Blast Cart-Hill AFB

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HILL AIR FORCE BASE

Introduction

The Blast Cart for Hill Air Force Base has been designed to hold a variety of aircraft parts for scheduled maintenance

Design Goals

- Wheel covers
- Telescoping legs for height adjustment
- FEA analysis for structural integrity and fatigue life calculations

Design Problems

- Support the required loads
- Prevent wheel bind-up from debris
- Adjustable to multiple working parts
- Being iterated to include automated movement?

Part Parameters

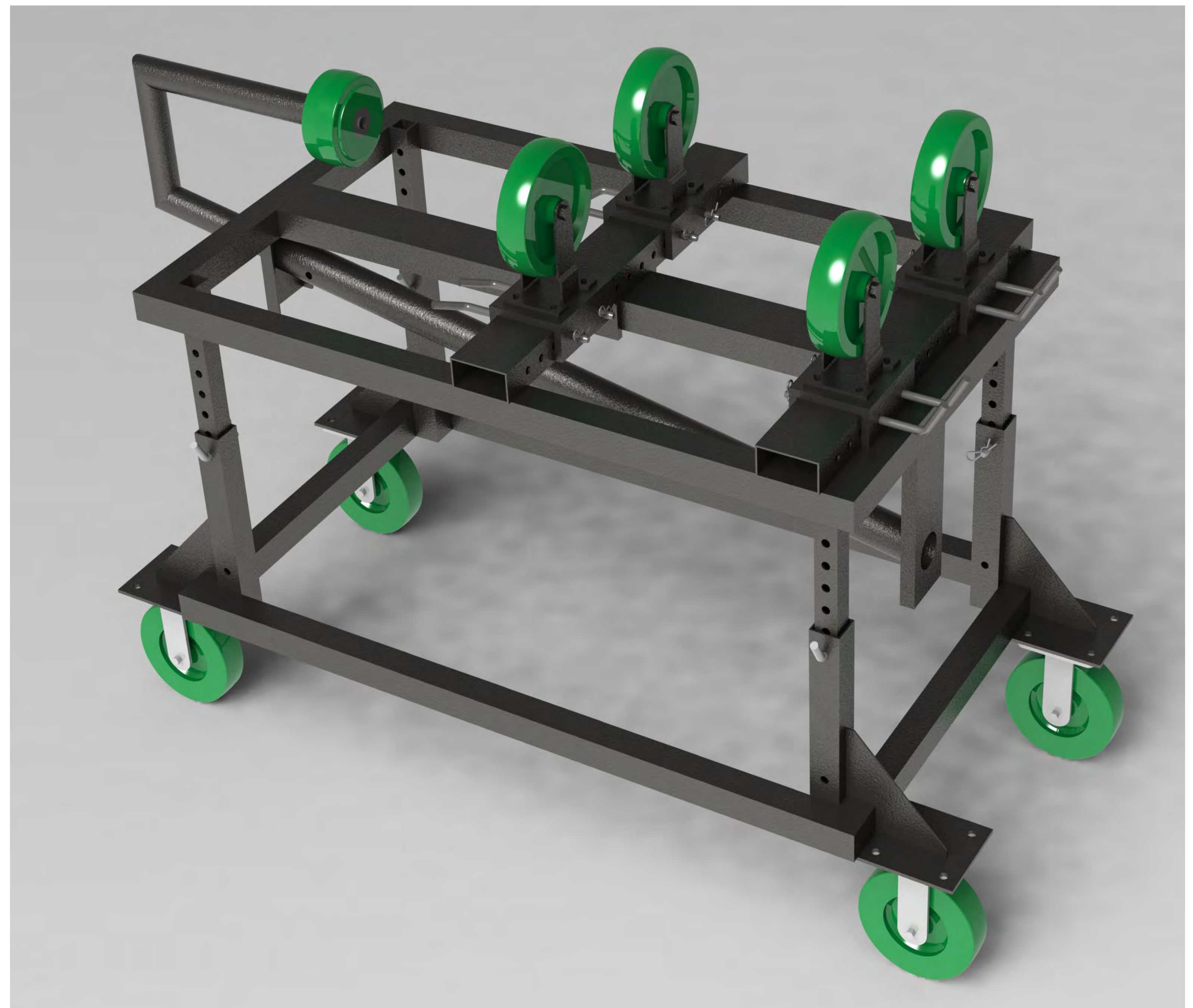
- Max. part weight: 700 lbs.
- 90% of weight on one end
- Cylindrical with max. diameter of 24 inches

Deliverables

- .SLDPRT files
- Drawings
- Final covers printed from PLA
- Final cart

Design Metrics

Metric	Unit	Value
Wheel exposure to debris is minimized	N/A	Yes/no
Debris on the cart can be easily cleaned off	N/A	Yes/no
Can hold a range of diameters	in	8<x<24
Can hold entire load at one end	lbf	700
Load bearing capability	lbs	n • 700
Parts are resistant to sand blasting	N/A	Yes/no
Length of cart	ft	4<x<6
Width of cart	ft	2<x<4
Height of cart	ft	2<x<4
Easy to maintain	N/A	Yes/no



