Suspension Rockers Redesign and Implementation Using 3D-Printed Material

Team: Nakoma Austin, Sean Bryant, Raio Lively, Jonas Nouchet, and Charles Wilson

Department of Mechanical and Aerospace Engineering, Old Dominion University, Norfolk VA

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Advisor: Dr. Ashish Tamhane

Graduate Student Advisor: Bryce Thacker

Outline

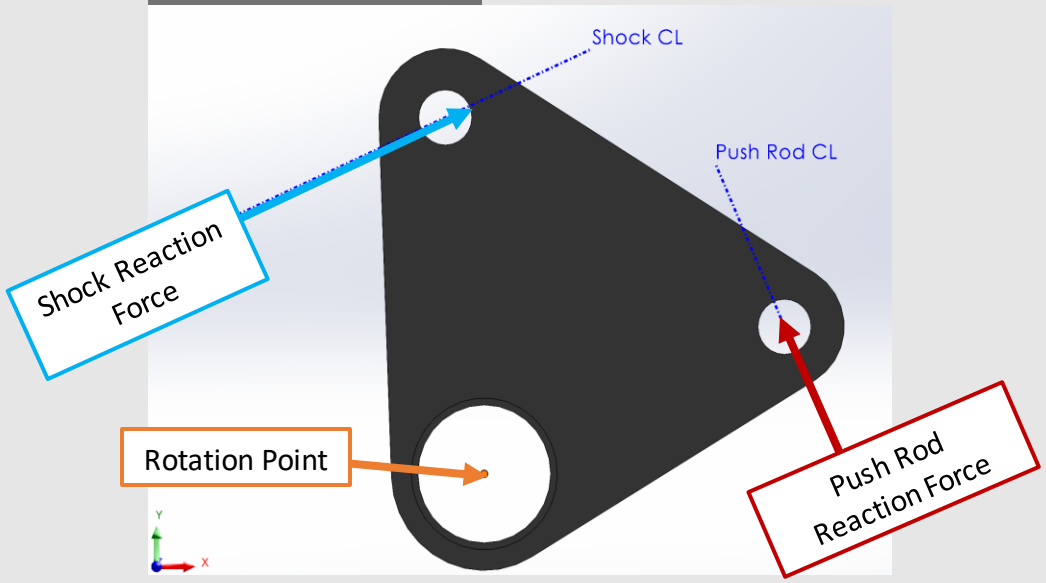
1. Project History and Background
2. Discussion of the Front Rockers
3. Discussion of the Rear Rockers
4. Bracket Design
5. Test Rig Set-Up and Test Plan
6. Gantt Chart
7. Conclusion
8. Complete List of Engineering Standards

Project History and Background

- Background: the ODU FSAE Team produces a racing vehicle every two years and competes nationally.
- Project was undertaken because the previous aluminum rockers were:
  - Expensive to produce
  - Heavy
  - Inconvenient (untimely) to obtain through outside vendors
- Objective: to determine if the FSAE Race Car can operate using PA-6CF 3D-Printed Rockers, which can be made on-campus with the AM Lab, are cheaper to produce, and made of a lighter material than aluminum.

