Spider Cage to Support Cerebral Palsy Patient

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Team: Kevin Collins - kdcollins2@wisc.edu (Team Leader)

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Date: March 1st - March 7th, 2017

Problem Statement:

A spider cage is a device used by therapists to work with individuals (usually children) who have cerebral palsy. The cage supports the patient's weight with the use of bungee cords that are connected to a custom suit that allows the patient to work on building leg and arm strength. This product is available commercially but it is quite expensive. The client is looking for a design that is relatively inexpensive, transportable via trailer, able to fit through a standard doorway, and customized to meet the needs of one particular person.

Last Week's Goals

- Coat the base with epoxy resin
- Put top of cage back on
- Begin testing protocol

Summary of Team Role Accomplishments

- *Leader* - Sent progress report to TA, Client and Adviser
- *BWIG* - Uploaded progress report
- *BSAC* - No meetings attended.

- *Communicator* - No communication necessary this week
- *BPAG* - Organized new expense tables, began the reimbursement process for our base purchase.

Summary of Accomplishments:

This week the team finished attaching the base and put the top back on the cage, meaning the cage is ready for testing. Steve tested the stiffness of the resistance bands and wrote a code that allows the team to know the vertical force applied to the harness by the bands during the exercises. Kevin and Sheetal were able to get into the cage with the harness on and resistance bands attached and have their full weight supported by the cage. Optimal resistance band placements and attachment points were determined from this.

Activities

Date	Person	Task	Time (hrs)	Weekly Total	Semester Total
3/2/17	Team	Finish attaching base, put top back on cage, and tested harness with resistance bands	2	2	7
3/2/17	Kevin	Got into harness and began researching/testing different resistance band placements/methods	1.5		
		Tested resistance band placements, brainstormed and tested different attachment methods (mainly for carabiners)	2	3.5	16.5
3/7/17	Darcy	Helped test harnessing and find different methods to shorten the bands. Decided how the resin would be applied on test OSB and sprayed	2	2	13.5

		on a different waterproof lacquer for OSB testing later.			
3/6/17 - 3/7/17	Sheetal	Exercise research and began testing protocol	3	3	14
3/5/17	Breanna	Exercise and resistance band placement research/testing methods	1.5		
3/7/17		Began preliminary testing	2	3.5	17.5
3/1/17	Stephen	Tested the stiffness of the elastic bands to find their elastic constants. Created EES code to approximate the vertical support force that would result from various connection schemes.	2	4	17
3/7/17		Wrote technical section of the progress report. Decided how the resin would be applied on test OSB and sprayed on a different waterproof lacquer for OSB testing later.	2		

Team Goals

- Figure out optimal bungee attachment locations
- Determine how to measure mesh deflection
- Test epoxy resin for base coating purposes

Individual Goals

- *Kevin:* Decide on method to attach resistance bands or to shorten the bands. Begin actual testing.
- *Darcy:* Apply epoxy resin in a non-hazardous way to the test OSB board
- *Sheetal:* Figure out ways to measure deflection for testing

- *Breanna:* Determine attachment locations for resistance bands
- *Stephen:* Apply epoxy resin to OSB or find an appropriate substitute. Enhance EES code to reflect different connection possibilities and formulate reference table for which to compare our theoretical values.

Project Timeline

	January		February				March					April				May
Task	19	26	2	9	16	23	2	9	16	23	30	6	13	20	27	4
Project R&D																
Base Support	X	X														
Harnesses and Bands		X	X	X												
Padding																
Assembly Tools																
Fabrication																
Order Materials				X	X	X										
Create Fastener Hole		X														
Base Support						X	X									
Padding																
Assembly Tools																
Testing																
Exercise Simulation							X									
Deflection Calculations																
Assembly Directions																
Redesign																
Deliverables																
Progress Report	X	X	X	X	X	X	X									
Individual Presentation				X	X											
Preliminary Presentation				X	X											
Preliminary Deliverables				X	X											
Poster																
Final Deliverables																
Meetings																
Advisor	X		X													
Client			X													
Team	X	X	X	X	X	X	X									
Website																
Update	X	X	X	X	X	X	X									
Colored Cells: Projected Timeline																
X: Completed Tasks																

Expenses

Fall 2016: University Funded Expenses: $1,702.75

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
Price Engineering Cage Materials & Shipping (Itemized BOM in separate file)	Price Engineering	N/A	N/A	1	1/1/2017	$1,702.75	$1,702.75
						Total	$1,702.75

Spring 2017: University Funded Expenses: $32.94

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
19/32 4'x8' OSB	Home Depot (IN STORE)	0000-339-696 5/8 OSB SQ	N/A	2	2/24/2017	$14.75	$29.50
TEE NUT ZINC 5/16-18 x 3/8"	Home Depot (IN STORE)	887480023114 TEE NUT	N/A	2	2/24/2017	$0.98	$1.96
HEX BOLT 5/16-18 x 3/4"	Home Depot (IN STORE)	AEE 5/16X3/4HBLT	N/A	8	2/24/2017	$0.16	$1.28
HEX BOLT 5/16-18 x 1"	Home Depot (IN STORE)	AFE 5/16X1HXBOLT	N/A	8	2/24/2017	$0.17	$1.36
						Total	$34.10

