



Fall Protection System

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Project Description

Sponsor of project: Zach Lerner,
Ph.D.

- Director of NAU's Biomechatronics Laboratory
- ◇ For participants with neuromuscular deficits caused by strokes, spinal cord injuries, cerebral palsy, etc.
- ◇ Intended for fall protection during gait studies
- ◇ Commercial systems are expensive and can be difficult to integrate

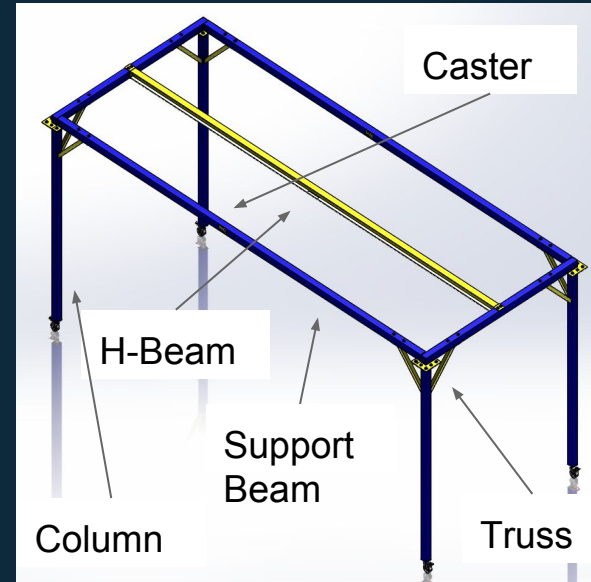


Figure 1: Final System Design

Updates

What's Done:

- ◆ Purchased casters, tether, and trolley
- ◆ Obtained metal on Friday 10/20
- ◆ Completed welds on Saturday 10/21
- ◆ Transported metal on Sunday 10/22
- ◆ Put metal in SLC on Monday 10/23
- ◆ Picked up all hardware from Copper State on Monday 10/23

What Has to Be Finished

- ◆ Drilling of caster mounting holes and truss fastening holes must be completed
- ◆ Paint must be applied
- ◆ Full system must be assembled



Figure 2: Shipping Parts



Figure 3: Trolley



Figure 4: Caster



Figure 5: Hardware

Design Changes

- ◇ Bolt diameter sizes changed from $\frac{3}{4}$ " to $\frac{5}{8}$ "
- ◇ Truss support sizes decreased
- ◇ Welding trusses directly to columns
- ◇ Bolting casters to columns
- ◇ New paint scheme
- ◇ New H-Beam bracket to angular steel from fabricating our own

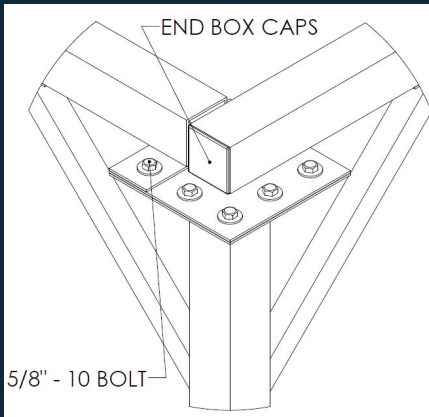


Figure 6: SolidWorks Truss Design



Figure 7: Steel Plate Weld

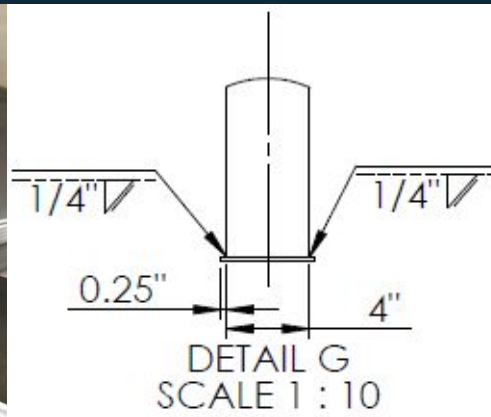


Figure 8: Weld Callouts



Figure 9: Truss Column Grind

Analytical Analysis

The following new analyses will be completed by the team members on the system,

- ◇ Compression force acting on the casters under loading
- ◇ Shearing of all bolts in system for max loading
- ◇ Deformation of H-Beam brackets under max loading
- ◇ Life cycle analysis of overall structural

