IMPROVED WALKER STEP CLIMBER

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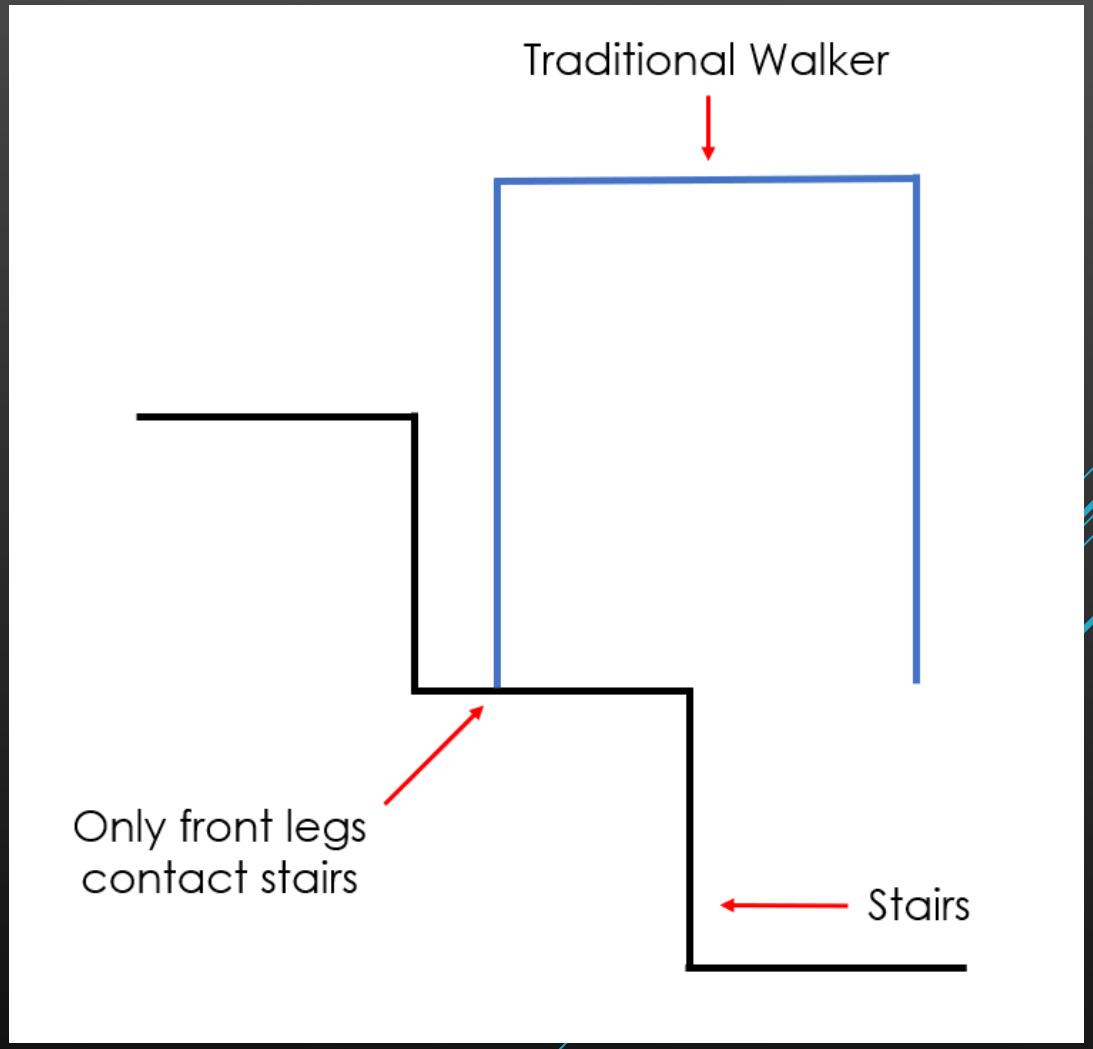
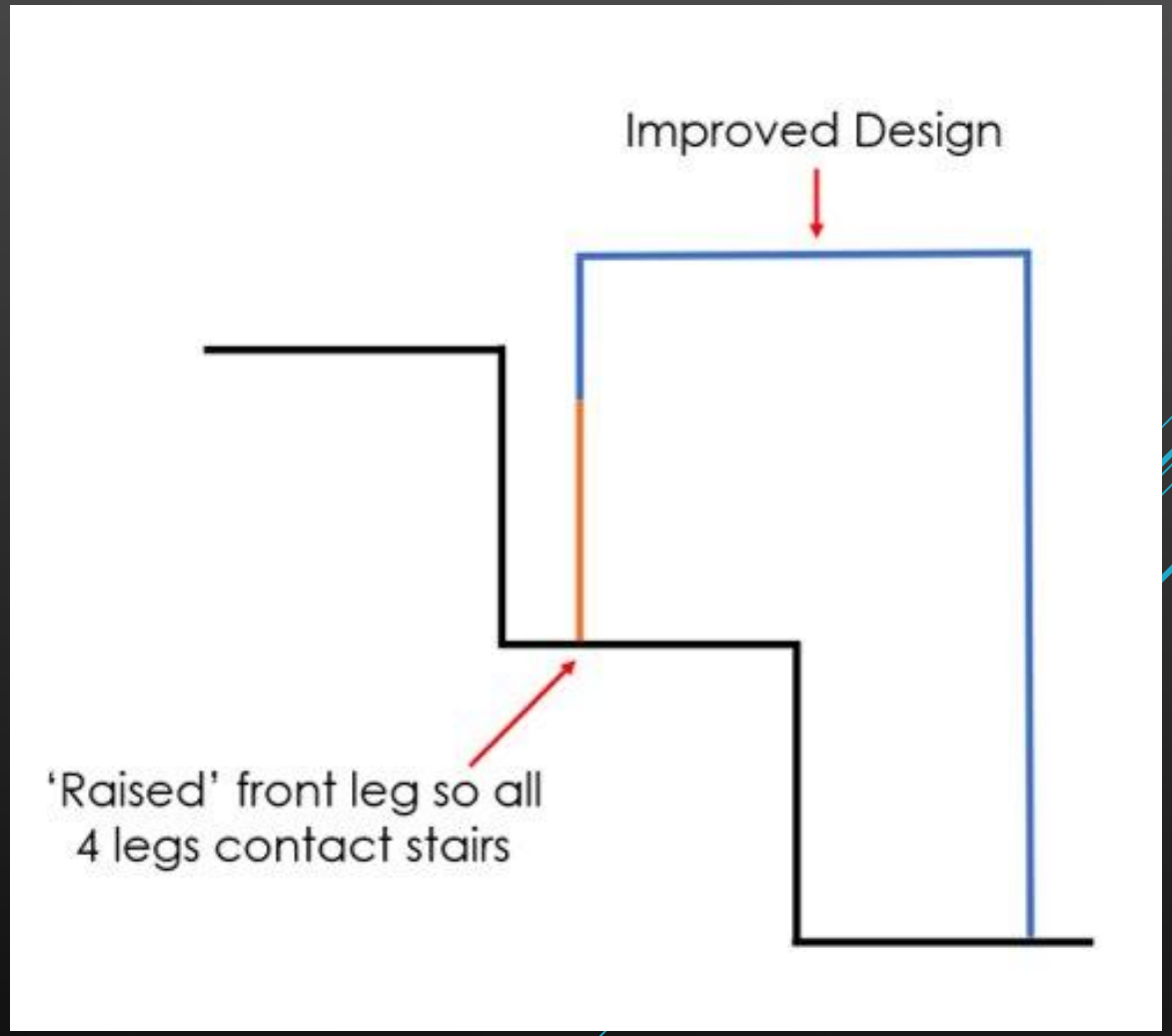
PROBLEM STATEMENT

