

# BME Design-Fall 2023 - Sallie Schoen Complete Notebook

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**RAYONA KINNY**

on

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## Team contact Information

Jacob Parsons - Sep 08, 2023, 1:42 PM CDT

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## Project description

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RAYONA KINNY - Dec 11, 2023, 9:34 PM CST

**Course Number:** BME 200/300, Lab 302

**Project Name:** Assistive device to help wheelchair users hoist pants all the way up

**Short Name:** Wheelchair pants hoist device - The Hoisters

**Project description/problem statement:** Individuals with Becker MD, a disease that results in progressive muscular degeneration, often face physical limitations that can pose challenges in performing everyday tasks, including the simple task of pulling up pants. Current solutions are not only cost-prohibitive but also demand a level of upper-body strength that many affected individuals may not possess. This project aims to develop a prototype solution that will enable individuals with limited arm strength to autonomously pull up their pants.

**About the client:** The client is Mr. Dan Dorszynski. He grew up in Wisconsin and has studied both civil and environmental engineering at Stanford. Mr. Dorszynski has Becker's muscular dystrophy and uses an electric wheelchair. The action of putting on pants is difficult, especially past the knees, as he often has to keep leaning and pulling, which takes him about seven minutes to do and a lot of effort. He typically wears athletic pants, such as golf pants that have belt loops. Mr. Dorszynski has voiced he doesn't mind if the solution is electric, manual, cloth, or any specific material/device.



## 2023/11/27 - Product Design Specifications

Sallie Schoen - Nov 27, 2023, 4:48 PM CST

**Title:** Product Design Specifications

**Date:** Running

**Content by:** Whole team

**Present:** N/A

**Goals:** Attach Product design specifications

**Content:**

The goal of the PDS is the outline the specifications for the final product and give guidelines on how the design will meet those specifications.

**Conclusions/action items:**

The PDS is updated throughout the design process and the most updated version is attached below.

Sallie Schoen - Nov 27, 2023, 4:48 PM CST

### Assistive Device for Wheelchair Users to Pull Pants all the Way Up

Sallie Schoen, Jacob Parsons, Rayann Khoury, Ella Eldred, Avery Schuch, and Kate Murray

Lab 302

October 4th, 2023

#### Function:

Muscular dystrophy (MD) is a genetic disease that causes progressive weakness and degeneration of skeletal muscles. A patient with Becker's MD, a type of MD caused by a mutation in the dystrophin gene [10], has physical limitations that make it difficult to pull up their pants all the way when getting dressed. The pants can be pulled up to the knees easily, and then a combination of leaning and pulling, along with frequent assistance, is needed to get the pants where they need to be. The total time taken is around 7 minutes. To minimize the time taken and eliminate the stress caused on the patient to pull up the pants, a two-part assistive device can be used. The first part of the system, the Lean and Lift device, is a stand-alone device that when positioned in front of the user, will allow the user to lean over the top to raise the lower body off the wheelchair. The Lean and Lift will be able to withstand a 230-lb, 6-ft-2-in male. The second part of the system, the Suspender device, will attach to the pants when at the knees and go around the shoulders. When the user is in the leaned-over position on top of the Lean and Lift device, the user will pull a string, attached to the suspenders, that will pull the pants up until comfortable. The amount of arm strength provided by the user with MD is limited, so the entire system will not require lifting more than 14 lb. The time required to operate the device should not exceed 3 minutes.

[Download](#)

**PDS\_11.27.23.pdf (129 kB)**



## 2023/9/8 - Client Questions

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**Title: Client Questions and Answers****Date:** 9/15/23**Content by:** Whole Team**Present:** Whole Team**Goals:** To gain basic information about the project.**Content:**

## Client Questions:

## 1. Can you tell us about yourself?

- Becker's muscular dystrophy slowly gets worse (very slowly) - electric wheelchair.
- Pants have been the biggest annoyance
- Walked till ~30s
- Feet don't come off ground, but cannot leave ground neither
  
- Grew up in Wisconsin, lots of family members went to Madison
- Studied engineering (civil & environmental) @ Stanford
- Closest connection is through the BME projects (been doing stuff for 7 years-ish)
  
- Any type of solution can be used (new pants, electric, manual, etc. etc)
- Cushion vs metal surface below
- Product for Dan, but can be applied to others
  
- Problem isn't getting pants up to knees, its from there on up (leaning, pulling, repeat) - last 6" is the difficult part
  
- Have used suspenders, suspenders won't help the pants get up any higher (back & up vs straight up)

## 2. What age range should the prototype be for (age of patient)?

- For Dan (won't tell us)

## 3. Is the device intended to be used by a specific person or should it be universal?

- For Dan

## 4. What height is the person who is using the device?

- 6'2"
- ~5' in the chair

5. How much arm strength does our client have? (are they able to pull/push themselves up to stand)
  - Minimal arm strength, cannot push down on the chair
  - Can grab onto things, good grip strength
  - Can lean side to side, forward & back
  - Cannot stand or push themselves up
  - Can pick something up, cannot lift arms up super high on his own
  - Can grab wrist & support it, can reach things on his lap, can reach shoulders
  - Not really limited dexterity in the fingers
6. Should the prototype be portable, or something that would be installed in a house?
  - Most of the time it will be at home (attached to wall or bed)
  - Doesn't need to be on the go
  - Not required to be attachable to chair (ideally yes, but not necessary)
7. How much hand/grip strength does our client have? Expected to get weaker over time?
  - Not "normal" but strong enough
  - Not expected to weaken significantly over time
8. Does our client typically wear pants with belt loops, or something of the sort, that could be hooked onto?
  - Shiny workout pants (slippery pants)
  - Golf pants (PGA tour quick dry, wrinkle free, cotton elastane) - also have belt loops
9. What is the budget for this project?
  - Will play it by ear for expensive things
  - \$200-300 dollars
10. How durable do the materials need to be?
  - Can last a while (will need to use it daily)
11. What kind of Muscular Dystrophy does our client have?
  - Becker's
12. How many prototypes should we produce for use?
  - 1
13. What type of pants are the hardest to pull up?
  - Jeans, corduroy, leather - anything that has a lot of friction
14. Are there any safety features or considerations that need to be factored into the design?
  - No, unless it is obviously dangerous
15. Are there any weight limitations for the design?

- He weighs about 220-230 lbs

16. Do you have any specific expectations for the testing a feedback process during the development of the prototype?

- Does have an extra chair that is like his (in case we need it)

**Conclusions/action items:**

Now that the team has met with Dan, we have a better understanding of what we are trying to design and who we are designing it for. From this more research will be done on Becker's muscular dystrophy. The team now also has enough information to start brainstorming some design ideas.



## 2023/29/9 - In-Person Client Meeting

---

**Title: In-Person Client Meeting****Date:** 9/29/23**Content by:** Ella Eklund**Present:** The whole Team and Dan**Goals:**

- Show Dan design ideas
- Ask more questions
- Get numbers for

**Content:**

- He likes a combination of the lean and lift and the suspenders
- Need to get height for lean device/ higher
- We need to measure his chair's starting point and its height
- Need to give him something to grab onto for suspenders to work
- Has used adult onesies which was very difficult for him to zip
- He is not a fan of the pants
- Go wider on the bar
- Floor to knee height: 25.5 in
- Shelf life: 5 years
- Dan said he is going to send a link
- Dan can swing his arms up so arms should go over the pad
- Ideal time - 3-5 min
- He can't lift his arm up so suspenders are needed
- Dan's idea: a motorized desk that goes up and down
- Able to swing straps onto shoulder
- 5 volt 1 amp or 5 volt 2.1 amp
- RC cars winch will lift like 20 lbs
- Firm but comfortable material for lean and lift - doctors table material
- Locked wheels are not necessary/ some kind of grip needed

**Dimensions**

Floor-to-chair height: 19 in

Width of chair: 23 in

Weight of chair and dan: 550-600

Weight of chair: 350

Arm length: 26 in

Elbow width: 23 in

Floor to the chair leaning? ( he said like when he would lean): 22 in

Inner wheel distance: 25 in

chair to armpit: 18.5 in

Width of the body (add a foot on each side): 23 in

Ideal height of pad: 35-36 in

Max back of a chair: 28 in

Max front of chair: 32 in

length of seat: 21 in

Strongest: left shoulder and right wrist

Lower Left

1st attempt: empty - check

- weight = 2.8 lbs

2nd attempt- calc/headphones/charger - check

- weight = 5 lbs

3rd attempt- add notebook/water bottle - doable but can't go over

- weight = 8.4 lbs

Ideal in between

4th attempt - add laptop

- weight = 12.8 lbs

**Conclusions/action items:**



## 2023/25/09 - Follow Up Client Questions (email)

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**Title: Follow Up Client Questions****Date:** 9/5/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Ask follow up questions over email to the client to clarify missing information**Content:**

How do you transfer in and out of your wheelchair? Can you do this unassisted?

I slide to/from the left side of my chair, typically from a higher to lower elevation. Since I can elevate/lower my wheelchair seat I can make this work. And yes I transfer unassisted.

If you were laying down in bed, can you lift yourself to a sitting position? Are you able to move your legs while in a laying position? Are you able to roll over in a laying position?

No to all of the above. I've seen all the "put on tight jeans by laying down" videos and...nope. LOL

Are you able to operate snaps and zippers? Is one easier for you to use?

Yes and yes. Zippers probably easier.

How much space is in the area that you want to use the device? Do you want to be able to use the device in the bathroom?

Haven't thought about space, but can make room for anything! Shall we say a 5x5 ft area as a limit?



How much weight are you able to lift?






5lbs is a good boundary. Pulling weight is easier and I think I can do more but not 100%.

Are you able to lean forward against an object if it was placed directly in front of you?

Yes. Leaning is my specialty!



**Progress Report 2**  

**DD** Dan Dorszynski <wetsand@gmail.com>       
To: AVERY CORRINE SCHUDA Mon 9/25/2023 1:01 PM

Hi Avery,  
I'm pretty sure Friday will be doable this week so let's plan on that. In the meantime here are some answers for you!

How do you transfer in and out of your wheelchair? Can you do this unassisted?  
I slide to/from the left side of my chair, typically from a higher to lower elevation. Since I can elevate/lower my wheelchair seat I can make this work. And yes I transfer unassisted.

If you were laying down in bed, can you lift yourself to a sitting position? Are you able to move your legs while in a laying position? Are you able to roll over in a laying position?  
No to all of the above. I've seen all the "put on tight jeans by laying down" videos and...nope. LOL

Are you able to operate snaps and zippers? Is one easier for you to use?  
Yes and yes. Zippers probably easier.

How much space is in the area that you want to use the device? Do you want to be able to use the device in the bathroom?  
Haven't thought about space, but can make room for anything! Shall we say a 5x5 ft area as a limit?

How much weight are you able to lift?  
5lbs is a good boundary. Pulling weight is easier and I think I can do more but not 100%.

Are you able to lean forward against an object if it was placed directly in front of you?  
Yes. Leaning is my specialty!

Hope this helps!  
Dan

**Conclusions/action items:**

Use information provided by client to update PDS. Brainstorm designs with these specifications in mind.



## 2023/10/27 - Materials Client Meeting

---

Kate Murray - Oct 27, 2023, 1:54 PM CDT

**Title: Materials Client Meeting**

**Date:** 10/27/2023

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To get all of our materials approved by Dan so that we can order our materials

**Content:**

- Dan approved all of our materials - good to order
- budget is going to plan
- we will order materials and begin fabricating
- would like to get him in here for testing - will be gone November 4th-December 2nd - will need to work around it
- Dan venmo'ed us for pizza! So nice :)

**Conclusions/action items:**

We will now order our materials and send in our spreadsheet and proposal to Dr. Puccinelli.



## 2023/9/8 - Team Introduction

---

Sallie Schoen - Sep 08, 2023, 1:49 PM CDT

**Title:** Team Introduction

**Date:** 9/8/23

**Content by:** Sallie

**Present:** Jacob, Kate, Sallie, Ella, Rayona, Avery

**Goals:** Meet the team members and decide roles.

**Content:**

Team roles are listed in the Project Information folder.

The weekly meeting with the advisor (Ashton) is at 12:30 in 3127 ME.

The outside weekly meeting with the team is at 3 p.m. in Wendt Commons on Sundays.

**Conclusions/action items:**

Research competing designs other than Pants Up.

Come up with a couple of questions to ask the client.

Everyone becomes comfortable with muscular dystrophy.



## 2023/9/15 - First Advisor Meeting

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Kate Murray - Sep 15, 2023, 1:22 PM CDT

**Title:** First Advisor Meeting

**Date:** 9/15/2023

**Content by:** Kate Murray

**Present:** All team members, Dr. Randolph Ashton

**Goals:** To discuss our project goals, specifications, and design requirements

**Content:**

- email progress report to client each week, cc Dr. Ashton
- set up client meetings for entire semester right away - twice a month?
- quantify problem statement over time, same with PDS
- give presentation dates to client
- add any relevant research should have own entry of you reading it (lab archives), conclusion statement is why it's important
- keep updating personal folder in lab archives - use proper citation
- lots of different disabilities/diseases that would require wheelchair - narrow down of what specific disability/disease does our device help with
- expected to get weaker over time?

**Conclusions/action items:**

We will need to discuss many different project specifications with our client, and once we do, we will work on our project design specification and continue to work on our own research.



**2023/9/22 - Second Advisor Meeting**

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**Title:** Second Advisor Meeting

**Date:** 9/22/2023

**Content by:** Ella Eklund

**Present:** Team

**Goals:**

- Talk to an advisor about client meetings and lab archives
- Address PDS
- Discuss items of action moving forward

**Content:**

- Discussed our meeting with Dan with Randolph and the details of our meeting
- Says we need to develop our problem quantitatively by maybe asking him to lift certain forces so we can get vectors and forces for our design
- Says design matrix should be pretty easy
- Showed Randolph a preliminary design idea and we discussed the pros and cons

**Questions to ask:**

- can he get out of the wheelchair by himself
- can he lift himself up from the bed
- is he able to lift certain weights
- ask about an extra chair
- research lifting chairs
- snap on pants?
- what can he do by himself?
- how much space do you have in your area
- is this for the bathroom

**Conclusions/action items:**

After our meeting with Randolph, we discovered that we need to ask our client Dan a few more questions about his abilities so we get a better measure of his strength and it helps us narrow down designs. We are going to turn in our PDS tonight and start drafting our design matrix.





## 2023/9/29 - Third Advisor Meeting

---

Kate Murray - Sep 29, 2023, 1:26 PM CDT

**Title:** Third Advisor Meeting

**Date:** 9/29/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To discuss our design matrix designs, our answered client questions, and the expectations for our Preliminary Design Presentation

**Content:**

- notebooks - decent, fix book citations (full information, do not need website address for book or journal)
- PDS - good start, BE MORE QUANTITATIVE, function description is way too qualitative, make more of an engineering description
- "accurately" pull up pants - how far up? details! quantitative!
- phrases like pulls up pants in minutes, works indefinitely, not super accurate, be more descriptive
- define temperature and humidity that the project can be in
- Prof. Ashton will not be at Preliminary Design Presentation (10 min per team), someone else will grade it
- We need to figure out how much strength Dan has when we meet with him today

**Conclusions/action items:**

**Moving forward, we will need to edit our PDS to be way more quantitative and continue to fill out our notebooks. Also, we will work on our preliminary design presentation.**





## 2023/10/13 - Fourth Advisor Meeting

---

Kate Murray - Oct 13, 2023, 1:29 PM CDT

**Title:** Fourth Advisor Meeting

**Date:** 10/13/2023

**Content by:** Kate Murray

**Present:** Whole Team, Prof Ashton

**Goals:** To discuss our preliminary report, presentation, and the beginning of our fabrication process

**Content:**

- change problem statement in preliminary report/design statement - past hips not past knees
- conversions - metric or standard? kg is not a weight, its a mass
- final report should have computer drawn drawings, angle in drawing should be over 90 degrees
- stability analysis? maybe with SolidWorks model
- feasible to make motorized suspenders - RC winch
- might need to only fabricate lean and lift this semester - but still need fully thought out problem statement and design with very clear specifications
- testing in solidworks - simulations
  - whether it can withstand weight, tipping, factor of safety
- could use just normal suspenders without motor if that is too difficult (Shouldn't be)
- split team up - suspenders, SolidWorks, stand
- find a welding facility
- should have a protocol that clearly explains what we are doing

**Conclusions/action items:**

- Most important - split up and focus on three things: SolidWorks testing, lean and lift fabrication, and suspender fabrication and testing
- Will need to get going with ordering materials through UW websites and start fabrication
- can make changes to the preliminary report/PDS



## 2023/10/20 - Fifth Advisor Meeting

---

Kate Murray - Oct 20, 2023, 1:26 PM CDT

**Title:** Fifth Advisor Meeting

**Date:** 10/20/2023

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To discuss the status of our project, talk about ordering materials, finalizing the design, and how we can get our UW Funding

**Content:**

- we should use steel instead of aluminum - steels rusts, which is a downside
- order materials through Dan - send email to Dr. John Puccinelli and Dan to try to figure out funding
- Sallie did great with SolidWorks lean and lift frame - yay
- worked on testing with SolidWorks design
- for finalized design - figure out angles of bars, dimensions should be fine with first design - will it fall over?
- talked about R/C Winch design and straps - which ones to use?
- discussed the notebook and mean girls - slight argument about who died

**Conclusions/action items:**

- Kate - email Dr. Puccinelli and Dan together about funding
- order materials!
- update PDS



## 2023/10/26 - Sixth Advisor Meeting

---

AVERY SCHUDA - Oct 27, 2023, 1:27 PM CDT

**Title: Sixth Advisor Meeting****Date:** 10/27/2023**Content by:** Avery Schuda**Present:** Full team and Prof. Ashton**Goals:** Review presentation, report, design updates and material ordering**Content:**

- Set exact time goal for pulling up pants and make clear in various presentations, reports
- Make everything as quantitative as possible in PDS
- Report and Final Presentation make sure drawings look as professional as possible, labels, dimensions, should be clear to someone who has never looked at it before
- Weight vs mass vs force in report
- Don't need to say X linked recessive and inherited
- Truncate paragraphs to be three sentences or more, combine paragraphs where possible
- Biology/Physiology section was lacking references, make sure references come after sentences that come from that reference, new paragraph add references after
- Need more primary sources than internet sources, beef up number of primary references especially for sections like biology/physiology
- Whoever is the strongest writer should review the whole paper to create consistent voice
- Notebooks have largely been the same, rubric for notebook is similar to report but RA bases it on having regular entries with citations, research, designs
- Individual sections are for individual contributions (like research, designs that you do on your own, can also provide commentary on team activities in your own section), team deliverables go into team sections (as we are fabricating together that goes in the team section)
- SolidWorks file should go in Sallie's notebook section since she created it, all team members should be able to do SW
- Individuals can do testing on the model and put results in their own sections
- RA thinks he might have seen Mean Girls
- RA is concerned about being able to weld directly to the standing desk but it seems like we have the solution
- Define safety factors and test in SW
- Model the new design in SW
- Getting the exact angle and position to pull the pants up (vectors)
- Order materials ASAP, it's almost November

**Conclusions/action items: Order materials ASAP**



## 2023/11/10 - Seventh Advisor Meeting

---

Kate Murray - Nov 10, 2023, 1:20 PM CST

**Title:** Seventh Advisor Meeting

**Date:** 11/10/2023

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To update Prof. Ashton on our fabrication progress and figure out how we should order the rest of our materials

**Content:**

- use SolidWorks modeling to figure out how to attach the winches - way more quantitative capability
- optimize where winches are placed such that it works in the best way possible
- need to add cushion to top of standing desk, attach winches (find their optimal position), and attach metal support to bottom
- maybe find some kind of adjustable arms to attach winches to (can rotate in 3 axis) - would save us a lot with testing and figuring out what would be perfect for Dan

**Conclusions/action items:**

- order whatever materials we would definitely need
- look into some kind of adjustable arm
- construction phase!



## 2023/11/17 - Eighth Advisor Meeting

---

Kate Murray - Nov 17, 2023, 1:15 PM CST

**Title:** Eighth Advisor

**Date:** 11/17/23

**Content by:** Kate Murray

**Present:** Whole Team, Prof. Ashton

**Goals:** To Discuss our Fabrication Plan and get advice from Prof. Ashton

**Content:**

Design Consultation

- do not need a metal piece for attaching foam
- good idea to attach metal sheet/bar underneath for counterweight with wheelchair over it
- need to attach winches
- could build rectangular frame that would have winches above Dan
  
- waiting on parts ordered through Dr. Puccinelli - need to test winches as soon as they
- test to make sure 2 connections of winch to pants will work (cant attach more clips if needed)
  
- sallie looking into dynamic simulation
- final project - have frame out on display for demo

**Conclusions/action items:**

- start testing winches as soon as batteries arrive
- attach cushion and figure out best way to attach winches



## 2023/12/1-Ninth Advisor Meeting

---

Kate Murray - Dec 01, 2023, 1:21 PM CST

**Title:** Ninth Advisor Meeting

**Date:** 12/1/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To tell Prof. Ashton about our progress with the project on our fabrication and our plans for winch application

**Content:**

- First we told Prof. Ashton about how we attached the cushion and support bar to the standing desk and did some rudimentary testing on the winches
- Take more pictures and videos of everything!
- If everything goes well with our testing, we will attach the winches to the protruding bars of the standing desk
- Need to start poster and final report
  - can add in prior welding plans and testing on SolidWorks - was it helpful?
- Should just make frame so that cord vector is going vertically up instead of at an angle - angle would stretch pants too much --> failure

**Conclusions/action items:**

- begin testing the winches and attach them!
- begin working on final deliverables



## 2023/9/30 - First Lean and Lift Prototype

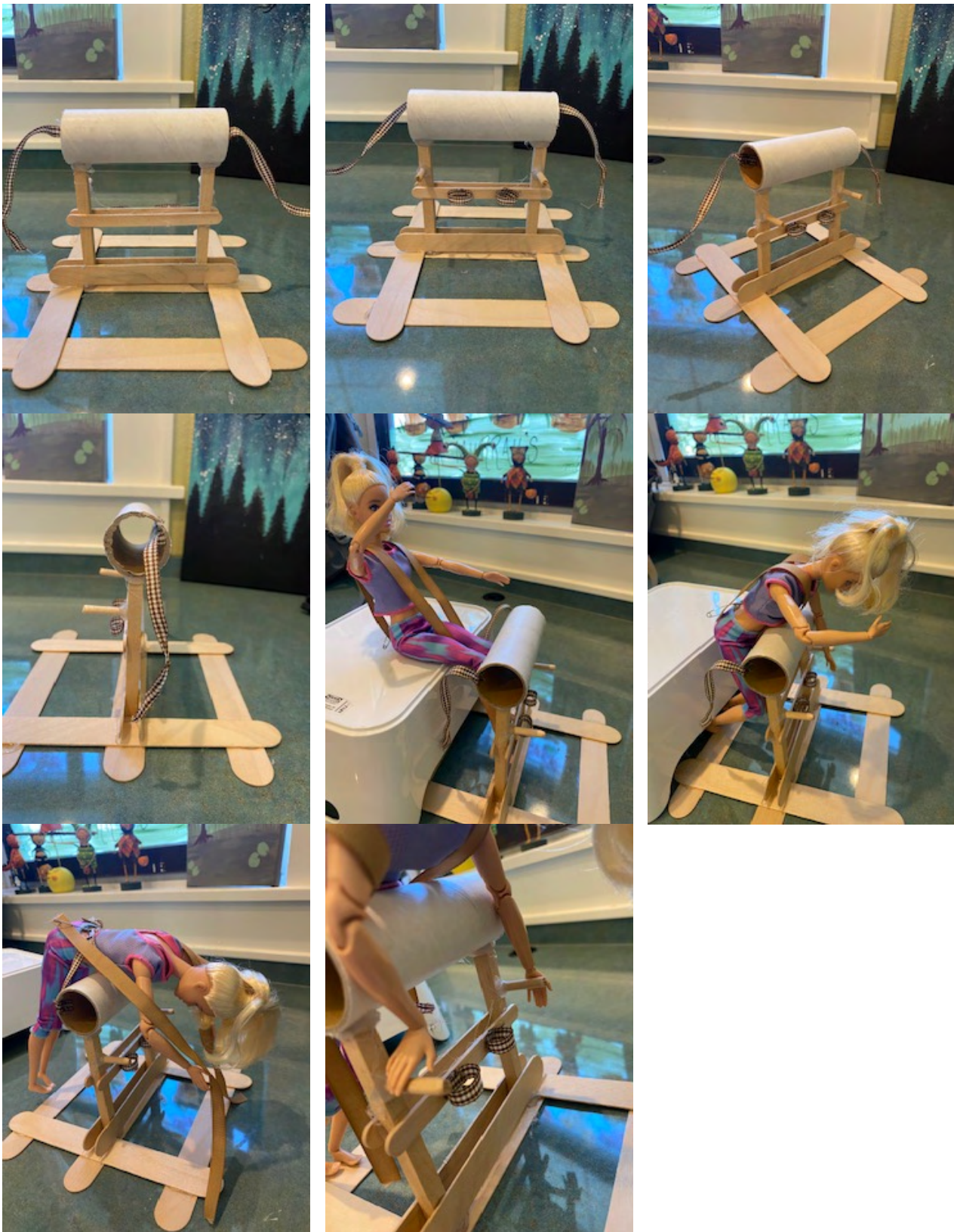
---

**Title: First Lean and Lift Design Prototype****Date:** 9/30/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To create a rudimentary prototype of our Lean and Lift design in order to visualize and test the feasibility of the design**Content:**

In this first prototype design, a Barbie doll is used to represent the client, Dan. The design features a frame-supported tube that would hold the client by their lower stomach, with an included strap to ensure that they do not fall off. On the front of the frame, there are handle bars and straps for the client to hold onto for easy mounting, dismounting, and dressing. Attached to the Barbie's pants are straps that can be pulled in order to pull up their pants without having to reach backwards.

From what Dan has said, the height of the bar that he would lean on should be about 35-36 inches above the ground and would ideally have an electrical element to the strap/suspender component that would allow his pants to be pulled up without the need for him to strain himself to pull them up. The real design will also need to support 230 pounds and should be wider than the width of his wheelchair, which is 23 inches.



**Conclusions/action items:**

This initial prototype will be helpful with testing the logistics of our design and visualizing how our design will work. With this prototype, we will further explain our project idea to Professor Ashton and make adjustments to the design to make it easier to use and produce.



## 2023/11/16 - Design Consult with TEAM Lab Staff

---

EVERY SCHUDA - Nov 16, 2023, 5:22 PM CST

**Title:** Design Consult with TEAM Lab Staff

**Date:** 11/16/2023

**Content by:** Avery Schuda

**Present:** Avery, Ella, Rayona, Jesse from TEAM Lab

**Goals:** Talk to a staff member of the TEAM Lab about what fabrication methods they offer and how best to use them in our project. Mainly we want to focus on: 1) If we need to add more material to the central leaning bar before we attach the foam padding, and if so what typer of material and dimensions would work best for this application, 2) Should we add a piece of material to the base of the legs for the client to wheel his chair onto to act as a counterweight while he is leaning over the device, 3) How best to mount the RC winches to the device.

**Content:**

Avoid adding too much complication to the frame. Consider carving the foam to the desired shape. Good idea to cut it and zip tie to start. (Avery can show the rest of the team in person before we make any cuts)

Legs could either be extended or the bar idea would work well. For original idea with bar just need to drill two holes into the bar and can screw in with the feet that are already on the desk base. Can buy material in the TEAM lab, we are going to need steel because aluminum is too flimsy. Going to check Wendt for extra materials.

For winches probably just going to need to do a ton of testing. Create frame that goes above the client out of 80/20 structural aluminum, basically the Legos of aluminum. AKA T-Slot Framing rails, available from McMaster Carr. Would want Drop-in fasteners.

Base 41" outside to outside 38.5" Center to center on holes

The piece of aluminum we found was \$23 and the 80/20 was going to be \$78 for 10 ft

Jesse is available from 9-5 in the TEAM Lab Tuesday, Wednesday, and Thursday

**Conclusions/action items:**

Look into buying steel bar and continue fabrication. Update the rest of the team about meeting with Jesse.





# 2023/12/10 - Final Copy of Expense Spreadsheet

AVERY SCHUDA - Dec 10, 2023, 8:24 PM CST

**Title:** Final Copy of Expense Spreadsheet

**Date:** 12/10/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Attach final updated copy of expense sheet

**Content:**

See attached spreadsheet below for final list of materials purchased for the design.

AVERY SCHUDA - Dec 10, 2023, 8:24 PM CST

Item	Description	Quantity	Unit Price	Total Price	Tax	Total
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**The\_Hoisters\_BPAG\_Expense\_Spreadsheet\_-\_Sheet1.pdf (72.4 kB)** Final expense spreadsheet



# 2023/11/5 Standing Desk Base Building Process

---

**Title: Standing Desk Base Building Process****Date:** 11/5/2023**Content by:** Kate Murray**Present:** Kate Murray, Jacob Parsons, Ella Eklund, Rayona Kinny**Goals:** To build the standing desk base for the lean and lift device**Content:**

- we unboxed our standing desk base and built it, ensuring that the width of the base would perfectly fit our three pieces of foam.
- Once the device was built, we did some tests, and it can support the weight of a 220 lb male (jacob)
- using the remote that can easily change the height of the desk, leaning onto the desk base was quite easy and simple
- brainstormed some ideas on how to mount other components of the design
  - metal sheet that would be flat on top of the desk then curve around side facing Dan for foam to attach to without getting in the way of the height changing mechanism
  - attaching winches to side wings of desk instead of welding on beams





**Conclusions/action items:**

On Wednesday, the whole team will meet up and finalize a fabrication plan and discuss what we brainstormed while building the desk. Hopefully, we can also begin to fabricate different components and begin testing if the rest of our materials arrive.





## 2023/11/29 - Steel Safety Bar Fabrication

---

AVERY SCHUDA - Nov 29, 2023, 1:09 PM CST

**Title:** Steel Safety Bar Fabrication

**Date:** 11/29/2023

**Content by:** Avery Schuda

**Present:** Avery Schuda and Sallie Schoen

**Goals:** Purchase a mild steel bar, fabricate the safety bar, and mount it on the base of the standing desk frame

**Content:**

-Outside to outside measurement of desk legs: 43.25"

-Center to center of predrilled holes in base of legs: 40.6"

-Purchased a mild steel bar from available stock in the TEAM Lab using Makerspace account set up by Dr. Puccinelli. Cost just over \$19

-Cut the bar down to 43.75" using the drop saw

-Drilled two 5/8" holes 40.6" apart using a drill press

-Hand deburred drilled holes and cut end using deburring tool and file

-Mounted steel bar to base of standing desk using the existing feet to screw the bar to the base of the desk

-Bar was easily able to support the weight of Avery and Sallie standing on it at the same time. Steel was the ideal choice of material based on our design consult with Jesse from TEAM Lab because it is stronger less prone to cracking than aluminum.

**Conclusions/action items:** The fabrication of the safety bar is now complete. The client will be able to wheel his 350 lb wheelchair on top of the bar to act as a counterweight as he leans forwards onto the crossbar of the desk. The remaining 4 team members will meet later tonight to glue the foam to the desk which has already been prepped otherwise for this.

AVERY SCHUDA - Nov 29, 2023, 1:10 PM CST



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**processed-C55292C5-4124-44C7-A4CB-CACE42F0C1DB.jpeg (2.89 MB)** Images of steel safety bar

AVERY SCHUDA - Nov 29, 2023, 1:10 PM CST



[Download](#)

**processed-E7A92723-0D4D-4CD9-868A-A0861C28F63E.jpeg (5.03 MB)** Images of steel safety bar



## 2023/11/29 - Foam Cushion Application

---

**Title: Foam Cushion Application**

**Date:** 11/29/23

**Content by:** Kate Murray

**Present:** Kate Murray, Rayona Kinny, Ella Eklund, Jacob Parsons

**Goals:** To attach our foam cushions to the standing desk frame and attach the fabric over the top of it

**Content:**

We used a caulk gun to attach our scored foam pieces to the metal frame. We then secured the foam pieces with zip ties and stapled a strip of fabric over the top of it to create a clean and finished final product





-Next, we started testing the winches to see how they pulled up clothes

- it is strong enough to pull up pants - was able to pull up Rayona's jacket

**Conclusions/action items:**

Tomorrow, we will solder the suspender clips to the winches, do more accurate testing, and attach the winches to potentially the sides of the standing desk frame (if that doesn't work out, can make a PVC frame)



## 2023/12/1 Winch Bar Application

---

**Title: Winch Bar Application****Date:** 12/1/23**Content by:** Kate Murray**Present:** Kate Murray, Jacob Parsons, Sallie Schoen**Goals:** To attach metal bars to the protruding beams of the frame for the winches to attach to**Content:**

1. Bought two pieces steel that were 3/16" thick, 8 inches long
2. Drilled holes on the ends of each steel piece that matched the holes of the protruding beams of the standing desk frame with a drill press
3. Bought washers, nuts, and bolts to attach the metal pieces
4. Attached metal pieces to the protruding beams with washers, nuts, and bolts

Attached below is the standing desk frame with the newly attached bars. The winches will be attached to the ends of the bars.