FEA Conditions

- Weight of 1000 lbs. for extreme use case
- Maximum part diameter of 24 inches
- Center of mass applied over one set of wheels
- Yield Strength of Steel: 42,000 psi (53,700 for pins)

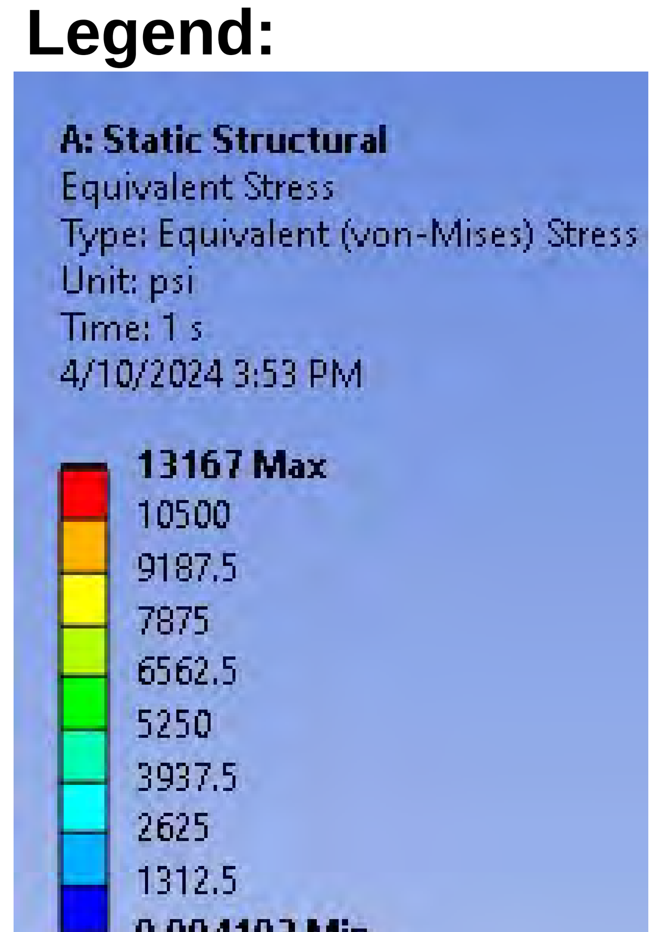
FEA Methods

- Started with large mesh to determine areas of high stress
- Refined mesh in high-stress areas to achieve accurate results
- Iterated the cart design until factor of safety of 4 was met

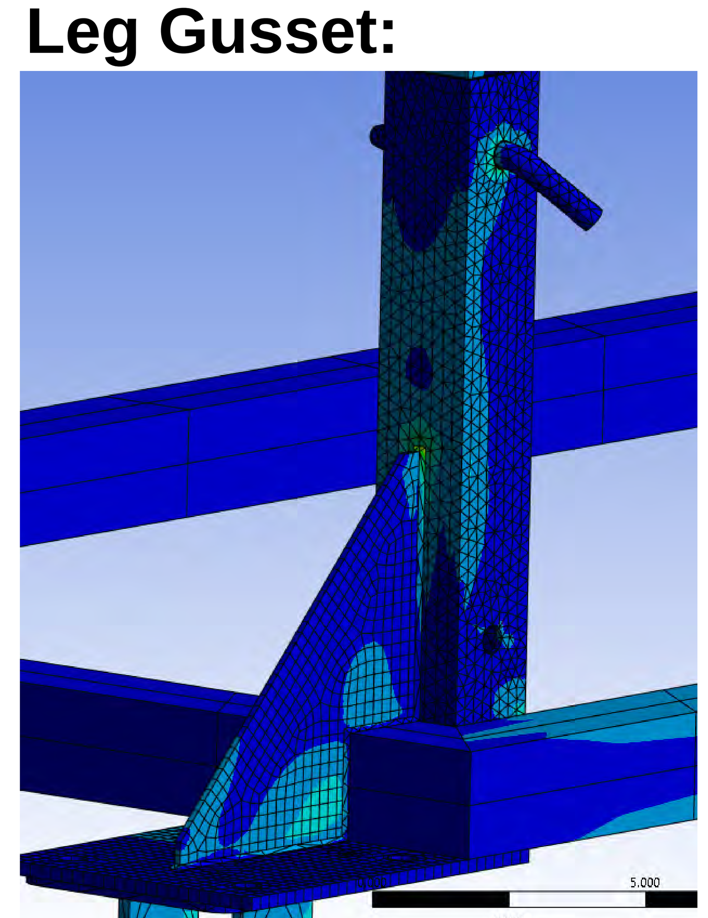
Significant FEA Results

Part	Max Stress (psi)	Factor of Safety	Max Principal Elastic Strain (µε)	Min Principal Elastic Strain (µε)	Infinite Life
Leg Gusset	5,662	7.42	80	-110	Yes
Arm	10,232	4.11	120	-350	Yes
U-Bolt	7,828	5.37	285	-200	Yes
Pin	11,082	4.85	275	-295	Yes