- Elderly people often use 'walkers' to assist in moving around
- Traditional walker with four legs is poorly suited for traveling up and down flights of stairs
- The group will attempt to design a walker that is stable for travelling on stairs



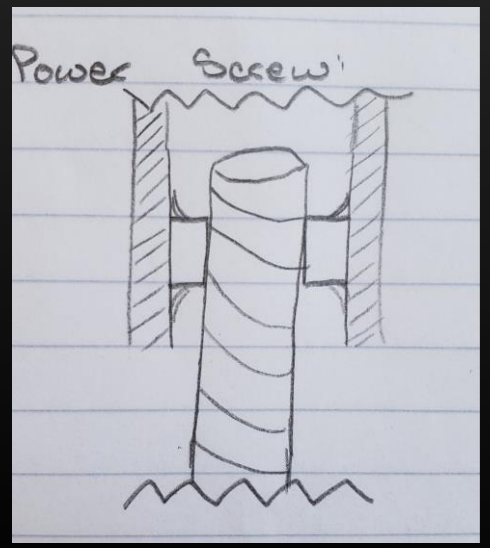
PROPOSED DESIGN

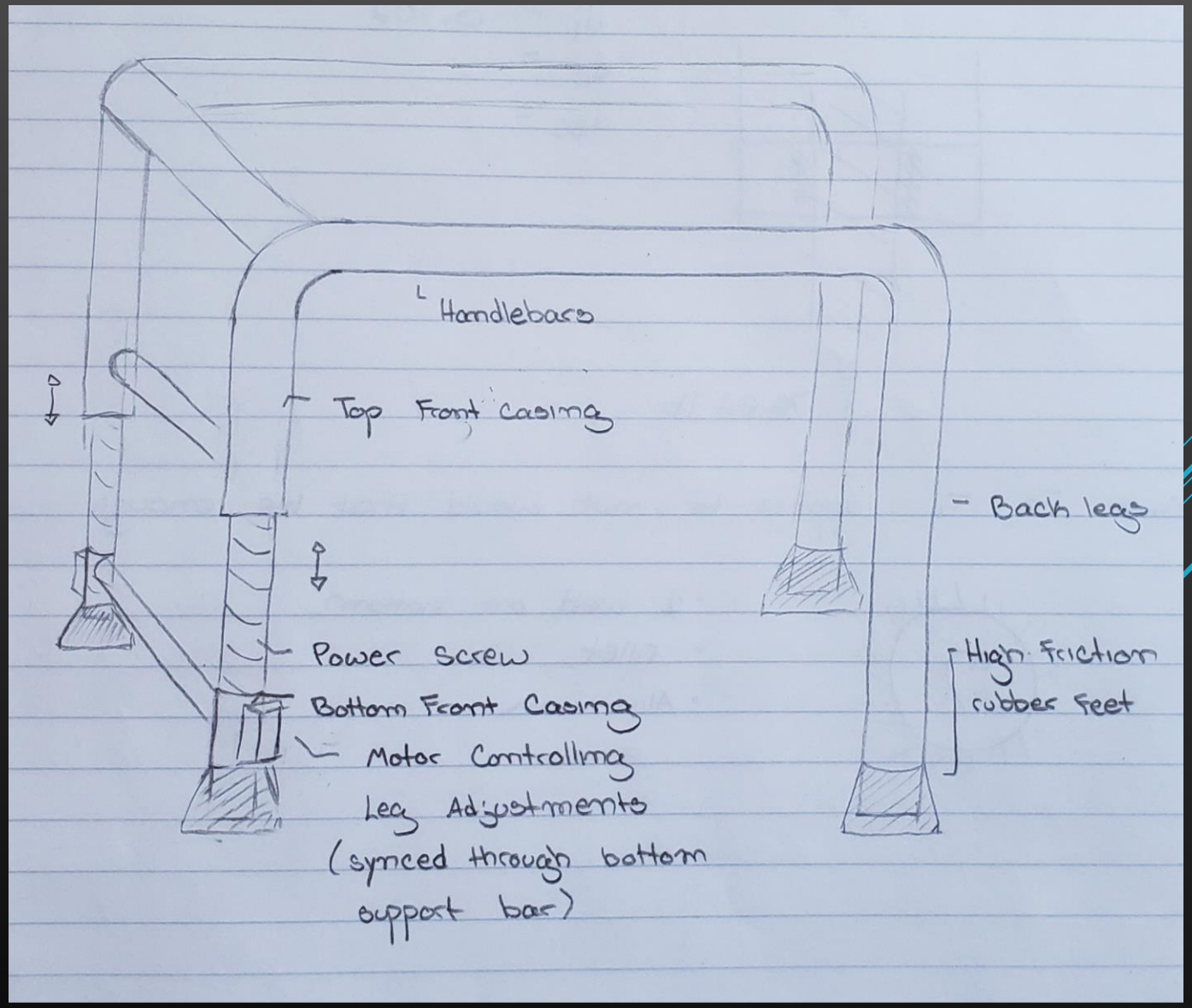
- Front legs will raise up and down to adjust to the height of the stairs
- Now all four legs are in contact with the stairs
- Much more balanced than using a traditional walker on the stairs