**Conclusions/action items:**

From here, the winches will be gorilla glued to the ends of the steel bars. Then, further testing can be done on the effectiveness of the winches.



## 2023/12/10 - Testing Protocols

Jacob Parsons - Dec 10, 2023, 1:24 PM CST

**Title:** Testing Protocols

**Date:** 12/12/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Explain how to complete the testing protocols

**Content:**

- In attached file below

Jacob Parsons - Dec 10, 2023, 1:23 PM CST

#### Client Strength Testing Protocol

1. The client will sit on his wheelchair and grab the weighted backpack with one arm
2. The client will begin with 2.0 lbs
3. If the client is able to lift the weight off the ground it counts as a pass, if the client is unable to lift the weight it counts as a fail
4. Repeat trials 1 through 3 for increasing amounts of weight; 5 lbs, 8.4 lbs, and 12.0 lbs

#### RC Winch Path Testing Protocol

1. Place 6 winches at proper position for testing position, for trial 1 it will be 1.5 inches away from the clients position
2. Release the clips from the stricken until it reaches the floor, then attach the pair of shorts
3. Upon the start of the winches pulling the pair of shorts up, start the timer and pull the shorts up with the winches
4. Once the winches pull all the way up, stop the timer
5. Calculate the velocity in inches per second and repeat the process for each respective trial

#### RC Winch Strength Testing Protocol

1. Hook the spring gauge to the RC winch attachment
2. Activate the winches and pull on the spring gauge to observe the strength of the winches
3. Record the maximum observed strength

#### Frame Strength Testing Protocol

1. Observe the initial height of the frame
2. Lean over the cushioned frame with the desired testing weight
3. Stay on the frame for 4 minutes
4. Record the final height of the frame

[Download](#)

**Testing\_Protocol.pdf (51.1 kB)**



## 2023/12/10 - Fabrication Protocol

Jacob Parsons - Dec 10, 2023, 4:21 PM CST

**Title:** Fabrication Protocol

**Date:** 12/10/23

**Content by:** Whole Team

**Present:** N/A

**Goals:** Explain fabrication Process

**Content:**

- Attachment included below

Jacob Parsons - Dec 10, 2023, 4:21 PM CST

#### Client Strength Testing Protocol

1. The client will sit on his wheelchair and grab the weighted backpack with one arm
2. The client will begin with 2.0 lbs
3. If the client is able to lift the weight off the ground it counts as a pass, if the client is unable to lift the weight it counts as a fail
4. Repeat trials 1 through 3 for increasing amounts of weight; 5 lbs, 8.4 lbs, and 12.0 lbs

#### RC Winch Path Testing Protocol

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#### Frame Strength Testing Protocol

1. Observe the initial height of the frame
2. Lean over the cushioned frame with the desired testing weight
3. Stay on the frame for 4 minutes
4. Record the final height of the frame

[Download](#)

**Testing\_Protocol.pdf (51.1 kB)**



## 2023/10/25 - Lean and Lift Simulation

---

**Title:** Lean and Lift SolidWorks Prototype Simulation

**Date:** 10/25

**Content by:** Sallie

**Present:** N/A

**Goals:** Show results and conclusions from the simulation of the lean and lift device.

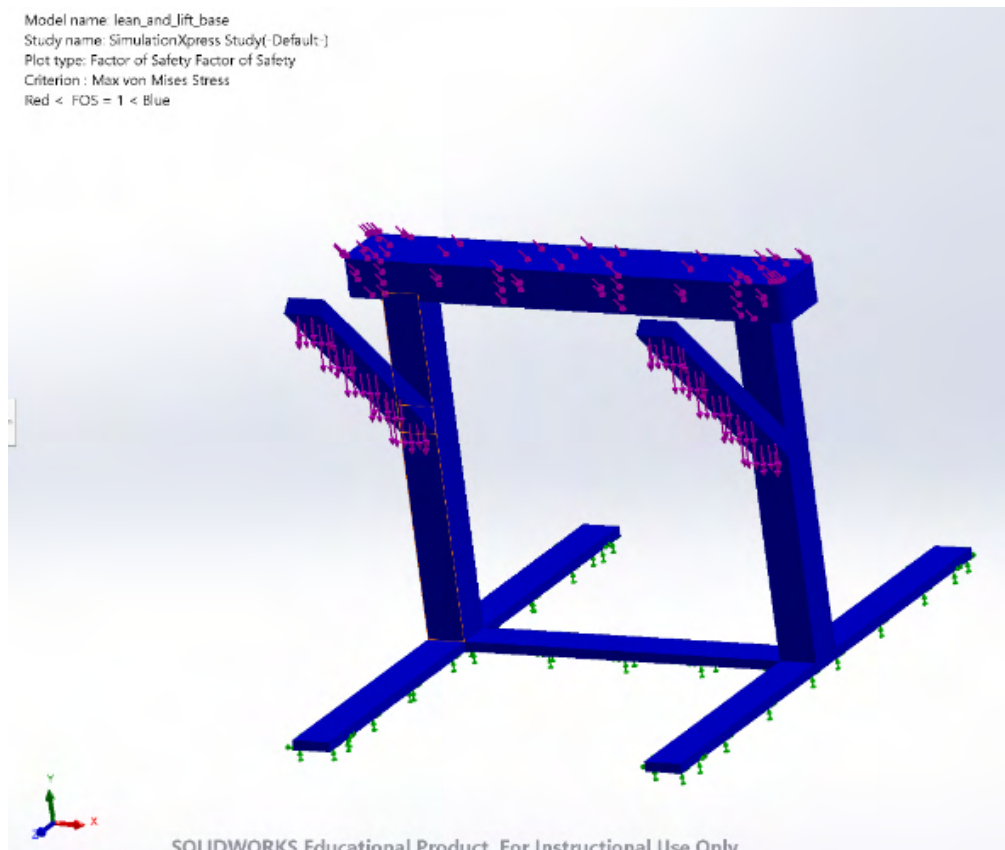
**Content:**

The lean and lift device was created in SolidWorks and can be viewed in the team activities/project files folder in lab archives. Using the Solidworks simulation express tool in the evaluate tab in Solidworks, the device's strength can be evaluated.

The device will have a 230-lbf placed on the top by the client. The device will also have forces placed on the bars at an angle used to attach an RC winch to and pull up the pants. The exact weight of the force that the pants and RC winch will apply on the device arms is unknown, but a force of 5 lbs was used as an estimate. The force will likely be less than 5 lbs.

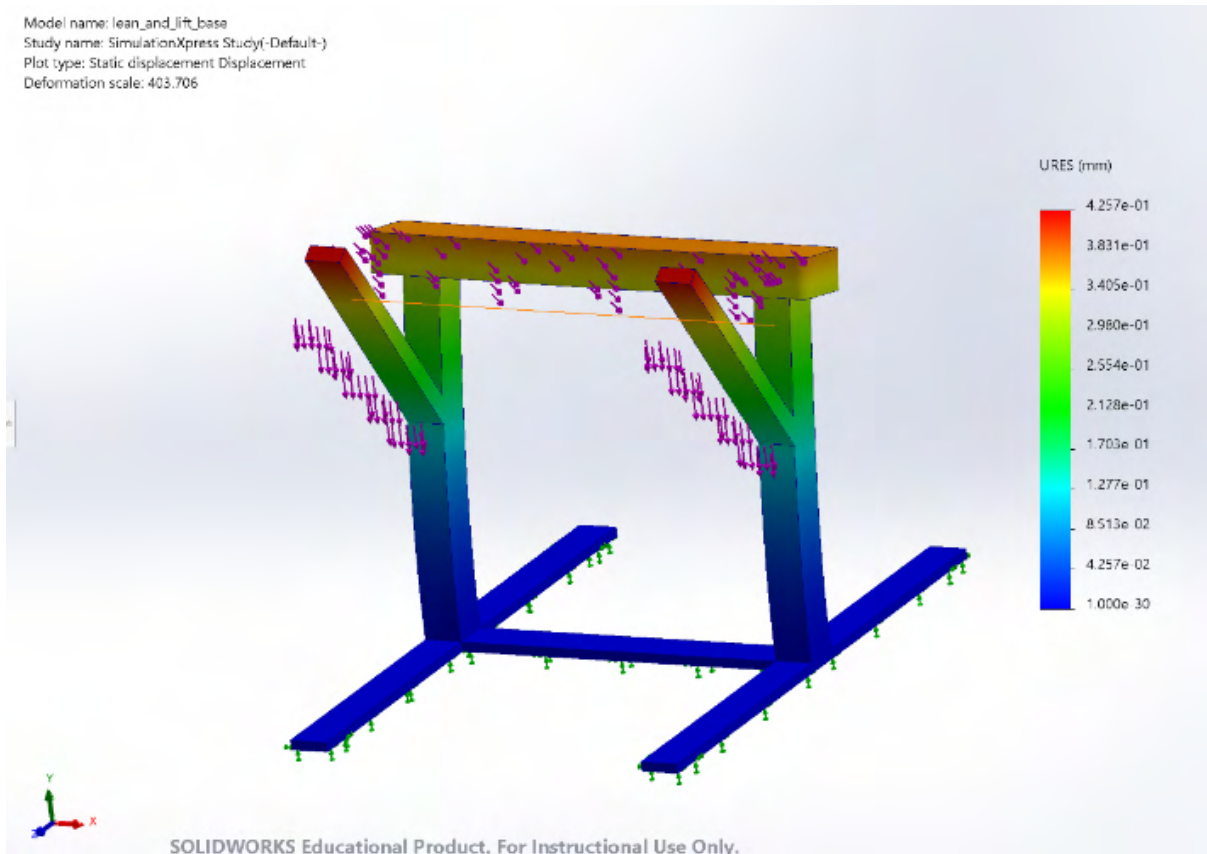
The material used was Aluminum Alloy 6061 T6

The picture below is the device showing anywhere that the factor of safety would be below 1. The factor of safety is 65.7, showing the device is strong enough to withstand the forces placed on it. The bottom of the device is fixed to the ground, which is what the green arrows show. The device showing all blue means the whole device is structurally sound. If it were to show red, that portion of the device would need to be modified to be safe to use.



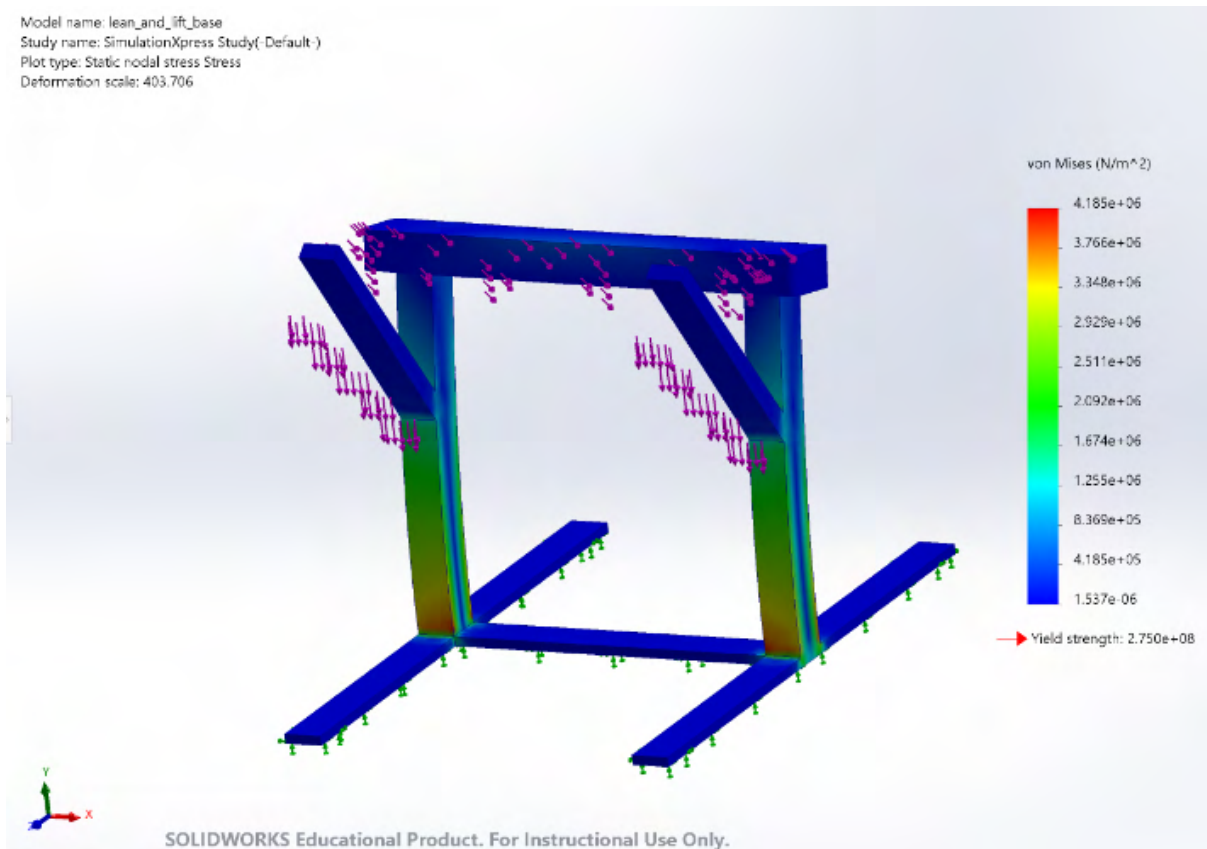
The image below shows the deformation of the device, which deforms as expected.

Model name: lean\_and\_lift\_base  
 Study name: SimulationXpress Study(-Default-)  
 Plot type: Static displacement Displacement  
 Deformation scale: 403.706



The image below shows the device's von Mises stress. Von Mises stress is a way of measuring how much a material can deform under stress before it permanently deforms or breaks.

Model name: lean\_and\_lift\_base  
 Study name: SimulationXpress Study(-Default-)  
 Plot type: Static nodal stress Stress  
 Deformation scale: 403.706



**Conclusions/action items:**

This simulation method can be used to analyze the dimensions and material we choose for the design. The device has a high factor of safety and the device could be optimized by changing dimensions or making the leg rods hollow.

The results of the simulation are attached below.

Sallie Schoen - Oct 25, 2023, 8:43 PM CDT



**Simulation of lean\_and\_lift\_base**  
 Date: Wednesday, October 25, 2023  
 Designer: Galdamese  
 Study name: Simulation/press Study  
 Analysis type: Static

**Table of Contents**  
 Description ..... 1  
 Assumptions ..... 2  
 Model Information ..... 2  
 Material Properties ..... 3  
 Loads and Fixtures ..... 4  
 Mesh Information ..... 5  
 Study Results ..... 7  
 Conclusions ..... 10

**Description**  
 No Data

SOLIDWORKS    Applied MESHWORKS Simulation    Simulation of lean\_and\_lift\_base 1

[Download](#)

**lean\_and\_lift\_simulation\_1.pdf (681 kB)**



# 2023/12/6 - Standing Desk Frame Simulation

Sallie Schoen - Dec 06, 2023, 4:54 PM CST

**Title:** Standing Desk Frame Simulation

**Date:** 12/6

**Content by:** Sallie

**Present:** N/A

**Goals:** Attach simulation results

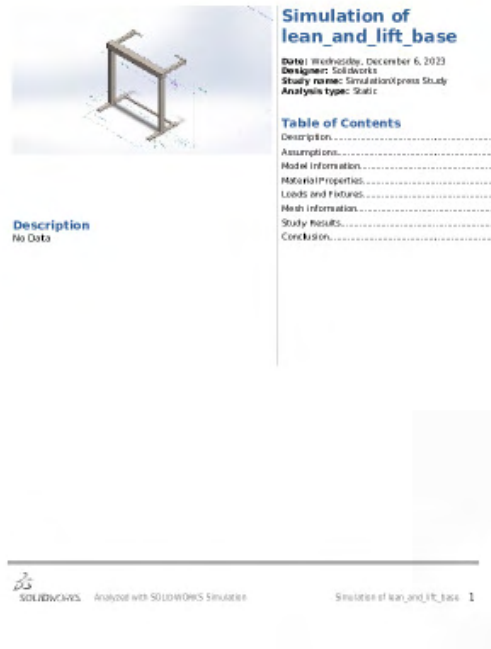
**Content:**

The standing desk frame's stress and displacement are analyzed using SolidWorks simulation. Although the frame specifies that it can hold up to 230 lbs, it is important to analyze the force of the client acting on the frame, as well as the force of the RC winches acting on the steel bars attached to the sides.

**Conclusions/action items:**

A simulation of the forces acting on the standing desk frame is attached below.

Sallie Schoen - Dec 06, 2023, 4:51 PM CST



[Download](#)

**standing\_desk\_frame-SimulationXpress\_Study-1.docx (1.34 MB)**

Sallie Schoen - Dec 06, 2023, 4:51 PM CST



[Download](#)

**standing\_desk\_frame-SimulationXpress\_Study.analysis.analysis.eprt (487 kB)**





## 2023/12/6 - Winch Testing

Jacob Parsons - Dec 06, 2023, 5:49 PM CST

**Title:** Winch Testing

**Date:** 12/6/23

**Content by:** Jacob

**Present:** N/A

**Goals:** Test the winches

**Content:**

The attached file is the culmination of the results of the RC winch testing.

Jacob Parsons - Dec 06, 2023, 5:46 PM CST

Testing of rc winch path:

Test #	Angle	Speed (in/sec)
1	27.98° (8.5 in away)	19.220 in/sec
2	23.83° (7 in away)	14.001 in/sec
3	18.97° (5.5 in away)	9.912 in/sec
4	10.82° (3 in away)	7.861 in/sec
5	6.24° (1.75 in away)	5.666 in/sec

Angle= angle that rc winch is pulling  
Speed= speed that RC winch pulls up at



Figure 1: Image of the 6.24° away testing of pulling up a pair of shorts.

The winches were positioned at the above angles relative to the shorts and the shorts were lifted from floor height to the position of the winches. The times were recorded and then the height in inches of the device (42 inches), was divided by the time it took to raise it. The angle of 6.24° was the quickest due to the minimal amount of pull the winches induced against each other. The

[Download](#)

Testing.pdf (5.21 MB)



## 2023/12/06 - Lean and Lift Base Solidworks Model

---

Sallie Schoen - Dec 06, 2023, 4:48 PM CST

**Title:** Lean and Lift Base Solidworks Model

**Date:** 12/6

**Content by:** Sallie

**Present:** N/A

**Goals:** attach solidworks file

**Content:**

This is the first solidworks prototype of the lean and lift design.

**Conclusions/action items:**

Attached below is the solidworks file

---

Sallie Schoen - Dec 06, 2023, 4:48 PM CST



[Download](#)

**lean\_and\_lift\_base.SLDPRT (144 kB)**



## 2023/12/06 - Standing Desk Frame Solidworks Model

---

Sallie Schoen - Dec 06, 2023, 4:50 PM CST

**Title:** Standing Desk Solidworks Model

**Date:** 12/6

**Content by:** Sallie

**Present:** N/A

**Goals:** attach solidworks file

**Content:**

This is the generalized solidworks prototype of the standing desk frame.

**Conclusions/action items:**

Attached below is the solidworks file

---

Sallie Schoen - Dec 06, 2023, 4:50 PM CST



[Download](#)

**standing\_desk\_frame.SLDPRT (204 kB)**



# 2023/12/06 - Final Design SolidWorks

AVERY SCHUDA - Dec 06, 2023, 11:17 PM CST

**Title:** Final Design SolidWorks

**Date:** 12/06/2023

**Content by:** Avery Schuda

**Present:** Sallie Schoen

**Goals:** Finalize SolidWorks model and update drawing

**Content:**

See attached SolidWorks files for the final design and updated drawing.

**Conclusions/action items:** Used model to rerun deformation and safety tests. Will present results in poster presentation and final report.

AVERY SCHUDA - Dec 06, 2023, 11:15 PM CST



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standing\_desk\_frame.SLDPRT (240 kB)

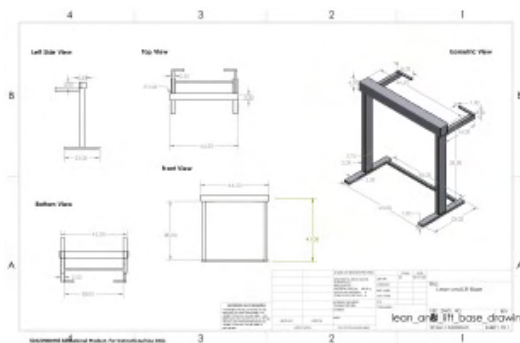
AVERY SCHUDA - Dec 06, 2023, 11:15 PM CST



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lean\_and\_lift\_base\_drawing.SLDDRW (165 kB)

AVERY SCHUDA - Dec 07, 2023, 3:00 PM CST



[Download](#)

lean\_and\_lift\_base\_drawing.pdf (102 kB)



## 2023/9/23 - PDS and Design Idea Meeting

---

ELLA EKLUND - Sep 23, 2023, 12:18 PM CDT

**Title:** PDS and Design Idea Meeting

**Date:** 9/23/2023

**Content by:** Ella Eklund

**Present:** Team

**Goals:**

- To finish editing our PDS
- Narrow down design ideas
- Plan the next meeting and agenda
- Start brainstorming for design matrix

**Content:**

- Reviewed and edited PDS

Turned into Canvas and added to the website

- Brainstormed new design ideas

- Crank suspenders
- Harness in ceiling
- Conveyor belt
- laying down foam roller
- Crank

- Emailed Dan with new questions that we developed with Randolph in our advisor meeting

Questions are in the second advisor meeting.

**Conclusions/action items:**

We finished editing our PDS, turned it into Canvas, and put it on the website. Then we discussed potential ideas and started narrowing down the best ideas. Decided on our next meeting time to develop our design matrix based on the answers to our questions from Dan. We also need to do some more research based on the questions and choose our final three designs.



## 2023/9/27 - Design Matrix Meeting

---

ELLA EKLUND - Sep 27, 2023, 6:53 PM CDT

**Title:** Design Matrix Meeting

**Date:** 9/27/23

**Content by:** Ella Eklund

**Present:** Whole Team

**Goals:** Finish the design matrix

**Content:**

-Decided on three designs for the design matrix.

Lean and Lift, Zip Pants, Backpack Suspenders

-Created the design matrix, listed the project criterion, and ranked each on a scale of 1-10.

-After creating the design matrix, the winner was The Zip Pants.

-Then we created the Design Matrix Explanation and listed our reasonings for each ranking and why.

-After we created our progress report for the week and added in the design matrix and explanations for the client.

**Conclusions/action items:**

After a successful team meeting, we have finished our draft of the design matrix and the explanation of our choices. For next week we are planning to show the design matrix to our client to make sure he agrees with our choice and then from there we are going to start working on the preliminary presentation.



## 2023/10/1 - Preliminary Design Presentation Meeting

---

Kate Murray - Oct 01, 2023, 12:17 PM CDT

**Title:** Preliminary Design Presentation

**Date:** 10/1/2023

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To assign roles for the preliminary design presentation

**Content:**

**Presentation:**

**Title Slide:** Sallie

**Overview of Presentation:** Jacob

**Problem Statement:** Jacob

**Background/Competing Designs:** Ella

**Summary PDS:** Sallie

**Design Alternatives Considered:** Kate and Avery

**Design Matrix:** Kate and Avery

**Future Work:** Rayona

**References and Acknowledgements:** Everyone :)

**Conclusions/action items:**

**-We will all work on our parts of the presentation before we meet to practice Wednesday 5:45 pm at Union South**

**-On Wednesday, we will assign roles for the Preliminary Design Report**

**-Research:**

**- Kate- production materials- metals to use as support, cost**

**- Research electronic devices for strap pull component of design**

**- Update PDS: Sallie started, everyone else can too**



## 2023/10/4 - Presentation Practice Meeting

---

Kate Murray - Oct 04, 2023, 6:42 PM CDT

**Title:** Presentation Practice Meeting

**Date:** 10/4/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To finalize and practice presentation, update the PDS, and assign roles for the report

**Content:**

During our meeting, we

1. finalized our presentation
2. practiced our presentation
3. worked on editing our pds

**Conclusions/action items:**

**We will continue practicing for our presentation**

**Sunday: We will meet and work on our preliminary design report**





## **2023/10/8 - Preliminary Design Report Meeting**

---

**Title: Preliminary Design Report Meeting****Date:** 10/8/23**Content by:** Kate Murray**Present:** Whole Team**Goals:** To assign roles for the preliminary design report and discuss other actions items for the week**Content:****First, we discussed who was doing what for the preliminary design report****Preliminary design report assignments:**

- abstract - sallie, jacob
- introduction - ella
- background - rayona
- preliminary designs - kate
- preliminary design evaluation - avery
- fabrication/development process - sallie
- testing (what we are going to do, strength testing) - jacob
- results - jacob
- discussions - jacob
- conclusions - kate
- references - everyone
- appendix - avery

**Other Action Items:**

- need to research suspender design
  - jacob
- Solidworks prototype - sallie (lean and lift)
- research materials
  - kate - aluminum, cushion

**- avery - modifying preexisting structures**

**Conclusions/action items:**

written above



## 2023/10/13 - Fabrication Plans Team Meeting

---

Kate Murray - Oct 15, 2023, 2:12 PM CDT

**Title: Initial Fabrication Plans Meeting**

**Date:** 10/13/2023

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To assign roles in our fabrication plans and have action items for the next week

**Content:**

Bottom of lean and lift - flat bar of metal to roll over

- Sallie will make the final SolidWorks design
- once that is finished, we will perform SolidWorks simulation testing
- change lean and lift design with bars for suspenders to hook onto
- need two RC winch
- need design matrix for materials
  - make sure T6 aircraft grade aluminum is weldable and able to be fabricated

**Conclusions/action items:**

Kate, Jacob - make metal design matrix (research metals -which types of aluminum, semi-fabricated metal frames), start ordering materials and handle budget (Kate), look into welding permit

Ella, Sallie, Rayona - Suspender winch design (researching material - firm straps, clips, winch, budgeting)

Avery - update FINAL drawings, fix units and problem statement in PDS and Preliminary Report - check advisor meeting for any other changes

Rayona - research fabrication methods and assembly of lean and lift handles and cushion, timeline for things we wanna do for the rest of the semester

MEETING - Wednesday 5:30 at Union South

- have your action items done so we can discuss the final design and order materials



# 2023/10/18 - Materials Ordering Meeting

---

**Title: Materials Ordering Meeting****Date:** 10/18/23**Content by:** Kate Murray, Avery Schuda**Present:** Whole Team**Goals:** To review our materials design matrix and confirm which aluminum we will use, review our final SolidWorks lean and lift design, discuss crank system, and decide on materials and welding plan**Content:**

-first, we reviewed what we had all worked on over the last few days

- materials design matrix - 6061 and 5083 aluminum are both good metals to work with, 5083 would be best

-SolidWorks design - should we put strap handles at an angle to make it easier to pull pants all the way up?

- foam- can be welded on, high density polyurethane, put fabric over the top to protect it - possibly plastically material, what you usually find at the doctor's office

- Jacob (and possibly Sallie) will be doing MIG welding

- best strap for us - simple hook strap - can hold 50 lbs, can choose length/easily modify

- need to figure out to attach the hook strap to the winch, should order winch soon as well as clip

- We will need to talk to Dan to confirm:

- double winch design

- lean and lift design - bars should be at angle or not? Is the design good to begin fabrication?

- Jacob will talk to people at TeamLab to see what scrap materials they have and ask about feasibility of the design

- double winch design - we will use a R/C winch on each side with attached clips that will be attached to the protruding beams of the lean and lift design to pull up pants

- when we order our materials, we will do it all at once - talk to Prof. Ashton before ordering anything

- what to order - aluminum (6061 or 5083), polyurethane foam, 2 R/C winches, straps, clips

Avery, Sallie, and Jacob completed safety testing of the design in SolidWorks. If made out of solid 1060-T6 Aluminum, the design is extremely safe, with a factor of safety well over 1. Further testing will be done with other potential materials we could order such as mild steel. Aluminum may be too difficult to weld as beginners, so we need to talk to the Team Lab staff to see what metal we should use and if welding Aluminum is feasible for us.

**Conclusions/action items:**

Kate - look into funding approval and how to track purchases

On Friday - we will review our lean and lift SolidWorks design with Prof. Ashton and discuss our purchasing plans

When we meet with Dan, we will have him approve or make adjustments to our lean and lift design (especially dimensions) and have him approve all of our purchases

Jacob and Sallie will discuss with the TeamLab the feasibility of welding aluminum and if there are any scrap materials we could use

Rayona - find the foam to order on Grainger - what size

Avery - look into metals on Grainger, safety testing on SW, keep design drawings updated

For next week, start testing and order materials



## 2023/10/25 - Final Ordering Materials Meetings

---

RAYONA KINNY - Oct 25, 2023, 7:02 PM CDT

**Title:** Final Ordering Materials Meeting

**Date:** 10/25/23

**Content by:** Ella Eklund and Rayona Kinny

**Present:** Team

**Goals:**

-Finalize our design idea

-Order materials

-Work on proposal

**Content:**

1. Finished our BPAG spreadsheet for ordering materials
2. Updated progress report
3. Continued to research/decide best options for metal base and continued the discussion of potentially more welding.
4. Discussed show and tell

**Conclusions/action items:**

After a successful team meeting, we have made great progress on the finalization of our materials and are ready to order within the week. The only setback is that we are not 100% confident on our decision for the metal base and if we want to use a pre-built frame to minimize the amount of welding we need to do. Our action items for the week is to decide on the best option for the metal base, research fabrication of bars, meet with Dan to confirm and order materials, and continue working on finalizing our prototype.





## 2023/11/01 - Show and Tell Prep

---

AVERY SCHUDA - Nov 01, 2023, 6:15 PM CDT

**Title:** Show and Tell Prep Meeting

**Date:** 11/01/2023

**Content by:** Avery Schuda

**Present:** Full team

**Goals:** Prepare elevator pitch and practice for the Show and Tell

**Content:**

-One minute pitch with several options of call to action questions

-Ask if anyone has experience with welding, especially welding to prefabricated materials

-Show SolidWorks to help explain design

-Bring RC winches if they arrive on time

-Wrote script

-Team A (pitch first, feedback second) - Ella, Kate, Sallie

-Team B (feedback first, pitch second) - Avery, Jacob, Rayona

**Conclusions/action items:** Practice pitch for Show and Tell on Friday. Receive ordered materials, after this finalize fabrication plan and begin fabrication. Update SolidWorks model to complete safety testing of the updated design.



## 2023/11/8 - Fabrication Plan Meeting

---

**Title: Fabrication Plan Meeting****Date:** 11/8/23**Content by:** Kate Murray**Present:** Whole Team**Goals:** To create a plan for our fabrication process and test our winches**Content:**

- over the weekend, Kate will get fabric that will be used over the cushion
- we need to
  - install piece of curved sheet metal to standing desk and cushion - need to buy sheet metal and cushion adhesive
  - install piece of sheet metal to bottom of standing desk - need to find/order sheet metal
  - order batteries (for remote and main winch) and set up winch - run tests to find ways to best install winches

to order/get:

- fabric - 40x16 in --> 50 in x 25 in
- sheet metal - 40 in x 12 in
- sheet metal - 40 in x (doesn't matter width)
- cushion adhesive
- 4 2PCS 3V CR2032 button batteries
- Injora winch control wireless remote receiver

**Conclusions/action items:**

- Avery- find adhesive for foam
- Jacob/Sallie - find winch battery reciever
- Ella/Rayona - will scout out other materials at the TeamLab and Makerspace and see what else we have to buy
- Kate - get fabric
  
- we will meet friday to order materials we still need



## 2023/11/19 - Fabrication Plan

---

Kate Murray - Nov 19, 2023, 12:45 PM CST

**Title:** Fabrication Plan

**Date:** 11/19/23

**Content by:** Kate Murray

**Present:** Kate Murray, Avery Schuda, Jacob Parsons

**Goals:** To create a fabrication plan

**Content:**

- when we met, we could not find any scrap metal to use and we were unable to remove the metal tabs

Fabrication Plan for Monday 11/20

1. Remove metal tabs
2. Sand area of glue application on standing desk
3. Cut foam to size (8 in)
4. Attach foam to standing desk (add in fabric?) - will need to grab glue, zip tie in place

If winch batteries applied, start testing the winches!

