DEPARTMENT OF
MECHANICAL ENGINEERING

TEAM A3
Stand Up Assistive Device for the Elderly

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Motivation & Goal

Motivation

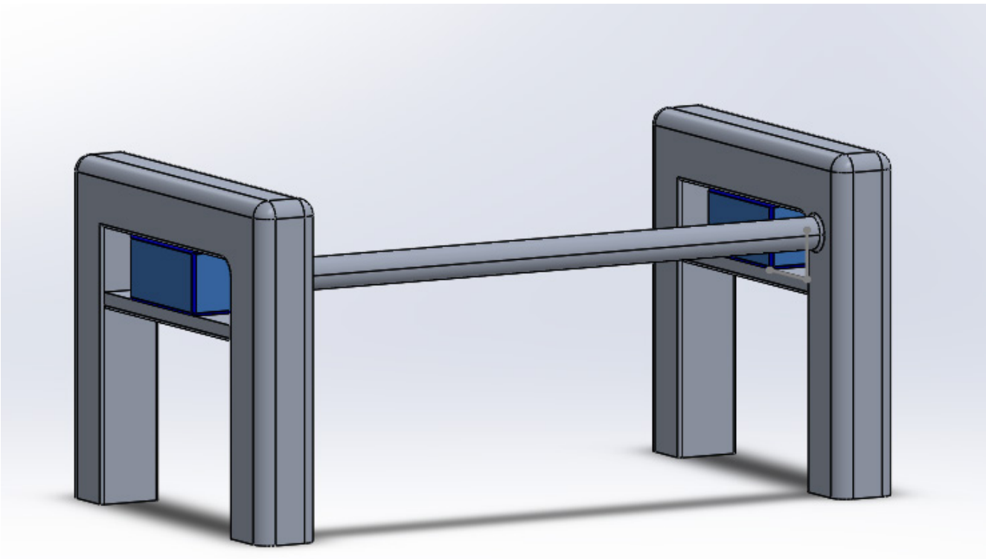
There are more than 55 million elderly adults in the US that are 65 years or older (CDC). Thats roughly 16% of the entire US population that are at risk of fall related injuries. Medical costs associated with fall related injuries exceeds $50 billion annually.