PRODUCT OVERVIEW

- Adjustable Height
  - Front legs
  - Buttons for control wired to handlebars with 3 settings
    - Off, expand, collapse
- High friction rubber feet
- Comfortable grip
- Hollow aluminum tubing

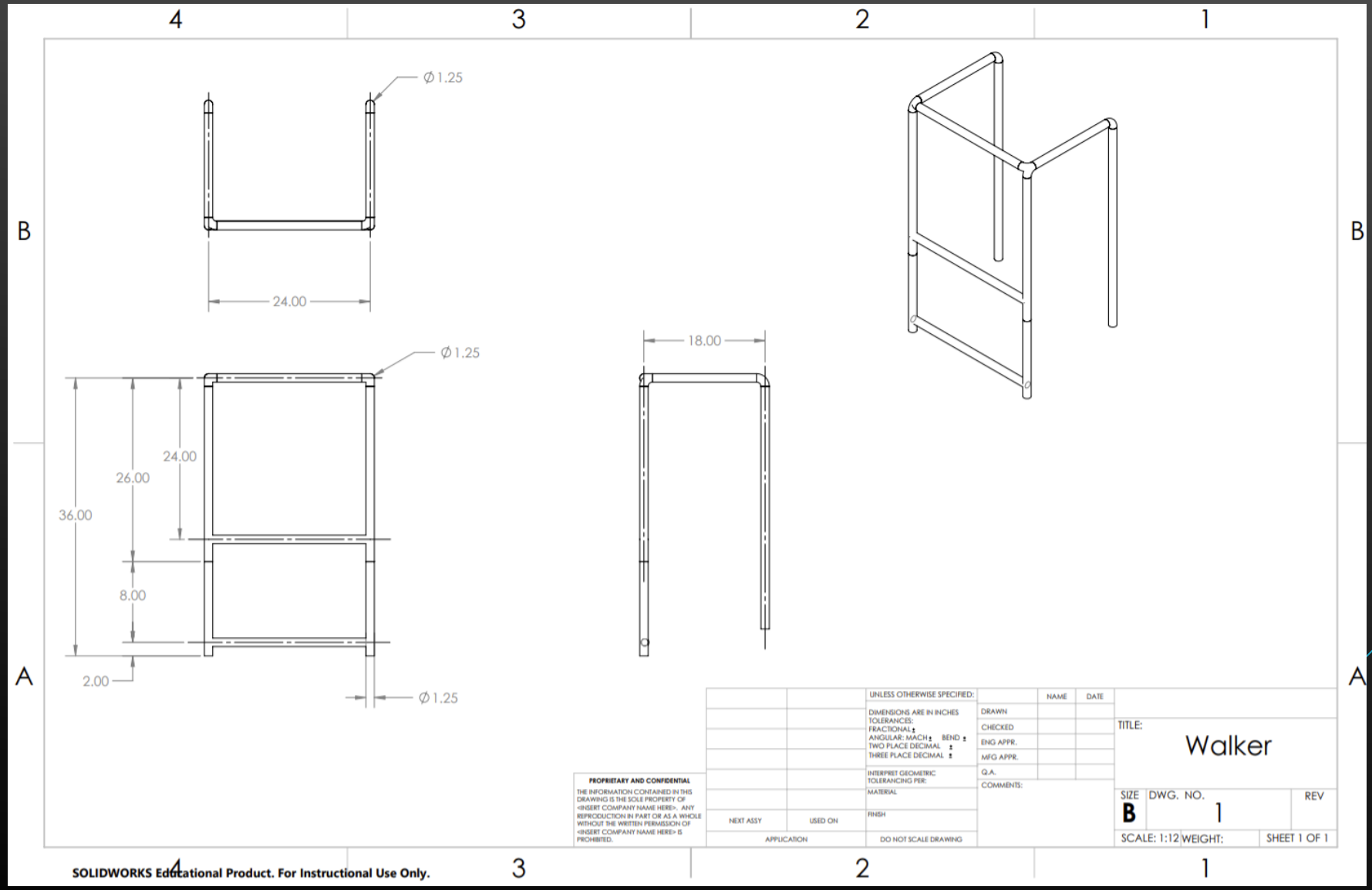




PRODUCT SAFETY: HOW TO USE

- Up the Stairs
  - User approaches stairs
  - Place walker, unadjusted, onto first step; it will be tilted
  - Adjust height of front leg until handlebars are horizontal
  - Lift oneself up using walker
  - Once steady, lift and move walker onto next step
  - Repeat until reaching second floor
  - Once on second floor, walker will be tilted downwards; readjust again until handlebars horizontal
- Down the Stairs
  - User approaches stairs
  - Place hands over back two legs
  - Place walker, unadjusted, onto first step; it will tilt downwards
    - Keep weight on back two legs
  - Adjust front legs until handlebars are horizontal
  - Place hands in comfortable position
  - Step down using walker for balance
  - Once steady, move walker forwards onto next step
  - Repeat until reach lower floor
  - Once on lower floor, walker will be tilted upwards; readjust again until handlebars horizontal