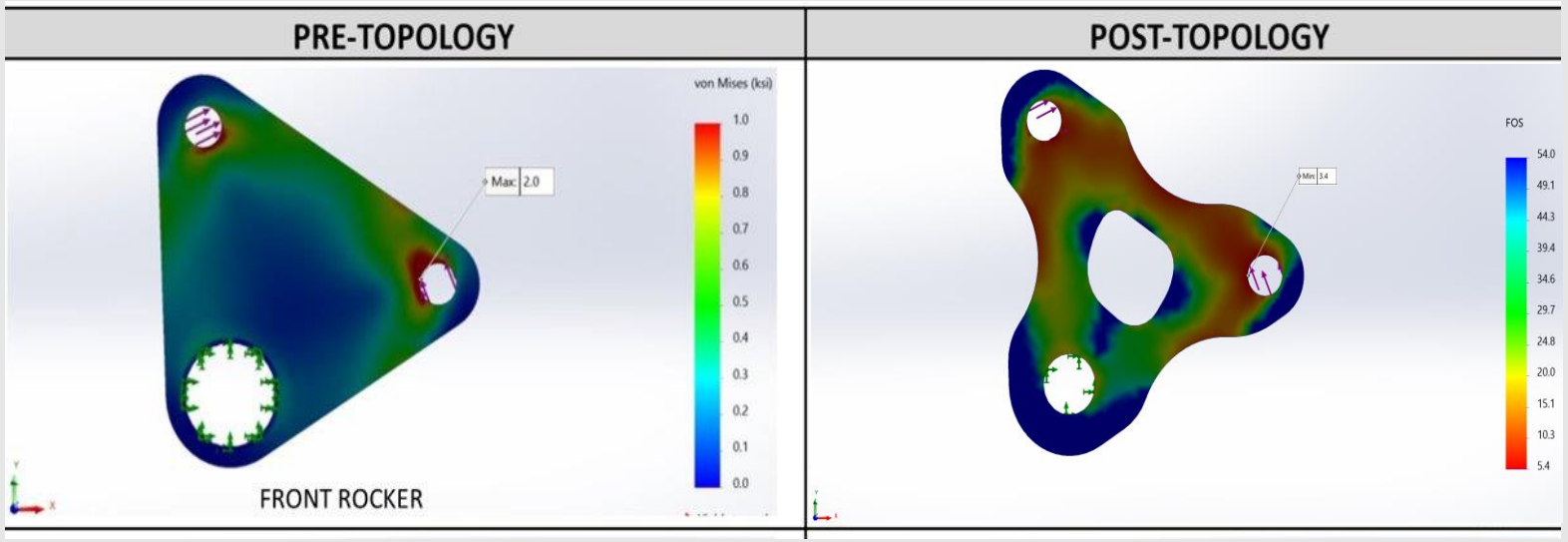
Front Rocker

Original Design

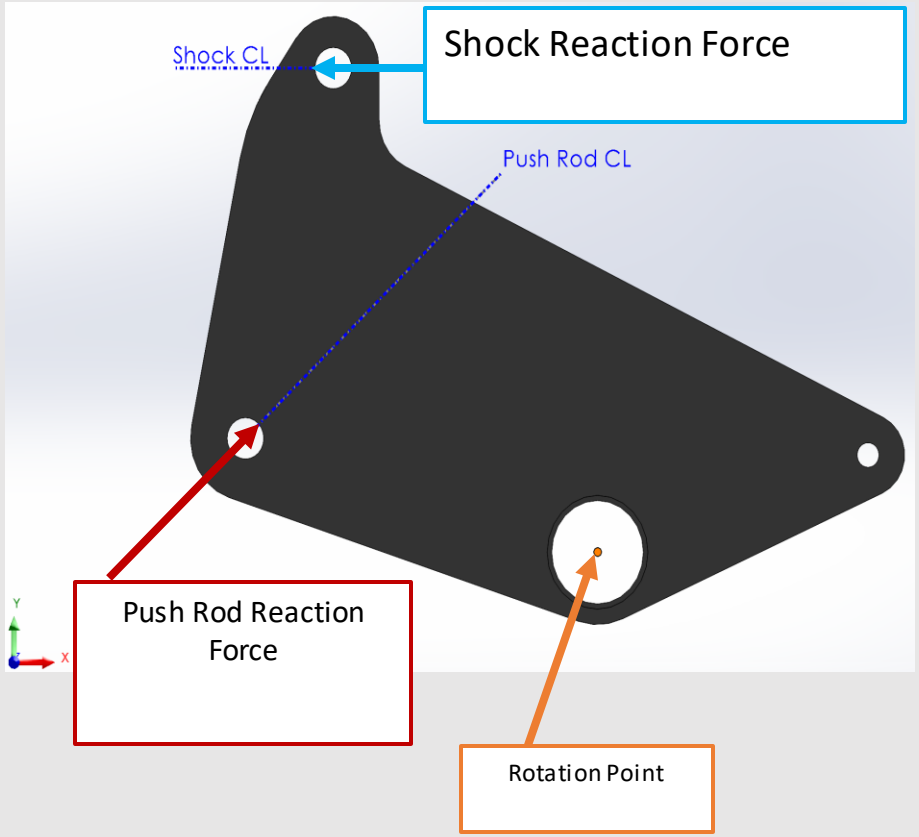


Front Rocker