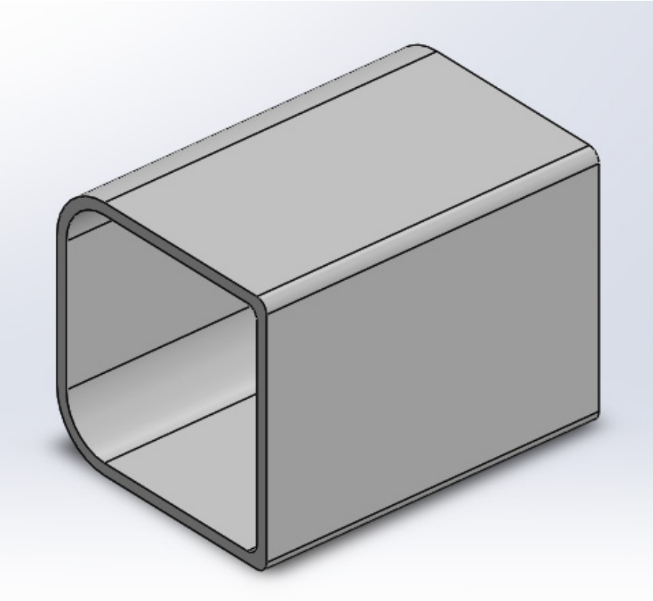
Problem Definition

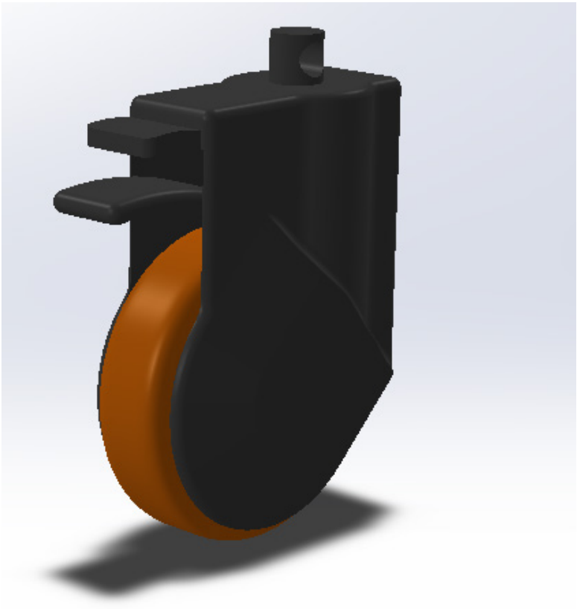
The specific use case for our design is to aid the user during sit to stand motion from any height and any type of seat.

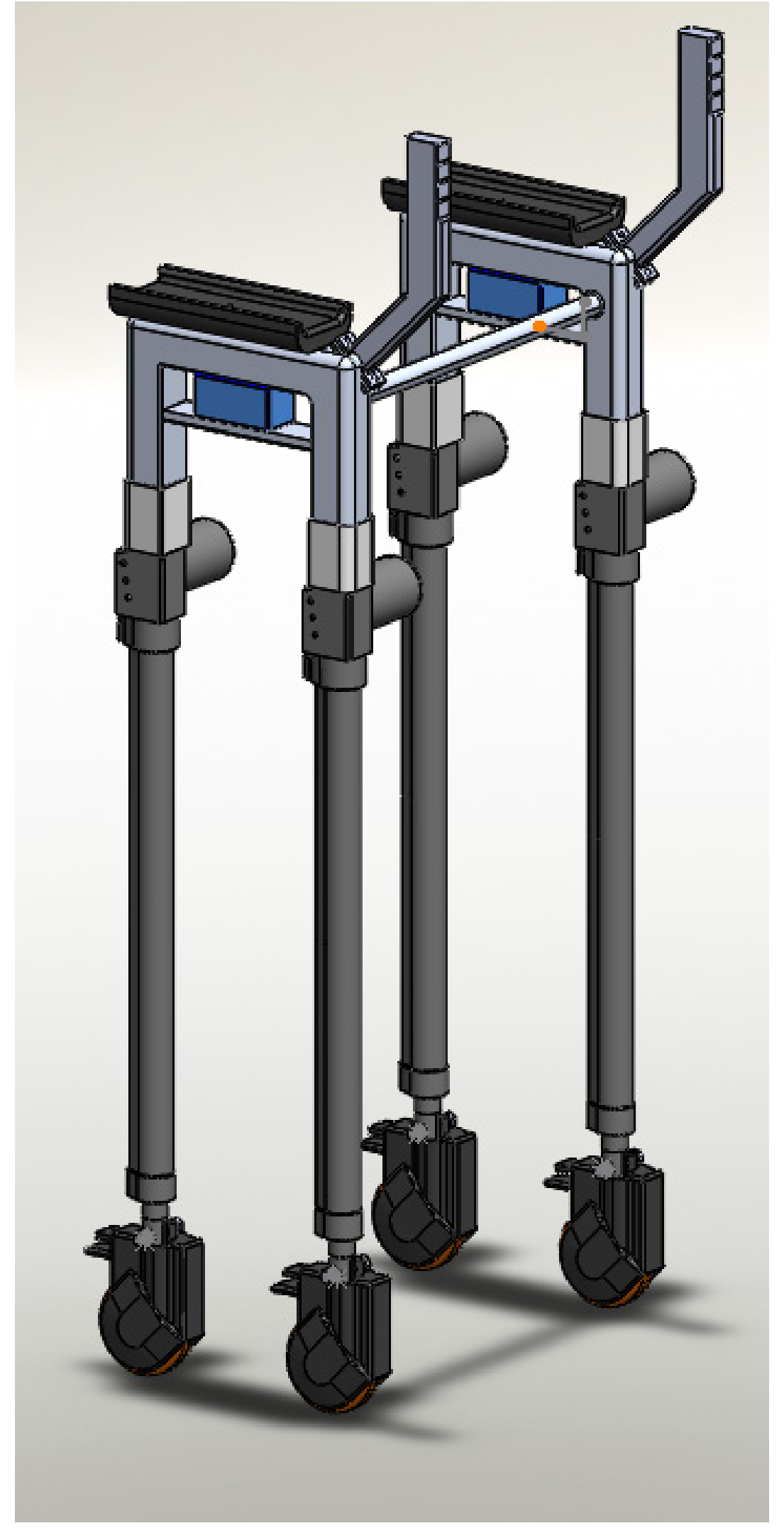
Our goal is to create a portable, height-adaptive stand up assistive device that improves safety during sit to stand transitions while reducing strain on families and health professionals.