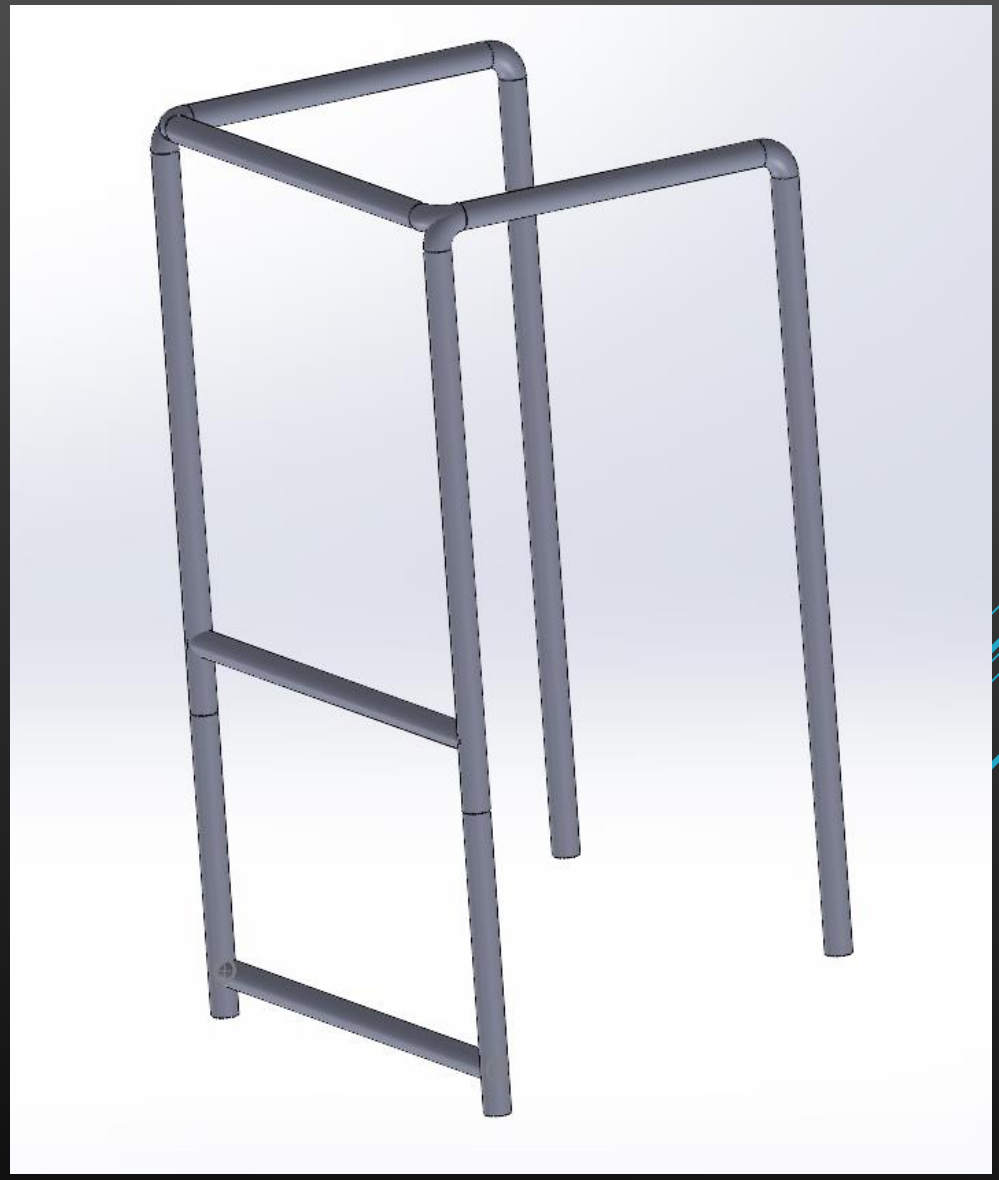
SOLIDWORKS MODEL



OVERALL DESIGN SPECS

Overall Design Parameters

- Lightweight (9.738 lbs)
- Size constraints:
  - Width: 24 inches
  - Height: 36 inches (adjustable)
  - Depth: 18 inches
- Durable
