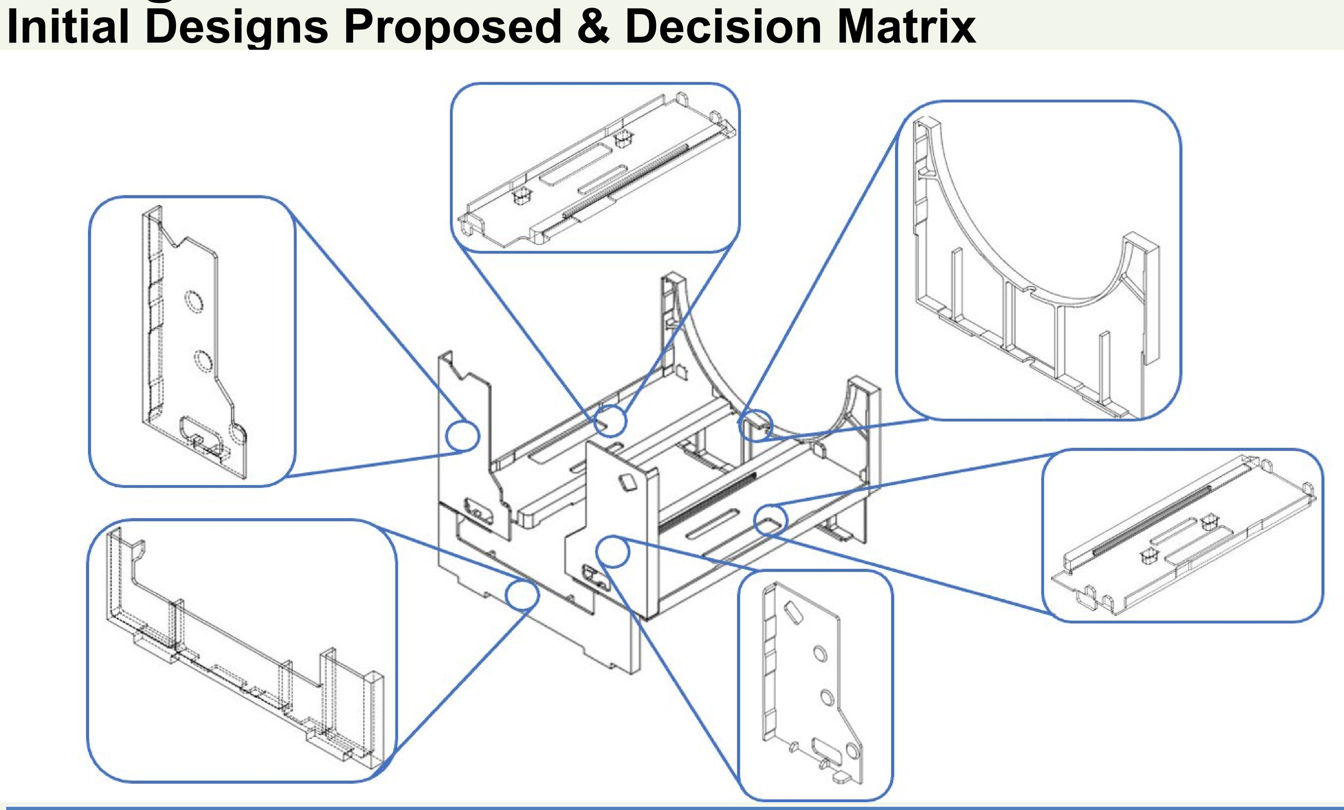
Wright State University
Optimization of Joining Methods for Generator/Converter Chassis

Abstract

GE Aviation is an aerospace company that contracts with the Department of Defense as a vendor for airplanes, jets, and other aerospace-related technologies. These jet planes are sold to the United States Military for their use overseas and at home, and during normal use, these planes withstand several abnormal conditions; including shock, vibration, and extreme climate change. The estimated life expected of a GE jet plane is 30 years of continuous use in these abnormal conditions. On these jet planes, there are uses for generators for powering various equipment used during flight, this makes the generator a vital part of the system. These generators suffer through the same extreme vibration and high shock values the plane faces, meaning they need a capable and reliable chassis to house them. There is currently a version of the chassis that has been used for multiple iterations of these jet planes, the joining of the chassis' members is currently done through a process called 'dip brazing', which yields extremely strong joints. However, this fabrication method requires multiple steps, making it very time-consuming and expensive. To improve upon the cost and lead time, this research project was conducted to assess other fabrication techniques to suit the application the same if not better while being cheaper and more efficient. Assessing and choosing a different method of fabrication for this chassis would reduce lead time and cost on the generators, and most importantly could render stronger joints allowing for a longer life expectancy of the chassis.