**Conclusions/action items:**

We will carry out this plan tomorrow



## 2023/11/27 - Fabrication Meeting

---

Kate Murray - Nov 27, 2023, 6:42 PM CST

**Title:** Fabrication Meeting

**Date:** 11/27/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To carry out our fabrication plans and test the winches

**Content:**

- first, Kate cut the foam pieces to size while the rest of the group testing the winches - they work!
- we measured the desk: 40.6 in - center to center distance of holes on the bottom of the standing desk
- we took off the tabs off the main support bar and sanded it down so that it is ready for the cushion application

**Conclusions/action items:**

Fabrication Plan for Wednesday:

- at 11:50 am, Sallie and Avery will purchase a piece of sheet metal and drill holes that are 40.6 inches apart from their centers, assemble metal sheet to bottom of standing desk
- at 5:30 pm, Jacob, Kate, Rayona, and Ella will meet to attach the foam cushion to the standing desk and perform tests on the winches



## 2023/12/04 - Poster Creation and Winch Testing Meeting

---

AVERY SCHUDA - Dec 04, 2023, 11:20 PM CST

**Title:** Poster Creation and Winch Testing Meeting

**Date:** 12/04/2023

**Content by:** Avery Schuda

**Present:** Whole Team

**Goals:** Work on completing the poster and continue testing the RC winches

**Content:**

-Plan for winch testing: Move the winches in from the existing bars by intervals of 1-2 inches and testing pulling up pants on a pass/fail basis. Use Jacob for testing because he is most similar in height and weight to the client. Goal is to find the most ideal position for the winches. If multiple widths work we will select a width that is the median.

-Originally tried to attach the winch to the swinging arm using gorilla glue, but discovered this was not strong enough. Glued one winch on with the Loctite PL Premium construction adhesive that was used on the cushoin since it can be used to fix metal to metal.

-Began working on the poster. Goal is to complete as much as possible today and print on Wednesday.

-Avery and Sallie remeasured the device and created an updated SolidWorks model and new drawing with full dimensions.

-Worked on protocols and final report.

**Conclusions/action items:**

Complete testing. Rerun simulations on updated SW model. Complete and print poster. Email Prof. Ashton to schedule final meeting Dec 15th+. Work on final report.



## 2023/12/6 - Final Report and Poster Worktime Meeting

---

Kate Murray - Dec 06, 2023, 6:49 PM CST

**Title: Final Report and Poster Presentation Worktime**

**Date:** 12/6/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To finish our poster, assign roles for the presentation, and work on the final report

**Content:**

- finished poster
- worked on almost every part of final report - still needs testing, abstract, and proofreading
- assigned roles for poster presentation
  - problem statement - ella
  - background - ella
  - motivation - avery
  - design criteria - avery
  - final prototype - kate
  - testing - sallie
  - model - sallie
  - discussion - jacob
  - future work - rayona
  - acknowledgements - rayona

**Conclusions/action items:**

We will meet again on Sunday to turn in the final report



## 2023/12/10 - Final Report Work

---

Kate Murray - Dec 10, 2023, 5:15 PM CST

**Title:** Final Report Worktime and Finalization

**Date:** 12/10/23

**Content by:** Kate Murray

**Present:** Whole Team

**Goals:** To finish our final report, proofread it, and turn it in

**Content:**

During our meeting, we first finished up with the content of the final report, then we proofread it and made adjustments, and turned it in

**Conclusions/action items:**

Project is complete! We will look out for feedback fruits assignment if there is one and turn in final notebook





# 2023/9/9-Muscular Dystrophy

---

**Title: Muscular Dystrophy Research****Date:** 9/9/2023**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To find out what Muscular Dystrophy is, how it affects certain muscle groups, and discover how it affects people on a daily basis.**Content:****Muscular Dystrophy:**

- group of genetic diseases - causes progressive weakness, degeneration of skeletal muscles
- more than 30 disorders (range in age of onset, severity, and affected muscle patterns)
- grow worse and worse as time progresses- muscles degenerate and weaken over time --> leading to loss of ability to walk
- can affect other organs (heart, lungs, swallowing disorders, etc)
- not contagious, not caused by injury or activity
- different kinds affect specific muscle groups
- can run in families, person can be first in their family to get it
- most common in boys - symptoms start at a young age in childhood

**How it affects muscles:**

- some forms of MD caused by defective dystrophin-glycoprotein, which prevent damage when muscle fibers contract and relax
- others from defects in connective tissue surrounding muscles
- this causes: muscle degeneration, progressive weakness, fiber death and phagocytosis, fiber branching and splitting, replacement of muscle tissue with fibrosis tissue and fat

**Duchenne Muscular Dystrophy:**

- most common in children
- mutation of X chromosome - mostly affects boys
- absence of dystrophin muscle protein

- becomes apparent during toddler years - begins at the upper legs and pelvis before spreading to upper arms
- loss of some reflexes, waddling gait, falls and clumsiness, difficulty getting up from sitting position/climbing stairs, change in posture, impaired breathing, heart problems, walking on toes, large calf muscles, learning disabilities, muscle pain and stiffness, delayed growth
- some children have cognitive and behavioral impairments

#### **Treating Muscular Dystrophy:**

- want to keep people independent as long as possible
- no cure, just ways to help with symptoms
- physical therapy, drug therapy, and surgery
- physical therapy, stretching, occupational therapy, regular exercise, can all help to maintain skills and muscle strength
- support aids like wheelchairs, splints, braces, spinal supports, and posture correction can help with muscle weakness and maintain mobility
- no dietary changes have shown signs of helping
- corrective surgeries can ease complications
- assistive ventilation often needed with respiratory muscle weakness (usually in later stages of MS)

#### **Works Cited:**

[https://www.ninds.nih.gov/health-information/disorders/muscular-dystrophy#:~:text=Muscular%20dystrophy%20\(MD\)%20refers%20to,pattern%20of%20the%20affected%20muscles.](https://www.ninds.nih.gov/health-information/disorders/muscular-dystrophy#:~:text=Muscular%20dystrophy%20(MD)%20refers%20to,pattern%20of%20the%20affected%20muscles.)

<https://www.cdc.gov/ncbddd/muscular-dystrophy/facts.html>

<https://www.mayoclinic.org/diseases-conditions/muscular-dystrophy/symptoms-causes/syc-20375388>

#### **Conclusions/action items:**

Muscular Dystrophy is a group of genetic diseases that deteriorates certain muscles over time. The disease most commonly appears with young boys, with the most common type, Duchenne Muscular Dystrophy. Typically, MS leads to difficulty walking to the point of needing a wheelchair, heart issues, and difficulty swallowing that makes unassisted living very difficult. Although there is no cure, plenty of treatments are available aiming to improve quality of life and give people with MS independence through physical therapy, drugs, surgery, and with assistive products such as wheelchairs or splints.



## 2023/9/17 - Becker's Muscular Dystrophy Experiment

---

**Title: Becker's Muscular Dystrophy Experiment Research****Date: 9/17/2023****Content by:** Kate Murray**Present:** Kate Murray**Goals:** To research Becker's Muscular Dystrophy in order to understand the abilities of our client and learn about how he would be able to use our product and what the progression of this disease looks like over time.**Content:**

Becker's Muscular Dystrophy

- genetic neuromuscular disease
- x linked
- caused by partial loss of function mutations in the dystrophin (DMD) gene
- reduced severity compared to Duchenne MS (DMD)
- understudied - few drugs to help or clinical trials

Trial done to study BMS:

- gave mice mutation on DMD gene, reproducing most common BMD patient mutation and tested their muscle pathogenesis and skeletal muscle and cardiac function
- BMS mice shown with significant muscle weakness, heart dysfunction, and impaired motor function in grip strength compared to normal mice
- BMS mice had decreased heart function with aging from reduced fractional shortening
- BMS muscles had increased levels of inflammatory genes, inflammatory miRNAs, and fibrosis genes

**Sources:**

Heier, Christopher R, et al. "The X-Linked Becker Muscular Dystrophy (BMX) Mouse Models Becker Muscular Dystrophy via Deletion of Murine Dystrophin Exons 45-47." *Journal of Cachexia, Sarcopenia, and Muscle*, vol. 14, no. 2, 11 Jan. 2023, pp. 940-954, <https://doi.org/10.1002/jcsm.13171>. Accessed 18 Sept. 2023.

**Conclusions/action items:**

Becker's Muscular Dystrophy is a less common type of Muscular Dystrophy that is genetic and x-linked. Despite it being less severe than Duchenne's Muscular Dystrophy, it is understudied with less medications and research available for patients. Over time, BMS causes muscle weakness, decreased heart function, and impaired grip strength over time.





# 2023/9/18 Becker's Muscular Dystrophy Research

---

**Title: Becker's Muscular Dystrophy Research****Date:** 9/18/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To discover more about Becker's Muscular Dystrophy in order to see how it limits movement and how it affects its patients over time. This information will be used to determine how much assistance our product should provide and how the product should be enhanced or upgraded over time.**Content:**

Becker's Muscular Dystrophy

- X-linked recessive disorder
- mutation in dystrophin gene --> progressive muscle degeneration and weakness
- almost exclusively found in males
- slows growth - usually leads to short stature (our patient is 6'2", not always the case)
- generalized weakness first affects muscles of hips, pelvic area, thighs, and shoulders
- calves usually enlarged
- can have significant heart issues
- most people with BMD live through mid-late adulthood (mean lifespan of mid 40s)
- principle cause of death is heart failure with BMD patients

**Sources:**

"Becker Muscular Dystrophy (BMD) | Muscular Dystrophy Association." *Muscular Dystrophy Association*, 31 Jan. 2018, [www.mda.org/disease/becker-muscular-dystrophy](http://www.mda.org/disease/becker-muscular-dystrophy).

Thada, Pawan K., et al. "Becker Muscular Dystrophy." *PubMed*, tatPearls Publishing, 2022, [www.ncbi.nlm.nih.gov/books/NBK556092/#:~:text=Becker%20muscular%20dystrophy%20\(BMD\)%20is](http://www.ncbi.nlm.nih.gov/books/NBK556092/#:~:text=Becker%20muscular%20dystrophy%20(BMD)%20is)

**Conclusions/action items:**

Becker's Muscular Dystrophy is an X-linked genetic disease that affects people throughout their entire lives. Symptoms usually begin with weakness in the hips, pelvic area, thighs, and shoulders that eventually leads to decreased mobility, leading to many patients needing wheelchairs for mobility. Despite muscle weakness getting worse over time, patients without heart issues typically live longer lives through mid to late adulthood.





## 2023/9/24 Becker's Muscular Dystrophy Progression Timeline

---

**Title: Becker's Muscular Dystrophy Progression Timeline****Date:** 9/24/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To understand how BMS affects patients over time and what skills and abilities are lost over time**Content:****BMS:**

-symptoms usually show up in teen or adult years

-slower progression than DMS, harder to predict

-BMS produces more dystrophin than DMS (protein that protects muscle fibers from breaking down when exposed to enzymes)

-starts with change in gait, with waddling and toe walking or pushing abdomen forward to maintain balance - lack of strength in hips and legs

-eventually lose enough muscle strength where patients need to use wheelchairs

-BMS can cause cardiomyopathy -weakening of heart muscles - can lead to heart failure and need of transplant

**Works Cited:**

"Becker Muscular Dystrophy." *Wwwhopkinsmedicine.org*, 8 Aug. 2021, [www.hopkinsmedicine.org/health/conditions-and-diseases/becker-muscular-dystrophy#:~:text=Becker%20muscular%20dystrophy%20can%20caus](http://www.hopkinsmedicine.org/health/conditions-and-diseases/becker-muscular-dystrophy#:~:text=Becker%20muscular%20dystrophy%20can%20caus)

"Muscular Dystrophy, Becker - NORD (National Organization for Rare Disorders)." *Nord (National Organization for Rare Disorders)*, NORD, 2015, [rarediseases.org/rare-diseases/muscular-dystrophy-becker/](http://rarediseases.org/rare-diseases/muscular-dystrophy-becker/).

**Conclusions/action items:**

Becker's Muscular Dystrophy usually begins to show symptoms in teen and early adult years with a change in gait, usually with toe walking or a waddle to maintain balance. Eventually, enough muscle strength becomes lost and patients need to use a wheelchair or eventually develop cardiomyopathy, which could lead to heart failure. The disease progresses much slower than Duchenne's Muscular Dystrophy, giving a longer lifespan typically.



**2023/9/24 Protekt STS 500**

---

**Title: Protekt STS 500 Compact Sit-to-Stand Patient Lift****Date:** 9/24/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To discover competing designs that help wheelchair users stand and understand how they work**Content:****Protekt STS 500 Compact Sit-to-Stand Patient Lift**

- device can be electronically lowered and raised to adjust to different heights with a remote
- has 4 rolling casters that can be locked in place during transfer
- made to be used with assistance from nurse or caregiver - seems to be able to be used independently
- designed mainly for transferring from the wheelchair to the toilet or bed
- knee pads for comfort
- uses a sling that straps around patient - lift attaches to sling and lifts up- lifts patient in a standing position as they lean back into the sling
- would only be useful for pulling pants up if pants were partially on before getting into sling
- Costs \$1,199.00 - very costly
- can support up to 500 lbs
- designed for people lacking in leg strength in lower extremities but still with ability to bear some weight
- 119 pounds
- has 0 reviews - could be new product on the market, or unpopular product

**Works Cited:**

"Proactive Medical Protekt STS 500 Compact Sit-To-Stand Patient Lift 34500-COM." *MDMaxx*,  
mdmaxx.com/products/proactive-medical-34500-com-protekt-sts-500-compact-sit-to-stand-patient-lift?  
channable=4138a461727469636c655f6e756d626572004d4438333233313245&gclid=Cj0KCQjwvL-  
oBhCxARIsAHkOiu27Uw\_-nO8Tt2kOC8mOoWlfgLnL\_YroOoGdbNT1Hplole5iVDUMMIUaArVIEALw\_wcB.

**Conclusions/action items:**

This product seems to be useful for transferring people who use a wheelchair into the standing position and could be very effective when putting pants on. However, the product is quite large and is in no means portable. It is also quite costly, and requires some preparation and setup to use. Our design will have to have the same effectiveness for dressing without being expensive and complicated, and preferably being more compact



## 2023/10/2 Materials Research

Kate Murray - Oct 02, 2023, 8:14 PM CDT

**Title:** Materials Research

**Date:** 10/2/23

**Content by:** Kate Murray

**Present:** Kate Murray

**Goals:** To find out which metal should be used as the base for the lean and lift device, based on price, sturdiness, and weight.

**Content:**

Aluminum vs. Steel

	1018 Mild/Carbon Steel	5052 Aluminum Alloy	304 Stainless Steel
Price (per pound)	\$0.40	\$0.44	\$0.29
Yield Strength (ksi)	53.7	35	30
Density (lb/in <sup>3</sup> )	0.284	0.097	0.289

Because aluminum is so much less dense than either steel options, it will be way cheaper to produce. All of the metals are extremely strong, so carrying out our project with aluminum will help decrease the cost and weight of the project while still being strong enough to hold the weight of our client for 5 years.

**Works Cited:**

"EML2322L -- Materials and Material Selection." *Ufl.edu*, 2023, [mae.ufl.edu/designlab/Class%20Projects/Background%20Information/Materials%20and%20material%20selection.htm](http://mae.ufl.edu/designlab/Class%20Projects/Background%20Information/Materials%20and%20material%20selection.htm)

"How Much Does Steel Plate Cost: 2023?" *Www.leecosteel.com*, [leecosteel.com/news/post/cost-of-steel-plate/#:~:text=Steel%20is%20typically%20priced%20by](http://leecosteel.com/news/post/cost-of-steel-plate/#:~:text=Steel%20is%20typically%20priced%20by). Accessed 3 Oct. 2023.

"There's Much to Think about When Comparing Aluminum vs. Steel Properties -- Cost, Strength, Weight, & Ductility. Learn to Choose the Right One Here!" *Mchone Industries*, 7 Aug. 2019, [www.mchoneind.com/aluminum-vs-steel/](http://www.mchoneind.com/aluminum-vs-steel/).

**Conclusions/action items:**

Knowing that aluminum will be the most weight and cost effective material for our project, I will begin researching ways to purchase aluminum for our beams when we have a more finalized prototype in CAD or SolidWorks with dimensions.



**2023/10/9 Materials Research - Lean and Lift**

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**Title: Materials Research for Lean and Lift Design****Date:** 10/9/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To find exactly which type of aluminum and foam material we should use for the lean and lift design.**Content:**

Cushion:

Need to compare different upholstery foams

- want something firm and durable yet comfortable
- best option: high density polyurethane foam
  - perfect for frequent indoor use, more durable
  - made for furniture, will last constant use on a daily basis

Aluminum:

- want something cheap and inexpensive
- wheelchairs use T6 aircraft grade aluminum, would want something similar as it serves a similar purpose
  - durable, can last several years without deterioration, lightweight
- Aluminum 6061-T6:
  - ultimate strength - 310 MPa
  - Tensile yield strength - 276 MPa
  - Melting point - 582-652 °C
  - Shear Strength - 207 MPa
- super strong and very high melting point, will withstand 5 years of usage

**Works Cited:**

[1] "Comparing Different Types of Upholstery Foam," [www.youtube.com](https://www.youtube.com/watch?v=BFK0o9W-loE). <https://www.youtube.com/watch?v=BFK0o9W-loE> (accessed Oct. 09, 2023). [csr 1686,](https://www.youtube.com/watch?v=BFK0o9W-loE)



[2] "Durable Wheelchairs: What is the best type of material to buy," *Karman® Wheelchairs*, Jul. 30, 2013.

<https://www.karmanhealthcare.com/durable-wheelchairs-best-material/#:~:text=For%20example%2C%20Aircraft%20grade%20aluminum>

### **Conclusions/action items:**

For the final product of the lean and lift portion of the project, the cushion will be made out of high density polyurethane foam and the base of the design will be made out of 6061-T6 Aluminum



# 2023/10/15 Lean and Lift Materials Research

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**Title: Lean and Lift Materials Research****Date:** 10/15/2023**Content by:** Kate Murray**Present:** Kate Murray

**Goals:** To research the price, ease of welding, strength, accessibility, and weight of different types of aluminum and organize them in a design matrix to decide which material we could use for the lean and lift fabrication

**Content:**

	Ease of Fabrication	Strength	Density	Accessibility	Cost
6061 T6 Aluminum	prone to hot cracking, back for welding (would need a filler metal to weld pieces together)	276 MPa, 40 ksi	2.7g/cm <sup>3</sup> , 0.0975 lb/in <sup>3</sup>	Avaliable in multiple varieties on grainger (UW Shop)	\$0.785/in for 0.028 in wall thickness on grainger
5083 Aluminum	naturally resistant to hot cracking, easier to weld autogenously, high weld efficiency and high joint strength	228 MPa, 33 ksi	2.66 g/cm <sup>3</sup> , 0.0961 lb/in <sup>3</sup>	available only as solid slabs on grainger	\$1.329 /in <sup>2</sup> on grainger
5454 Aluminum	moderate to high strength, excellent weldability - soldering and brazing not recommended	215-275 MPa	2.69 g/cm <sup>3</sup>	having a hard time finding this material	N/A

all are corrosion resistant

**Works Cited:**

[1] "Aluminum Workshop: Welding 6061-T6 without filler metal; choosing shielding gas for GMAW," *Thefabricator.com*, Jan. 06, 2015. <https://www.thefabricator.com/thewelder/article/aluminumwelding/aluminum-workshop-welding-6061-t6-without-filler-metal-choosing-shielding-gas-for-gmaw#:~:text=A%3A%20A%20common%20aluminum%20alloy>

[1] "ASM Material Data Sheet," *asm.matweb.com*. <https://asm.matweb.com/search/SpecificMaterial.asp?bassnum=MA6061T6>

[1] ["Which Aluminum Alloys are Best for Welding? - Gabrian," www.gabrian.com, Dec. 02, 2021.](https://www.gabrian.com/which-aluminum-alloys-are-best-for-welding/)  
<https://www.gabrian.com/which-aluminum-alloys-are-best-for-welding/>

[1] ["Aluminium Alloy - Commercial Alloy - 5454 - 'O' and H111 Sheet," www.aalco.co.uk.](https://www.aalco.co.uk/datasheets/Aluminium-Alloy-5454-O-and-H111-Sheet_238.ashx#:~:text=Aluminium%20alloy%205454%20has%20very)  
[https://www.aalco.co.uk/datasheets/Aluminium-Alloy-5454-O-and-H111-Sheet\\_238.ashx#:~:text=Aluminium%20alloy%205454%20has%20very](https://www.aalco.co.uk/datasheets/Aluminium-Alloy-5454-O-and-H111-Sheet_238.ashx#:~:text=Aluminium%20alloy%205454%20has%20very) (accessed Oct. 15, 2023).

#### **Conclusions/action items:**

**Because 5083 Aluminum is the best for welding and is easily accessible, it seems to be the best metal for our welding project for the lean and lift device**



# 10/26/2023 Standing Desk Research

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**Title: Standing Desk Research****Date:** 10/26/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To find a standing desk that could be modified for the lean and lift frame design**Content:**

## 1. Home Depot Standing Desk

- adjustable (hand crank), made from steel (weldable), wide enough to give Dan room to move around
- fairly expensive, would need to see if we can expand budget
- 66 lb, does not say how much weight it could hold

<https://www.homedepot.com/p/ErgoMax-25-5-in-Rectangular-Black-Standing-Desk-with-Adjustable-Height-Feature-ABC256BK/300743265#overlay>

## 2. Steel Folding Sawhorse

- can hold up to 750 pounds
- could be welded to be made sturdier, less likelihood of collapsing
- would need to possibly add height somehow, low to the ground only 28.4 in tall
- 34.4 in wide - gives room for dan to move around
- total depth of 21.7 in
- only \$24.98!!
- could either use one or put two together welding a metal bar between them

<https://www.homedepot.com/p/28-4-in-Steel-Folding-Sawhorse-SH106C/314519885>

## 3. STEELMAN Folding Sawhorse

- 30 3/8 in tall
- can hold 800 pounds
- may need some adjustments with the height
- \$51.14 but on grainger, preferable

- made of steel, can be welded easily
- only 25 inches of width, less room for Dan, could extend by welding or with attaching cushion

<https://www.grainger.com/product/STEELMAN-Folding-Sawhorse-Fixed-Ht-45ND38>

**Conclusions/action items:**

I will show these pre-made frames to the rest of the team and Dan to compare our options and finalize which product we will purchase.



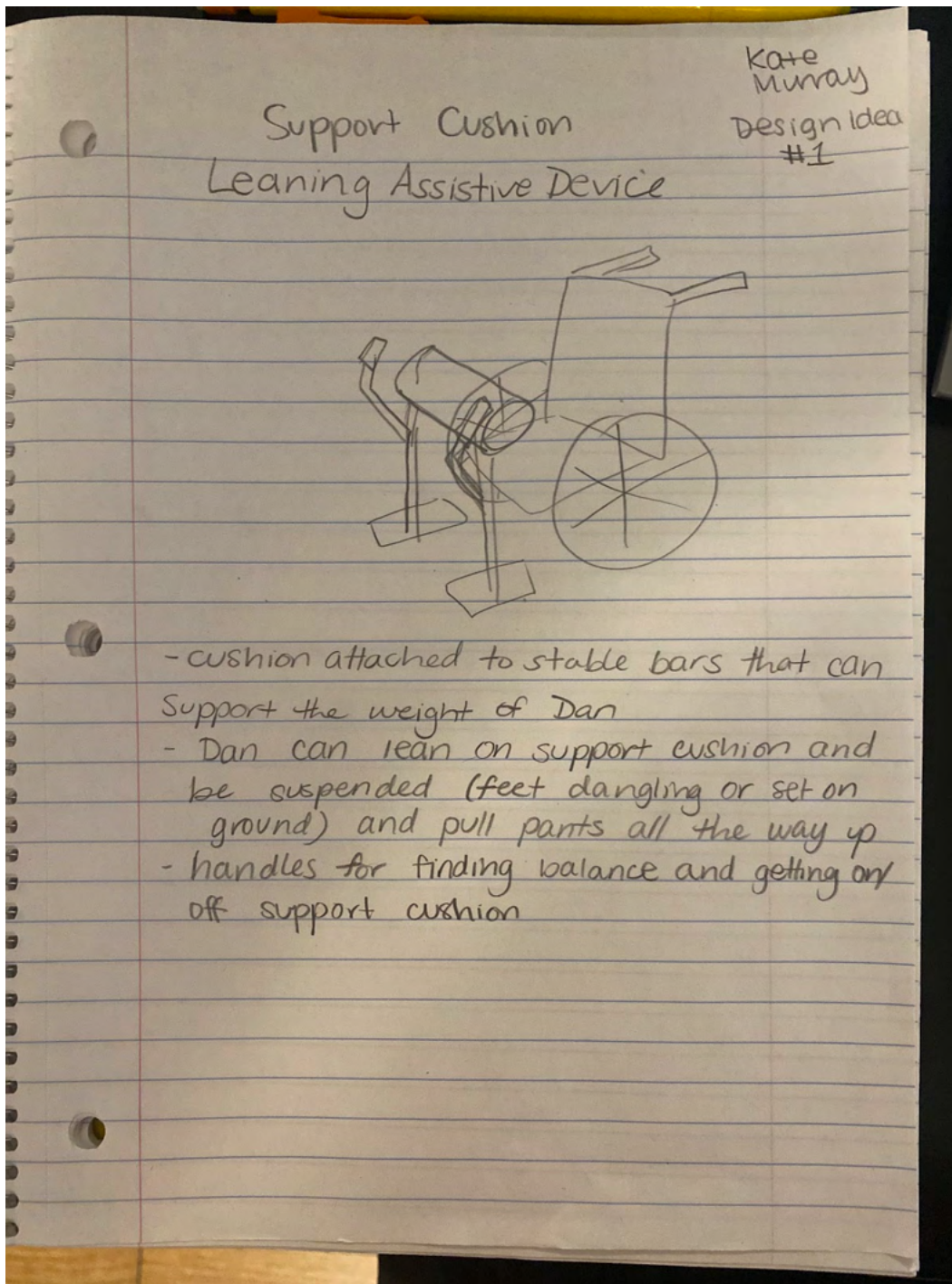
**2023/9/17 First Design Idea**

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**Title: Support Cushion Leaning Assistive Device Design****Date:** 9/17/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To brainstorm a functional design that will allow Dan to successfully pull up his pants without assistance from others.**Content:**

**This design features a cylindrical cushion attached to two posts that will hold it at waist-level (from the wheelchair) above the ground. The client will be able to lean on the cushion area on the device, putting almost all of his weight on it, in order to pull his pants all the way up. For help with getting on and off of the cushion, handlebars will be installed.**



#### Conclusions/action items:

I will show this design to my team and from there, we will discuss the logistics and likelihood of success this design idea has. If we believe this design idea could be useful to our client, we will look further into the materials and specifications for this product and will begin prototyping.

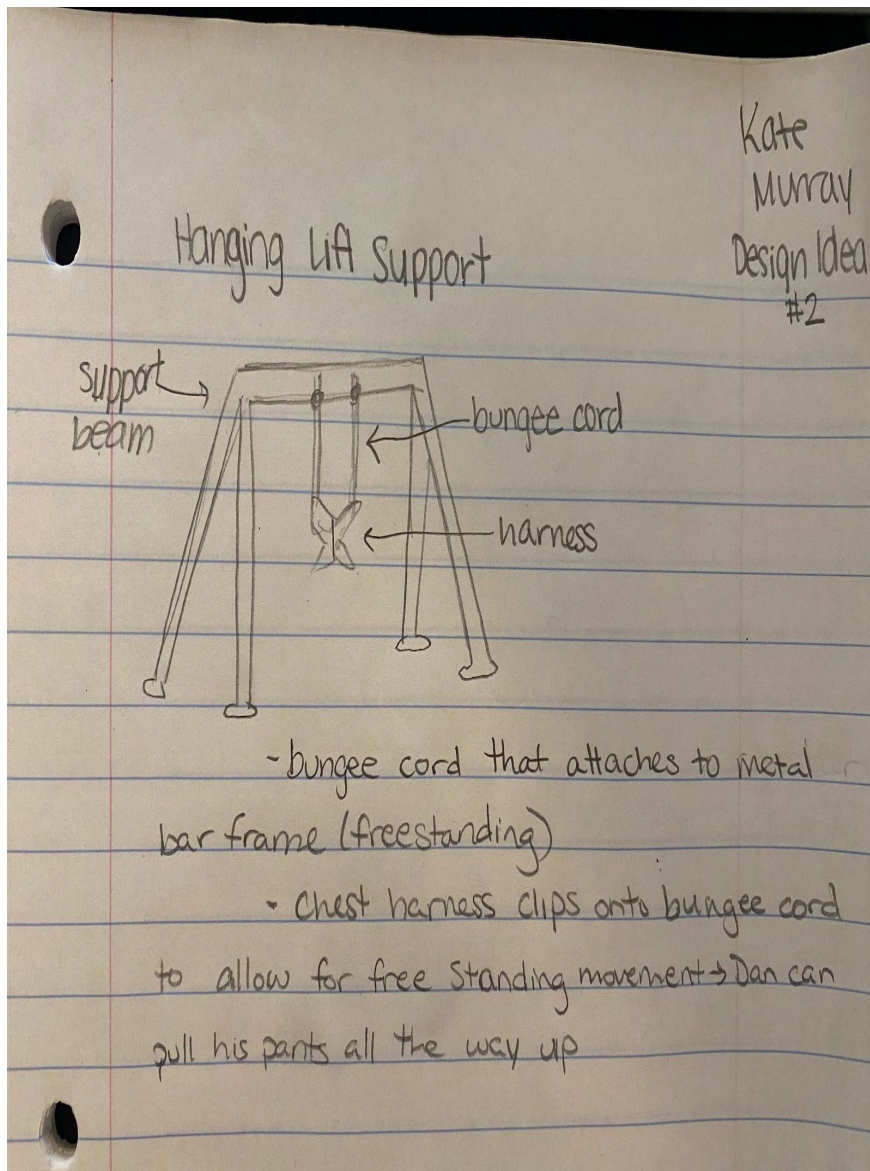


**2023/9/24 Second Design Idea**

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**Title: Hanging Lift Support Design****Date:** 9/24/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To develop a design that allows Dan to fully put on a pair of pants in a simple and cost effective design.**Content:**

**This design incorporates a metal bar frame that would support two bungee cords. Dan would be able to strap into a harness that fits around his arms and chest that would hook onto the back of the harness and hold Dan upwards in a standing position. In this position, Dan would be able to freely pull his pants all the way up without friction between the pants and his wheelchair seat.**



### Conclusions/action items:

For this design, the team and I will consider the feasibility and utility of it and decide from there if it should be in our design matrix. If so, we will begin the early stages of prototyping and figure out which materials would best suit the design.

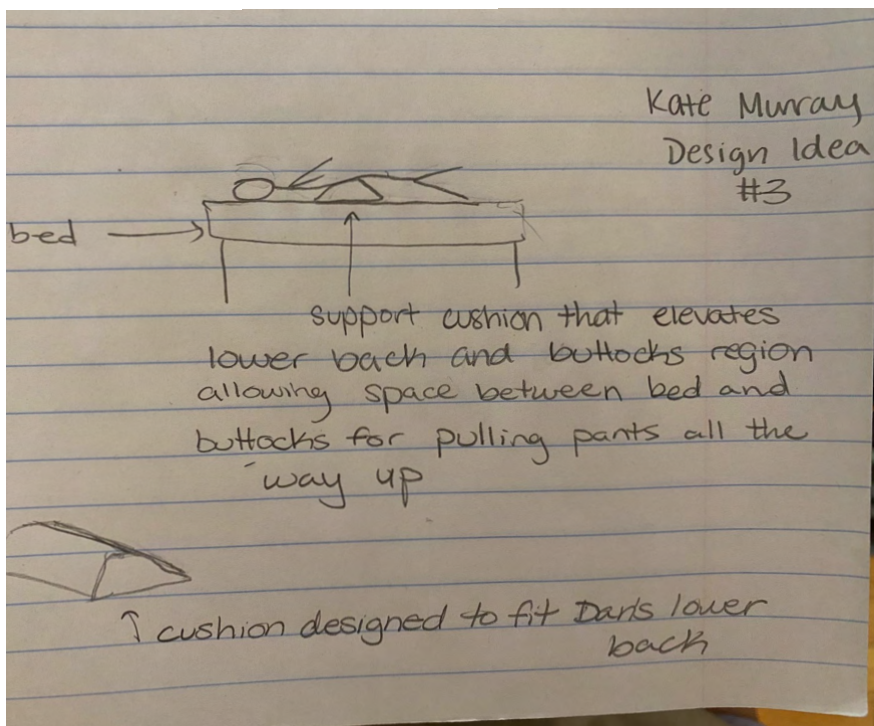


**2023/9/24 Third Design Idea**

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**Title: Bed Lower Back Support Design****Date:** 9/24/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To develop a design that will allow Dan to independently fully put on a pair of pants in a simple and cost effective manner**Content:**

This design is simply a foam cushion tailored to the curvature of Dan's back that will slide under him while he is in a laying position. By placing it under his lower back, his buttocks area will be lifted above the bed, allowing him to put on his pants without friction from his wheelchair or the bed.