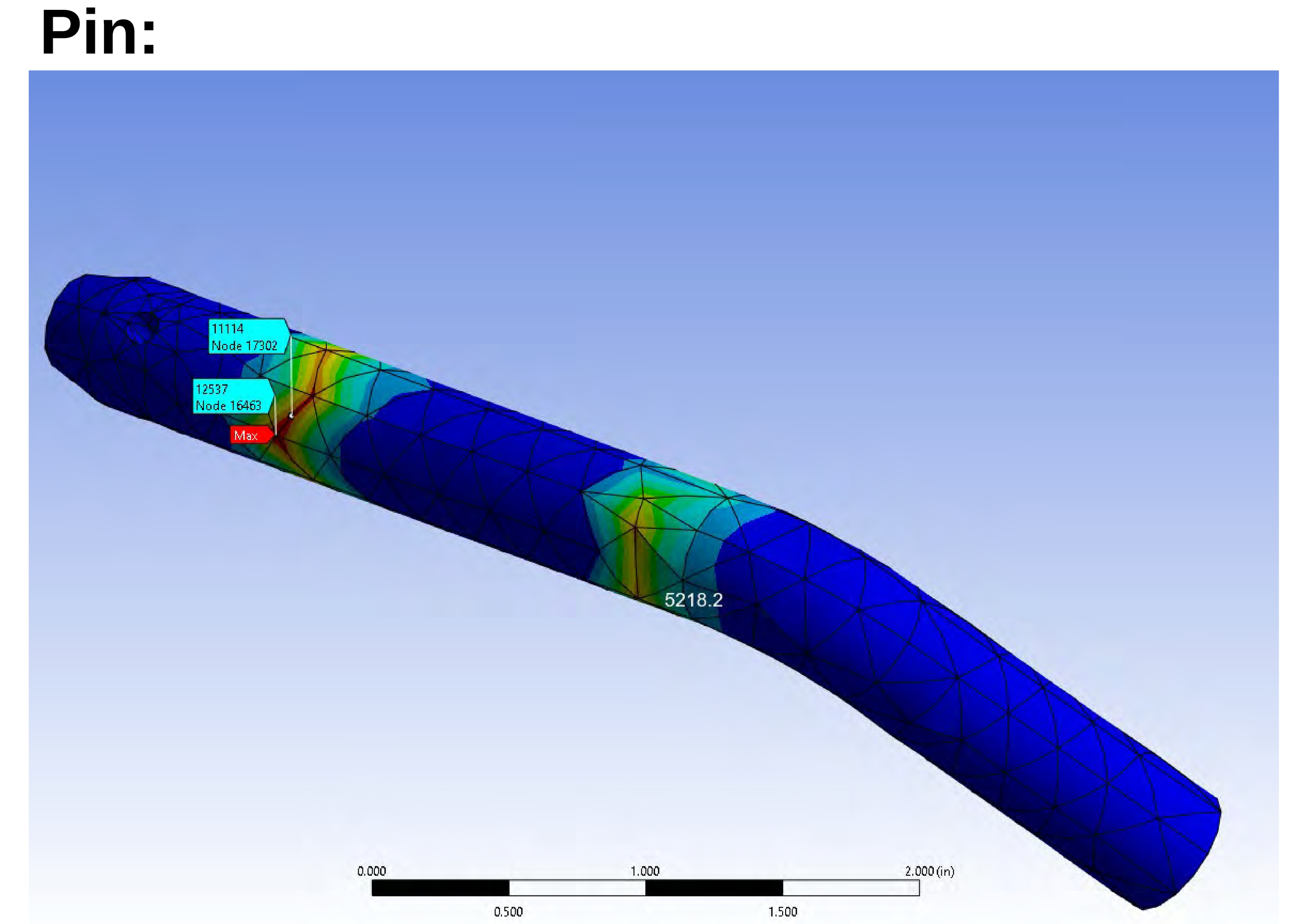
Legend:



Leg Gusset:



Pin:



Methods Used in Design

- Finite Element Analysis (FEA)
  - Ansys
- Fatigue Life Calculations
- CAD modeling
  - SolidWorks
- 3D Printing

Manufacturing Processes

Main structure was cut, machined and welded professionally in conjunction with Bonneville Machine.

Wheel Cover Methods

Wheel covers were designed in SolidWorks to fit 8-inch diameter wheels from McMaster. Two main cover designs to minimize exposure:

- Fixed wheels
- Swivel wheels

Wheel Cover Testing

- Wheel covers are printed using FDM process
- A test apparatus was built to simulate a sandblasting environment
- Multiple exposures to sand were performed before inspecting the inside of the covers and testing the wheels for performance under load

Conclusion

Based on our FEA results, our blast cart design achieves an infinite life while maintaining a factor of safety of at least 4 in all areas that were tested.

Wheel covers proved to minimize the wheels exposure to sand.

Future Development

Automated movement through mounted servos, motors, or hydraulics. Progress towards full part articulation (rotation about each axis)