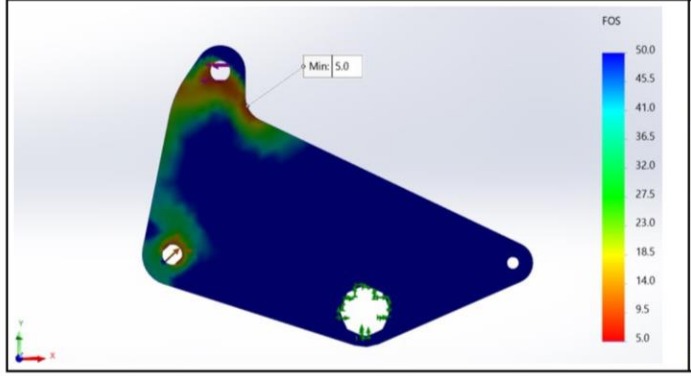
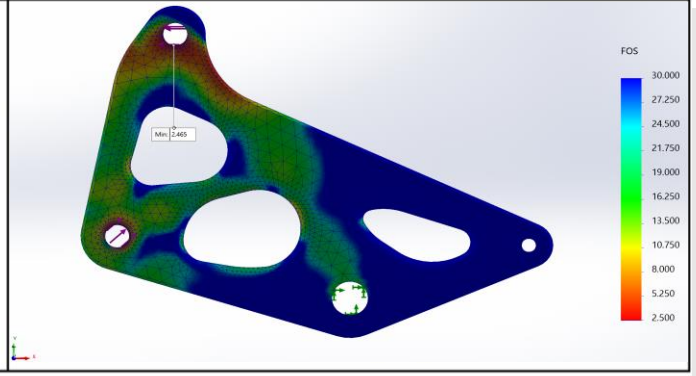
PA6-CF 3D-Printed Front Rocker