**Conclusions/action items:**

Before carrying on with this design idea, we will need to confirm with Dan that he has the capability of bending his legs and pulling his pants up from a laying position. If he is not able to, we will modify the design idea with a roller bed design that would assist in the pants putting on process.



## 2023/9/29 BPAG Meeting

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**Title: BPAG Meeting****Date:** 9/29/23**Content by:** Kate Murray**Present:** Kate Murray**Goals:** To understand my roles and responsibilities as the BPAG**Content:**

- if not affiliated through UW and not using UW funds, get reimbursed by client
- For us - project is getting paid through university - go through John Puccinelli to get reimbursed
- ShopUW+
  - complete list of vendors
  - client pays for materials with a funding string - you CANNOT order directly
  - if client is using UW funding, you must show that these vendors do not have the product available (cost irrelevant) to purchase items elsewhere
- can get stuff from the makerspace and in grainger, staples, etc. also stuff from team lab when ECB opens up again...
- can learn a lot through Makerspace and TeamLab (\$50/semester shop fee)
- only BPAG should be seeking reimbursement (easier to just have them pay you all back at end of the year)
- 90 days to get reimbursed from day of purchase for UW funds - need super detailed receipts and all that (email receipts, download invoice, need name date, quantities, dates, where/who it was from, etc.)

**Non-Reimbursable Expenses**

- lab archives - \$15
- COE TeamLab/Makerspace - \$50 each
- Poster printing - \$50 per team

**Accounting:**

- Make a table with ALL vital information to purchase again
- ensure table is legible (shrink links )
- make final table of only materials/expenses for final design

- can separate out between prototypes
- have all expenses approved prior to purchase
- any purchase over \$1000 needs department and client approval

-can find all this information on the BME design website under BPAG

**Conclusions/action items:**

As the BPAG, I am responsible for all purchasing and reimbursement for the team. The university for be paying for Dan's expenses so I will have to go through the university for reimbursement.



## 9/13/23 - General Muscular Dystrophy Info

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Jacob Parsons - Sep 13, 2023, 6:30 PM CDT

**Title:** Muscular Dystrophy Notes

**Date:** 9/13/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Learn more about the basics of muscular dystrophy

**Content:**

On PUBMED, searched "Muscular Dystrophy"

Citation: J. C. Carter, D. W. Sheehan, A. Prochoroff, and D. J. Birnkrant, "Muscular dystrophies," *Clinics in Chest Medicine*, vol. 39, no. 2, pp. 377–389, 2018. doi:10.1016/j.ccm.2018.01.004

Notes:

- The most common type of muscular dystrophy in childhood is DMD. 8.3 per 100,000 boys experience this.
- The 2nd most common for childhood is Becker muscular dystrophy, occurring in 7.3 per 100,000.
- The most common type in adults occurs in 10.6 out of 100,000 people, it is myotonic dystrophy.
- Subtypes of muscular dystrophy are based on the genetic defect - if known
- Just cause patients have the same phenotypes (physical traits) does not mean they have the same genotypes (genetics), and vice versa
- DMD (Duchenne Muscular Dystrophy) is the most studied muscular dystrophy in regards to respiratory issues
- Boys with DMD have exhibit some of the following symptoms in childhood; troubles climbing stairs, clumsiness, toe-walking, weakness, and others

**Conclusions/action items:**

Muscular dystrophy is a complex group of neuromuscular conditions that can lead to unique respiratory and other medical needs. The most common type is Duchenne Muscular Dystrophy, so further research on the physical of individuals with this type should be conducted. Also, knowing the age of the potential consumer for the product would be important to know in the future so the more common types of muscular dystrophies for that age range can be studied.



## 9/13/23 - Duchenne Muscular Dystrophy Gait Notes

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Jacob Parsons - Sep 13, 2023, 7:20 PM CDT

**Title:** Duchenne Muscular Dystrophy Gait Notes

**Date:** 9/13/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To learn more information about Duchenne Muscular Dystrophy

**Content:**

On PubMed search "Duchenne muscular dystrophy upper body strength"

Citation: S. Armand *et al.*, "A comparison of gait in spinal muscular atrophy, type II and Duchenne muscular dystrophy," *Gait & Posture*, vol. 21, no. 4, pp. 369–378, 2005. doi:10.1016/j.gaitpost.2004.04.006

Notes:

- In this study, spinal muscular atrophy, type II (SMA II) and Duchenne muscular dystrophy (DMD) were compared in regards to the gaits of the individuals with each.
- The gait is the walking "pattern" of an individual.
- Both of these diseases can lead to progressive muscular weakness, leading to the need for assistance while walking.
- SMA II patients generally used pelvic rotation, initiated by the upper body, to walk forward.
- DMD patients generally used hip flexion and plantar flexion to walk.
- DMD patients generally exhibited less of an amplitude change in posture while walking compared to SMA II patients.

**Conclusions/action items:**

In review of the article, while both can lead to progressive muscular weaknesses in the legs, the muscular weaknesses experienced by the patients with different diseases were different. A following article should be reflective of the upper body tendencies from individuals with these diseases as well. This assessment can give a better insight into the variety and range of conditions the project may need to account for.



## 9/13/23 - Muscle Weakness in Neuromuscular Disease

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Jacob Parsons - Sep 13, 2023, 7:27 PM CDT

**Title:** Muscle Weakness in Neuromuscular Disease Notes

**Date:** 9/13/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To find information on the muscular capabilities of individuals with neuromuscular diseases (specifically upper body)

**Content:**

On PubMed search "Duchenne muscular dystrophy upper body strength"

Citation: P. Kaya, İ. Alemdaroğlu, Ö. Yılmaz, A. Karaduman, and H. Topaloğlu, "Effect of muscle weakness distribution on balance in neuromuscular disease," *Pediatrics International*, vol. 57, no. 1, pp. 92–97, 2014. doi:10.1111/ped.12428

Notes:

- The study consisted of 40 individuals with neuromuscular disease, and were separated into 2 groups. Group 1 were individuals with proximal hinderances, while group 2 was distal.
- Muscular strength, balance, timed up-and-go testing, and functional performance were assessed.
- The scores of the lower and upper limbs and trunk muscle strengths were significantly differently between the two groups.
- The article stated that the distal patients were greater affected by their neuromuscular disease with regard to dynamic balance.
- Proximal patients were greater affected by their neuromuscular disease regarding static balance.
- Muscular strength was important for providing dynamic balance in the distal group, and for maintaining proximal stabilization during dynamic activities in the proximal group.

**Conclusions/action items:**

Similar to the previous article that was read, individuals with varying muscular diseases will experience different muscular effects. Knowledge of whether the target consumer for this project will have distal or proximal musculature weakness would be beneficial to know how to better design the product. However, if this is not addressed, then a product that can either help both needs to be designed, or one of the patient types may need to be cut out of the equation for this product (this seems to be a worst case situation).



## 9/20/23 - Becker's Muscular Dystrophy

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Jacob Parsons - Oct 05, 2023, 1:00 PM CDT

**Title:** Becker's Muscular Dystrophy Notes

**Date:** 9/20/23

**Content by:** Jacob Parsons

**Present:** n/a

**Goals:** To learn more about the specific muscular dystrophy that the client has.

**Content:**

Citation: Thada PK, Bhandari J, Umapathi KK. Becker Muscular Dystrophy. [Updated 2023 Jul 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK556092/>

Notes:

- Becker's Muscular Dystrophy is abbreviated as BMD
- It is a recessive X-linked disorder due to the mutation in the dystrophin protein
- Leads to progressive muscular degeneration and proximal muscle weakness
- Less common & less severe than Duchenne's Muscular Dystrophy
- Varies widely in when it affects people, 5-60 years of age
- Almost exclusively in males
- Chances of survival decrease with time as the disease progresses. Usually death occurs due to dilated cardiomyopathy

**Conclusions/action items:**

The article gives us a basic knowledge of what Becker's muscular dystrophy is; however direct communication with the patient about his range of motion and strength would be more beneficial due to the wide range of symptoms patients experience at a wide range of ages.



## 9/13/23 - Pants Up Easy Review

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Jacob Parsons - Sep 13, 2023, 6:03 PM CDT

**Title:** Pants Up Easy Notes

**Date:** 9/13/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Inform myself on the competing design Pants Up Easy

**Content:**

Citation: "Helping wheelchair users and others with mobility impairments to pull up their pants independently," Pants Up Easy, <https://www.pantsupeasy.com/> (accessed Sep. 13, 2023).

- A device that seems to attach to the wheelchair or can be mounted on the wall.
- It is 2 pads that lie above the user's shoulders, and are capable of rotating and turning.
- In order to get themselves up; the patient raises their arms, hoists themselves up and over - pulling themselves up off the chair, and then they are able to pull their pants up.
- The product costs upwards of \$1500.
- However there are ways that potential clients can have a discounted price: the VA covers 100%, Medicaid waiver funds, and most insurance coverage's
- The travel model is transportable.

**Conclusions/action items:**

Overall, the product seems to be a very functional and useful product for the clients. However, the product does have a couple of drawbacks. Firstly, it requires the patient to have enough upper body strength, mobility, and coordination - which some individuals who are in wheelchairs may not have. Another downside to the product is the price. The cheapest model (the wall mount) is \$1500 dollars, while the wheelchair model is \$3600 (excluding special offer).



## 9/28/23 - Buddy Bar

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Jacob Parsons - Sep 28, 2023, 12:32 PM CDT

**Title:** Buddy Bar Notes

**Date:** 9/28/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To learn more about the buddy bar device

**Content:**

Citation:

"Buddy Bar Standing Assistance Aid for wheelchairs and toilets," Rehabmart.com, [https://www.rehabmart.com/product/buddy-bar-standing-assistance-aid-49878.html?gclid=CjwKCAjwyNSoBhA9EiwA5aYlbyI6\\_uCNqWsByvXLP9ig9nf6JOSgyQJTJRyH3yCgbv7mxiUOgt3NRwhoCNtAQAvD\\_BwE](https://www.rehabmart.com/product/buddy-bar-standing-assistance-aid-49878.html?gclid=CjwKCAjwyNSoBhA9EiwA5aYlbyI6_uCNqWsByvXLP9ig9nf6JOSgyQJTJRyH3yCgbv7mxiUOgt3NRwhoCNtAQAvD_BwE) (accessed Sep. 28, 2023).

Notes:

- The buddy bar is a device that attaches to the wheelchair, it is a set of 2 handles that assist the user in standing up
- Our client has struggles with upper body strength, so this device may not be the best option, however some modification or use of this device on top of the leaning contraption could work
- It has a weight limit of up to 300 lbs
- The price of this device is \$185.89
- The bars can rotate down too afterwards so they're not in the way
- There is also a model that can go around a toilet, so its easier to get up from the toilet

**Conclusions/action items:**

While the device alone may not be useful to our client, a mixture of this device with another part that the client can lean on could be helpful. A further analysis of the upper body strength of our client will need to be done so we know how much of his bodyweight he can pull.





[Download](#)

**buddybar.png (771 kB)**



## 9/28/23 - Protekt Dash Stand Assist

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Jacob Parsons - Sep 28, 2023, 12:51 PM CDT

**Title:** Protekt Dash Stand Assist

**Date:** 9/28/23

**Content by:** Jacob Parsons

**Present:** n/a

**Goals:** To learn more about different lift assist devices and use that as inspiration for our designs

**Content:**

Source:

"Protekt Dash Stand Assist Transfer w/ expandable base," NewLeaf Home Medical, [https://newleafhomemedical.com/protekt-dash-stand-assist-transfer-w-expandable-base/?gclid=CjwKCAjwyNSoBhA9EiwA5aYlb36PEW81d3hDI89xVfWmwajXN4jFKsjJu1KVgfdmC79Vx7BEEDEnBoCT08QAvD\\_BwE](https://newleafhomemedical.com/protekt-dash-stand-assist-transfer-w-expandable-base/?gclid=CjwKCAjwyNSoBhA9EiwA5aYlb36PEW81d3hDI89xVfWmwajXN4jFKsjJu1KVgfdmC79Vx7BEEDEnBoCT08QAvD_BwE) (accessed Sep. 28, 2023).

Notes:

- This design, again, in its raw form would not work for us
- It seems that there is a large factor of strength on the pulling up, and even some standing
- However, a device similar to this that our client leans on, or is strapped into, and then it raises him like a pendulum could work.
- This device is used as a stand assist with two options, a grab and pull or a belt that another person pulls you up with
- The allowable height range is 5'1" to 6'6"
- The device MSRP is \$800
- It does have an adjustable base, which allows for some variance in its size - 28" maximum width it seems



[Download](#)

**protekt.png (638 kB)**



## 10/5/23 - RC Winch Notes

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Jacob Parsons - Oct 20, 2023, 1:16 PM CDT

**Title:** RC Winch Notes

**Date:** 10/5/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To learn about the specs of the RC winch that the client has

**Content:**

Citation:

Maxsdrc, Perry\_zilla, and Anay, "RC4WD warn 9.5CTI-S 1/10 scale winch [RC4ZE0119]," AMain Hobbies, <https://www.ainhobbies.com/rc4wd-warn-9.5ctis-1-10-scale-winch-rc4ze0119/p1278949> (accessed Oct. 5, 2023).

Notes:

- Voltage: 6V to 11.1V
- Load limits: Dead lift 6.6lbs
- Load limits: Rolling drag 9 lbs
- Length: 2.98 in
- total width: 1.16 in
- Height: 1.39 in
- Weight: 3.39 oz

**Conclusions/action items:**

This is the RC winch that our client has. The specs require a higher voltage than an arduino uno would be able to supply, so a different voltage power & microcontroller would be required if we were to use it.



## 10/9/23 - Arduino Microcontroller Changes

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Jacob Parsons - Oct 10, 2023, 1:12 AM CDT

**Title:** Arduino Microcontroller Changes Notes

**Date:** 10/9/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To research Arduino Microcontroller adjustments that allow for a supply that can power the RC Winch

**Content:**

- Needs to supply 6V to 11.1V

**Citation:**

T. A. Team, "Arduino hardware," Arduino, <https://www.arduino.cc/en/hardware> (accessed Oct. 10, 2023).

**Notes:**

- No arduino microcontroller can supply more than 5V for an output voltage
- Not without damaging it internally, which would make it obsolete
- In order to increase the output voltage while having arduino stay as the microcontroller, you'll need to follow these steps:  
Use a left shifter or drive with help of a Transistor (MOSFET or BJT) to transform the voltage - 0/12.
- An external power supply will be required

**Conclusions/action items:**

In order to complete this properly, I will need to further improve my knowledge on a transistor and a left shifter or drive. If I know how to make this, the proper parts could be purchased in order to do this.



## 10/24/23 - Welding Material Notes

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Jacob Parsons - Oct 25, 2023, 12:23 AM CDT

**Title:** Welding Material Notes

**Date:** 10/24/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** To discuss the materials that can be used for the different types of welding and the advantages/disadvantages

**Content:**

- Facts of Tig:

Can weld more metals & alloys than other process

High quality, clean welds

No smoke or fumes

- TIG has precise welds, 2 hands used, foot pedal used as well

- Facts of MIG:

Can weld most commercial metals & alloys

For UW Madison, likely not aluminum

- MIG has a very simple technique

**Conclusions/action items:**

For our project, ideally the welding of aluminum would be preferred since it is cheaper and stronger, however it may be easier to weld steel. TIG welding would be the preferred method since TIG can form stronger and more precise welds - hence it would be more fitting for the lean and lift design. However, an analysis of the forces induced on the frame could allow for MIG welding if very strong welds are not needed. Completion of the TIG course would be beneficial if we have the time as well - so the team needs to discuss their commitment to welding and if they can find other alternatives.



## 10/25/23 - T Joints, Welding Alternative

Jacob Parsons - Oct 27, 2023, 1:14 PM CDT

**Title:** T Joints & Welding Alternative

**Date:** 10/25/23

**Content by:** Jacob Parsons

**Present:** N/

**Goals:** To look into T intersections & fabrication possibilities with that

**Content:**

- Could use T-joints to combine the bars instead
- Think of ladders game, where the corner intersections and T-intersections would be used to connect the tubes of the frame without welding
- May use screws, or be able to be twisted in, or potentially a perfect fit with

Source:

"Pipe decor 1/2 in. Iron Black 4-way FPT x FPT x FPT x FPT side outlet tee fitting (4-pack) PDB SOT-12-4," The Home Depot, <https://www.homedepot.com/p/PIPE-DECOR-1-2-in-Iron-Black-4-Way-FPT-x-FPT-x-FPT-x-FPT-Side-Outlet-Tee-Fitting-4-Pack-PDB-SOT-12-4/317995643?source=shoppingads&locale=en-US&srsId=AfmBOopQBrL3gYFc5oQLs1JQnMOeQFJrkvrrtAYHR4tVhd5paCDq8zvxMd4> (accessed Oct. 26, 2023).

- These 4 way intersections where pipes can be screwed in could prove to be beneficial in forming a frame that isn't soldered
- These joints can be used for the intersection between the bottom of the frame and the vertical portion - elbow joints would need to be used for corners

Source:

"Pipe decor 1/2 in. x 12 in. Black Industrial Steel Grey Plumbing Nipple (6-pack) 362 PD12X12-6," The Home Depot, <https://www.homedepot.com/p/Pipe-Decor-1-2-in-x-12-in-Black-Industrial-Steel-Grey-Plumbing-Nipple-6-Pack-362-PD12X12-6/313928961#overlay> (accessed Oct. 26, 2023).

- This pipe is one of the ones that can be screwed in, it is 12" so a longer size may be needed at some point

Source:

"Pipe decor 1/2 in. X 16 in. Black Industrial Steel Grey Plumbing Pipe (6-pack) 362 PD12X16-6," The Home Depot, <https://www.homedepot.com/p/PIPE-DECOR-1-2-in-x-16-in-Black-Industrial-Steel-Grey-Plumbing-Pipe-6-Pack-362-PD12X16-6/313929038> (accessed Oct. 26, 2023).

- This pipe is one of the ones that can be screwed in, it is 16" so a longer size may be needed at some point - even a middle intersection point

Source:

10pcs stainless steel T brackets 80mm80mm flat corner braces 1.5mm ..., <https://www.amazon.com/Stainless-Brackets-80mm80mm-Thickness-Furniture/dp/B09PFWCD2B> (accessed Oct. 27, 2023).

- These t joints are an option that can be used for any metal bars that we are to use
- These can be screwed in conjunction with the pipes

**Conclusions/action items:**

In case there is an issue with purchasing a pre-existing structure, or even welding, these options can lead to an alternative for the frame. A follow up on the amount of force the pipes can withstand from Home Depot would be beneficial to know how viable of an option it is.



## 11/9/23 - Winch Parts

Jacob Parsons - Nov 10, 2023, 1:17 PM CST

**Title:** Winch Parts

**Date:** 11/9/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Find last necessary components for the device to work

**Content:**

Reference:

B. Baldwin, "DIY RC Airplanes from scratch: The brooklyn aerodrome bible for hacking the skies," Amazon, <https://www.amazon.com/rc-battery/s?k=rc%2Bbattery> (accessed Nov. 10, 2023).

- Not all parts came with
- Need receiver or battery that can be connected
- Likely just a battery will need to be purchased, ideally under \$20 dollars to stay within budget in case 2 are needed.
- A battery can be found by searching "RC battery" on Amazon



**Conclusions/action items:**

Purchase the necessary component. Attach the component to the product and ensure that it works.





## 9/20/23 - Snap On Pants Idea

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Jacob Parsons - Sep 27, 2023, 10:36 PM CDT

**Title:** Snap On Pants Design Idea

**Date:** 9/20/23

**Content by:** Jacob Parsons

**Present:** n/a

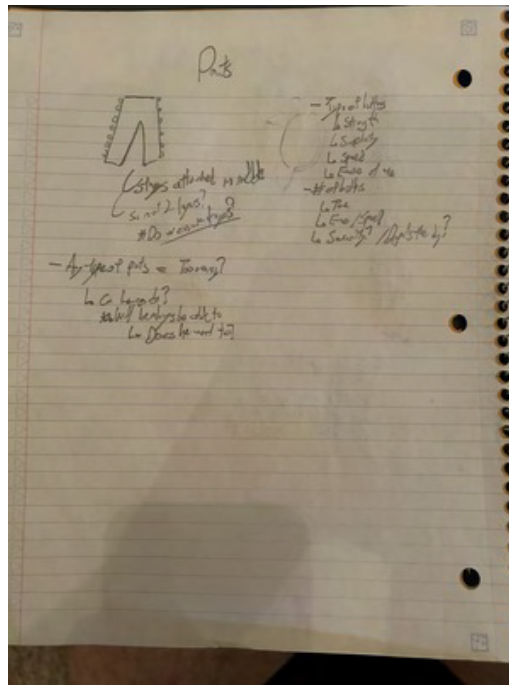
**Goals:** Explain the elementary design idea of snap on pants.

**Content:**

- The idea is very elementary, but has potential if the client likes it.
- Essentially snap on pants, once completely unsnapped, are two "V" shaped "blankets".
- The bottom pant can be laid on the wheelchair in such a manner that it looks like a leg print.
- The client can then get onto the wheelchair, sitting on the lower pant like a blanket, and then take the top pair of pants and place it over their legs like a blanket.
- The client then snaps the two pants together.
  
- This idea works on the assumption that the client is able to position themselves in such a way that they can reach the snaps - our client indicated to us some range of motion, so an in person test would be best to evaluate if the idea is even possible.
- Another alternative idea is to have zip up pants in case they are easier/better for the client to use.

**Conclusions/action items:**

The first action item is to propose this idea to the client and see if he is able to reach most of the way down his legs. If this is possible, then purchasing a cheap pair of snap on pants would be beneficial to test the idea. If it doesn't work, the team can quickly move on from the idea, if it does work, the team should consider it in the design matrix.



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IMG\_3319.JPG (2.16 MB)



## 9/27/23 - Lean and Lift Idea

Jacob Parsons - Sep 27, 2023, 10:39 PM CDT

**Title:** Lean and Lift Ideas

**Date:** 9/27/23

**Content by:** Jacob Parsons

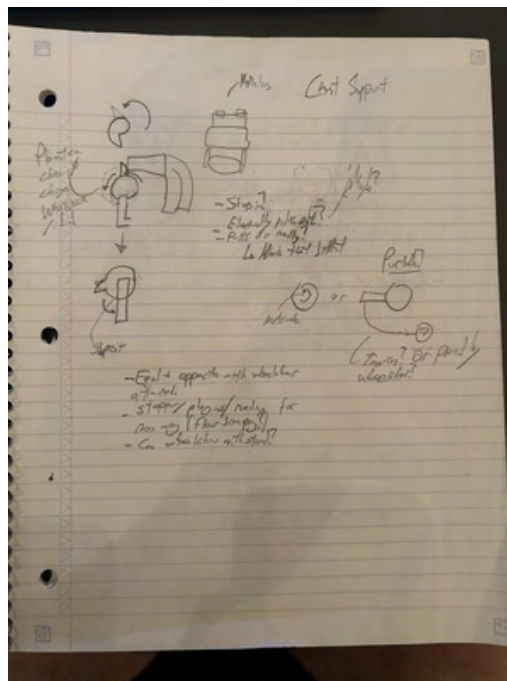
**Present:** N/A

**Goals:** To explore different design ideas for the lean and lift model.

**Content:**

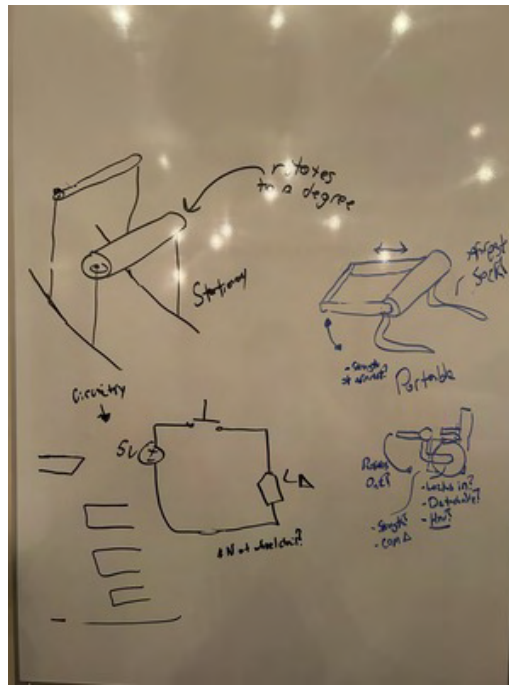
- The lean and lift design is based off of the principle of the client leaning over some sort of object in front of them, and putting a majority of their weight on said object so they can pull their pants up without the seat getting in the way.
- Below in the attached photo are a couple of design ideas.
- These design ideas include a stationary and a rotary leaning device, one that is electronically powered and one that spins till it hits a point.
- There are also ideas about portability here, where it can attach to the chair and swing in / swing out
- The "simpler" ideas would likely be a stationary one that is bedside or can be rolled around (compressible?)
- The major hump to get over on this one is if the client is able to get enough of their own weight on the pad unassisted, if not this may cause for some issues.

Jacob Parsons - Sep 27, 2023, 10:34 PM CDT



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IMG\_3318.JPG (2.23 MB)



[Download](#)

IMG\_3321.JPG (2.16 MB)



## 9/27/23 - Miscellaneous Ideas

Jacob Parsons - Sep 27, 2023, 10:44 PM CDT

**Title:** Miscellaneous Ideas for Project

**Date:** 9/27/23

**Content by:** Jacob Parsons

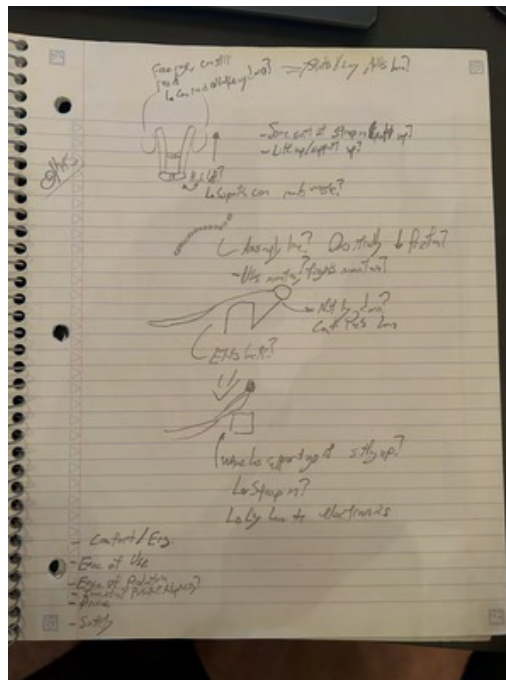
**Present:** N/A

**Goals:** To explore a couple different ideas that may not be large enough on their own, but could be potentially useful to add to a current design

**Content:**

- The miscellaneous ideas aren't big enough to have their own independent design, but they can be used to assist other designs.
- The first idea is some sort of strap idea. This can be used to assist the load of lifting the patient up, or holding the patient up if a design were to require it.
- The second idea is some sort of lifted object that would be placed above the waistline so that there is no contact from knee up. This would allow for an easier way to lift up the pants. However, the client still needs to reach the pants - which would require them sitting up. This idea, after some discussion, likely is not very effective.

Jacob Parsons - Sep 27, 2023, 10:35 PM CDT



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IMG\_3320.JPG (2.23 MB)



## 10/17/23 - MIG Welding Training

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Jacob Parsons - Oct 17, 2023, 6:17 PM CDT

**Title:** MIG Welding Training

**Date:** 10/17/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Get my welding certification for the team lab

**Content:**

- I completed the review of the study material for the MIG quiz
- The study material included a brief history on the origin of MIG welding, the safety precautions, and the details of the different parts of the system
- Then I completed a quiz on Canvas to ensure that I was prepared
- An in person learning lesson was then scheduled were I came into the team Lab for 2 hours and was taught on how to use it



## 10/24/23 - TIG Welding Training

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Jacob Parsons - Oct 24, 2023, 8:53 PM CDT

**Title:** MIG Welding Training

**Date:** 10/17/23

**Content by:** Jacob Parsons

**Present:** N/A

**Goals:** Get my TIG welding certification for the team lab

**Content:**

- I completed the review of the study material for the TIG quiz
- The study material included a brief history on the origin of TIG welding, the safety precautions, and the details of the different parts of the system
- Then I completed a quiz on Canvas to ensure that I was prepared
- 2 in person 3 hour sessions were scheduled where I had hands on training to be certified in TIG welding



## 2023/09/14 - "Muscular dystrophy"

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Sallie Schoen - Sep 14, 2023, 11:35 AM CDT

**Title:** "Muscular Dystrophy: Disease Mechanisms and Therapies"

**Date:** 9/14/23

**Content by:** Sallie

**Present:** N/A

**Goals:**

**Search Term:** muscular dystrophy

**Citation:**

**Content:**

Muscular dystrophy (MD) is a group of inherited muscle diseases that cause wasting and weakness of the muscles. MD is heterogenous, varying in age and onset, severity, pattern of muscle involvement and inheritance.

Chronic inflammation in patients with DMD may be related to loss of muscle function or to obesity.

Signs and symptoms: frequent falls, difficulty rising from a lying or sitting position, trouble running and jumping, walking on toes, large calf muscles, muscle pain and stiffness, learning disabilities, delayed growth.

becker MD - similar to duschenne (DMD) but milder and progress slower. symptoms begin in teens-mid 20s.

myotonic- inability to relax muscles following contractions.

facioscapulohumeral (FSHD)- muscle weakness in face, hip, and shoulder.

congenital- affects boys and girls and apparent at birth or before age 2.

limb-girdle- hip and shoulder muscles affected first, difficulty lifting front part of the foot, trip frequently.

DMD occurs commonly in young boys.

**Conclusions/action items:**

Find an article about the problems those of MD have with daily life.



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 Silver Spring, MD 20910, USA  
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## Editorial

### Muscular Dystrophy: Disease Mechanisms and Therapies

Suechinda Nand Pandey,<sup>1</sup> Aman Chhik Kesari,<sup>2</sup>  
 Teshfani Yokota,<sup>3</sup> and Geeta Shankar Pandey<sup>4</sup>

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Progressive weakness and degeneration of skeletal muscle caused by genetic alterations fall into the category of muscular dystrophy. Muscular dystrophy occurs worldwide and affects all races. The overall incidence of muscular dystrophy varies among forms, as some forms are more common than others. Muscle loss and weakness are not necessarily caused by genetic alterations. Skeletal muscle inactivity, disuse atrophy, cancer-associated cachexia, and physiological responses to fasting or starvation cause skeletal muscle waste loss through inhibition of synthesis and breakdown of proteins. Several genes have been identified that are directly or indirectly involved in various muscle wasting. Studies performed in human and animal models have substantially contributed to our knowledge of molecular mechanisms of muscle degeneration but all these findings are inadequate for developing effective therapy. Therefore, precise diagnosis of molecular mechanism provides the way for the development of therapeutic interventions for muscular dystrophies as well as for skeletal muscle loss.

In this special issue, we intended to publish research and review articles on exploring molecular mechanisms and target identification for treatment of muscle diseases. This issue will give insight into cellular and molecular mechanisms, activation of signaling pathways, base activation of these pathways cause muscle dysfunction, and subsequent disease progression. The review articles published in this special issue discuss the animal model for muscular dystrophy associated with dystroglycan (F. Sotnik et al.), followed by an article focusing on inflammation origin and maintenance in

Duchenne muscular dystrophy (DMD) patients (C. B. Cruz-Guerra et al.). The other demonstration related to cellular and molecular modeling of skeletal muscle loss. These studies describe the onset of disease onset in the skeletal muscle research, leading to the possibility for developing tools in therapeutic intervention. A study conducted by E. Gouglidis et al. provides new insight into the role of transferring growth factor beta 1 (TGFB1) in skeletal muscle. TGFB1 is considered to be a key player in skeletal muscle atrophy and endomyal fibrosis. E. Gouglidis et al. demonstrated that TGFB1 alone can induce TGF $\beta$ 1 phosphorylation of STAT3 in skeletal muscle cells, and higher pSTAT3 (Tyr705) leads to a seven-fold increase in myogenic TGF $\beta$ 1 gene.

C. B. Cruz-Guerra et al. have shown that chronic inflammation in patients with DMD may be related to loss of muscle function or to obesity. It is not known whether circulating pro-inflammatory cytokines such as, IL-6, IL-1, and TNF- $\alpha$  levels are associated with muscle function. Therefore, the purpose of this study was to evaluate whether an association exists between systemic inflammation with muscle function and nutritional status in DMD patients. The study concluded that systemic inflammation is increased in patients with better muscle function and decreased in DMD patients with poorer muscle function. Nevertheless, systemic inflammation is similar among different levels of nutritional status in DMD patients.