Schedule

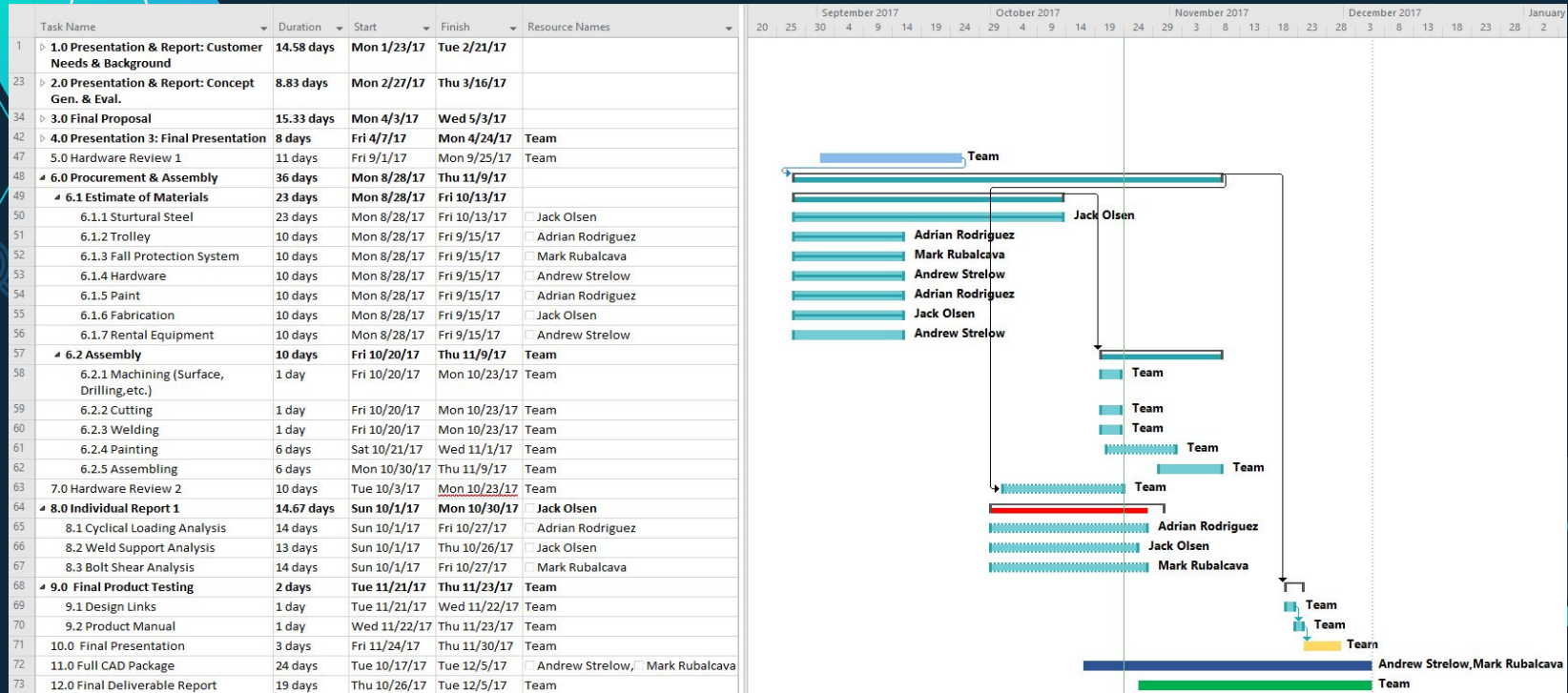


Figure 10: Gantt Chart

- ◆ Slightly behind schedule
 - Finishing manufacturing
 - Begin Testing Design

Bill of Materials

Table 1: Bill of Materials

Project Name		Fall Protection Support System for Gait Studies						
Team		Team C: Andrew Strelow, Jack Olsen, Mark Rubakava, Adrian Rodriguez						
Vendor	Part #	Part Name	Qty	Description	Material	Dimensions	Cost per unit (\$)	Total Cost (\$)
Copper State Hardware	1	F.1.Plate Bolt	24	Heavy Hex Head Structural Bolt	A325 Type 1 Steel Plain Finish	5/8"-10 x 1.75"	Free	0
	2	F.2.Truss Bolt	20	Heavy Hex Head Structural Bolt	A325 Type 1 Steel Plain Finish	5/8"-10 x 5.5"	Free	0
	3	F.4.Hex Nut	44	Heavy Hex Nut	Grade 2H Plain	5/8"-10	Free	0
	4	F.5.Washer	88	Flat Washer Type 1 Plain	F436 Steel Plain Finish	5/8"	Free	0
							TOTAL (\$)	0
Metals Supermarket Phoe	5	M.1.A.Columns	6	Vertical Structural Components	A500 Grade B Square Tubing	4" x 4" x 3/16"x10'	99.635	597.81
	6	M.2.Outside Beam	2	Horizontal Structure Components	A500 Grade B Square Tubing	4" x 4" x 3/16"x24'	239.125	478.25
	7	M.3.H Beam	1	Horizontal Trolley Guide	A992 H Beam W4x13	4.16" x .280" x 4.06"x24"	287.97	287.97
	8	M.4.Truss Support	8	Diagonal Framing Supports	A500 Grade B Square Tubing	2" x 2" x 3/16"x5'	10.2	81.6
	9	M.5.Column Plate	8	Assembly Fastening Mounts	HR A36 Flat Plate	12" x 12" x 3/16"	6.09125	48.73
	10	M.6.Caster Plate	4	Assembly Fastening Mounts	HR A36 Flat Plate	4" x 4" x 3/16"	0.76	3.04
	11	M.7.Truss Plate	8	Assembly Fastening Mounts	HR A36 Flat Plate	4" x 10" x 3/16"	1.69	13.52
	12	M.9.Outside Beam Plate	4	Assembly Fastening Mounts	HR A36 Flat Plate	3.765" x 12" x 3/16"	1.9125	7.65
	13	M.8.H Beam Bracket	2	Assembly Fastening Mounts	HR Angular Structural Steel	5" x 5" x 1/4"	3.715	7.43
			N/A	Cutting to Trusses, Columns, Beams, Plates	N/A	N/A	N/A	40.31
			N/A	Drills to Trusses, Columns, Beams, Plates	N/A	N/A	N/A	160
			N/A	Tax	Part #5-13	N/A	N/A	148.46
								TOTAL (\$)
Vendor	Part #	Part Name	Qty	Description	Material	Dimensions	Cost per unit (\$)	Total Cost (\$)
Amazon Prime	14	A.1.Fishes	1	Miller Personal Fall Limiter	Polyester	9'	170	170