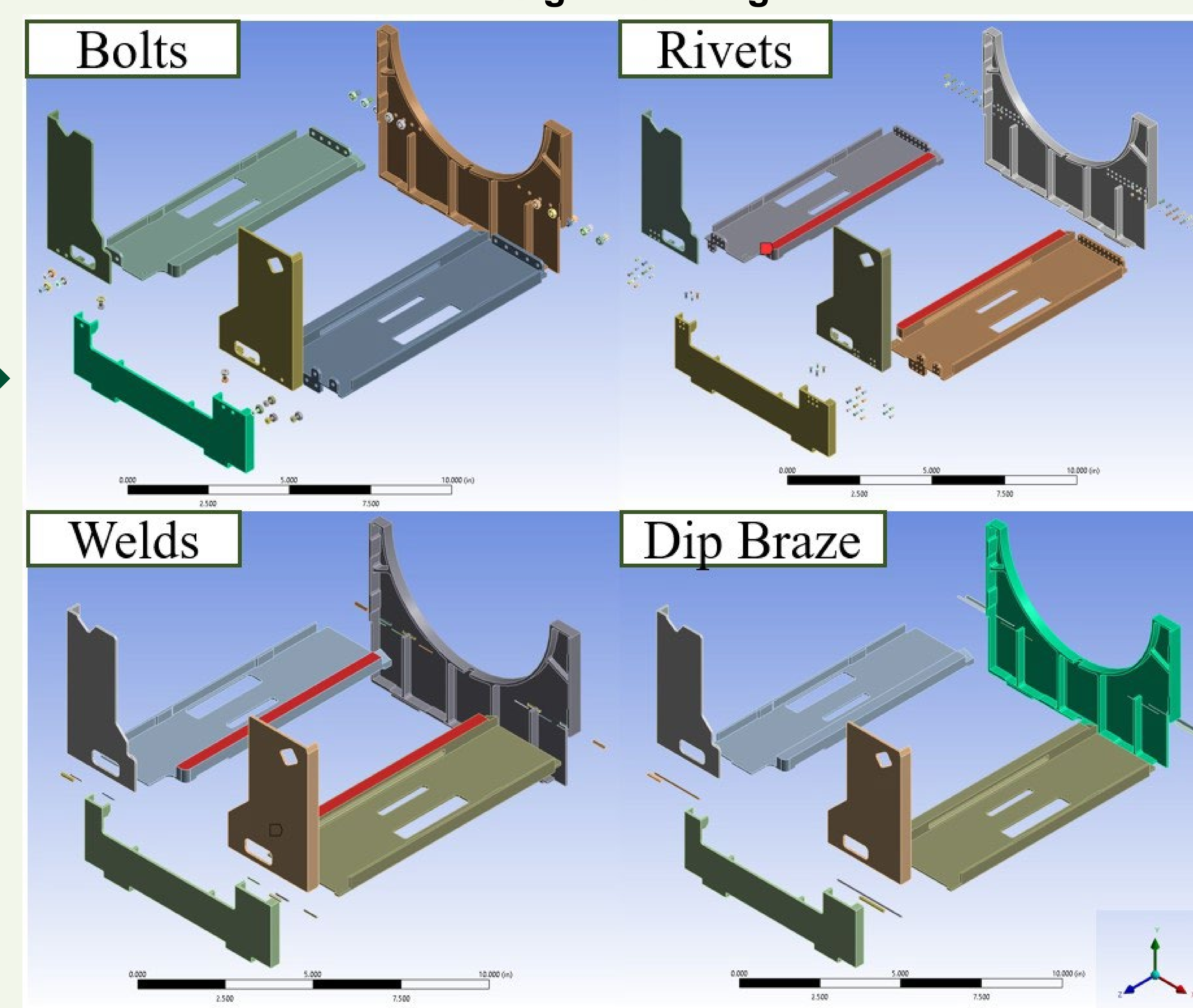
Design Process

Initial Designs Proposed & Decision Matrix

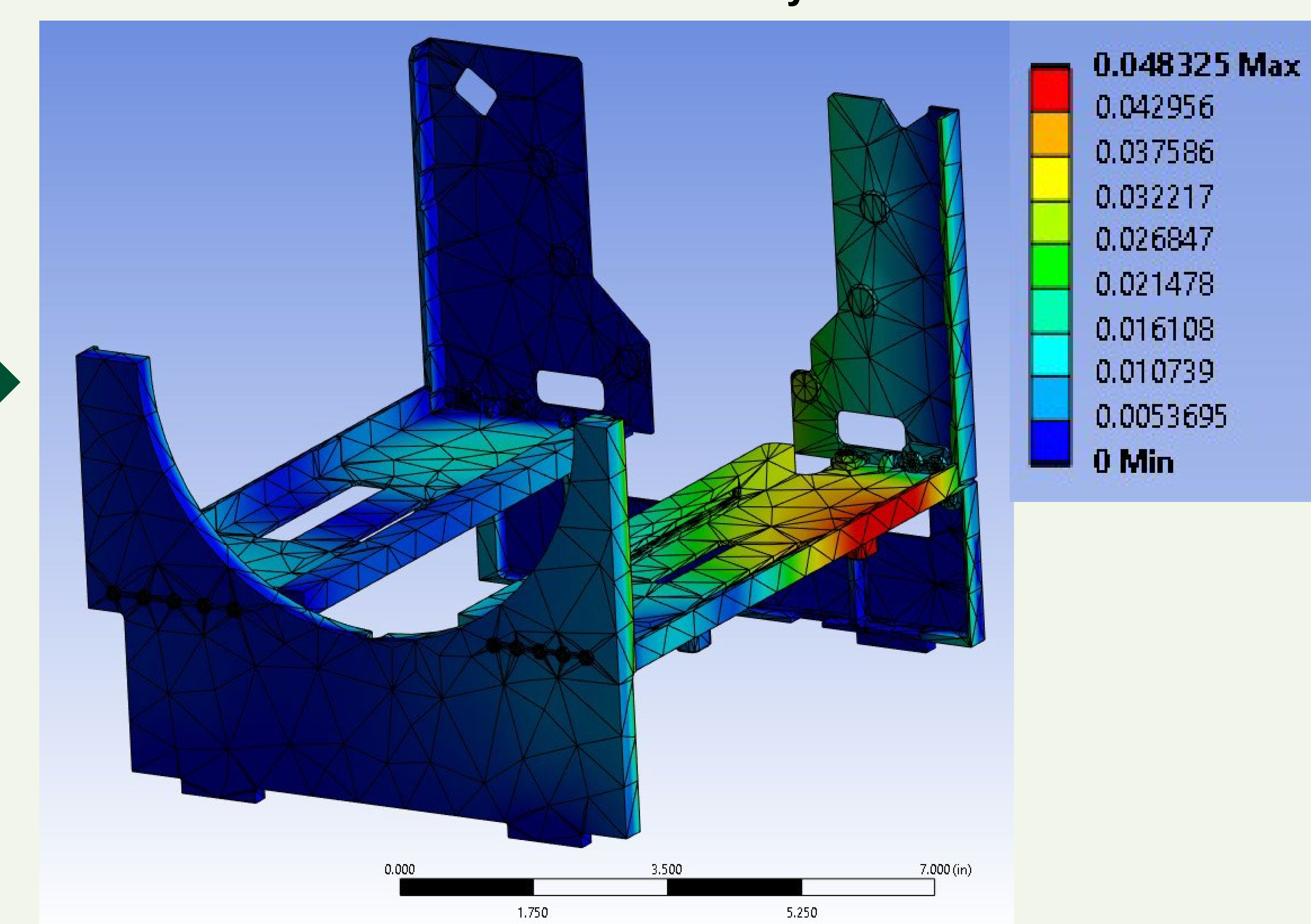


Decision Matrix					
Joining Method	Cost	Ease of Manufacturability	Factor of Safety / Durability	Lifespan / Static loading	Total
Dip Brazing	1	1	2	4	8
Riveting	3	3	3	2	11
Welding	2	2	1	3	8
Bolting	4	4	4	1	13

Design Modeling



Vibration & Shock Analysis



Final Results			
Fastening Type	Load Type	Max Deformation (in)	Minimum Factor of Safety
Bolts	Shock	0.507 in Z-Axis	9.14
Rivets	Shock	0.157 in Y-Axis	4.3
Welding	Shock	0.168 in Z-Axis	1.23
Dip Brazing	Shock	0.173 in Z-Axis	1.47

RESULTS

As shown in the table on the left: the maximum deformation for each fastening type is due to Shock. This is because Aluminum 6061-T6 (the metal used for this application) is very efficient at dampening vibrational loads.

Since all joining methods were able to withstand the required loads, and deformations, the decision for most suitable option can be determined through manufacturability, and lifespan.

Bolts give you the higher factor of safety, but this is due to the testing parameters. The shear strength of the steel bolts is much higher than the shear strength of aluminum. The aluminum will fail around the bolts before the bolts fail. This means if testing was able to be carried out in a different way, rivets would be the "safest" option.

With this in consideration, as well as our decision matrix factors, **rivets** is the most suitable option.

INVESTIGATORS:
Tyriek Craigs
Seth Perkins
Robert Hall
Jacob Evans

Advisor:
Dr Ahsan Mian

Mentor:
Julio Almanza

SPONSOR:
GE Aviation