- Easy to use
- Stable and reliable (support 300lb weight)
- Good profitability



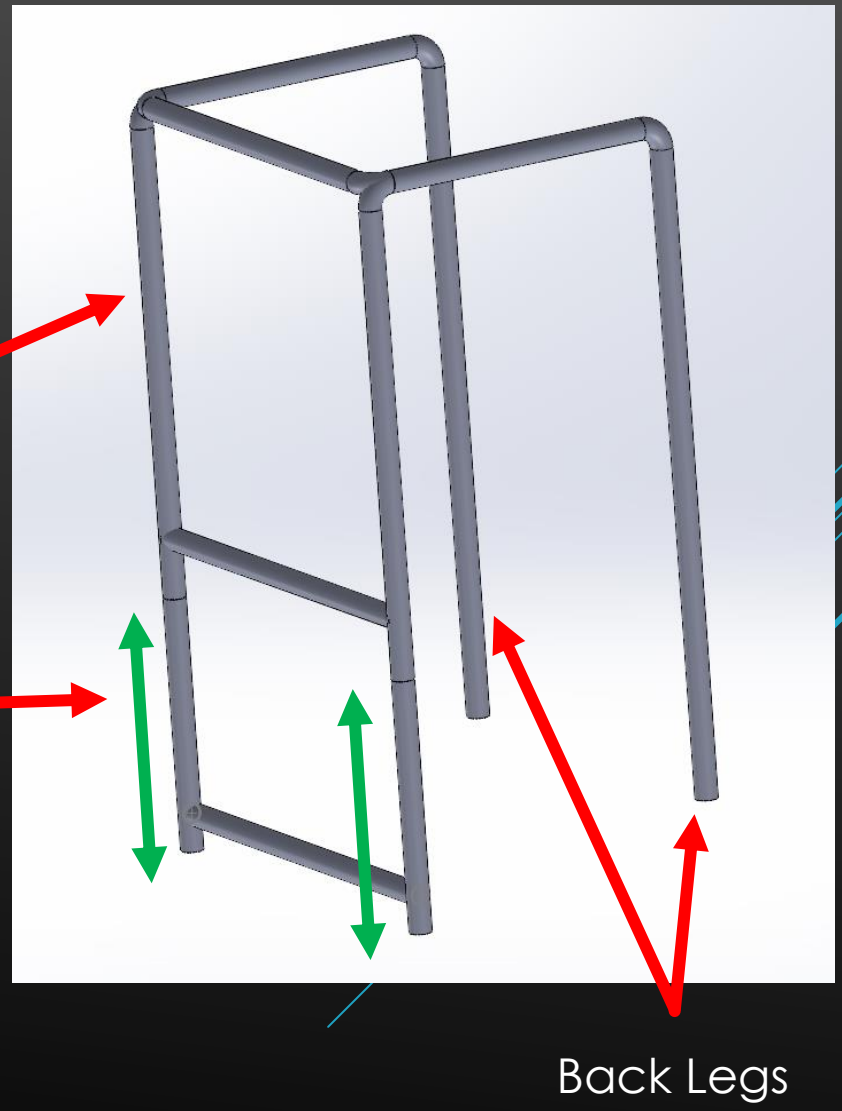
COMPONENT DESIGN SPECS

Front legs

- Strong and corrosion resistant
- Lightweight
- Extends/Retracts 7"
- High machinability