Spring 2017: Client Funded Expenses: $159.74

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
Harnesses	Zoro	Zoro #: G1320821 Mfr #: 1191209	https://www.zoro.com/protecta-full-body-harness-ml-420-lb-redgray-1191209/i/G1320821/?gclid=COn-5on-_NECFR61wAodtbMCkg	1	2/9/2017	$75.86	$75.86
Resistance Bands	Fitness Insanity	Unsure	https://www.amazon.com/gp/product/B01GCA4BJC?ref_=sr_1_7&qid=1486677502&sr=8-7&keywords=Fitness%20Resistant%20Bands&pldnSite=1	4	2/9/2017	$20.97	$83.88
						Total	$159.74

Total UW - Expenses: $1735.69
Total Client Expenses: $159.74
Total Expenses: $1895.43

ME Technical Section

Before full cage deflection testing can begin, the group must determine where resistance bands should be connected from the harness to the cage. Factors that determine how the resistance bands should be connected to the cage are the weight of the patient, the height of the patient, the desired horizontal stability, and the desired support force. In order to better understand how these factors affect one another, a program was written in EES to help determine the effect of various connection schemes. In the process of writing the program, each resistance band's elastic constant needed to be determined. Testing was done in order to determine the constants.

Resistance Band Elastic Constant Testing

Each of the bands were connected to the top of the cage to allow for full deflection. The initial length of each band was measured. A five pound weight was hung from each one of the bands and their final length was measured. The deflection of the bands was calculated from the difference between their final and initial lengths. Knowing the amount of force applied to each band from the hanging weight, elastic constants were determined by dividing weight by the band deflection. Figures 1 shows the bands with the weight applied as well as the method of measurement.

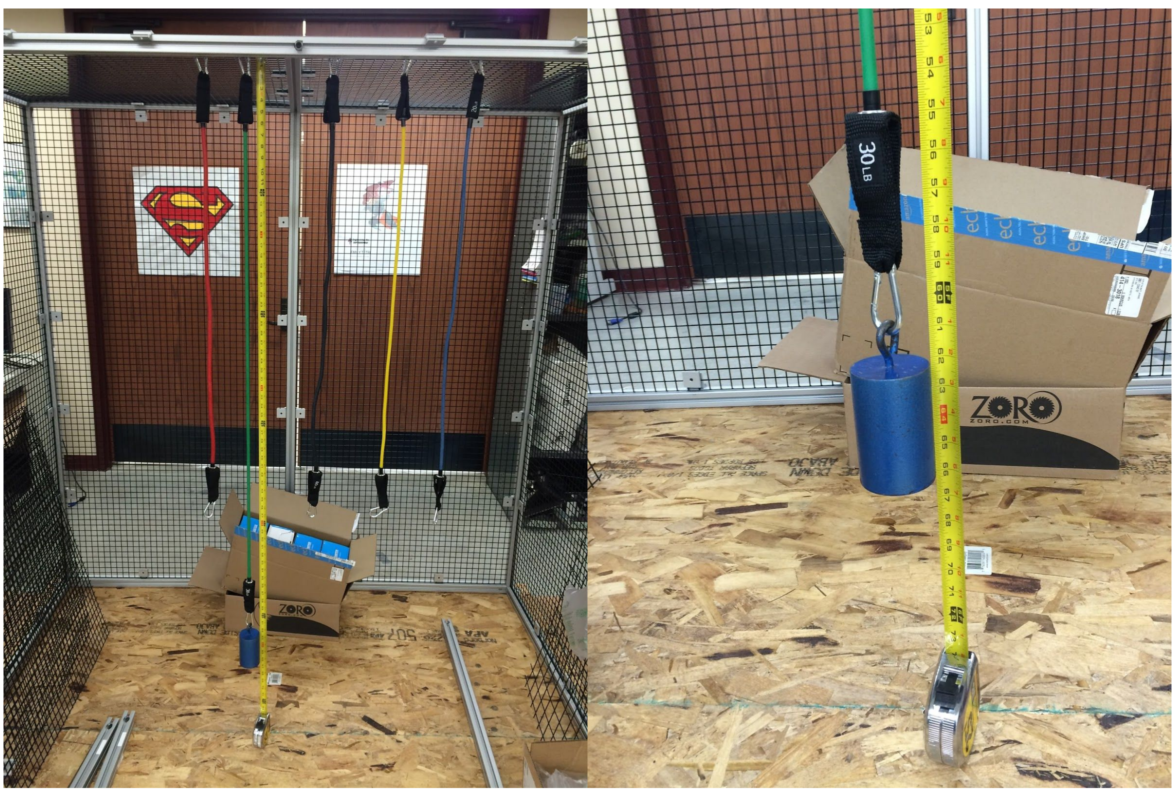

Figure 1: General test setup with weight applied (left), close up of deflection measurement (right).

Support Calculator