	15	A.2.Trolley	1	Patient Suspension Mechanism	Steel	13.4"x7.3"x4.2"	75	75
	16	-	-	Tax	-	-	-	21.93
							TOTAL (\$)	266.93
Vendor	Part #	Part Name	Qty	Description	Material	Dimensions	Cost per unit (\$)	Total Cost (\$)
Home Depot	17	Paint	10	Matte black for emissivity	Spray Powdercoat	15oz	7.46	74.6
	18	Masking Tape	2	Scotch Painting Tape	Adhesive	1.41" x 180'	2.97	5.94
	19	Clear Painters Sheet	1	High Density Painters Plastic	Plastic	12' x 400'	24.98	24.98
	20	-	-	-	-	-	-	-
							TOTAL (\$)	105.52
Vendor	Part #	Part Name	Qty	Description	Material	Dimensions	Cost per unit (\$)	Total Cost (\$)
Caster Depot	21	Wheels	4	Swivel Caster W/ Brake	Stamped Steel/Phenolic	6" x 2"	19.58	78.32
							TOTAL (\$)	78.32
Vendor	Process	Qty	Description			Cost per unit (\$)	Total Cost (\$)	
Sean Ungvarsky	Surfacing	1	Grind off mill scale & other impurities. Prepare for Weld			25	25	
	Welding	1	TIG weld joints and plates as per LRS DRW. Package			125	125	
	N/A	-	Shop Supplies			-	-	
						TOTAL (\$)	150	
Vendor	Equipment	Qty	Description			Cost per unit (\$)	Total Cost (\$)	
U-Haul	Truck	1	26' Dry Bed Truck			0	0	
	-	40	Fuel			0	0	
						TOTAL (\$)	0	
Vendor	Equipment	Qty	Description			Cost per unit (\$)	Total Cost (\$)	
Grand Rental	Contractor Lift Assembly	2	12' - 18' Lifting Assistance equipment			52.8	105.6	
						TOTAL (\$)	105.6	
PROJECT TOTAL \$							2,581.14	

Budget and Expenses to Date

Table 2: Spending

	COST	CURRENT SPENDING %	% OF BUDGET
Parts & Materials	\$ 2,244.86	94%	90%
Fabrication	\$ 150.00	6%	6%
Rental Equipment	\$ -	0%	0%
PROJECT TOTAL			\$ 2,394.86
	COST	% OF BUDGET	
PROJECT BUDGET			\$ 2,500 96%

Table 3: Invoices

INVOICE TRACKER						
INVOICE #	PART #	CATEGORY	DATE	VEDNOR	AMOUNT	PDF RECEIPT
1	21	Parts & Materials	Monday, October 9, 2017	Caster Depot	\$ 103.15	
2	14,15	Parts & Materials	Wednesday, October 4, 2017	Amazon Prime	\$ 266.93	
3	N/A	Fabrication	Friday, October 20, 2017	Sean Ungvasky	\$ 150.00	
4	5 to 13	Parts & Materials	Friday, October 20, 2017	Metals Supermarket Phoenix	\$ 1,874.78	
5	1 to 4	Parts & Materials	Monday, October 23, 2017	Copper State Hardware	\$ -	
6	N/A	Rental Equipment	Sunday, October 22, 2017	U-Haul	\$ -	
					TOTAL	\$ 2,394.86