Rear Rocker


Shock CL
Shock Reaction Force
Push Rod CL
Push Rod Reaction Force
Rotation Point

Rear Rocker

PRE-TOPOLOGY	POST-TOPOLOGY
	

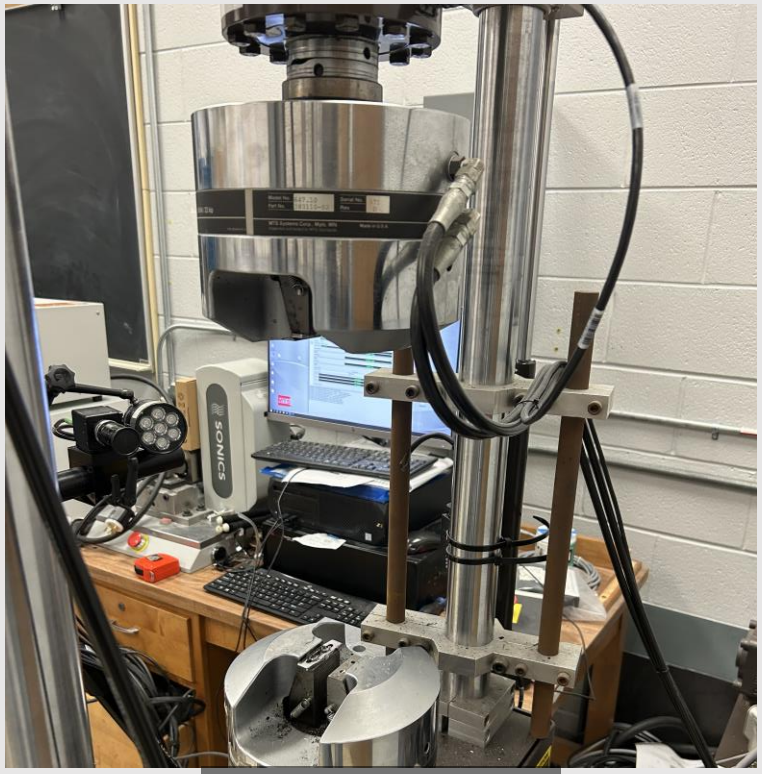
Bracket Design

Top and Bottom Bracket Assembly

Bottom Bracket Attachment

Top Bracket Attachment

Material Testing System (MTS) Machine

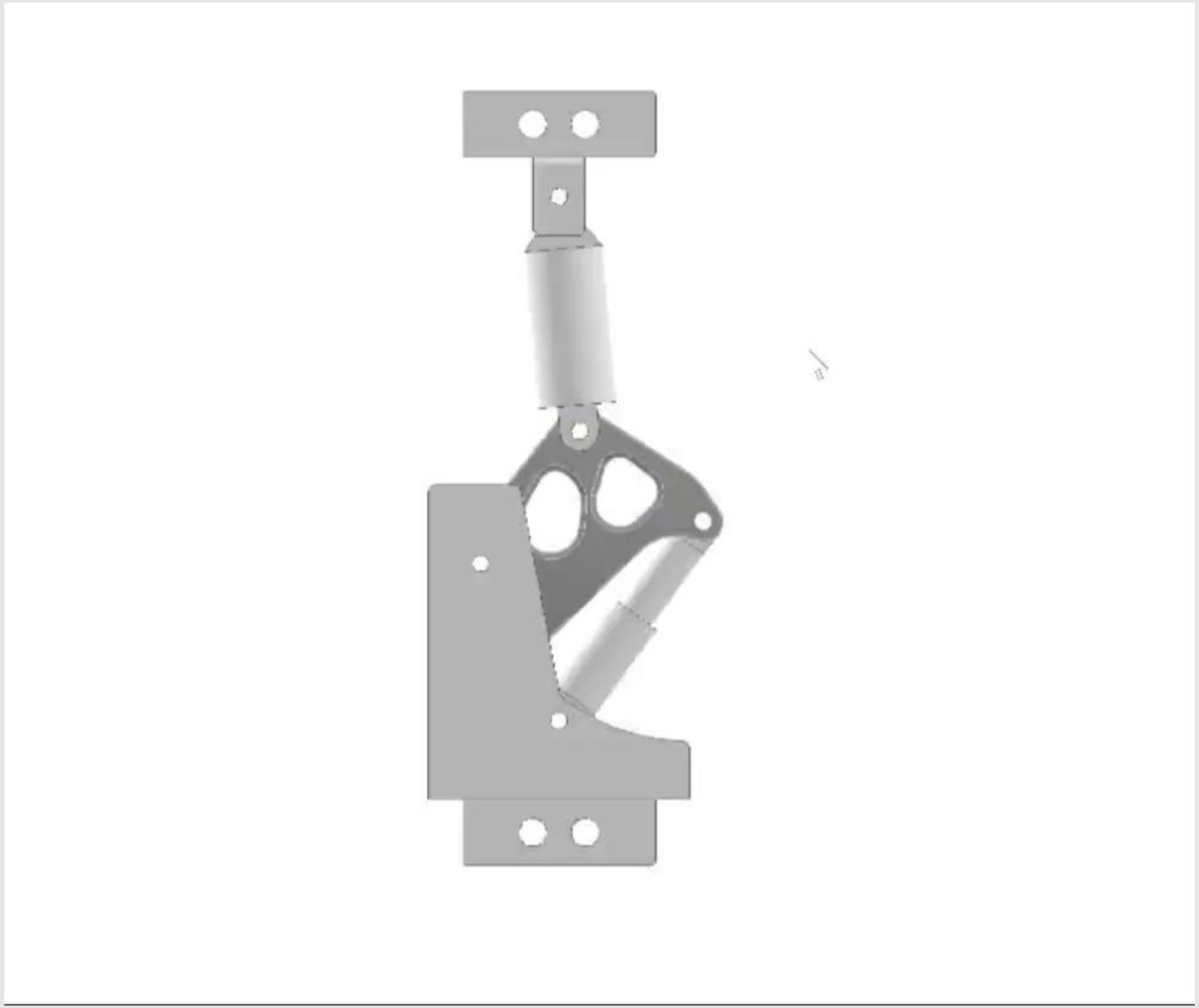


Full MTS Machine

Bottom Clamping Head of MTS Machine

Top Clamping Head of MTS Machine

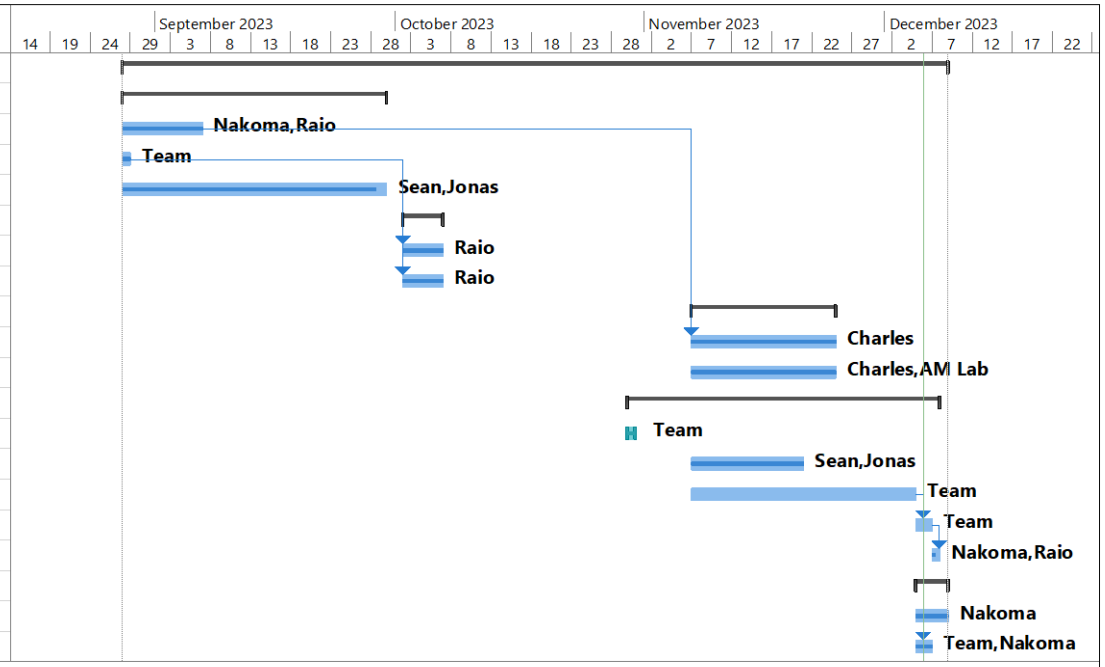
Bracket Motion



Front Rocker Static Testing

Gantt Chart and Budget Synopsis

ID	% Complete	Task Name	Duration	Start	Finish
1	**79%**	**ROCKER REDESIGN PROJECT**	**75 days**	**Mon 8/28/23**	**Fri 12/8/23**
2	**96%**	**1. DOCUMENTATION**	**25 days**	**Mon 8/28/23**	**Fri 9/29/23**
3	100%	1.1. Project Proposal	8 days	Mon 8/28/23	Wed 9/6/23
4	100%	1.2. Responsibility Assignments	1 day	Mon 8/28/23	Mon 8/28/23
5	95%	1.3. Load Testing Plan	25 days	Mon 8/28/23	Fri 9/29/23
6	**100%**	**2. SIMULATION**	**5 days**	**Mon 10/2/23**	**Fri 10/6/23**
7	100%	2.1. Complete Static Analysis	5 days	Mon 10/2/23	Fri 10/6/23
8	100%	2.2. Complete Dynamic Analysis	5 days	Mon 10/2/23	Fri 10/6/23
9	**100%**	**3. MANUFACTURE PARTS**	**14 days**	**Tue 11/7/23**	**Fri 11/24/23**
10	100%	3.1. Secure Material (PA6-CF)	14 days	Tue 11/7/23	Fri 11/24/23