Dystroglycan (DGC) is highly expressed in skeletal muscle and serves as extracellular matrix receptor. Mutation in components of the DGC complex can cause inherited muscular

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md1.pdf (454 kB)



## 2023/09/21 - "Motor activity and Becker's muscular dystrophy: lights and shadows"

Sallie Schoen - Sep 21, 2023, 6:03 PM CDT

**Title:** "Motor activity and Becker's muscular dystrophy: lights and shadows"

**Date:** 9/21/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Describe what the article says about becker muscular dystrophy

**Search Term:** becker muscular dystrophy

**Citation:** Straub V, Guglieri M. An update on Becker muscular dystrophy. *Curr Opin Neurol.* 2023 Oct 1;36(5):450-454. doi: 10.1097/WCO.0000000000001191. Epub 2023 Aug 21. PMID: 37591308; PMCID: PMC10487383.

**Content:**

Becker's disease is an inherited muscular dystrophy caused by mutations in the gene coding for dystrophin protein that leads to quantitative or qualitative protein dysfunction. Patients undergoing workouts on a cycle ergometer or treadmill have a heart rate  $\leq$  65% of their maximal oxygen uptake, showing that aerobic exercise counteracts physical deterioration and loss of functional abilities.

Becker MD progresses more slowly than Duchenne MD.

Some symptoms of BMD are progressive muscle weakness beginning in the hip area, difficulty walking and performing tasks that require strength and coordination, and weakened respiratory muscles leading to respiratory problems.

**Conclusions/action items:**

There is no cure for BMD but there are therapies and interventions that can help manage symptoms.



## 2023/09/23 - "Mechanical Properties of SLM-Printed Aluminium Alloys: A Review"

Sallie Schoen - Sep 28, 2023, 5:40 PM CDT

**Title:** "Mechanical Properties of SLM-Printed Aluminium Alloys: A Review"

**Date:** 9/28/23

**Content by:** Sallie

**Present:** N/A

**Citation:** Ponnusamy P, Rahman Rashid RA, Masood SH, Ruan D, Palanisamy S. Mechanical Properties of SLM-Printed Aluminium Alloys: A Review. *Materials (Basel)*. 2020 Sep 26;13(19):4301. doi: 10.3390/ma13194301. PMID: 32993134; PMCID: PMC7579539.

**Goals:** Find possible materials that can be used for the lean and life design.

### **Content:**

I searched on chat gpt which material would be able to support a 230lb male and the following materials were listed: hardwood, plywood, metal, solid wood, and composite materials. I began to further research Al metal for the legs aspect of the lean and lift design.

3D printing (3DP), also known as additive manufacturing (AM) is used for many engineering applications. Many technologies are in practice for AM of metallic parts, such as selective laser melting (SLM), electron beam melting (EBM), laser-engineered net shaping (LENS), direct metal deposition (DMD), and cold spray additive manufacturing (CSAM).

Al alloys are one of the most common SLM-processed metals. Al alloys are characterized by their lightweight, high strength, corrosion resistance, and good weldability, making them suitable for a range of applications (machinery). Al-Si are used in the SLM process because of their fabricability.

There are few studies on the mechanical properties of SLM Al alloys carrying out the dynamic behaviors in tension and compression, fatigue, impact, and wear.

### **Conclusions/action items:**

I researched this article because I wanted to get familiar with aluminum materials because they could be a good candidate to use for some parts of the lean and lift design if the team chooses that design as the final design. If Al is a chosen material, more research on specific Al needs to be conducted.

It is important to think about every aspect of the design when deciding on materials. The legs and body should provide enough support to hold up the upper body of a 230-lb male without fail. The portion of the lean and lift design that the user leans against should be comfortable, not a hard or rigid material. If the lean and lift design is chosen, the team should discuss together and with the client if there will be wheels with locks on the bottom to allow the design to move around and lock in place to make it more portable. The team should also discuss if the design will fold or come apart so it can be transported out of the user's house if needed.

Review  
**Mechanical Properties of SLM-Printed Aluminium Alloys: A Review**

Praveen Prasadmany <sup>1,2</sup>, Kiran, Abdul Rahman, Rashid <sup>1,3</sup>, Syed Hassan Masood <sup>1,2,3</sup>,  
 Ding Huan <sup>1,2</sup> and Ibrahim Polatsoy <sup>1\*</sup>

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<sup>2</sup> Defence Materials Technology Centre (DMTC), Inland, Hawthorn, VIC 3122, Australia  
<sup>3</sup> Correspondence: rsh.masood@swin.edu.au

Received: 30 July 2023; Accepted: 27 September 2023; Published: 28 September 2023



**Abstract:** Selective laser melting (SLM) is a powder bed fusion type metal additive manufacturing process which is being applied to manufacture highly complex and value added parts in biomedical, defence, aerospace, and automotive industries. Aluminium alloy is one of the widely used metals in manufacturing parts in SLM in these sectors due to its light weight, high strength, and corrosion resistance properties. Parts used in such applications can be subjected to severe dynamic loadings and high temperature conditions in service. It is important to understand the mechanical response of such products produced by SLM under different loading and operating conditions. This paper presents a comprehensive review of the latest research carried out in understanding the mechanical properties of aluminium alloys processed by SLM under static, dynamic, different build orientations, and heat treatment conditions with the aim of identifying research gaps and future research directions.

**Keywords:** selective laser melting; aluminium alloys; mechanical properties; tensile; compression; fatigue; heat treatment; build orientation

### 1. Introduction

Additive manufacturing (AM), more popularly known as 3D printing (3DP), has been extensively applied for various engineering applications. When compared to conventional manufacturing, highly complex parts such as lattice structures can be produced by AM because of the layer-by-layer fabrication process [1]. In recent times, AM technologies are being sought after for providing customised solutions to problems arising due to the COVID-19 virus [2]. Several technologies are in practice for the AM of metallic parts, which include selective laser melting (SLM), electron beam melting (EBM), laser engineered net shaping (LENS), direct metal deposition (DMD), and cold spray additive manufacturing (CSAM). Each of these processes offers its own merits and limitations in terms of quality of the parts, mechanical property, performance of the component, and the range of materials that can be fabricated. Among these AM processes, SLM is being widely accepted by industry to manufacture complex, high value added, and complex metal components for aerospace, automotive, defence, and biomedical applications [3]. SLM is a powder-bed fusion type process that produces metal parts by selectively fusing metal powder on a platform using a laser beam. Figure 1 presents the schematic illustration of the SLM process. According to Keenan et al. [4], the fusing occurs through the melting and rapid solidification of metal powder scattered by a laser beam along a 3D print-path created by a processing software.

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materials-13-04301.pdf (875 kB)



## 2023/09/21 - Pants up Easy

---

Sallie Schoen - Sep 21, 2023, 5:46 PM CDT

**Title:** Pants Up Easy

**Date:** 9/21/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Describe the competing design.

**Link:** <https://www.pantsupeasyoffers.com/>

**Content:**

Advantages of PantsUp Easy

- hands-free lift system
- saves significant time
- reduces the need for assistance and pain
- increases stability while pulling pants up

Very costly- \$1497 is the cheapest

There are many different models- wall mount, toilet, wheelchair, and travel.

Wheelchair model- made of heavy-duty steel for anywhere in the home or office. Gives the highest level of support where needed. Casting wheels allow it to move or lock in place. Can be stored quickly using folding legs. \$2897

**Conclusions/action items:**

Pants Up Easy is a great design that proves to be effective in helping patients pull their pants all the way up in a wheelchair. The cost is way too high, it is not portable, and you have to assemble the product.

The wheelchair model brought good design considerations if our prototype will be mounted to a wheelchair/compatible with a wheelchair. Our prototype should be easily stored, able to be locked in place or move freely if that's what the design asks for, and provide the maximum weight support.



## 2023/09/28 - My Buddy Bars

Sallie Schoen - Sep 28, 2023, 5:08 PM CDT

**Title:** My Buddy Bar

**Date:** 9/28/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Describe the competing design.

**Link:** <https://mybuddybars.com/>

**Content:**

Buddy bar is a durable grip bar that mounts to most wheelchairs and helps the user pull themselves forward/up from a seated position with minimal assistance. It is a FDA Class I cleared transfer device.

With regular use, can help build upper body strength leading to more mobility, balance, and greater confidence to stand up.

How it works:

Buddy Bar flipped down  
and out of the way.



Buddy Bar flipped up and  
ready to support a patient.



Stable grip structure that can easily attach to the wheelchair.

For someone helping the user in a wheelchair, you don't need to reach down to grab the patient. This minimizes possible accidents or strains on the helper.

Currently unavailable on Amazon. 1 box contains a set of 2 bars- one to attach to the right and one to attach to the left side of the wheelchair.

**Conclusions/action items:**

This is a good competing design and could possibly be used as to reference in the making of our final design.

I saw this competing design in Jacob's research section and thought it would be a good idea to look into it more.



**2023/1/10 - Al Alloys Mechanical Properties**

---

**Title:** Aluminum alloys mechanical properties

**Date:** 10/10/23

**Content by:** Sallie

**Present:** n/a

**Citation:**

The Engineering ToolBox (2008). *Aluminum Alloys - Mechanical Properties*. [online] Available at: [https://www.engineeringtoolbox.com/properties-aluminum-pipe-d\\_1340.html](https://www.engineeringtoolbox.com/properties-aluminum-pipe-d_1340.html) [Accessed Day Month Year].

**Goals:** Show important information of aluminum alloys

**Content:**

This is a table of common alluminum alloys and their mechanical properties:

Aluminum Alloys - Mechanical Properties					
Aluminum Alloy	Temper	Elastic Modulus - E - (10 <sup>6</sup> psi) (GPa)	Shear Modulus - G - (10 <sup>6</sup> psi) (GPa)	Yield Strength - σ <sub>y</sub> - (10 <sup>3</sup> psi) (MPa)	Tensile Strength - σ <sub>u</sub> - (10 <sup>3</sup> psi) (MPa)
1100		10.0	3.75	3.5	11
1100	H12	10.0	3.75	11	14
2014		10.8	4.00	8	22
2014	T6	10.6	4.00	58	66
2014	T62	10.8	4.00	59	67
2017	T4	10.5	3.95	32	55
2024	T3	10.6	4.00	42	64
2024	T4	10.6	4.00	40	62
2025	T6	10.4	3.90	33	52
2124	T851	10.4	4.00	57	66
2219	T62	10.5	4.00	36	54
2618	T61	10.7	4.10	42	55
3003		10.0	3.75	5	14
3003	H18	10.0	3.75	25	27
3003	H112	10.0	3.75	10	17
354	T61	10.6	4.00	36	47
355	T51	10.2	3.80	22	27
355	T6	10.3	3.80	23	37
356	T7	10.3	3.85	21	29
356	T6	10.3	3.85	20	30
5052		10.2	3.80	9.5	25
5052	H32	10.2	3.80	23	31
5056	H38	10.3	3.75	50	60
5056	ANL	10.3	4.00	22	42
6061	T4	10.0	3.80	16	30
6062		10.0	3.75	5	14
6062	T4	10.0	3.75	16	26
6062	T6	10.0	3.75	35	38
6063	T42	10.0	3.75	10	17
6063	T5	10.0	3.75	16	22
6063	T6	10.0	3.75	25	30
6151	T6	10.1	3.85	37	44
7050	T7452	10.1 - 11.6		58	68
7050	T74			60	70
7075	T6	10.4	3.90	70	78
7075	T6			63	73
A356	T61	10.4	3.90	28	38
D712	T5	10.3	3.80	20	32

For our client, a force of 230 lb will need to be supported by the lean and lift device.

**Conclusions/action items:**



This table is important because the team needs to know the mechanical properties of the material we choose as the base of the lean and lift system so that it can hold up the clients weight. The next step is to pick three Al alloys to consider in a design matrix for the base of the lean and lift device.



## 2023/10/11 - rc winch

---

Sallie Schoen - Oct 11, 2023, 9:36 PM CDT

**Title:** RC winch

**Date:**

**Content by:**

**Present:**

**Goals:** How to install,

Link: <https://www.youtube.com/watch?v=ORqgkceXlo>

<https://www.youtube.com/watch?v=zRkS2pZJth4>

**Content:**

**I couldnt find any articles about the RC winch so I watched youtube videos of them being set up.**

Wired winch with 3 switch control that can be mounted using hot glue or nuts and bolts. Wired winch plugs into the extension that plugs into the power cord on the receiver.

Manual shows you how to set up.

Reuquires 4 AA batteries.

Wireless control

- RC4WD winch and control unit ( Part # Z-S1092)

- comes with screws to mount

comes with 2 cables and remote

attach adapter cable to battery (using converter), connect then to B side receiver. push and hold to bind unit. Connect receiver to W side of batter. Winch connected to receiver.

Pressing left button lets out rope and using right button retrieve rope

**Conclusions/action items:**

An rc winch will be a crucial part of our suspender design because it will allow the user the activate the pants being pulled up using a remote while on top of the lean and lift device.



## 2023/10/11 - Al alloy 6061 Welding

Sallie Schoen - Oct 11, 2023, 10:07 PM CDT

**Title:** "Welding parameters influence on fatigue life and microstructure in resistance spot welding of 6061-T6 aluminum alloy"

**Date:** 10/11/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Present welding techniques for Al alloy 6061 T6

**Content:**

**Citation:** X. Cao xinjin.cao@nrc.ca , W. Wallace , C. Poon & J.-P. Immarigeon (2003) Research and Progress in Laser Welding of Wrought Aluminum Alloys. I. Laser Welding Processes, Materials and Manufacturing Processes, 18:1, 1-22, DOI: 10.1081/AMP-120017586

Al 6061 has high yield strength and good ductibility properties. Wrought Al alloys display anisotropic plasticity and ductibility due to manufacturing process.

Laser Welding Processes-

high power and high quality CO2 lasers,

different Al alloys have different thickness and shapes, applicable to sheets, extrusions, casting, and hyrdoformed parts, that will be laser welded in the future.

two modes- conduction and deep penetration (keyhole)

conduction- material's surface is heated above melting point but below vaporization, resulting in hemispherical weld bead. This is used for thin materials.

Keyhole- higher power density, causing local vaporization and creating a narrow, deeply penetrated vapor cavity.

Beam spinning or weaving enhances the tolerance to joint gaps

Addition of filler materials lowers the sensitivity to joint gaps

Al alloys with magnesium, zinc, and lithium are more easily melted by the laser beam. Thicker Al plates require a higher power or lower melding speed.

optimization of welding parameters- Optimum welding parameters, including current, force, and welding time, for the RSW of Al 6061-T6 alloy.

**Conclusions/action items:**

chat gpt- aluminum alloy 6061 can be mounted to the cushion material used for the top of the lean and lift device using polyurethane or epoxy adhesives.

[ResearchGate](#)

for educators, researchers and for the industry | <https://www.researchgate.net/profile/SallieSchoen>

### Research and Progress in Laser Welding of Wrought Aluminum Alloys. I. Laser Welding Processes



Article in *Materials* · January 2023

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<p>2023</p> <p>2023</p>	<p>Views</p> <p>2,268</p>
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**Laser Welding**

 <p><b>Sallie Schoen</b> PhD in Mechanical Engineering 440 Publications <a href="#">View Profile</a></p>	 <p><b>S. Saito</b> PhD in Mechanical Engineering 440 Publications <a href="#">View Profile</a></p>
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All content following this page was uploaded by Sallie Schoen on 10/11/2023 at 10:07 PM CDT.  
You can request a copy directly from Sallie Schoen.

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**MMP2003-1.pdf (303 kB)**



# 2023/10/25 -Adjustable Standing Desk Frame

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**Title:** Standing Desk Frame Legs-Adjustable Desk Frame, Smart Controller System

**Date:** 10/25/23

**Content by:** Sallie Schoen

**Present:** N/A

**Goals:** Find a frame to be used for lean and lift device to minimize welding.

**Link:** [Amazon.com: Win Up Time Standing Desk Frame Legs- Adjustable Desk Frame, Sit Stand Desk Frame, Smart Controller System for 43"-70" Desk Top, Home& Office DIY Workstation \(Black Frame Only\) : Office Products](#)

**Content:**

The team proposed the idea of buying an already fabricated frame for the lean and lift device because the welding process of the previous design would be difficult and could pose issues to the stability of the device.



The above image shows a desk frame that could be used as the frame of the lean and lift device.

Price: 139.99 on Amazon

Brand: Win Up Time

Product Dimensions: 22.8"D x 63"W x 47"H

Style: Eclectic

Item weight: 32 lbs

Base material: steel

Special Feature: Adjustable

This device allows the user to adjust the height between 28-44.5" at a speed of 1"/second with low noise (under 45 dB). The sturdy construction frame can hold up to 280 lbs.

The user can lock the frame by holding the two buttons.

The team would have to assemble this device, but it comes with a complete set of tools and parts, as well as a complete installation manual. The estimated time taken to build is 15 minutes.

**Conclusions/action items:**

This device is ideal for the project because it allows the team to minimize welding by not needing to weld the frame of the lean and lift. It also allows the user to adjust the height electronically, which was one point the client was interested in during our client meetings. The device allows a weight that is more than the weight of the client.

The only alterations to the device would be attaching the bars that the RC winch will attach to and suspending to the pants to pull them up. Foam padding would need to be wrapped around the top bar to allow the comfort of the user. A handle bar can also be attached to the opposite side of the device so the user can hold onto it.

The only downside of this device is the price. It would be ideal if the lean and lift device were closer to \$100.

In order to attach the bars with the RC winch to the device, the client will need to use this exact device so the team can measure the angle that the bars will need to be at to accurately pull up the pants at an angle.



## 2023/11/10- RC winch

---



**Title:** RC winch missing component

**Date:** 11/10/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Find out the missing component we need for the RC winch

**Links:** <https://www.youtube.com/watch?v=ILXZ9KERvrM&t=1s>

<https://www.youtube.com/watch?v=H9WiqNbLImw&t=207s>

<https://www.youtube.com/watch?v=YCaGkzBQLqY>

**Content:**

The team needs batteries to power the remote we already have, which is specified in the team meeting notes.

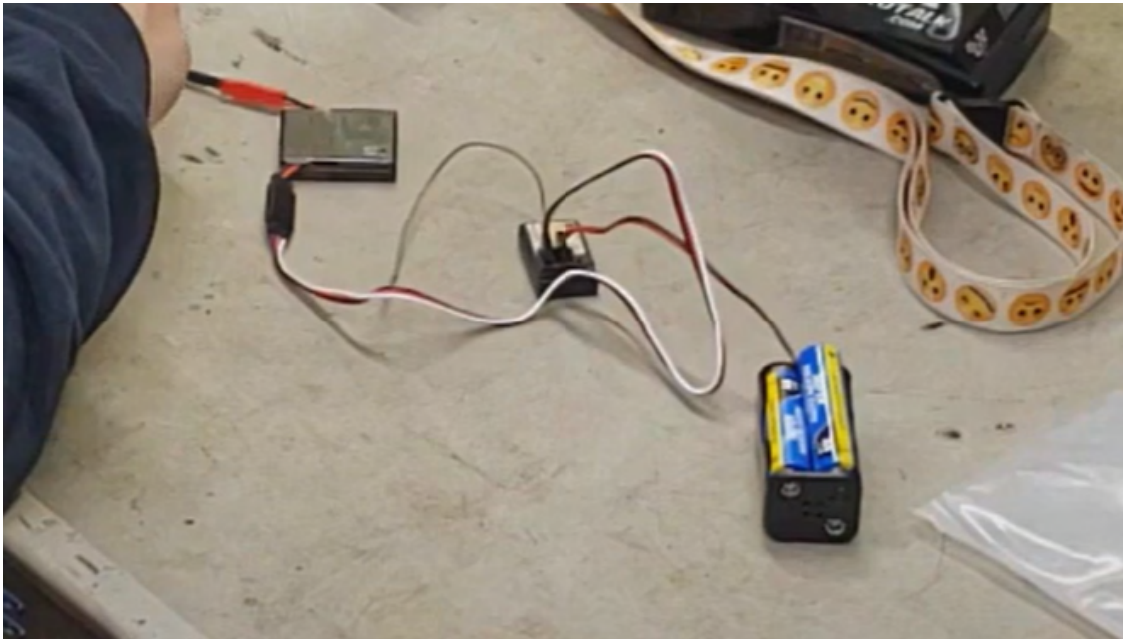
The team is missing a component of the RC winch assembly because we have two extra cords and no place to plug them into.

I watched a couple of videos on YouTube assembling a winch system to figure out the missing piece we need.

The first video I watched: The user bought a LiPro battery and servo connector which plugs into the control box that we have.

The second video I watched: She mentions at the beginning of the video, you need a receiver box to hook up to the winch controller. She says you are going to need a receiver and transmitter with a spare channel where you can plug your wired winch controller into.

Third video: The user is using an injora rc winch, which is the one we have.



The user has these two pieces, which seem to be what we are missing. He connected the servo wire to the receiver for power.

This is a comment under the video: Thanks, your video helped me get my new winch in. I ran the long red/black and white wire from 1 side of the control box directly to my receiver. So when I turn on power to my ESC, which turns power on the receiver, I can use the winch, which means no extra battery!

- This would mean the team wouldn't have to get the battery, which is guess is the blue and yellow thing on the right of the picture.

**Conclusions/action items:**

The 3rd video seems to be the one the team should follow to make sure our rc winch has all its components since the user in that video is using an injora rc winch. I left a comment on the video to ask where to get the receiver and battery shown in the video because he never mentioned what they're called.

I need to research more to find the exact battery and receiver needed for our rc winch.



## 2023/12/01 - Attach RC Winch to Bar

---

Sallie Schoen - Dec 01, 2023, 4:57 PM CST

**Title:** GUIDE TO GLUE ON METAL

**Date:** 12/1/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Explain how to attach an RC winch to a steel bar

**Link:** <https://uk.gorillaglu.com/guide-to-glue-on-metal/>

**Content:**

The best glue to use on metal has a complex answer. Some good glues are polyurethane-based glues (gorilla glue) and cyanoacrylate-based adhesives (like gorilla superglue). Attaching metal to metal, epoxies, polyurethane, and cyanoacrylate-based adhesives will work well. Epoxy is the most versatile, if you're looking for a strong, weather-resistant solution. To adhere two to two, clean the surface thoroughly and sand the two surfaces down so they are slightly rough. Clamping the metal in place for the duration of the drying time is also important.

**Conclusions/action items:**

It would be easy and quick to attach the RC winch to the steel bar on the standing desk frame and wouldn't require the team to drill holes/use nuts and bolts, which can be time-consuming.



## 2023/9/21 - Magnetic Glove

Sallie Schoen - Sep 21, 2023, 4:

**Title:** Magnetic Glove Design

**Date:** 9/21

**Content by:** Sallie Schoen

**Present:** N/A

**Goals:** Show the design and describe how it would work.

**Content:**



loop thru pants hole, magnets connect + pull up.

↳ could also use velcro

This is the magnetic glove design. It would be a glove that the client can put on and is secure around the wrist. Magnets will be on the fingertips and in the center of the glove. The way this works is the fingers loop around the pants (if it has a belt loop), or it could wrap around the belt, connect to the center magnet, and assist in pulling up the pants.

**Conclusions/action items:**

The problem with this design is the client would still be leaning every time he needs to pull the other side of the pants up, the magnets could come undone, and it doesn't give the client much movement because his arms will be obstructed.

This could also utilize Velcro over magnets.



## 2023/9/21 - Air Pressure Leg Sleeves

Sallie Schoen - Sep 21, 2023, 4:4

**Title:** Air Pressure Leg Sleeves Design

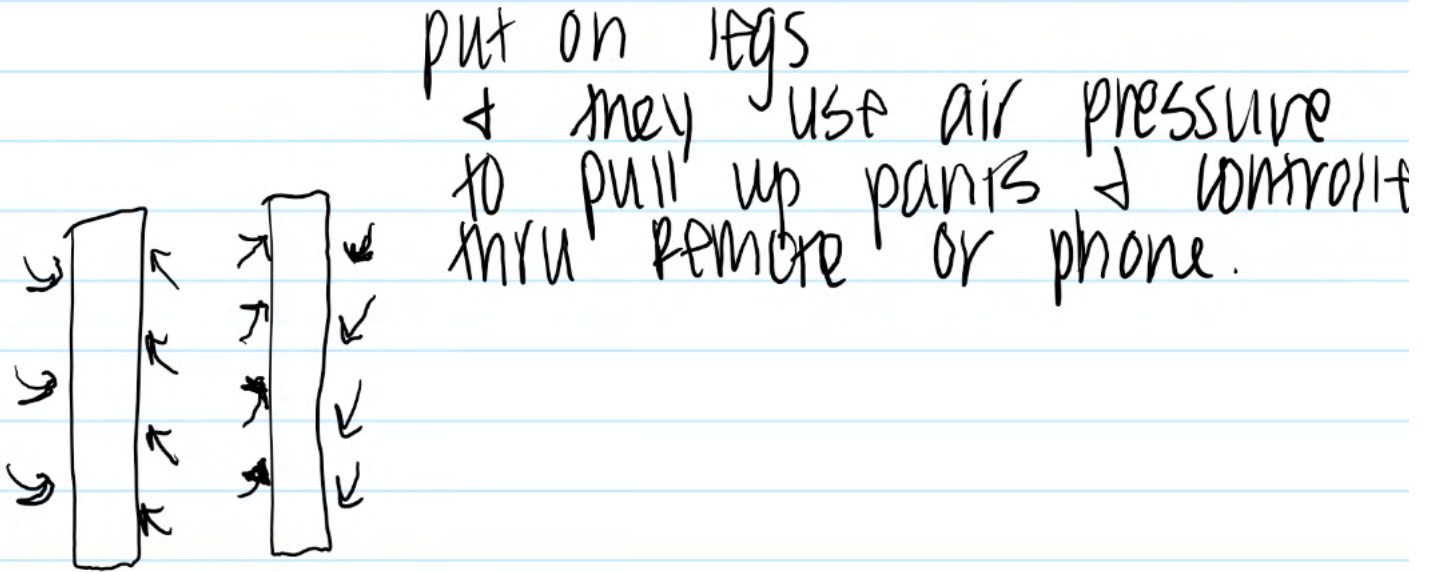
**Date:** 9/21

**Content by:** Sallie Schoen

**Present:** N/A

**Goals:** Show the design and describe how it would work.

**Content:**



The design above is leg sleeves that will be pulled up the leg (to about the knee) because that is where the client has the least trouble pulling up pants. The sleeves will use the air pressure, or pants he chooses to put on are over the leg sleeves, of the pants and his legs to pull the pants up. The leg sleeves would be controlled by a mobile device or remote. While the user has the leg on, the air chambers on the leg sleeves inflate and can create a lifting force for the user to pull up pants.

**Conclusions/action items:**

The problem with this design is that the team doesn't know that much about air pressure to know if this would be an ideal design. The user would need a way to get his bottom off of the chair & turning on the leg sleeve system. Extensive research on air pressure or designs that utilize this idea is needed to include this design in the design matrix.



## 2023/9/21 - Pant Snaps

---

Sallie Schoen - Sep 21, 2023, 5:53 PM CDT

**Title:** Pant Snaps Design

**Date:** 9/21

**Content by:** Sallie Schoen

**Present:** N/A

**Goals:** Describe the design and how it works.

**Content:**

This design entails custom-made pants that have "snaps" on the inside. The idea is that the back side of the pants will lay flat on the chair, the user will sit on top of the bottom half of the pants, then connect the top half of the pants to the bottom. The "snaps" could be a number of different things. Some ideas are velcro, zipper, magnets, or something similar that will attach the bottom half to the top half. The pants will be fashionable and made to the client's liking. It could be possible for there to be two layers to the pants so the "snaps" part will not be visible. The waist will likely be elastic or have a way to add a belt so that the pants stay in place.

**Conclusions/action items:**

Design considerations are: Assistance will be needed laying the pants on the chair right. This design could be used to make different types of pants that the client wants.



## 2023/10/19 - MIG Welding Training

---

Sallie Schoen - Oct 25, 2023, 3:21 PM CDT

**Title:** MIG welding training

**Date:** 10/19/2023

**Content by:** Sallie

**Present:** N/A

**Goals:** What is MIG welding

**Content:**

MIG welding is used for various metals and other materials to fix one part to another. The training was 2 hours long learning MIG welding. The teamlab used to have an aluminum welding class that is required to take after completing the MIG and TIG welding classes if you want to use aluminum in welding. Because aluminum is hard to weld, and the lean and lift device will be pretty big, the team will reconsider using aluminum for the lean and lift device.

**Conclusions/action items:**

MIG welding is a vital skill to know in order to fabricate the lean and lift device. TIG welding will also need to be learned so the team can fabricate the device because we will use either steel or aluminum.

TIG welding training can be completed at the teamlab.



---

Sallie Schoen - Sep 08, 2023, 1:42 PM CDT

**Title:** Team Introduction

**Date:** 9/8/23

**Content by:** Sallie

**Present:** Jacob, Kate, Sallie, Ella, Rayona, Avery

**Goals:** Meet the team members and decide roles.

**Content:**

Team roles are listed in the Project Information folder.

The weekly meeting with the advisor is at 12:30 in 3127 ME.

The outside weekly meeting with the team is at 3 p.m. in Wendt Commons.

**Conclusions/action items:**

Research competing designs other than Pants Up. Come up with a couple of questions to ask the client. Everyone becomes comfortable with muscular dystrophy.





**2023/9/15**

---

Sallie Schoen - Sep 15, 2023, 1:58 PM CDT

**Title:** Advisor and Client Meeting

**Date:** 9/15/23

**Content by:** Sallie

**Present:** Jacob, Kate, Sallie, Ella, Rayona, Avery

**Goals:**

**Content:**

Make a quantitative problem statement.

Biology and physiology notes should be primary.

**Conclusions/action items:**

facts about Dan from the client meeting:

- beckers MD
- gets worse and worse
- uses an electric wheelchair
- started using a wheelchair at age 30



## 2023/09/29 - Client Meeting 2

---

Sallie Schoen - Sep 29, 2023, 2:09 PM CDT

**Title:** Client Meeting 2

**Date:** 9/29/23

**Content by:**

**Present:**

**Goals:**

**Content:**

combo of lean and lift and suspenders. wants lean and lift at higher position

wheelchair can go up 12 inches

lean and lift- have something to grab onto like a backpack handle.

height of lean and lift-

suspender- motorized or easy to pull onto

knee height in chair- 25.5

height of chair- 19

width of chair- 23

chair weight 550 lb

motorized desks- can be adjustable so he can be at any height, he wants between 35-36 in height of lean and lift.

can swing arms

takes him 3-5 minutes now to get pants on

length chair 21 in

max chair height 32

could use a clip on pants

lean and lift system that he leans on similar to doctor table chair.

dont need wheels.

**Conclusions/action items:**

look up RC winch, mini winch that lifts up.



## 2023/10/11 - Personal Note

---

Sallie Schoen - Oct 11, 2023, 9:15 PM CDT

**Title:** Personal Note for Moving Forward

**Date:** 10/11/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Explain all things that need to be done.

**Content:**

Research materials for lean and lift base/legs and cushion

Make design matrix for materials of each part of decide on what material is best.

Find protocol for RC winch

Make protocol for attaching RC winch to suspenders

Make protocol for attaching cushion to base of lean and lift

Make solidworks drawing for lean and lift.

**Conclusions/action items:**

Each member of the team needs to research a specific material to put in the design matrix.

I mainly made this so on friday I could remind the team of all the things we need to do so we don't forget anything and get behind.



# 2023/10/17 - Calculations for dimensions of Lean and Lift

Sallie Schoen - Oct 18, 2023, 12:00 AM CDT

**Title:** Mathematical Calculations for the Dimensions of the Lean and Lift Device

**Date:** 10.17.23

**Content by:** Sallie

**Present:** Avery, Sallie

**Goals:** Calculate dimensions for the lean and lift device to use for the Solidworks prototype to test the strength

**Content:**

The image below shows the calculations and notes used to create the dimensions of the lean and lift device prototype 1 (refer to lab archives folder team activities/project files/lean and lift prototype 1) When measuring the dimensions of the client's chair, the units used were inches. Proper conversions need to happen so that the prototype uses meters instead. The lean and lift device was modified because it would require more work to create the final drawn prototype (first image below) in Solidworks. Using the measurements from the in-person client meeting, the calculations below were used to create the Solidworks prototype. The ideal height of the lean and lift, as mentioned by the client, is 36 in. The width of the base of the device needs to be wider than the width of the wheelchair, so it is set to be 35 inches. The length of the top part where the cushion will attach just needs to be wide enough for the user's arm width, so will be 41 in. The thickness of the two metal bars connected by a center bar that lay flat on the ground is 1 in. The rods that extend from the device are 21 in because that is the depth of the chair. The length of the legs that lay flat on the ground is 60 in, but can easily be changed if needed.