Back Legs

- Stable to support user
- Lightweight
- Corrosion resistant and waterproof
- Height adjustable



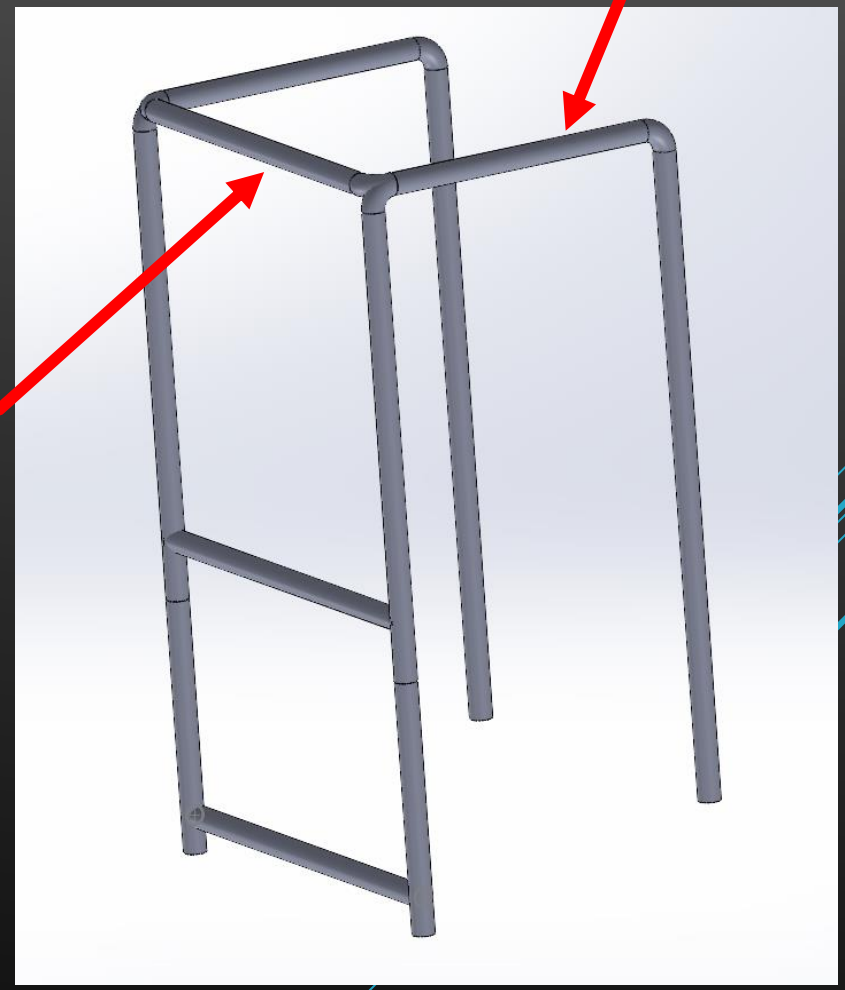
COMPONENT DESIGN SPECS

Handlebar

- Good strength
- Easy to grip

Front Bar

- Strong
  - To hold multiple components
  - To enable coherent movement of front legs



COMPONENT CALCULATIONS

- Assumptions
  - Maximum weight capacity: 300lb
  - User exerts half of their weight on the walker as a maximum load
    - Maximum Load = 150 lbf
  - Weight is evenly distributed along the two handlebars (75 lbf each).