11	100%	3.2. Manufacture Front and Rear Rockers	14 days	Tue 11/7/23	Fri 11/24/23
12	**33%**	**4. TEST AND ANALYZE ROCKERS**	**29 days**	**Mon 10/30/23**	**Thu 12/7/23**
13	100%	4.1. Obtain Load Testing Plan Approval	1 day	Mon 10/30/23	Mon 10/30/23
14	100%	4.2. Secure Test Rig	10 days	Tue 11/7/23	Mon 11/20/23
15	0%	4.3. Perform Cyclic Testing and Record Data	20 days	Tue 11/7/23	Mon 12/4/23
16	0%	4.4. Revise Initial Data and Testing Methods	2 days	Tue 12/5/23	Wed 12/6/23
17	25%	4.5. Analyze New Data	1 day	Thu 12/7/23	Thu 12/7/23
18	**100%**	**5. REPORT AND PRESENTATION**	**4 days**	**Tue 12/5/23**	**Fri 12/8/23**
19	100%	5.1. Create Project Report	4 days	Tue 12/5/23	Fri 12/8/23
20	100%	5.2. Create Project Presentation	2 days	Tue 12/5/23	Wed 12/6/23



Budget Synopsis

- Steel Plate - $76.69
- Filament - $261.25
- Shocks - $149.98
- Ball Joint (Low Carbon Steel Rod, Oil Feelers Bronze Bearing) - $109.89

Conclusion

Completed

- Static Simulations (SolidWorks) and Test
- Dynamic Calculations
- Re-run of the Topology Simulations (SolidWorks)
- Basis/Template of the Test Plan (ASTM-E606)
- Completion of Test Rig Bracket Designs (ASME Y14.35 & 14.5)
- Creation of the Test Rig Brackets (AWS D1.3 & ANSI Z49.1)
- Bushing Hollowed and Pressed Into Rotation Point of the Rockers (ASTM-B438).

In the Future

- Finish the Test Plan – Make sure the advisors know to sign up the next group for training
- Complete Fatigue Testing
- Explore Different Manufacturing Options and Styles

Complete List of Engineering Standards

- ANSI Z49.1: covers all aspects of safety and health in the welding environment, with an emphasis on oxyfuel gas and arc welding.
- ASME Y14.35: establishes the practice for revising drawings and associated documentation and demonstrates methods for identification and revisions.
- ASME Y14.5: establishes the rules, symbols, definitions, requirements, defaults, and recommended practices for stating and interpreting Geometric Dimensions and Tolerances on engineering drawings, models defined in digital data files, and related documents.
- ASTM-E606: fatigue testing by cyclic load simulated by typically used by servo-hydraulic testing until failure.
- ASTM-B438: specifies requirements of bronze-based bearings produced from mixed metal powders using powder metallurgy technology and then impregnated with oil to supply lubrication.
- AWS D1.3: structural welding of steel sheet metal to other structural sheet steels or to supporting structural steel members, including Tungsten Inert Gas (TID) welding.
- ISO 9001: international standard that specifies requirements for a quality management system.


Questions?