$1 \text{ in} = .0254 \text{ m}$

- too wide on the bar
- Floor to knee nce height: 25.5 in
- Shelf life: 5 years
- Dan said he is going to send a link
- Dan can swing his arms up so arms should go over the pad
- Ideal time - 3-5 min
- He can't lift his arm up so suspenders are needed
- Dan's idea: a motorized desk that goes up and down
- Able to swing straps onto shoulder
- 5 volt 1 amp or 5 volt 2.1 amp
- RC cars winch will lift like 20 lbs
- Firm but comfortable material for lean and lift - doctors table material
- Junked wheels are not necessary/ some kind of rein needed

height user will be (ground - arm/PH)  
 $22 + 18.5 = 40.5 \text{ in} \left( \frac{0.254 \text{ m}}{1 \text{ in}} \right) = 1.0287 \text{ m}$

desired height of L+L = 36 in = 0.9144 m

width of L+L:  $23 \text{ in} + 12 \text{ in} = 35 \text{ in} = 0.889 \text{ m}$

length of cushion: 41 in = 1.0414 m

length rods + suspenders: 21 in = 0.5334 m

height from rods to cushion: 3 in = 0.0762 m

**Dimensions**

- Floor to chair height: 19 in
- Width of chair: 23 in
- Weight of chair and dan: 550-600
- Weight of chair: 350
- Arm length: 26 in
- Elbow width: 23 in
- Floor to the chair leaning? ( he said like when he would lean): 22 in
- Inner wheel distance: 25 in
- chair to armpit: 18.5 in
- Width of the body (add a foot on each side): 23 in
- Ideal height of pad: 35-36 in
- Max back of a chair: 28 in
- Max front of chair: 32 in
- length of seat: 21 in

**Conclusions/action items:**

Refer to the Solidworks files of the prototype under the team activities/project files folder in lab archives.



## 2023/10/17 - Lean and Lift Prototype 1

---

Sallie Schoen - Oct 27, 2023, 1:10 PM CDT

**Title:** First Lean and Lift Prototype in Solidworks

**Date:** 10/17/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Present solidworks design and explain design elements

**Content:**

The lean and lift prototype is attached below.

The prototype does not include the cushion material that will be added on top of the aluminum at the top of the lean and lift for comfort. The simulation will take into account the strength of the material chosen (probably aluminum) and how it will withstand the 230 lb weight of the user.

The prototype will have to be altered to add handlebars for the user to hold onto if the team decides that it's necessary. Also, more discussion with the client is needed to determine a way to decide if the rods coming off the side of the prototype will be able to pull the pants up to the desired area. I have a feeling the rods might have to be at an angle in order to pull the pants up because the client will be leaned over.

**Conclusions/action items:**

The simulation needs to be run using the proper weight force to test if the device will uphold the weight of the user.

Sallie Schoen - Oct 27, 2023, 1:31 PM CDT

[Download](#)

**lean\_and\_lift\_base\_drawing.SLDDRW (163 kB)**

Sallie Schoen - Oct 25, 2023, 9:53 PM CDT

[Download](#)

**lean\_and\_lift\_base.SLDPRT (144 kB)**



## 2023/11/10 - Show and Tell reflection

---

Sallie Schoen - Nov 10, 2023, 9:47 AM CST

**Title: Show and Tell Reflection**

**Date:** 11/10/23

**Content by:** Sallie

**Present:** N/A

**Goals:** Reflect on comments made by other teams when presenting the design

**Content:**

Most teams brought up incorporating the metal bar on the bottom of the lean and lift to counteract the user's weight.

One team asked how the user would get the clips off his pants once the rc winches were done pulling them up and we have not thought of that yet, so the team must discuss that.

Each team thought it was smart, so we ordered the standing frame to eliminate the welding.

We originally wanted to find someone who had experience welding, but only found one person with minimal experience welding.

**Conclusions/action items:**

My biggest concern following the show and tell is will the rc winches pull the pants up all the way to the desired length and will the base tip over when the client is using it.



## 2023/11/10 - Next Steps

---

Sallie Schoen - Nov 10, 2023, 10:09 AM CST

**Title:** Next Steps (note to self)

**Date:** 11/10/23

**Content by:** Sallie

**Present:** N/A

**Goals:** What are the next steps of the design process?

**Content:**

1. Find out which parts of the RC winch are missing an order ASAP so the team can start testing what angle the bars need to be at.
2. Weld/use nuts and bolts to attach the metal peices we are adding to the bottom and top of frame to counteract weight of user bending over (piece on bottom) and to attach foam to (top piece).
3. Find adhesive to attach foam to metal.
4. Test the design by having heaviest team member lean over the top for 3 minutes.
5. Find out which angle the bars need to be at to pull the pants up.
6. Fabricate bars and test with rc winch.

**Conclusions/action items:**



## 2023/12/06 - Standing Desk Frame Solidwork Model

---

Sallie Schoen - Dec 06, 2023, 4:46 PM CST

**Title:** Standing Desk Frame Solidwork Model

**Date:** 12/6

**Content by:** Sallie

**Present:** N/A

**Goals:** attach model

**Content:**

The prior lean and lift solidworks model was used as a reference for the general shape we wanted for the base of our design. The team found a fabricated steel standing desk frame that includes electronic elements so the client can easily control the base's height. A solidworks model of the standing desk frame is needed to analyze the forces on it.

**Conclusions/action items:**

The standing desk frame specifies that it can hold up to 280 lbs. 2 steel bars were added to hold the RC winch up on the bars protruding towards the user. 1 steel bar was added to the bottom of the frame to act as a counterweight. A generalized model is made so that only the parts of the design that need to be analyzed can be.

Attached below is the file of the standing desk frame model.

---

Sallie Schoen - Dec 06, 2023, 4:45 PM CST



[Download](#)

**standing\_desk\_frame.SLDPRT (204 kB)**





**9/17/2023 - Becker's Muscular Dystrophy Research**

---

**Title: Becker's Muscular Dystrophy Research****Date:** 9/17/2023**Content by:** Ella Eklund**Present:** N/A**Goals:**

- Find out what Becker's muscular dystrophy is and how it is caused
- What differs Becker's muscular dystrophy from other types
- The details of Becker's and treatment

**Content:**

Sources:

"Becker Muscular Dystrophy." Pawan, Jenish, Krishna. *National Library of Medicine*, [https://www.ncbi.nlm.nih.gov/books/NBK556092/#:~:text=Becker%20muscular%20dystrophy%20\(BMD\)%20is,Duchenne%20muscular%20dystro](https://www.ncbi.nlm.nih.gov/books/NBK556092/#:~:text=Becker%20muscular%20dystrophy%20(BMD)%20is,Duchenne%20muscular%20dystro) Last updated 19 July. 2023. Accessed 17 Sept. 2023.

"Becker Muscular Dystrophy." *Mount Sinai Health System*, [www.mountsinai.org/health-library/diseases-conditions/becker-muscular-dystrophy#:~:text=Becker%20muscular%20dystrophy%20is%20very,and%20it%20is%20less%20common](http://www.mountsinai.org/health-library/diseases-conditions/becker-muscular-dystrophy#:~:text=Becker%20muscular%20dystrophy%20is%20very,and%20it%20is%20less%20common). Accessed 17 Sept. 2023.

## 1. Find out what Becker's Muscular Dystrophy is and how it is caused

Becker muscular dystrophy is an X-linked recessive disorder due to a mutation in the dystrophin gene, resulting in progressive muscle degeneration and weakness.

Becker muscular dystrophy is caused by a mutation in a protein called dystrophin. The defective gene is located in the Xp21.2 chromosome, and the defect is an X-linked recessive trait. Patients without a clear X-linked pattern of inheritance may have defects in other genes, affecting the dystrophin-associated glycoprotein complex.

## 2. What differs between Becker's Muscular dystrophy from other types

Becker muscular dystrophy is very similar to Duchenne muscular dystrophy. The main difference is that it gets worse at a much slower rate and it is less common.

**Duchenne Muscular Dystrophy:** More severe and early onset than BMD. The patient becomes wheelchair-bound earlier, and the length of survival is shorter. Patients usually have lower dystrophin concentration.

## 3. The details of Becker's and treatment options

Muscle weakness of the lower body, including the legs and pelvis area, slowly gets worse, causing:

- Difficulty walking that gets worse over time; by age 25 to 30, the person is usually unable to walk
- Frequent falls
- Difficulty getting up from the floor and climbing stairs
- Difficulty with running, hopping, and jumping
- Loss of muscle mass
- Toe walking
- Muscle weakness in the arms, neck, and other areas is not as severe as in the lower body

There is no known cure for Becker muscular dystrophy. However there are many new drugs currently undergoing clinical testing that show significant promise for the disease. The current goal of treatment is to control symptoms to maximize the person's quality of life. Some providers prescribe steroids to help keep a person as long as possible.

**Conclusions/action items:**

After some research on Beckers I feel that I have a better grasp of what the disease is and how it affects our client. After speaking to Dan I feel like with his statements about the disease and the research I just conducted that I know alot more and I am able to start brainstorming design ideas that will be able to t his issue of getting his pants up. Before class next week, I would like to draw out some intial design ideas and share my research with my teammates.



**9/12/2023 - Pants Up Easy Research**

---

**Title:** Pants Up Easy Research

**Date:** 9/12/2023

**Content by:** Ella Eklund

**Present:** N/A

**Goals:**

1. Determine how the device works
2. Highlight the strengths and weaknesses of the device
3. Find the price and accessibility of the device
4. Find reviews and personal statements

**Content:**

Website: <https://www.pantsupeasy.com/>

1. After watching videos and exploring the website I discovered how the device works. Pants Up Easy comes in four design types:

-The Wheelchair Model - a mobile model of the device with locking wheels and with compactable arms and legs for storage



-The Toilet Model - a model that slips behind the toilet and doesn't require professional installation



-The Wall Mount Model - a model that is professionally installed to any wall in the home



-The Travel Model- a lightweight model that is able to fold up and can be transported easily



The device in each model works by the customer reaching up and putting arms over the cushioned metal arms of the device and lifting themselves up so they can easily reach and slide their pants up.

2. The strengths of the device include:

- Hands-free, the arms fit under the armpits so the hands are available to pull up pants
- Saves time
- Reduces the need for independence
- Increases stability and reduces risk of falling

Weaknesses:

While none were listed online and not totally confirmed heres what I infer:

- Could be difficult to use if upper body strength is limited
- Seems heavy and large
- Depending on model, not all needs can be met

3. Price and Accesibility

These prices were listed on their website but could be found elsewhere

Wall Mount Model: \$1497

Toilet Model: \$1597

Wheelchair Model: \$2957

Travel Model : \$2697

You can purchase on their website or they have a system of partnerships and professional reps to sell their products as well. Something to note that as the device becomes more transportable the price increases.

#### 4. Reviews and Personal Statements:

I am 59 years old and have been in a chair for 10 years since M.S. Took my legs. I am very independent. Drive my car to work every day. I look after everything except standing to pull up my pants. This is the only thing I can't do on my own until Pants Up Easy. I have a Wall Model installed in my own home and will have them installed at my office and vacation property. I have looked for years for Pants Up Easy. Thank you for giving me back my independence.

Bill Sparfel, Toronto, Ontario, Canada

Ever since I've been injured, it has been a struggle getting dressed for years. As the owner of Endless Ability Enterprises, it has been my mission to seek new methods to make life easier for myself as well as others in similar situations. When I met Douglas at the Abilities Expo tradeshow, and discovered Pants Up Easy, I thought to myself 'Why has something like this not been thought of already?' It's so simple and easy to use; I would recommend it to anyone that has minimal use of their legs due to spinal cord injuries, multiple sclerosis, etc. After using this product in my home for several months, I can attest to Pants Up Easy being a game changer in my life.

Antonio Quistian Jr., Morgan Hill CA

Reviews seem very positive and a lot of people seem very glad to have regained their independence back.

#### **Conclusions/action items:**

After my research The Pants Up Easy seems like a great device. It will definitely give us a good starting point for ideas for the device we will be creating. The main flaw with the Pants Up Easy that wont work for our client is that you need a significant amount of arm strength to use the device. We will have to discover a solution to this to adapt yo for our client. Action items for me is to share this information with my teammates so we are aware of how the device works and what we will do differently.



**9/23/2023 - Wheelchair Pants Research**

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**Title: Wheelchair Pants Research****Date:** 9/23/2023**Content by:** Ella Eklund**Present:** N/A**Goals:**

- Research two different wheelchair pants to see what already on the market
- Find price
- List the pros and cons of the design

**Content:****CareZips by Joe & Bella**

Website: <https://joeandbella.com/products/ultimate-wheelchair-pant>

The first wheelchair pant I looked at is called the CareZips Adaptive Pants.



-One pair costs \$80 and it ranges in size from S-3XL.

-You can purchase the pants from their website.

-The design features two side zippers with snaps on the top that range from the waist to the knee. It also features a patented third inseam zipper that opens

-Features extra long easy to grab zipper pulls, and an elastic waistband

**Cons of the design**

-The CareZips pants are made out of polyester which is a good fabric but this specific design doesn't allow the user to wear more difficult materials such as

-The zippers on the sides only go from the knee to the waist which would make it hard for someone in a wheelchair who can't lift their feet be able to get into

-The snaps on the top might be difficult for someone with limited arm strength to close or get their arm there.

**No Limbits Adaptive Men's Wheelchair Pant**

Website: [https://no-limbits.com/products/mens-darkwash-wheelchair?variant=43551540510912&currency=USD&utm\\_medium=product\\_sync&utm\\_source=google&utm\\_content=sag\\_organic&utm\\_campaign=sag\\_organic&utm\\_UgMkC-HlBwddvNASH9oF8G1jQtWsZ7BoCbi4QAvD\\_BwE](https://no-limbits.com/products/mens-darkwash-wheelchair?variant=43551540510912&currency=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&utm_UgMkC-HlBwddvNASH9oF8G1jQtWsZ7BoCbi4QAvD_BwE)

The second pant I looked at is the No Limbits Adaptive Men's Wheelchair Pant



-One pair costs \$75 and has a very large size range from 30-52.

-Can be purchased on their website

#### Features of the Design

-This design also has dual side zippers with a ring zipper so the front and back can fold down. The pants also have a higher rise in the back and a lower rise

-Features a stretchy waistband a hidden catheter leg loop and no back pockets to avoid bed sores.

-Made of 97.5% cotton and has the appearance of jeans

#### Cons of the design

-This design also does not feature zippers that go all the way down to the feet which would not help our client and his particular issues.

-Other than that there are not a lot of cons to this design

#### **Conclusions/action items:**

After looking at these two competing designs if we decide to go with the wheelchair pants I have found lots of conclusions that could help us if we decide to

Both designs featured side zippers but neither had zippers that went all the way down which wouldn't help Dan. The No Limbits had the appearance of Jean

No Limits also had no back pockets and a higher rise in the back which could help our client with the issue of his pants falling and getting sores

Now moving forward I need to show my research to my teammates to see how we can adapt and recognize what we would do differently if we went with the



**10/15/23 - Strap Research**

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**Title: Strap Research****Date:** 10/15/23**Content by:** Ella Eklund**Present:** N/A**Goals:**

- Find durable straps that we can use for the suspenders for the design
- Get knowledgeable on the types/prices and differences in straps out there

**Content:**Winch StrapSource: <https://www.uscargocontrol.com/products/winch-straps-4x27-w-flat-hook-defender>**-4 X 27 Winch Straps with Flat Hook and Defender**

- Load limit: 5400 lbs
- Works with any standard 4 in winch
- Price: \$12.99
- Notes: This may be extreme for our task, we do not need straps that can hold 5400 lbs. Also, we need to consider which winch we are going to buy because that might adjust for the length/width of strap we use and its durability

RC Winch StrapSource: <https://www.amazon.com/YFGXFXF-Crawler-Kinetic-Trailer-Traxxas/dp/B0C21MMMBF?th=1>**RC Crawler Kinetic Winch Strap**

- Length: 20 in
- Load limit: 4 lbs
- Price:\$8.99
- Notes: This strap is better for the RC winch we will purchase, but I don't think the length is enough to act as a suspender fully. Also, this type of strap could be uncomfortable.



### Basic Hook and Loop Straps

Source: [https://www.amazon.com/YMCRLUX-Adjustable-Fastening-Reusable-Organizer/dp/B09XMVVRH8/ref=sr\\_1\\_25?keywords=straps&qid=1697394847&sr=8-25&th=1](https://www.amazon.com/YMCRLUX-Adjustable-Fastening-Reusable-Organizer/dp/B09XMVVRH8/ref=sr_1_25?keywords=straps&qid=1697394847&sr=8-25&th=1)

#### YMCRLUX 1"x32ft Hook and Loop Straps with 50 Metal Buckles

- Can cut to length
- Can hold up to 50 lbs
- Features velcro
- Price: \$12.99
- Notes: I think this is a great option for us. It holds a great amount of weight and being able to choose the length is very useful. The only downside is we are not sure if this would work with the RC we purchase.



### Most Basic Strap

Source: [https://www.amazon.com/TECEUM-Inch-Webbing-Climbing-Outdoors/dp/B0BQ8WJN4G/ref=sr\\_1\\_44?keywords=straps&qid=1697396597&sr=8-44&th=1&psc=1](https://www.amazon.com/TECEUM-Inch-Webbing-Climbing-Outdoors/dp/B0BQ8WJN4G/ref=sr_1_44?keywords=straps&qid=1697396597&sr=8-44&th=1&psc=1)

#### TECEUM 1" & 1.5" & 2" Webbing – 10 25 50 Yards

- Polypropolene material
- Doesnt list load limit
- Price: \$15.99
- Most basic form of strap
- Notes: This is like the previous option but a little more simple. This could also work great but we still need to determine if this could connect to the winch we inevitably end up using

**Conclusions/action items:**

After researching different types of straps, I have made several conclusions. I think purchasing ultra-durable straps is not useful for our purposes. I think the more basic the design is better. We just need to make sure that whatever winch we are using is able to connect to the strap and that the strap is long enough. Now moving forward I need to share this research with my team and we can decide which strap we agree would be the best option for us.



## 10/15/23 - Winch research

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**Title:** Winch Research

**Date:** 10/15/23

**Content by:** Ella Eklund

**Present:** N/A

**Goals:**

- Figure out how a winch works/ what it is
- Find potential winches that can work for our project

**Content:**

### Winch Information

A winch is a rotating spool, driven by a motor, that can tighten or loosen a cable. The cable generally has a hook at the end. Typically, a winch is attached to the front or rear bumper of a vehicle, although it can also sit at the front of a trailer. The primary function of a winch is to leverage that cable tension to pull a vehicle out of a difficult situation — whether it's stuck in mud, or water, facing a steep incline, or unable to move under its own power. [1]

- When speaking with our client he suggested using a RC Winch to help pull the pants up. We would have to figure out which winch to purchase and how to attach straps

### RC Winches

1. INJORA Metal Automatic Winch Wireless Remote Controller System for 1:10 RC Crawler Car Axial SCX10 90046 TRX4 Redcat (Black)

Source: [https://www.amazon.com/INJORA-Automatic-Wireless-Remote-Controller/dp/B083NTSH1J/ref=sr\\_1\\_2?keywords=rc%2Bwinch&qid=1697397537&sr=8-2&th=1](https://www.amazon.com/INJORA-Automatic-Wireless-Remote-Controller/dp/B083NTSH1J/ref=sr_1_2?keywords=rc%2Bwinch&qid=1697397537&sr=8-2&th=1)

- \$31.98
- Wireless remote receiver
- 8 X 6 X 1.02 in
- Weight; 4.6 lbs
- Notes: This winch looks like it could definitely work for our project. It has a small weight and the remote controller would be very useful with our client's background.





## RC4WD 1/10 Warn 9.5cti-s Winch

Source: <https://store.rc4wd.com/rc4wd-110-warn-95cti-s-winch.html>

- Price: \$35.99
- Dead lift: 6.6 lbs
- Rolling drag: 9 lbs
- 3 X 1.39 X 1.15
- Notes: This also seems like a great option. I think most of these winches would work for our project.



### Sources

[1] "What Is a Winch, and How Do You Use It Safely?," *Capital One Auto Navigator*.

<https://www.capitalone.com/cars/learn/finding-the-right-car/what-is-a-winch-and-how-do-you-use-it-safely/1734>

### **Conclusions/action items:**

After researching winches and RC winches on the market I feel I have a better understanding of winches. When looking at potential ones for our project I think choosing one that is lightweight and could easily attach to our straps is the best option. Now I need to share my finding with my team so we can move forward on fabrication.



**9/23/2023 - Initial Design Ideas**

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**Title: Initial Design Ideas**

**Date:** 9/23/2023

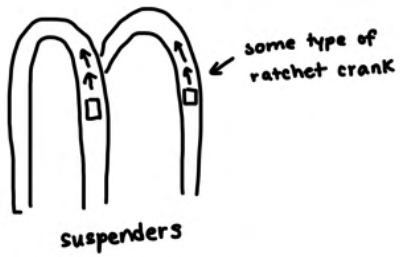
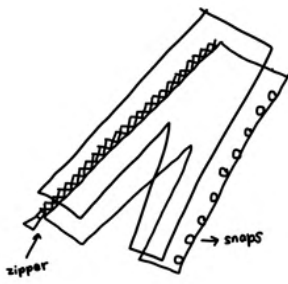
**Content by:** Ella Eklund

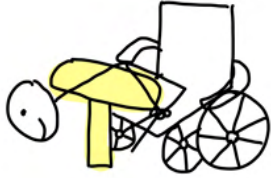
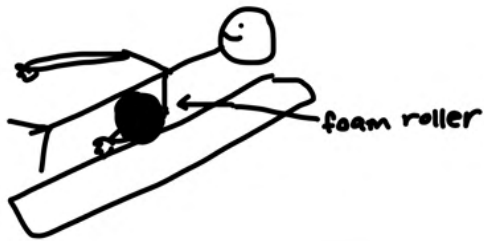
**Present:** N/A

**Goals:**

-Sketch initial design ideas

**Content:**





### Conclusions/action items:

After sketching some initial design ideas, I think I have a good idea of what designs would be best for our design matrix and what ones we should consider going forward. I think the snap-on/zipper pants, the lean-over method, and the foam roller might be the best ideas moving forward. Next, I need to propose to the team and see what they like best.



## 10/4/2023 - Final Initial Design Sketch

ELLA EKLUND - Oct 04, 2023, 1:38 PM CDT

**Title:** Final Initial Design Sketch

**Date:** 10/4/2023

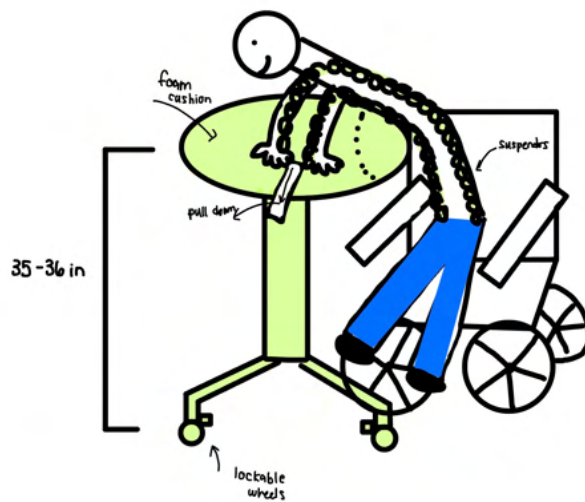
**Content by:** Ella Eklund

**Present:** N/A

**Goals:**

Get a better sketch of the initial design we decided with Dan

**Content:**



**Conclusions/action items:**

After getting a good sketch of our design, we need to start finding materials and dimensions to prepare a final design for our client. I think our design could work and we will have to see when testing but I am glad to get something on paper to base off of going towards the future.



## 2023/9/15 - Muscular Dystrophy Overview Research

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**Title: Muscular Dystrophy Overview Research****Date:** 9/15/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Gain a brief overview about the different types and symptoms of each type of Muscular Dystrophy.**Content:**

Website link: [What are the types and symptoms of muscular dystrophy \(MD\)? | NICHD - Eunice Kennedy Shriver National Institute of Child Health and Human Development \(nih.gov\)](https://www.nichd.nih.gov/health/topics/muscular-dys/conditioninfo/types)

Notes:

Duchenne MD (DMD):

- Most common form of MD in children. Mainly occurs in boys 3-5 years old. Caused by dystrophin gene.
- Most severe form of MD. Rapid progression. Most lose the ability to walk by age 12.
- Muscle weakness typically begins in upper legs/pelvis. May eventually need respirator to breathe.
- Life expectancy now 30-40 years. Previous life expectancy age 20 due to heart trouble, respiratory complications, and infection.

Becker MD:

- Caused by dystrophin gene. Typically, milder symptoms than DMD.
- Mainly occurs in boys and men ages 11-25.
- Can progress slowly or quickly. Some never need to use a wheelchair. Others lose ability to walk in teens, mid-30s, or later.

Myotonic MD:

- Most common adult-onset MD.
- Mainly occurs in ages 20-30. Can occur in children.
- Two types but share primary symptom that muscles cannot relax following sudden contraction.

Facioscapulohumeral MD (FSHD):

- Affects the face (facio), shoulders (scapulo), and upper arms (humeral). Appears first as difficulty opening and closing eyelids and inability to smile or pucker lips.
- Symptoms vary from mild to severe disability.
- Mainly occurs during teen years. Can occur as late as age 40. Typically, does not affect lifespan.
- Can be passed down within a family (autosomal dominant manner).

Limb-Girdle MD:

- Mainly occurs during adolescence/young adult years. Can occur in childhood.
- Can progress quickly or slowly. Most become severely disabled.
- Causes muscle damage and inability to walk. Typically progresses to this stage within 20 years of development.
- Usually inherited recessively.

Citation: U.S. Department of Health and Human Services. (2020, November 9). *What are the types and symptoms of muscular dystrophy (MD)?*. Eunice Kennedy Shriver National Institute of Child Health and Human Development. <https://www.nichd.nih.gov/health/topics/muscular-dys/conditioninfo/types>

**Conclusions/action items:**

The many different forms of Muscular Dystrophy can cause a wide range of symptoms. It will be important to keep in mind the specifications given by our client since MD progresses differently even in people with the same kind of MD. Action item: further research Brecker Muscular Dystrophy





## 2023/9/20 - Becker's Muscular Dystrophy Notes

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AVERY SCHUDA - Sep 20, 2023, 10:22 PM CDT

**Title:** Becker's Muscular Dystrophy Notes

**Date:** 9/20/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Learn more about the type of muscular dystrophy that the client has.

**Content:**

- Becker's Muscular Dystrophy (BMD) is characterized by progressive muscle weakness. Similar to Duchenne muscular dystrophy (DMD) except it typically progresses at slower rates, is less common, and has milder symptoms.
- Typically occurs in males beginning in teen or early adulthood. More unpredictable than DMD and slower course of progression.
- Caused by a genetic problem producing dystrophin, a protein that protects muscle fibers from breaking down when exposed to enzymes. People with BMD produce more dystrophin than those with DMD, partially explaining the slower progression of symptoms.
- Pattern of muscle weakness commonly begins around hips/pelvis and progresses to thighs and shoulders. Weakness causes a change in gait, and many begin to notice symptoms while playing sports.
- Difficult to diagnose. Diagnosed most commonly through blood tests, muscle biopsy, and EKG.
- Physical and occupational rehab needed. Orthopedic surgery sometimes required to treat contractures and scoliosis. Cardiologists monitor heart function as heart muscles can weaken over time.

Citation: *Becker muscular dystrophy*. Johns Hopkins Medicine. (2021, August 8). <https://www.hopkinsmedicine.org/health/conditions-and-diseases/becker-muscular-dystrophy>

**Conclusions/action items:** BMD progresses differently in every patient so it will be important to communicate with the client his exact needs, areas of muscle weakness, and ensure that we create a device that he is able to operate.



# 2023/9/15 - Pants Up Easy Research

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**Title: Pants Up Easy Research****Date:** 9/15/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Research alternative device highlighted by the client. Learn about the benefits of the device and what makes it inaccessible to the client.**Content:**Website provided by client: <https://www.pantsupeasy.com/>**Notes:**

Overview: Pants Up Easy is a device that helps wheelchair users elevate themselves to put on pants. The device features two arms that go under the user's armpits. The user squeezes these arms beneath their armpits in order to elevate themselves enough to slide their pants on. Since the device goes under the user's armpits, they have their hands free to adjust pants. Device requires arm mobility to operate.

Cost: \$1497-\$3597 depending on model and inclusions. They have some grants and appear to be working towards being covered by insurance. Largely appears that people must pay for this device out of pocket. Definitely not an affordable option for most people.

Wall Mount Model: Two arms mount to a wall. Arms swing out of way when not in use. Requires sturdy place to mount or reinforcement.



Toilet Model: Two arms are supported by a base that goes around the toilet. Arms swing out of way when not in use. Does not require mounting but not designed to be portable.



**Wheelchair Model:** Two arms are mounted on a semi-portable wheeled base. Legs of base can be folded inward when not in use. Wheels can be locked or unlocked. Designed to be used anywhere within a home or office.



**Travel Model:** Two arms on a portable base. Designed to be disassembled and put into a case for travel, and can be used with both a wheelchair and toilet. The website features and able-bodied person assembling the travel model. It appears that it would be difficult for someone with limited mobility to set up this model independently.



Citation: *Helping wheelchair users and others with mobility impairments to pull up their pants independently.* Pants Up Easy. (2019, January 30). <https://www.pantsupeasy.com/>

### **Conclusions/action items:**

While this seems like a helpful device for some people in wheelchairs, it has a number of drawbacks. The device requires a good amount of upper body and arm strength to operate, which many people with muscular dystrophy like our client do not possess. The device is also very expensive. The travel option does not appear to be able to be set up independently, which when the main purpose of the device is to help wheelchair users dress independently, this seems like a significant drawback. One or more of these designs could serve as inspiration for form or materials, but significant adaptations would need to be made for our client.



## 2023/10/09 - RC Winch Research

AVERY SCHUDA - Oct 09, 2023, 1:52 PM CDT

**Title:** RC Winch Research

**Date:** 10/09/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Gain a better understanding of the RC winch that Dan discussed when talking about potential design solutions

**Content:**

Originally, we discussed the RRC winch as a potential means to shorten the length of the Suspender design in a hands-free way effectively pulling up the client's pants. The RC winch that Dan already has is inexpensive and easy to work with in his experience.

From Dan: "Thank you for the report and reminding me about the RC winch! Here's the one I have - <https://www.amainhobbies.com/rc4wd-warn-9.5ctis-1-10-scale-winch-rc4ze0119/p1278949>

There might be some stronger mini ones, but also a regular power winch of some sort might be a possibility as well. We can attach anything to my chair!"

Specs:

- Voltage: 6v to 11.1v
- Load Limits: Dead Lift 6.6lbs/3kgs
- Load Limits: Rolling Drag 9lbs/4.1kgs
- Length: 2.98in / 75.85mm
- Total Width: 1.16in / 29.62mm
- Height: 1.39in / 35.35mm
- Weight: 3.39oz / 96.2g

Features:

- Cast Zinc Case
- Stamped Steel Components
- Working Spring Loaded Warn Hook
- Synthetic Winch Rope
- Highly Detailed
- Full Warn Decals Installed
- Can operate on 3 Cell Lipo
- Easily Rebuildable
- 3ft/.9M Rope Pre-Installed
- Same Mounting Locations as Bulldog Winch
- 30 Day Warranty

Cost: \$35.99

Additional Required Parts: RC4Z-S1092 - RC4WD "Warn" Wireless Winch Controller w/Remote & Receiver (Miniature Scale Accessory) and RC4Z-S1089 - RC4WD Wired Winch Controller Unit (Miniature Scale Accessory). Raises the total cost to \$115.97, though there are potentially other components that are compatible and available elsewhere.

Citation: *RC4WD Warn 9.5cti-s 1/10 Scale Winch [RC4ZE0119] - AMain Hobbies*. (n.d.). [www.amainhobbies.com](http://www.amainhobbies.com). Retrieved October 9, 2023, from <https://www.amainhobbies.com/rc4wd-warn-9.5ctis-1-10-scale-winch-rc4ze0119/p1278949>

**Conclusions/action items:** If one component costs more than a third of our \$300 budget, it may not be feasible to include electric assist in the suspender portion of the design and still be able to fully fabricate both the suspenders and the lean and lift within the constraints of the project. If we choose to go the electronics route, we may only be able to fully fabricate one half of the design. and the other part may need to be delayed for future work. Action items: discuss these findings with the client at next meeting and ask for feedback about what features of the design are most important and if it is acceptable to complete a more complex design in multiple semesters.