Component	Material	Bending Stress (ksi)	Factor of Safety against bending	Critical Load for Buckling (kip)	Factor of Safety against buckling
Back Leg	6061-T6 Aluminum	9.9	3.5	4.04	53.8
Front Leg Casing	6061-T6 Aluminum	9.9	3.53	6.69	80.9
Lower Front Leg	6061-T6 Aluminum	9.9	3.53	8.5	112.7
Handlebars	6061-T6 Aluminum	2.47	14.13	N/A	N/A
Support Bar	6061-T6 Aluminum	6.6	5.3	N/A	N/A
Screw	AISI 1010 CD Steel	16.3	2.69	21.5	287

CONNECTION CALCULATIONS

- Assumptions
  - Maximum weight capacity: 300lb
  - User exerts half of their weight on the walker as a maximum load
    - Maximum Load = 150 lbf
  - Weight is evenly distributed along the two handlebars (75 lbf each).

Component	Material	Resultant Stress (ksi)	Factor of Safety against bending	Factor of Safety against Fatigue
Weld for support bar	E120XX	16.2	2.25	1.6
Weld for Internal Nut in Front Leg	E60XX	0.14	125	39.5

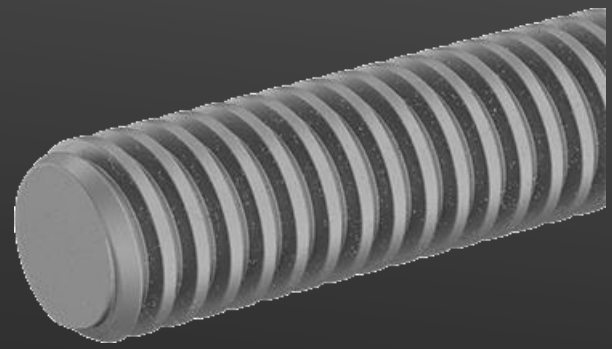
POWERTRAIN CALCULATIONS

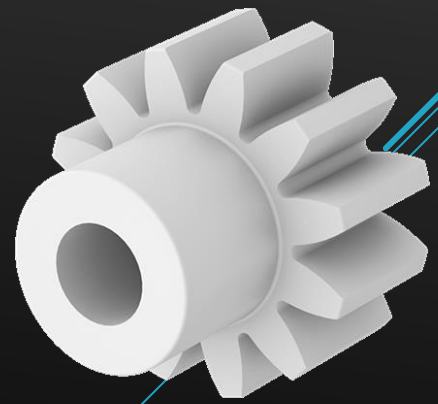
- Assumptions
  - Same as Components and Connections

- Lead Screw Specifications
  - ¾" - 8 AISI 1010 CD Steel
  - Tr = 17.71 lb-in
  - For 1 in/s head speed ~ 480 rpm
  - Requires 0.135 hp

- Motor Specifications
  - 2.5 lb-in, 4200 rpm 24V DC motor
  - 0.1667 hp

- Gear Box Specifications
  - Gear Ratio = 9
  - 2 stacked 12 – 36 teeth gears
  - Module 1 Plastic: n = 1.34





COST ANALYSIS

Component	Material	Weight (lbs.)	Cost per Item	Quantity	Total Weight (lbs.)	Total Cost
Back Leg	6061-T6 Aluminum	0.853	$32.20 / lb	2	1.706	$54.93
Front Leg Casing	6061-T6 Aluminum	0.6165	$32.20 / lb	2	1.233	$39.70
Lower Front Leg	6061-T6 Aluminum	0.047	$32.20 / lb	2	0.094	$3.03
Handlebars	6061-T6 Aluminum	0.426	$32.20 / lb	2	0.853	$27.50
Support Bar	6061-T6 Aluminum	0.569	$32.20 / lb	3	1.71	$55.00
Screw	AISI 1010 CD Steel	4.01	$13.38	1 3ft screw (cut in half)	4.01	$13.38
Welding Electrode	E120XX	2.2 (per box of 100)	$1.06	3/100	0.066	$1.06
Welding Electrode Nut	E60XX	2.2 (per box of 100)	$1.00	3/100	0.066	$1.00
Motor	DC Motor	Not Specified	$240.00	2	Not Specified	$480.00
Gear type #1	Acetal	Not Specified	$4.62	2	Not Specified	$9.24
Gear type #2	Acetal	Not Specified	$7.96	2	Not Specified	$15.92
					Total (lbs.)	Total Cost
					9.738	$700.76

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