Our System vs Society

Commercialized

- ◆ Advanced track system
- ◆ Trolley and tether combination



Figure 11: Commercial Example

Our System

- ◆ Made specifically for client's needs
- ◆ Mobile track system

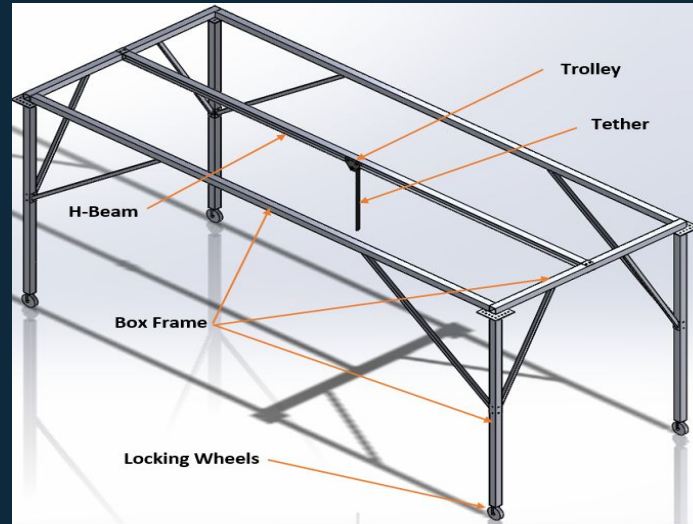


Figure 12: General System Design

Manufacturing Updates



Figure 13: Aligning Plates



Figure 14: Marking layout



Figure 15: Aligning Plates



Figure 16: Tacked Steel Truss

Manufacturing Updates



Figure 17: Custom Drilling



Figure 18: Truss Welded Plates

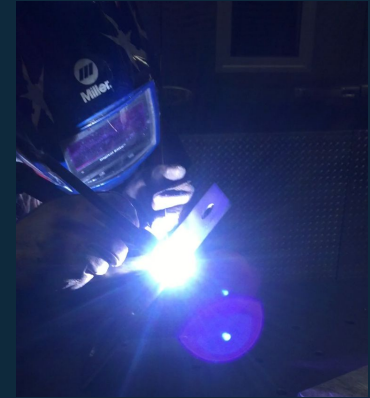


Figure 19: Welding Truss Plate

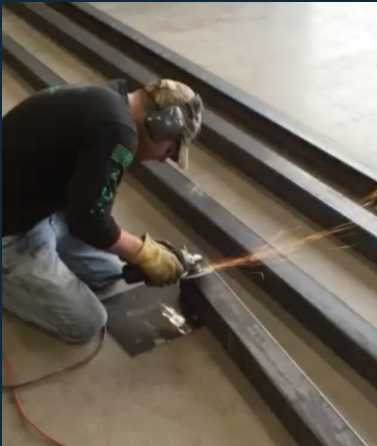


Figure 20: Grinding Sharp Edges



Figure 21: Horizontal Beams



Figure 22: Welding Truss Plate

Manufacturing Updates



Figure 23: Truss Fillet Weld



Figure 24: Cross Beam Fillet Weld



Testing Design

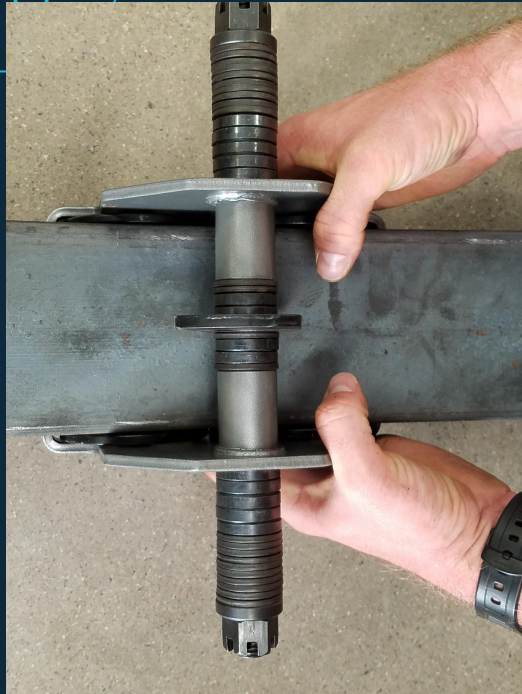


Figure 25: Trolley Fit Test



Figure 26: Column Alignment

- ◇ Assembly Tests
 - Trolley Fit
 - Column & Truss
 - Alignment

- ◇ Product Test
 - Fall arrest system
 - Casters
 - Design Links
 - Emissivity



Questions?