**2023/10/09 - Standing Desk Research**

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**Title: Standing Desk Research****Date:** 10/09/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Research costs and load capabilities of readily available standing desks as a potential prefabricated item to be purchased and modified for the Lean and Lift design**Content:**

Previously discussed with client the potential to modify a standing desk base as the base of the Lean and Lift design. This would allow Dan to use the motorized base to elevate his bottom of the seat of his wheelchair without relying on wiggling and using the raising and lowering features of his wheelchair to get into pants up position.

**Material:** Alloy Steel**Current Price:** \$199.99**Dimensions:** 23.5"D x 39"W x 28"H**Frame Length:** 39" to 67", **Frame Height:** 28" to 46.5". **Recommended table top sizes:** Length of 40" to 87", Width of 23" to 42", and a thickness of 3/4" and greater**Load Capacity:** Supports up to 220lbs**Features:** 1 inch/second lift speed, controller with 3 memory settings to save desired heights

**Citation:** Amazon.com: VIVO Electric Stand Up Desk Frame, DIY Workstation, Frame Only, Dual Motor Ergonomic Standing Height Adjustable Base with Memory Controller, Black, DESK-E-200B : Office Products. (n.d.). Www.amazon.com. Retrieved October 9, 2023, from [https://www.amazon.com/dp/B08P56RD43?ref=emc\\_p\\_m\\_5\\_i&th=1](https://www.amazon.com/dp/B08P56RD43?ref=emc_p_m_5_i&th=1)



Material: Alloy Steel

Current Price: \$164.99

Dimensions: 44"D x 22.6"W x 46"H

Frame Length: 40 to 57", Frame Height: 27" to 45". Recommended table top measurements: Length of 48" to 70", Width of 24" to 30", and a thickness of 1"

Load Capacity: Supports up to 265 lbs

Features: 4 memory save positions, adjustable feet

Citation: *Amazon.com: Radlove Dual Motor Height Adjustable Standing Desk Frame, Adjustable Desk Legs for 48" to 70" Desk Tops, Home Office Sit Stand Desk Base, Heavy Duty 265 lb Load Capacity for Home Office : Office Products.* (n.d.). [www.amazon.com](https://www.amazon.com/Height-Adjustable-Standing-Radlove-Capacity/dp/B09VGDC7Q6/ref=asc_df_B09VGC71B6?tag=bingshoppinga-20&linkCode=df0&hvadid=80195759882177&hvnetw=o&hvqmt=e&hvbmt=be&hvdev=c&hvlocint=&hvlocphy=&hvtargid=pla-4583795279301164&th=1). Retrieved October 9, 2023, from [https://www.amazon.com/Height-Adjustable-Standing-Radlove-Capacity/dp/B09VGDC7Q6/ref=asc\\_df\\_B09VGC71B6?tag=bingshoppinga-20&linkCode=df0&hvadid=80195759882177&hvnetw=o&hvqmt=e&hvbmt=be&hvdev=c&hvlocint=&hvlocphy=&hvtargid=pla-4583795279301164&th=1](https://www.amazon.com/Height-Adjustable-Standing-Radlove-Capacity/dp/B09VGDC7Q6/ref=asc_df_B09VGC71B6?tag=bingshoppinga-20&linkCode=df0&hvadid=80195759882177&hvnetw=o&hvqmt=e&hvbmt=be&hvdev=c&hvlocint=&hvlocphy=&hvtargid=pla-4583795279301164&th=1)

**Conclusions/action items:** These standing desk frames could provide a simple way to create an adjustable motorized base for the lean and lift. This solution would help further reduce the time and effort for the client to put on his pants. Action items: create and updated design drawing incorporating the standing desk and present findings to team.





**Title: Grainger Metal Research****Date:** 10/19/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Gain a basic understanding of the types of metal available from Grainger that we might use for fabrication.**Content:**

1061-T6 Aluminum Flat Bar

**4 in x 4 ft****T6 Temper**

↑Thickness	Thickness Tolerance	Fabrication	Mechanical Finish	Heat Treatable	Heat Treatment	Brinell Hardness
0.016 in	+/-0.001 in	—	Mill	Yes	No Heat Treatment	95
0.025 in	+/-0.0015 in	—	Mill	Yes	No Heat Treatment	95
0.032 in	+/-0.002 in	—	Mill	Yes	No Heat Treatment	95
0.04 in	+/-0.0025 in	—	Mill	Yes	No Heat Treatment	95
0.05 in	+/-0.003 in	—	Mill	Yes	No Heat Treatment	95
0.063 in	+/-0.003 in	—	Mill	Yes	No Heat Treatment	95
0.08 in	+/-0.0035 in	—	Mill	Yes	No Heat Treatment	95
0.09 in	+/-0.0035 in	—	Mill	Yes	No Heat Treatment	95
0.125 in	+/-0.0045 in	—	Mill	Yes	No Heat Treatment	95
0.16 in	+/-0.007 in	—	Mill	Yes	No Heat Treatment	95
0.19 in	+/-0.007 in	—	Mill	Yes	No Heat Treatment	95

1061-T6 Aluminum Flat Bar

**6 in x 4 ft****T6 Temper**

↑Thickness	Thickness Tolerance	Fabrication	Mechanical Finish	Heat Treatable	Heat Treatment	Brinell Hardness
0.016 in	+/-0.001 in	—	Mill	Yes	No Heat Treatment	95
0.025 in	+/-0.0015 in	—	Mill	Yes	No Heat Treatment	95
0.032 in	+/-0.002 in	—	Mill	Yes	No Heat Treatment	95
0.04 in	+/-0.0025 in	—	Mill	Yes	No Heat Treatment	95
0.05 in	+/-0.003 in	—	Mill	Yes	No Heat Treatment	95
0.063 in	+/-0.003 in	—	Mill	Yes	No Heat Treatment	95
0.08 in	+/-0.0035 in	—	Mill	Yes	No Heat Treatment	95
0.09 in	+/-0.0035 in	—	Mill	Yes	No Heat Treatment	95
0.125 in	+/-0.0045 in	—	Mill	Yes	No Heat Treatment	95
0.16 in	+/-0.007 in	—	Mill	Yes	No Heat Treatment	95
0.19 in	+/-0.007 in	—	Mill	Yes	No Heat Treatment	95

1061-T6 Rectangular Tubing



High-strength 6061 aluminum rectangular tube stock is strong, easy to machine, and weld. These tubes are heat treatable and can be anodized or coated for added protection. Typical uses include aircraft components, cameras, couplings, marine fittings, and hardware. Additional applications include electrical components and connectors.

- Mechanical Finish: Mill
- Fabrication: Extruded
- Yield Strength: 40,000 psi

**T6 Temper**

↑ Outside Width	Outside Height	Wall Thickness	Brinell Hardness	Heat Treatable	Overall Length				
					12 in	24 in	36 in	4 ft	6 ft
3/4 in	3/4 in	0.062 in	95	—	\$5.62	\$7.88	\$11.08	\$13.12	\$18.18
1 in	1 in	0.065 in	95	—	\$5.62	\$10.45	\$14.70	\$17.43	\$24.20
1 1/2 in	1 1/2 in	0.188 in	95	—	\$25.88	\$49.68	\$69.84	\$82.80	\$114.88
2 in	1 in	0.062 in	95	—	\$7.30	\$13.98	\$19.62	\$23.32	\$32.32
2 1/2 in	2 1/2 in	0.188 in	95	—	\$35.16	\$67.40	\$94.80	\$112.28	\$155.80
3 in	1 1/2 in	0.125 in	95	—	\$24.28	\$46.56	\$65.40	\$77.52	\$107.60
3 1/2 in	3 1/2 in	0.25 in	95	—	\$71.72	\$137.80	\$193.80	\$229.60	\$318.60
4 in	4 in	0.125 in	95	—	\$48.96	\$94.04	\$132.40	\$156.80	\$217.40
5 in	2 in	0.25 in	95	—	\$89.92	\$172.60	\$242.80	\$287.80	\$399.20
5 in	3 in	0.188 in	95	—	\$63.32	\$121.60	\$171.00	\$202.60	\$281.00
5 in	3 in	0.25 in	95	—	\$91.00	\$174.80	\$245.80	\$291.20	\$404.00
5 in	5 in	0.188 in	95	—	\$82.28	\$158.00	\$222.20	\$263.40	\$365.40
6 in	3 in	0.25 in	95	—	\$93.60	\$179.80	\$252.80	\$299.60	\$415.60
6 in	4 in	0.5 in	95	—	\$183.00	\$351.40	\$505.20	\$644.40	\$878.40
8 in	3 in	0.25 in	95	—	\$230.80	\$443.20	\$623.20	\$738.80	\$1,024.80
8 in	6 in	0.375 in	95	—	\$226.20	\$434.40	\$581.60	\$689.20	\$956.80
8 in	8 in	0.25 in	95	—	\$216.40	\$415.20	\$556.40	\$659.20	\$914.40

**1060-T6 Sheets/Plates:**

**12 in x 36 in**

**T6 Temper**

↑ Thickness	Thickness Tolerance	Mechanical Finish	Yield Strength	Brinell Hardness	Heat Treatable	Price
0.016 in	+/- 0.001 in	Mill	40,000 psi	95	Yes	\$18.68
0.016 in	—	Mill	40,000 psi	95	Yes	\$27.50
0.02 in	—	Mill	40,000 psi	95	Yes	\$27.94
0.025 in	+/- 0.0015 in	Mill	40,000 psi	95	Yes	\$23.28
0.032 in	+/- 0.002 in	Mill	40,000 psi	95	Yes	\$17.77
0.032 in	—	Mill	40,000 psi	95	Yes	\$29.57
0.04 in	+/- 0.0025 in	Mill	40,000 psi	95	Yes	\$18.72
0.04 in	—	Mill	40,000 psi	95	Yes	\$31.15
0.05 in	+/- 0.003 in	Mill	40,000 psi	95	Yes	\$26.14
0.05 in	—	Mill	40,000 psi	95	Yes	\$43.43
0.063 in	+/- 0.003 in	Mill	40,000 psi	95	Yes	\$28.69
0.063 in	—	Mill	40,000 psi	95	Yes	\$47.74
0.08 in	+/- 0.0035 in	Mill	40,000 psi	95	Yes	\$42.77
0.08 in	—	Mill	40,000 psi	95	Yes	\$71.15
0.09 in	+/- 0.0035 in	Mill	40,000 psi	95	Yes	\$47.61
0.09 in	—	Mill	40,000 psi	95	Yes	\$79.24
0.1 in	—	Mill	40,000 psi	95	Yes	\$70.40
0.125 in	+/- 0.0045 in	Mill	40,000 psi	95	Yes	\$63.23
0.125 in	—	Mill	40,000 psi	95	Yes	\$105.20
0.16 in	+/- 0.007 in	Mill	40,000 psi	95	Yes	\$65.78
0.16 in	—	Mill	40,000 psi	95	Yes	\$119.24
0.19 in	+/- 0.007 in	Mill	40,000 psi	95	Yes	\$84.92
0.19 in	—	Mill	40,000 psi	95	Yes	\$132.22

**4130 Steel Flat Bar**

### 6 in x 36 in Nominal Size (WxL)

#### Cold Finished

↑Thickness	Thickness Tolerance	Temper	Mechanical Finish	Heat Treatable	Yield Strength
0.025 in	+/-0.005 in	O	Mill	Yes	66,000 psi
0.032 in	+/-0.005 in	O	Mill	Yes	66,000 psi
0.04 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.05 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.063 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.071 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.08 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.1 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.125 in	+/-0.009 in	O	Mill	Yes	66,000 psi
0.16 in	+/-0.009 in	O	Mill	Yes	66,000 psi

4140 Steel Flat Bar

### 1 in x 36 in Nominal Size (WxL)

#### Cold Finished

↑Thickness	Thickness Tolerance	Temper	Mechanical Finish	Heat Treatable	Yield Strength	Brinell Hardness	Price
0.25 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$21.93
0.38 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$31.67
0.5 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$41.63
0.63 in	+0.000 in/-0.004 in	O	Mill	Yes	60,000 psi	187	\$65.64
0.75 in	+0.000 in/-0.004 in	O	Mill	Yes	60,000 psi	187	\$63.92
1 in	+0.000 in/-0.005 in	+0.000 in/-0.004 in	Mill	Yes	60,000 psi	187	\$76.64

### 1 in x 6 ft Nominal Size (WxL)

#### Cold Finished

↑Thickness	Thickness Tolerance	Temper	Mechanical Finish	Heat Treatable	Yield Strength	Brinell Hardness	Price
0.25 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$42.00
0.38 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$60.33
0.5 in	+0.000 in/-0.007 in	O	Mill	Yes	60,000 psi	187	\$81.91
0.63 in	+0.000 in/-0.004 in	O	Mill	Yes	60,000 psi	187	\$114.48
0.75 in	+0.000 in/-0.004 in	O	Mill	Yes	60,000 psi	187	\$111.48
1 in	+0.000 in/-0.009 in	O	Mill	Yes	60,000 psi	187	\$144.19

**Conclusions/action items:** Aluminum is cheaper and more lightweight but may be more difficult to weld for beginners. We may want to go with a mild steel such as 4130 or 4140 for welding, about welding capabilities and see if they have any recommendations regarding material. Complete safety testing in SolidWorks for 4130/4140 steel (1060-T6 has already been tested and wa



## 2023/10/25 - Prefabricated Base Research

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**Title: Prefabricated Base Research****Date:** 10/25/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Obtain several options of steel bases that could be ordered and modified into the base of the Lean and Lift design. This will make fabrication more feasible for the team.**Content:**

"BMJX 43.3" Work Benches for Garage Height Adjustable Work Table with Crank Handle & Casters, Heights from 30" to 41.3", Wooden Top Workbench for Workshop, Office, Home - Amazon.com." [www.amazon.com, www.amazon.com/dp/B0CB7QWYJ3/ref=emc\\_b\\_5\\_t](https://www.amazon.com/dp/B0CB7QWYJ3/ref=emc_b_5_t). Accessed 25 Oct. 2023.

BMJX 43.3" Work Benches for Garage Height Adjustable Work Table with Crank Handle & Casters, Heights from 30" to 41.3", Wooden Top Workbench for Workshop, Office, Home - Amazon.com

-\$179.99

-Supports up to 600 lbs.

-Adjustable height via crank. 30" to 41.3" (75 to 105 cm)

-Wood top is 43.3" x 23.6" (110 x 60 cm)



"Montezuma Adjustable Steel Multi-Use Workspace Frame, 64" X 17" X 41" - Amazon.com." [www.amazon.com, www.amazon.com/Montezuma-Adjustable-Steel-Multi-Use-Workspace/dp/B08F7ZFT97/ref=sr\\_1\\_4?crid=33XY1OD3GNZ8O&keywords=montezuma+adjustable+steel+multi-](https://www.amazon.com/Montezuma-Adjustable-Steel-Multi-Use-Workspace/dp/B08F7ZFT97/ref=sr_1_4?crid=33XY1OD3GNZ8O&keywords=montezuma+adjustable+steel+multi-)

use+workspace+frame&qid=1698269118&s=home-garden&sprefix=montezuma+adjustable+steel+multi-use+workspace+frame%2Cgarden%2C79&sr=1-4. Accessed 25 Oct. 2023.

Montezuma Adjustable Steel Multi-Use Workspace Frame, 64" x 17" x 41" - Amazon.com

-\$112.16

-Weight capacity: 1000 lbs

-Adjustable width 40" to 64" (100 to 162.5 cm)

-Frame height can be raised or lowered in 1" increments and adjusts from 29" to 41" high (74 to 105 cm)

-17" depth (43 cm)

-18 gauge steel construction

8 Products

Standard Duty Adjustable-Height Workbench Legs

Use two legs to hold up to 4,000 lbs. Adjust height in 1 1/2" increments with rivets that slide into keyhole slots. All legs have knockouts in the front and back to accept duplex electrical outlets.

At least three workbench legs are required for tops 96" wide and larger.

Legs



For Top Dp.	Ht.	Adjustments		Cap. per Leg, lbs.	Material	Color	Gauge	Top Mtg. Holes			Floor Mtg. holes			Each	
		Ctr.-to-Ctr.	Type					No. of.	Dia.	Fasteners Included	No. of	Dia.	Fasteners Included		
Stationary															
30"	28"-35 1/2"	1 1/2"	Keyhole Slots	2,000	Painted Steel	Gray	14	16	5/16"	No	2	3/8"	No	4915T62	\$70.29
36"	28"-35 1/2"	1 1/2"	Keyhole Slots	2,000	Painted Steel	Gray	14	16	5/16"	No	2	3/8"	No	4915T43	80.60

Optional Lower Shelves



For Top		O'all			Material	Color	Gauge	Cap., lbs.	Mounting				Each	
Wd.	Dp.	Wd.	Dp.	Ht.					Fasteners Included	No. of Holes	Hole Wd.	Hole Lg.		
48"	24"-36"	48"	14"	3"	Powder-Coated Steel	Gray	16	700	Yes	4	5/16"	5/8"	9054T89	\$72.14
60"	24"-36"	60"	14"	3"	Powder-Coated Steel	Gray	16	1,000	Yes	4	5/16"	5/8"	9054T42	89.25
72"	24"-36"	72"	14"	3"	Powder-Coated Steel	Gray	16	1,000	Yes	4	5/16"	5/8"	9054T44	108.46

Support Braces



For Top Wd.	Material	Color	Gauge	Mounting Fasteners Included	Each
48"	Powder-Coated Steel	Gray	14	Yes	4885T45 \$22.60
60"	Powder-Coated Steel	Gray	14	Yes	4885T43 29.68
72"	Powder-Coated Steel	Gray	14	Yes	4885T44 41.56

"McMaster-Carr." [www.mcmaster.com](http://www.mcmaster.com), [www.mcmaster.com/products/adjustable-height-workbench-legs/standard-duty-adjustable-height-workbench-legs/](http://www.mcmaster.com/products/adjustable-height-workbench-legs/standard-duty-adjustable-height-workbench-legs/). Accessed 25 Oct. 2023.

[adjustable-height workbench legs](#) | McMaster-Carr

-Also have the option of buying components and assembling ourselves

-See image for specs

**Conclusions/action items:** These are potential options to be discussed with team. Listed weight capacities are well above 230lbs, but tipping may be an issue. This could be solved by welding a piece of sheet metal to the bottom of the legs for the client to wheel his wheelchair onto. This would create an effective counterweight. Action item: finalize shopping list of materials to be ordered.



**2023/11/10 - Adhesive Research**

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**Title: Adhesive Research****Date:** 11/10/2023**Content by:** Avery Schuda**Present:** N/A**Goals:** Determine an effective adhesive that can be used to attach the polyurethane foam padding to the metal standing desk frame.**Content:**

"Polyurethanes are also commonly used with metal. Polyurethanes are water-resistant and UV-resistant and set quickly without being brittle. Once cured, they can be sanded, stained, and painted. That makes them great for many jobs around the house, including repairing flooring or finished carpentry like cabinets or tables.

A quality exterior construction adhesive should be a polyurethane-based, moisture-curing adhesive to create stronger bonds than ordinary construction adhesives. Like many polyurethanes, it works on metal across a wide range of temperatures, making it the best metal glue for outdoor use."

*Metal Glue: All You Need to Know.* (n.d.). [www.loctiteproducts.com](http://www.loctiteproducts.com). <https://www.loctiteproducts.com/en/know-how/fix-stuff/metal-glue.html>

**Loctite PL Premium Construction Adhesive**

-Bonds to most common construction materials such as wood, plywood, OSB, MDF, treated wood, hardwood, flooring, concrete, stone, granite, marble, slate, masonry, brick, foam insulation of all sorts including EPS (expanded polystyrene foam), XPS (extruded polystyrene foam), and **polysio (urethane) foam**, carpets, **metal, stainless steel, galvanized metal**, lead, cement-based products, fiber cement panels, ceramic, fiberglass, drywall, rigid and cellular vinyl/PVC trim and molding and polyash trim

-Low in VOC and meets stringent state and federal regulatory requirements as well as ASTM, HUD, and APA AFG-01 specs.

-Permanently bonds together almost any substrate and sets in 30 minutes and fully cures in 24 hours

-One component polyurethane-based adhesive

-\$12.48 for a 28oz tube or \$7.28 for a 10oz tube from Home Depot

From Performance Spec Data Sheet: General Application: 1. Apply adhesive to one surface of the material being bonded. 2. Press the surfaces firmly together within 15 to 20 minutes. 3. Materials may be repositioned within 30 to 45 minutes after applying the adhesive. 4. If bonding two non-porous surfaces (such as foam, metal or rigid fiberglass) or under very dry conditions (less than 30% relative humidity), add water in the form of a very light or atomized spray from a plant mister bottle/spray bottle to the extruded adhesive. a. Follow same procedure if bonding large size sheet goods. b. The repositioning time will then be reduced to less than 15 minutes. 5. Use mechanical support for 24 hours while the adhesive cures. 6. Cure time is dependent upon temperature, humidity, porosity of substrate and amount of adhesive used. a. Low temperature and humidity will slow cure time. 7. When bonding EPS and XPS foam insulation, avoid cure and surface temperatures above 90°F (32°C) as this may cause cavitation of the foam. 8. User is responsible for determining suitable and acceptable results for their intended project. 9. Test before use.

\*need a caulk gun for this product--make sure we have access to this or we will need to buy one as well

*Loctite® PL® Premium Polyurethane Construction Adhesive.* (n.d.). [www.loctiteproducts.com](http://www.loctiteproducts.com). Retrieved November 10, 2023, from [https://www.loctiteproducts.com/en/products/build/construction-adhesives/pl-pro-line/loctite\\_pl\\_premiumpolyurethaneconstructionadhesive4ozsqueezetube.1390595.html#variant](https://www.loctiteproducts.com/en/products/build/construction-adhesives/pl-pro-line/loctite_pl_premiumpolyurethaneconstructionadhesive4ozsqueezetube.1390595.html#variant)

**3M Double Coated Urethane Foam Tape 4032 Double Sided Durable Adhesive**

-This foam tape is coated with a strong acrylic adhesive that helps fill gaps and can be used to bond uneven or textured surfaces together.

-This permanent adhesive tape is used for bonding materials like glass, metals, and plastics with high surface energy like ABS and polycarbonate.

-High shear adhesive with high temperature resistance. Durable foam is ideal for interior mounting applications

-Did not perform very well in customer reviews

-\$14.04 for one roll on Amazon

*3MTM Double Coated Urethane Foam Tape 4032 | 3M United States. (2017). 3m.com; MMM-ext. [https://www.3m.com/3M/en\\_US/p/d/b40067227/](https://www.3m.com/3M/en_US/p/d/b40067227/)*

**Conclusions/action items: I believe that the Loctite Adhesive will perform best for our purposes. Will present to team and order upon approval.**



## 2023/9/20 - Design Idea 1 - Lean and Lift

AVERY SCHUDA - Sep 20, 2023, 9:57 PM CDT

**Title:** Design Idea 1 - Lean and Lift

**Date:** 9/20/2023

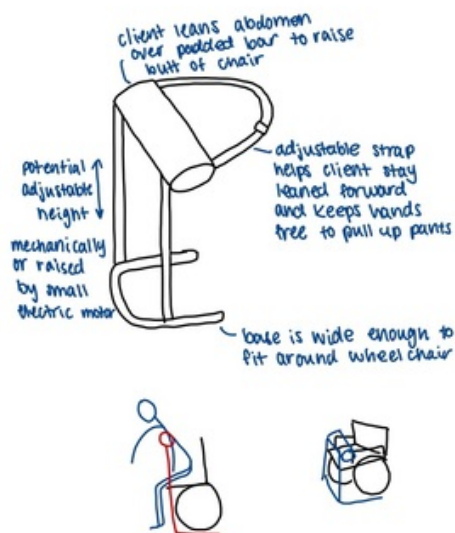
**Content by:** Avery Schuda

**Present:** N/A

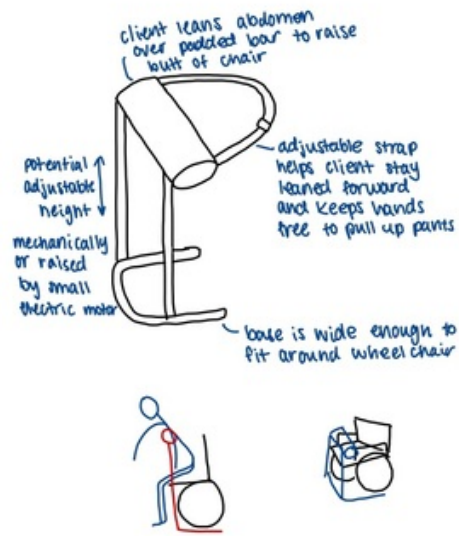
**Goals:** Brainstorm preliminary design ideas for the client

**Content:**

In this design the client leans forward to elevate his bottom off of his chair to make putting pants on easier. An adjustable strap help keep the client's body forward and bottom elevated while leaving his hands free to pull up his pants. The device would fit ergonomically around the client's wheelchair. There is the potential for height adjustability here via a mechanical operation or potentially some kind of electric motor that raises and lowers the height of the bar. This may assist the client with elevating his bottom to give enough room to more easily pull pants up.



**Conclusions/action items:** Get feedback from team members - is this design achievable within the constraints of the project? Get feedback from the client - Can this action be performed by the client, what are his concerns?



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**Design\_Idea\_1 - Lean\_and\_Lift.jpg (87.8 kB)**



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**CDB60150-2312-4A84-ADEA-BF6191C351EC.jpg (345 kB)**



## 2023/10/10 - Modified Standing Desk Lean and Lift Design

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AVERY SCHUDA - Oct 10, 2023, 2:07 PM CDT

**Title:** Modified Standing Desk Lean and Lift Design


**Date:** 10/10/2023

**Content by:** Avery Schuda

**Present:** N/A

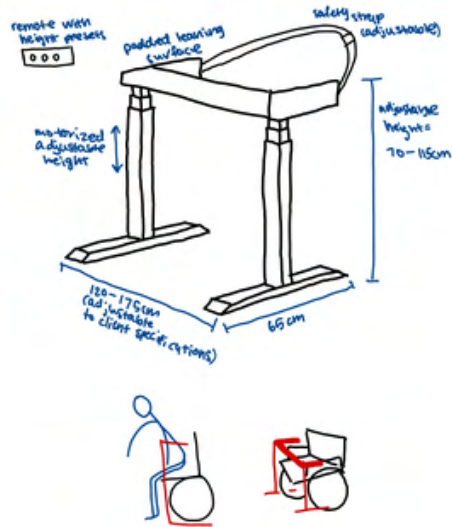
**Goals:** After talking with the client about the possibility of modifying a standing desk into my previous Lean and Lift Design and completing research about the type of standing desk that would be most promising for the task, I drew out a potential design using the base of a standing desk.

**Content:**

 Modified\_Standing\_Desk\_Lean\_and\_Lift\_Design.jpg

- Design builds off previous Lean and Lift design
- Modifies standing desk base which can be purchased as base of the Lean and Lift
- Width of standing desk base is adjustable and could be fixed in place once tested with the client for maximum comfort and maneuverability
- Base is motorized allowing the height to be adjusted from 70-115 cm
- Comes with remote that allows user to set 3-4 height presets.
- Updated leaning surface contours more to the client's body
- Safety strap included to help client remain leaning forwards
- Standing desk base supports up to 265lbs. Client is only 220lbs, and base will not be supporting full body weight since he is leaning forwards with feet still planted on ground.

**Conclusions/action items:** Present findings to team members, advisor, and client.



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Modified\_Standing\_Desk\_Lean\_and\_Lift\_Design.jpg (739 kB)



## 2023/10/15 - Updated Lean and Lift Digital Drawing

AVERY SCHUDA - Oct 17, 2023, 12:38 PM CDT

**Title:** Updated Lean and Lift Digital Drawing

**Date:** 10/15/2023


**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Created a new digital design drawing of the Lean and Lift with most recent updates

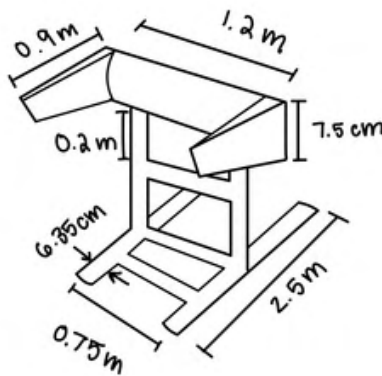
**Content:**

Changes: Digitalize sketch. Replace handles in favor of a bar for easier fabrication. Leaning surface will only be curved on one side rather than fully round for better ergonomics. Section added to base for client to roll his wheelchair onto as a counterweight for better stability. Padded arms added to leaning surface.

 Updated\_Lean\_and\_Lift\_Digital\_Drawing.jpg

**Conclusions/action items:** Complete digital design drawings of other design. Update Preliminary Design Report based on advisor feedback. Collaborate with Sallie on SolidWorks model.

AVERY SCHUDA - Oct 16, 2023, 9:34 AM CDT



[Download](#)

Updated\_Lean\_and\_Lift\_Digital\_Drawing.jpg (95.3 kB)



## 2023/10/15 - Updated Snap/Zip Pants Digital Drawing

AVERY SCHUDA - Oct 17, 2023, 12:38 PM CDT

**Title:** Updated Snap/Zip Pants Digital Drawing

**Date:** 10/15/2023


**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Created a new digital design drawing of the Snap/Zip Pants Design with most recent updates

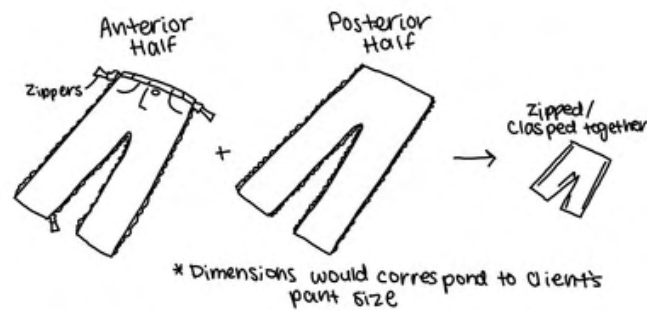
**Content:**

Changes: Digitalize sketch. All other aspects of the design remain unchanged.

 Updated\_Snap\_Zip\_Pants\_Digital\_Drawing.jpg

**Conclusions/action items:** Complete digital design drawings of other design. Update Preliminary Design Report based on advisor feedback. Collaborate with Sallie on SolidWorks model.

AVERY SCHUDA - Oct 16, 2023, 9:35 AM CDT



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Updated\_Snap\_Zip\_Pants\_Digital\_Drawing.jpg (112 kB)





## 2023/10/15 - Updated Suspenders Digital Drawing

AVERY SCHUDA - Oct 17, 2023, 12:37 PM CDT

**Title:** Updated Suspenders Digital Drawing

**Date:** 10/15/2023


**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Created a new digital design drawing of the Suspenders with most recent updates

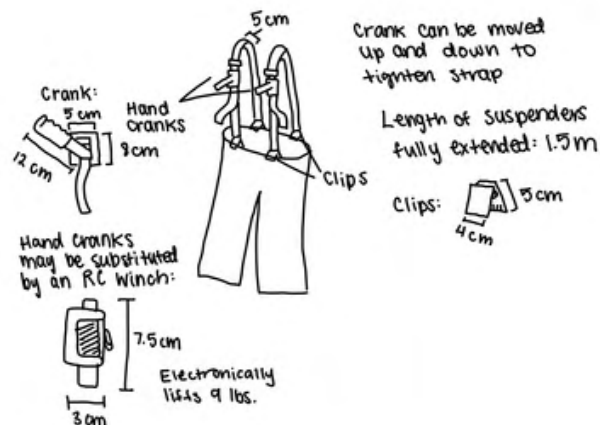
**Content:**

Changes: Digitalize sketch. Added potential to replace hand cranks with RC winch for electronic lift.

 Updated\_Suspenders\_Digital\_Drawing.jpg

**Conclusions/action items:** Complete digital design drawings of other design. Update Preliminary Design Report based on advisor feedback. Collaborate with Sallie on SolidWorks model.

AVERY SCHUDA - Oct 16, 2023, 9:35 AM CDT



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Updated\_Suspenders\_Digital\_Drawing.jpg (146 kB)



## 2023/10/17 - Final Design Sketch

AVERY SCHUDA - Oct 17, 2023, 12:37 PM CDT

**Title:** Final Design Sketch

**Date:** 10/17/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Created a new digital design drawing of the final design, combining the Lean and Lift with the pulling mechanism from the Suspenders design with most recent updates

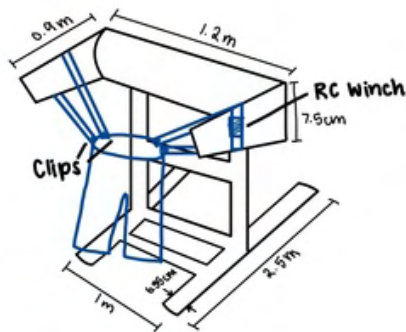
**Content:**

The final design features the complete Lean and Lift design but incorporates the pulling mechanism from the Suspenders design. The loops of the suspenders that would typically be worn over the shoulders, are instead places over the arms of the Lean and Lift. This eliminates any discomfort from tightening the suspenders straps. The client starts sitting in his wheelchair and pulls his pants up to his knees, then clips the suspenders to the waist of the pants. He then uses the mechanism built into his wheelchair that allow him to raise himself up and lean forwards over the leaning surface of the Lean and Lift. He presses a button, and an RC winch is used to electronically used to lift up the pants. He then unclips the suspenders and sits back down in his wheelchair with pants fully on.

 Final\_Design\_Sketch\_1.jpg

**Conclusions/action items:** Update Preliminary Design Report based on advisor feedback. Collaborate with Sallie on SolidWorks model. Add dimensions to drawing based on testing from SolidWorks model.

AVERY SCHUDA - Oct 17, 2023, 12:30 PM CDT



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Final\_Design\_Sketch\_1.jpg (103 kB)



## 2023/11/08 - Show and Tell Reflection

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AVERY SCHUDA - Nov 08, 2023, 4:51 PM CST

**Title:** Show and Tell Reflection

**Date:** 11/08/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Summarize and reflect on helpful feedback from the show and tell presentation (feedback originally recorded on a google doc during the presentation)

**Content:**

-Many people asked about tipping and thought that having a metal bar or sheet on the bottom for extra stability so that the client's wheelchair can act as a counterweight

-Some people thought we should have random people try the design and time how long it takes them to pull up their pants - I have mixed feelings about this since they do not have MD so the device likely will not actually improve their ability to pull up their pants. Also, the device is customized to the client's exact measurements and specifications, not designed to be a universal device. I think that SolidWorks testing and functional testing with the client will be sufficient.

-Some people were concerned about how the client will remove the straps after pants are fully up. This is something we will need to test with the client and make sure the angle of the RC winches are optimized so the client has maximum mobility.

-Our main call to action was to ask for ideas to attach the metal bars to the standing desk frame. One person suggested having a separate stands for the RC winches, but this would over complicate the design and does not align with the client's specifications. One person suggested completely fill in the sides with plywood or another material but didn't elaborate further how this would actually help solve the problem and likely wouldn't work for the same reason as the previous suggestion. One person suggested trying to attach the bars or winches to the top part of the standing desk, which I think could be a feasible option. Another suggested cutting the bars to have a lip on two of the sides so that the bar basically has a built-in bracket so that the bar can be screwed to the standing desk frame. I think this is one of the best options. Several people said we should just figure out how to weld, but we did not encounter anyone who had welding experience.

**Conclusions/action items:** Obtain detailed measurements of the standing desk frame for new SolidWorks model. Finalize fabrication plan and decide if any further materials need to be purchased. Test RC winches.



## 2023/12/04 - Lean and Lift SolidWorks with Final Dimensions

---

AVERY SCHUDA - Dec 04, 2023, 11:16 PM CST

**Title:** Lean and Lift SolidWorks with Final Dimensions

**Date:** 12/04/2023

**Content by:** Avery Schuda

**Present:** Avery Schuda and Sallie Schoen

**Goals:** Present SolidWorks design and explain design elements

**Content:**

The lean and lift prototype is attached below. We remodeled the design including updated dimensions and created a new SW drawing.

The prototype does not include the cushion material that will be added on top of the aluminum at the top of the lean and lift for comfort. The simulation will take into account the strength of the material chosen (probably aluminum) and how it will withstand the 230 lb weight of the user.

The prototype will have to be altered to add handlebars for the user to hold onto if the team decides that it's necessary. Also, more discussion with the client is needed to determine a way to decide if the rods coming off the side of the prototype will be able to pull the pants up to the desired area. I have a feeling the rods might have to be at an angle in order to pull the pants up because the client will be leaned over.

**Conclusions/action items:**

The simulation needs to be rerun using the new dimensions.

AVERY SCHUDA - Dec 04, 2023, 4:35 PM CST

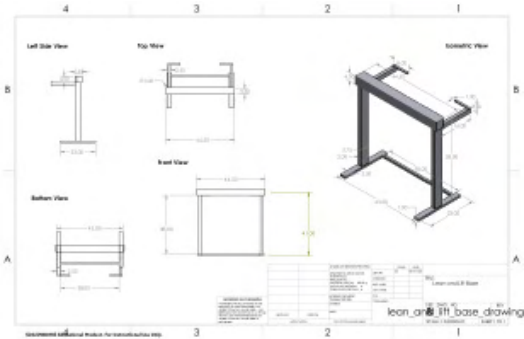
[Download](#)

lean\_and\_lift\_base.SLDPRT (152 kB)

AVERY SCHUDA - Dec 04, 2023, 5:55 PM CST

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lean\_and\_lift\_base\_drawing.SLDDRW (142 kB)



[Download](#)

lean\_and\_lift\_base\_drawing.pdf (102 kB)



# 2023/12/10 - Sketches with Dimensions Changed to Inches

AVERY SCHUDA - Dec 10, 2023, 4:57 PM CST

**Title:** Sketches with Dimensions Changed to Inches

**Date:** 12/10/2023

**Content by:** Avery Schuda

**Present:** N/A

**Goals:** Update design sketches included in the preliminary design matrix to reflect units of inches so that the final report has consistent units

**Content:**

See attached images for updated units.

**Conclusions/action items:** Complete final report. Nothing about designs were changed except converting units to inches and updating images in the design matrix.

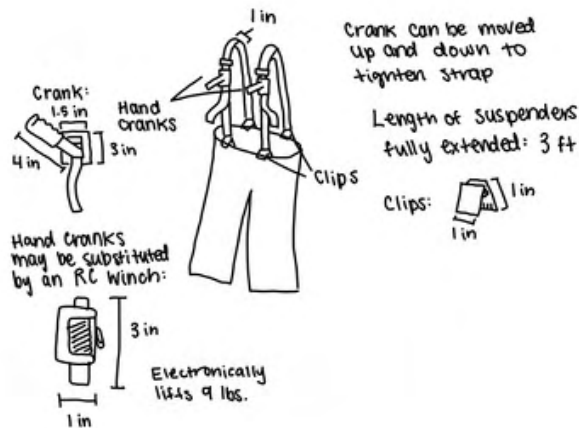
AVERY SCHUDA - Dec 10, 2023, 4:57 PM CST

Rank	Criteria	Weighted Score	Design 1: Lean and Lift Score (out of 10) / Weighted Score	Design 2: SnapZip Pants Score (out of 10) / Weighted Score	Design 3: Suspenders Score (out of 10) / Weighted Score
1	Effectiveness	25	9 / 22.5	6 / 15	7 / 17.5
2	Ease of use	20	6 / 12	4 / 8	6 / 12
3	Ease of fabrication	20	7 / 14	6 / 12	8 / 16
4	Comfort	15	10 / 15	9 / 13.5	8 / 12
5	Price	10	5 / 5	10 / 10	10 / 10
6	Safety	5	9 / 4.5	10 / 5	9 / 4.5
	Sum	100	Sum: 61	Sum: 65.5	Sum: 72

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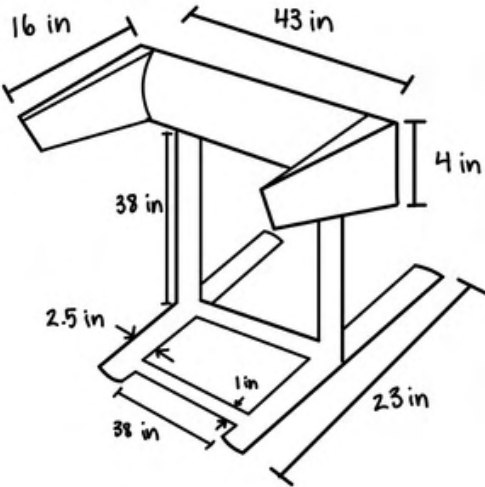
Screenshot\_2023-12-10\_164727.png (133 kB) Design matrix with images in units of inches

AVERY SCHUDA - Dec 10, 2023, 4:59 PM CST



[Download](#)

thumbnail\_Updated\_Suspenders-1.jpg (231 kB) Suspenders design drawing updated with units of inches



[Download](#)

thumbnail\_Updated\_Lean\_and\_Lift-1.jpg (138 kB) Lean and Lift design drawing with updated units of inches



## 9/20/23-Becker's Muscular Dystrophy

RAYONA KINNY - Oct 11, 2023, 11:00 PM CDT

**Title:** Becker's Muscular Dystrophy Research

**Date:** 9/20/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Learn more about Becker's Muscular Dystrophy and its causes, symptoms, treatments, and any other information relevant to the project.

**Content:**

- Rare disease almost exclusively in males due to X-linked inheritance.
- Results in progressive muscle degeneration and weakness overtime
- Starts with symptoms like cramping with strenuous activity, the delayed ability of jumping, running, stair climbing, and cognitive impairment
- Generalized weakness first affects muscles of the hips, pelvic area, thighs, and shoulders
- No curative treatment, but supportive therapy and rehabilitation are the mainstay of treatment, such as physical therapy to strengthen the motor activity along with speech therapy, occupational therapy, and recreational therapy
- The average life expectancy of the patient with Becker muscular dystrophy is about 40 to 50 years
- Braces, also called *orthoses*, can support just the ankle and foot or extend over the knee
- Some people with BMD ultimately require wheelchairs or scooters
- Researchers have started investigating the possibility that phosphodiesterase inhibitors can improve skeletal or heart muscle function in people with BMD or DMD

**Sources:**

Thada PK, Bhandari J, Umapathi KK. Becker Muscular Dystrophy. [Updated 2023 Jul 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK556092>

"Becker Muscular Dystrophy (BMD) | Muscular Dystrophy Association." *Muscular Dystrophy Association*, 31 Jan. 2018, [www.mda.org/disease/becker-muscular-dystrophy](http://www.mda.org/disease/becker-muscular-dystrophy).

**Conclusions/action items:**

Becker's muscular dystrophy is a rare disease that mostly effects males, primarily affecting voluntary muscles, leading them to get weaker over time. Symptoms first affects lower body areas as well as the shoulders, which is why many who have BMD are restricted to a wheelchair or scooter, which is what our client uses. There is no definite cure but treatment includes many types of therapy such as physical and speech. All these aspects helps the group get a better understanding of our client.





## 9/25/23-Muscular Dystrophy and Standing

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RAYONA KINNY - Sep 26, 2023, 12:29 AM CDT

**Title:** Muscular Dystrophy and Standing Research

**Date:** 9/25/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Learn more about how people with muscular dystrophy stand and if/when they do it and what they do it with, if using a device.

**Content:**

- A Powered Wheelchair Standing Device (PWSD) allows standing within the powered wheelchair structure despite muscle weakness
- provides opportunities for the individual to stand by controlling a joystick and without need for a transfer.
- choose when and where to stand for participation in a range of activities
- PWSDs are increasingly being used by individuals with DMD
- there has been no systematic evaluation of how the standing function of the PWSD is used by individuals with DMD for health, wellbeing and participation in social, educational and recreational activities

Source: Vorster, Nitamarie, et al. "Powered Standing Wheelchairs Promote Independence, Health and Community Involvement in Adolescents with Duchenne Muscular Dystrophy." *Neuromuscular Disorders*, vol. 29, no. 3, 2019, pp. 221–230, doi:10.1016/j.nmd.2019.01.010.

**Conclusions/action items:**

A powered wheelchair standing device could be useful for the project, whether it be for using it with the design or getting more information on people with muscular dystrophy. The device allows those with muscular dystrophy stand up when needed and helps them with daily activities like going to the bathroom and more.



## 9/25/23-Functional Clothing for Wheelchair Users

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RAYONA KINNY - Sep 26, 2023, 12:57 AM CDT

**Title:** Functional Clothing for Wheelchair Users Research

**Date:** 9/25/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Research clothing that has been made specifically for wheelchair users

**Content:**

- An evaluating system combined with sports tournament and rehabilitation medicine was introduced to assess the new designed clothing
- A set of normal functional clothing was employed as a comparison (Control)
- The time required to complete three different daily living activities, like dressing and undressing, going to toilet and bathing, were recorded
- Results showed that with the new clothing wheelchair users' competence of managing toilet was increased by 52.9%
- The time needed for toilet was reduced by 45.7%
- Their capability of managing dressing and undressing was improved by 24.6%.

Source: Wang, Yunyi, et al. "Evaluation on an Ergonomic Design of Functional Clothing for Wheelchair Users." *Applied Ergonomics*, vol. 45, no. 3, 2014, pp. 550–555, doi:10.1016/j.apergo.2013.07.010.

**Conclusions/action items:**

Researching if creating new clothing is a good option for the project of helping put pants on a person in a wheelchair. The study here indicated that the newly designed clothing could facilitate wheelchair users' daily living activities related with clothing. Creating new pants could be a possible design for the design matrix.



**9/12/23 - Wings-Pants Dressing Aid**

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**Title:** Wings-Pants Dressing Aid Research

**Date:** 9/12/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Learn more about a competing device and determine how it works, price, accessibility, and how it compares to other devices.

**Content:**



Link: <https://www.caregiverproducts.com/wings-pants-dressing-aid.html>

Sold by CaregiverProducts.com, which sells daily living aids for in home care since 1999.

Description:

- The Wings-Pants Dressing Aid is ideal for those who have difficulty with dressing their lower body
- This adapted dressing tool holds the pants open and works with trousers, blue jeans, sweatpants, and underwear
- accommodates many different styles of pants, including those with special loops attached
- The frame is adjustable by opening the release and pulling outward, allowing the user to slide up the piece with ease and release for hassle-free dressing
- Design for users who have limited motion in their spine, back, hips, knees, joints, etc., Also people recovering or suffering from accidents, people who are overweight, pregnant women and also, the elderly.
- the product is easily adjustable to fit the required size

Video of use: <https://www.youtube.com/watch?v=ThEaeG7skOQ>

Instructions:

First, securely position the pants onto the WingsPants, the rectangular shape of the dressing aid will hold the pants open. Then lower the handle to the floor. Users can be seated or standing.

Full instructions attached.

Retail price: \$49.95

Price being sold: \$39.95

Sizes:

- The small size fits 12.5 to 15 inches width hips
- large size fits 14.75 to 17-inch width hips. \$2 more

Material: polypropylene

Reviews:

- only three reviews but they are all five stars

"I have Cerebral Palsy, which makes dressing myself very tricky and time consuming. With this tool it is not only easier, but it also goes much faster and I no longer need to ask for assistance when getting dressed! Very pleased with this purchase!" - *Kimberly from Detroit, MI on 4/2/2018*

"The Wings-Pants Dressing Aid has been a huge help to my 92 year old mother for putting on her briefs. She couldn't reach down low enough to put them on any more, but with this dressing aid, she's able to put them on on her own. The device is very sturdy and looks like it will last well. You need to have some strength to put the briefs on the dressing aid. I have to do this for her. But I leave a pair on the device next to the toilet and she can change her briefs on her own when she needs to, whether I'm there or not." - *Shirley from Lakeland, FL on 4/7/2018*

"Excellent form follows function design with this dressing aid. I ordered this for my severely overweight Lymphedema and incontinence stricken roommate who could no longer dress herself with anything below her waist. This device eliminated her constant need for assisted care (me) living. Although not advertised, it also works well with adult diapers and she requires 15 ~ 20 changes a day! I highly recommend this product." - *Michael D Grissom from Morrisville, NC on 11/30/2017*

- All really positive reviews

#### **Conclusions/action items:**

The Wings-Pants Dressing Aid is an overall affordable device that aids those that have difficulty dressing their lower body. It comes in two sizes and is made of easily adjustable material. The shape of the device holds the pants open as the user puts them on. The product has only good reviews from those that have bought it.

### WingsPants



30/31 - Small, Hip Width: 32 1/2" - 15"

30/34 - Large, Hip Width: 34 1/4" - 17"



Video demonstration of WingsPants:  
<https://doi.org/10.2196/33013/wingspant-aid>

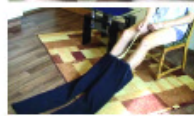
The width of the WingsPants can be adjusted by opening the release and pulling outward to the desired width.



Securely position the shorts/pants onto the WingsPants.



Handle angle is self adjusting. Once secured, the rectangular shape of the WingsPants hold them open to easily don your shorts/pants.



Can be used in a sitting or standing position.



[Download](#)

**cke307-wingspants-instructions.pdf (1.43 MB)**



## 9/26/23-Wheelchair Pants

RAYONA KINNY - Sep 26, 2023, 4:22 PM CDT

**Title:** Wheelchair Pants Research

**Date:** 9/26/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Research pants that have been designed and created specifically for wheelchair users and its price, material, and more.

**Content:**

Website: <https://izadaptive.com/collections/bottoms-men>

Company: IZ Adaptive

- IZ Adaptive was launched in 2009 after fashion designer Izzy Camilleri spent a few years creating custom clothing for a client who was a wheelchair user living with paralysis

- They offer men and women as well as non gender clothing

- IZ Adaptive has created a line of functional bottoms designed with the seated positions in mind

- Pants for wheelchair users or those with limited mobility offer options for closures, fasteners and fabric designed for both formal occasions and casual wear

- They have "seamless" bottoms that are specifically for those who get sores on their bottom areas

- Many designs: shorts, jeans, chinos, dress pants, cargo pants, and sweats, in various colors

- prices range from \$73 - \$201

- most products are elastic or stretchy

- One product is a tear away track pant, cost is \$167 (attached picture)

- Another products is a zip-up jeans, cost is \$201 - the most expensive (attached picture)

**Conclusions/action items:**

IZ Adaptive is a company that has designed custom clothing for those in wheelchairs. Many of their mens bottoms are elastic, stretchy, and seamless specifically for people who get sores. They have one tear away track pants that has buttons to separate the two sides and a zip up jeans with a zipper. While these are great products, they are very costly, but can be helpful for the idea of creating new pants for the client.

RAYONA KINNY - Sep 26, 2023, 4:17 PM CDT



[Download](#)

euS8bco6Qi2tAUdiwgNN\_9.webp (24.4 kB)



[Download](#)

**zipuppants.webp (48.6 kB)**





## 10/10/23 - Foam Materials

RAYONA KINNY - Oct 10, 2023, 11:19 PM CDT

**Title:** Foam Materials Research

**Date:** 10/10/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Research foam materials and determine what would be best for the lean and lift device.

**Content:**

Polyethylene:

- based on Polyethylene, which is one of the most used plastic material in the world
- PE foam is typically shows a closed-cell structure
- light weight, durable and flexible
- It is resistant to water, moisture, and chemicals, furthermore its vibration damping and absorbing effect makes it extremely durable
- PE's thermal and sound insulation abilities are also outstanding.
- Extruded Polyethylene foam has a closed cell structure but is not crosslinked. It is typically used for packaging applications, as the production process is very cost effective

Rubber foam:

- not made of plastic, but from rubber, even though it's considered as a foam
- Different types of rubber foams are available:
  - NBR (nitrile butadiene rubber)
  - EPDM (ethylene propylene diene monomer)
  - Normal caoutchouc

PVC:

- PVC foam can have a broad range of characteristics, based on the PVC grade used, plasticizers and other components in the recipe rigid or flexible foam types, can be generated

Polyurethane:

- Polyurethane or PU foams are broadly used, mainly for furniture cushioning, mattresses, seating and textile backing.

Cite: Gergo. "Foam Materials: Polyethylene, Polyurethane, Polystyrene." *Trocellen*, 2 June 2023, trocellen.com/foam-materials/#:-:text=What%20is%20foam%20made%20of,polyethylene%2C%20polyurethane%2C%20and%20polystyrene.

**Conclusions/action items:**

According to this research, it seems like Polyurethane foam would be the best to use for the cushion part of the lean and lift device. Since this material is mainly used for cushioning, mattresses, and seating, it may be the most comfortable material for the client to lean on while still being firm. Action items include informing the team and deciding and ordering enough of the foam for prototyping and testing.



# 10/23/23 - Grainger Foam Options

RAYONA KINNY - Oct 23, 2023, 10:48 PM CDT

**Title:** Grainger Foam Options

**Date:** 10/23/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Determine what is needed to order regarding the Polyurethane foam needed for the lean and lift.

**Content:**

## Flame-Resistant Polyurethane Foam Sheets



These polyurethane foam sheets meet UL 94 HF-1 flame resistance standards. They resist moisture and absorb shocks. They are often used for packaging, cushioning, and insulating.

- Cell Type: Open Cell
- Texture: Smooth

### 12 in x 12 in

**Firmness:** Medium (9 to 13 psi)

↑ Thickness	Color	Tensile Strength Rating	Temperature Range	Foam Backing	
				Plain	1-Sided Adhesive
1/4 in	Black	Good (50-99 psi)	-40 °F to 194 °F	—	\$28.84

### 24 in x 24 in

**Firmness:** Medium (9 to 13 psi)

↑ Thickness	Color	Tensile Strength Rating	Temperature Range	Foam Backing	
				Plain	1-Sided Adhesive
1/4 in	Black	Good (50-99 psi)	-40 °F to 194 °F	—	\$121.17

### 36 in x 54 in

[https://www.grainger.com/search/raw-materials/foam/foam-sheets-strips-rolls/polyurethane-moisture-resistant-cushioning-foam?attrs=Firmness%7CMedium+\(9+to+13+psi\)~Foam+Backing%7C1-Sided+Adhesive&filters=attrs&searchQuery=polyuerathane+foam&sst=4&gwwRemoveElement=true&tv\\_optin=true](https://www.grainger.com/search/raw-materials/foam/foam-sheets-strips-rolls/polyurethane-moisture-resistant-cushioning-foam?attrs=Firmness%7CMedium+(9+to+13+psi)~Foam+Backing%7C1-Sided+Adhesive&filters=attrs&searchQuery=polyuerathane+foam&sst=4&gwwRemoveElement=true&tv_optin=true)

**Conclusions/action items:**

The foam the team believes will work best is polyurethane foam. The best option on the grainger website was having it have medium firmness, as well as one-sided adhesive, making it easier to fabricate. The dimensions needed to order will need to be decided, but the 24x24in seems like it will be enough.



## 10/17/23 - Fabrication of Foam

---

RAYONA KINNY - Oct 17, 2023, 9:37 PM CDT

**Title:** Fabrication of Foam Research

**Date:** 10/17/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Learn the best way to fabricate and attach the polyurethane foam to the metal lean and lift frame and what is needed.

**Content:**

Source:

[1] F. M. Casati, W. D. F. D. Felipe, and S. Siavoshani, "Heat bonding polyurethane foams," Sep. 17, 2013

- One foam joining method without glue or adhesive is heat bonding, also called heat laminating or heat sealing
- A surface of a foam layer is heated to a temperature sufficient to locally melt the foam. The foam layer is then joined to a substrate while the surface is melted
- Upon cooling, the melted surface solidifies to form a bond or adhesion between the foam and the substrate
- The resulting bond between the foam and substrate is frequently as strong or stronger than the strength of the original foam
- Heat bonding includes such processes as flame bonding or lamination and ultrasound or other high frequency bonding, lamination or welding
- Can be dangerous due to the high heat and flames

Product:

"How to Bond Polyurethane." *Permabond*, 20 Apr. 2023, [www.permabond.com/materials\\_bonded/how-to-bond-polyurethane/#:~:text=All%20grades%20of%20Permabond%20Cyanoacrylates,to%20cure%20on%20porous%20surfaces](http://www.permabond.com/materials_bonded/how-to-bond-polyurethane/#:~:text=All%20grades%20of%20Permabond%20Cyanoacrylates,to%20cure%20on%20porous%20surfaces).

- All grades of Permabond [Cyanoacrylates](#) adhere well to PU
- Use an activator such as QFS16 or CSA-NF to bond PU foam. The activators cure cyanoacrylate faster, enabling the adhesive to cure on porous surfaces.

**Conclusions/action items:**

From this research, it seems as though the team has a few options for fabricating the foam to the metal frame of the lean and lift design. One option is to use heat bonding, and in the teams case, welding seems to be a good option. Another is to buy the adhesive and essentially "glue" it on. The team can also do one of these options as well as adding a cloth material over the whole top area and stappling it below, so it adds another factor of comfort and secureness, as well as adds to the aesthetics of the design, creating a smoother finish.



## 9/20/23-Wings Pants Inspired Design

RAYONA KINNY - Sep 20, 2023, 12:44 PM CDT

**Title:** Wings Pants Inspired Design Idea 1

**Date:** 9/20/23

**Content by:** Rayona Kinny

**Present:** Rayona Kinny

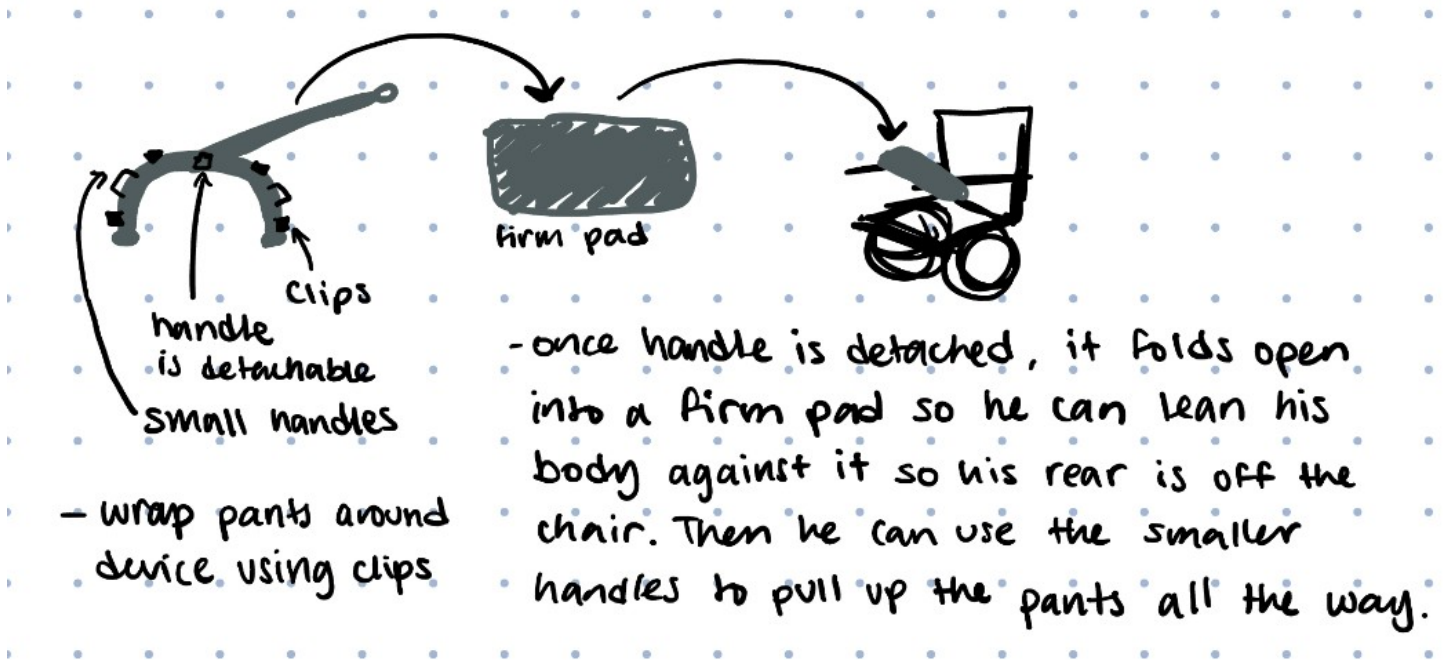
**Goals:** Describe the first design idea for the project

**Content:**

The design is inspired by the Wings Pants product researched earlier, but with some changed features.

The Wings-Pants dressing aid is really effective with pulling up the pants up to the knees, but from there, the user has to pull the rest up themselves.

The client has voiced that the hardest part of the process is getting it past his knees.



**Conclusions/action items:**

This initial design is using a device similar to our project and adjusting and changes aspects to fit our client and possibly make it more effective. Actions items include sharing the idea with the group and getting feedback and editing and possibly using similar ideas to create a design the group likes.



## 9/26/23- Snap on Pants Design

RAYONA KINNY - Sep 26, 2023, 10:16 PM CDT

**Title:** Snap on Pants Design Idea 2

**Date:** 9/26/23

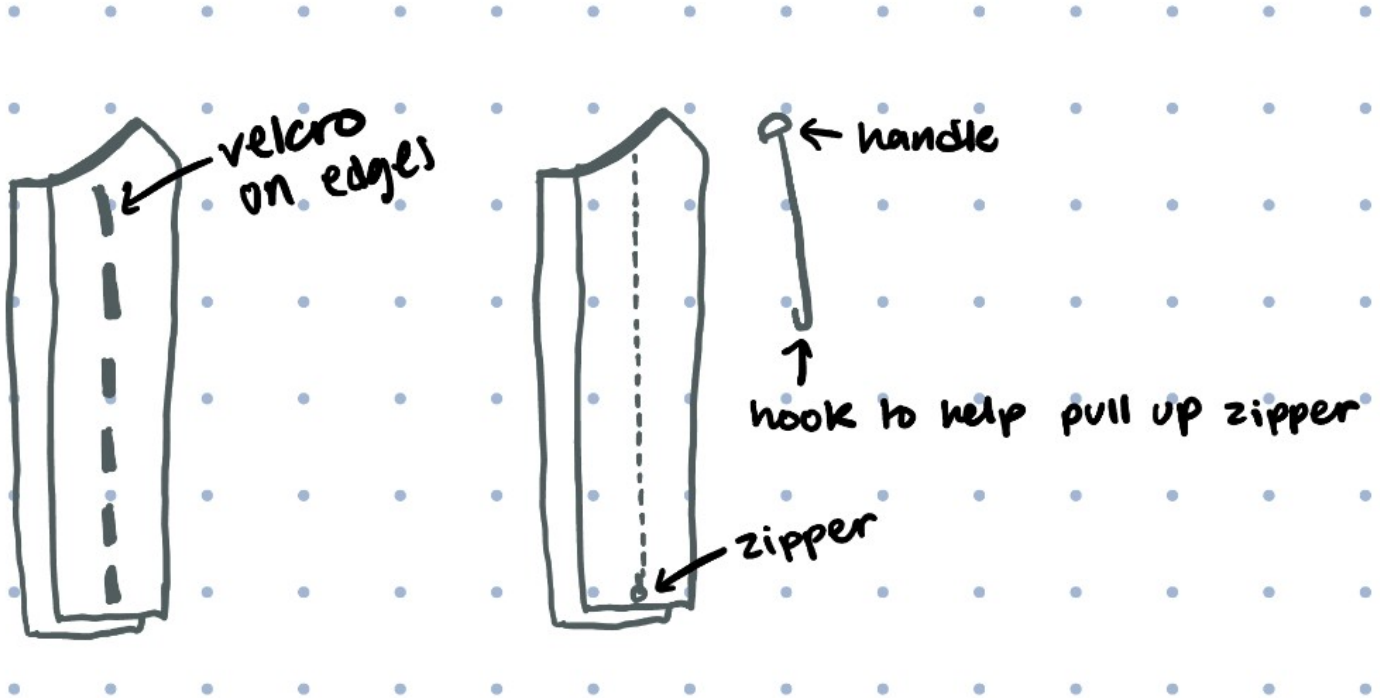
**Content by:** Rayona Kinny

**Present:** Rayona Kinny

**Goals:** Describe a new design idea.

**Content:**

The team talked about possibly making new clothing, specifically new pants for the client.



The first drawing is pants that separate the bottom half with the front half with velcro so the client can sit on the wheelchair with the bottom part of the pants already laying down, then he can easily attach the top of the pants.

The second drawing is similar but has a zipper instead of velcro. The design can also possibly come with a hook type device so it would make it easier for the client to hook on to the zipper and pull up to zip.

**Conclusions/action items:**

These designs use the idea of making new pants for the project and explores different ways to latch the pants on. Actions items include sharing the idea with the group and getting feedback and editing and possibly using similar ideas to create a design the group likes.



## 2014/11/03-Entry guidelines

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John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity. subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

**Title:** Descriptive title (i.e. Client Meeting)

**Date:** 9/5/2016

**Content by:** The one person who wrote the content

**Present:** Names of those present if more than just you (not necessary for individual work)

**Goals:** Establish clear goals for all text entries (meetings, individual work, etc.).

**Content:**

Contains clear and organized notes (also includes any references used)

**Conclusions/action items:**

Recap only the most significant findings and/or action items resulting from the entry.



**Title:**

**Date:**

**Content by:**

**Present:**

**Goals:**

**Content:**

**Conclusions/action items:**