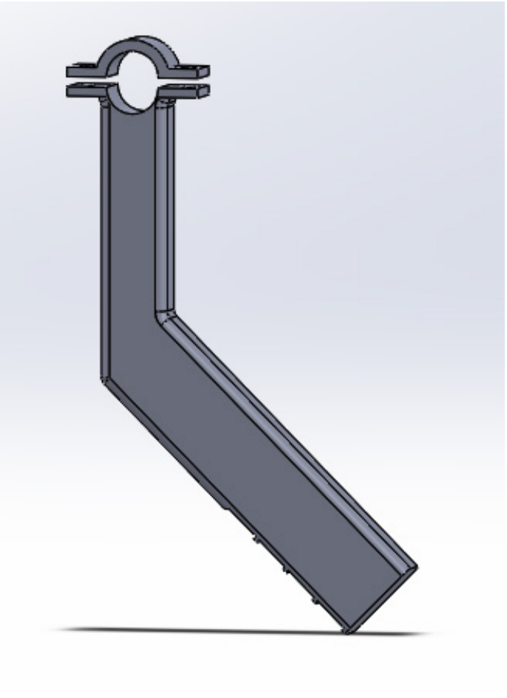
Final Design


Upper Body


Clamp


Wheel


Main Design


Handle


Cushion


12in Actuator

Why Ours Is Different

Actuator Assisted Support

- Linear actuators lift user during most labor intensive part of standing
- Traditional walkers and canes provide an anchor but not active support

Home Friendly & Portable

- Existing solutions are bulky, expensive, and limited to specific environment
- Competitive pricing
- Portable, requires no permanent installation,
- Works in many environments, including bathrooms, sofas, and beds.

User Independence and Customer Discovery

A senior care director noted that many elderly individuals have limited upper and lower body strength, often requiring assistance from two caregivers just to stand up. This highlights a key gap in current solution and show that they heavily depends on external help.

Our device addresses this by enabling users to stand safely with minimal or no assistance. By shifting control to the user, our design promotes greater independence, dignity, and confidence, while also reducing the burden on caregivers.

Design Calculations & Decisions

Full Calculations

Calculations

Bending Stress Analysis:

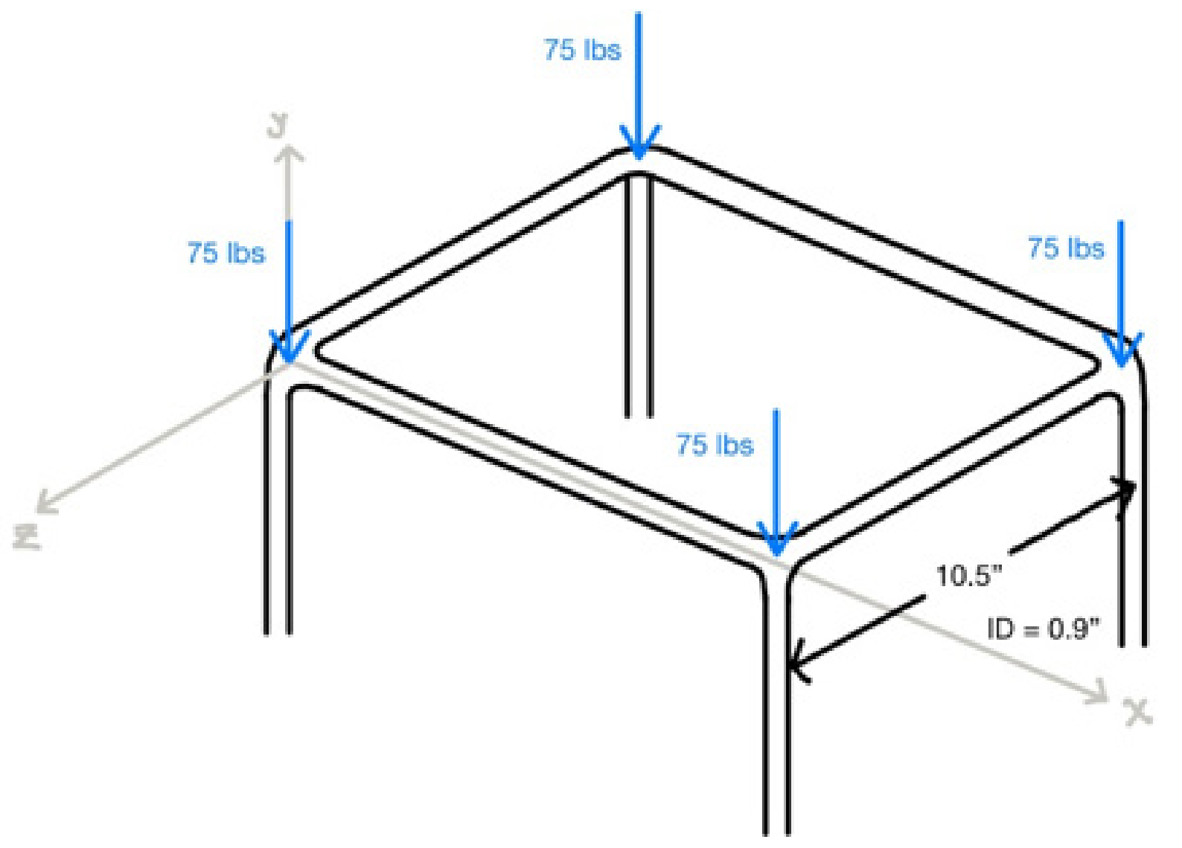
$$\sigma_b = \frac{Mc}{I} = \frac{(393.75)(0.5)}{0.01688} = 11{,}662\ psi,\ SF_{bending\ stress} = \frac{\sigma_y}{\sigma_b} = \frac{40{,}000}{11{,}662} = 3.4$$

Buckling Analysis:

$$P_{cr} = \frac{\pi^2 EI}{(KL)^2} = \frac{\pi^2(10^7)(0.01688)}{(52.5)^2} = 604.5\ lb,\ SF_{buckling} = \frac{P_{cr}}{P} = \frac{604.5}{75} = 8.06$$

Deflection Analysis:

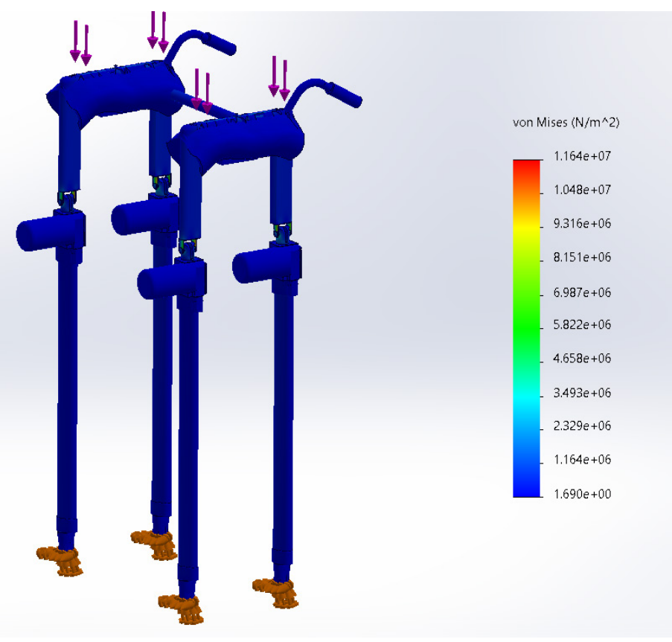
$$\delta = \frac{PL^3}{48EI} = \frac{(75)(10.5)^3}{48(10^7)(0.01688)} = 0.0107\ in,\ \delta < \delta_{allow} = \frac{L}{360} = 0.0292\ in$$



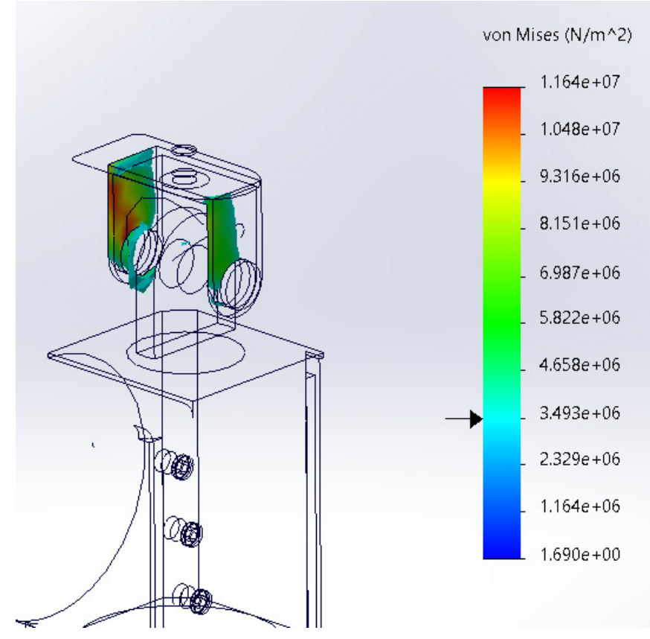
FEA Simulation

Each simulation was run through SolidWorks, with two,150 lb distributed loads on each arm rest. The walker was assumed to be Aluminum 3003, with the arm rests and handle grips being Polyurethane.

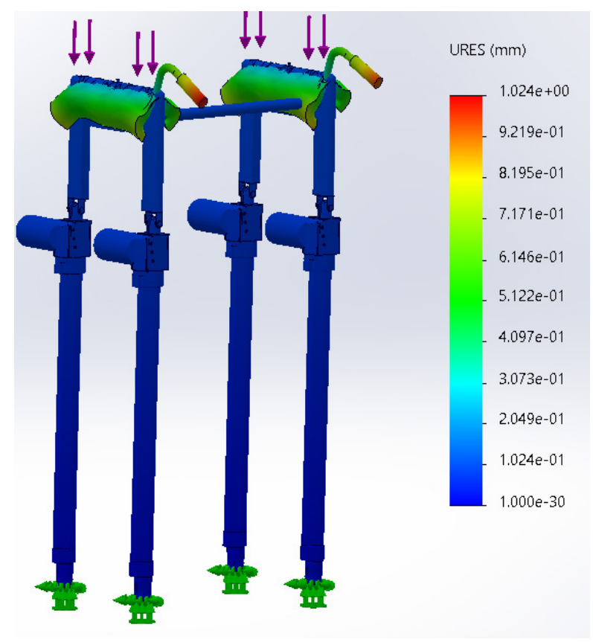
The maximum Von Mises stress was 11 MPa or 1640 psi, found in the bracket connecting the walker base to the linear actuator. Aluminum 3003's yield strength is 125 MPa, so there is no risk of yielding.



Von Mises Stress

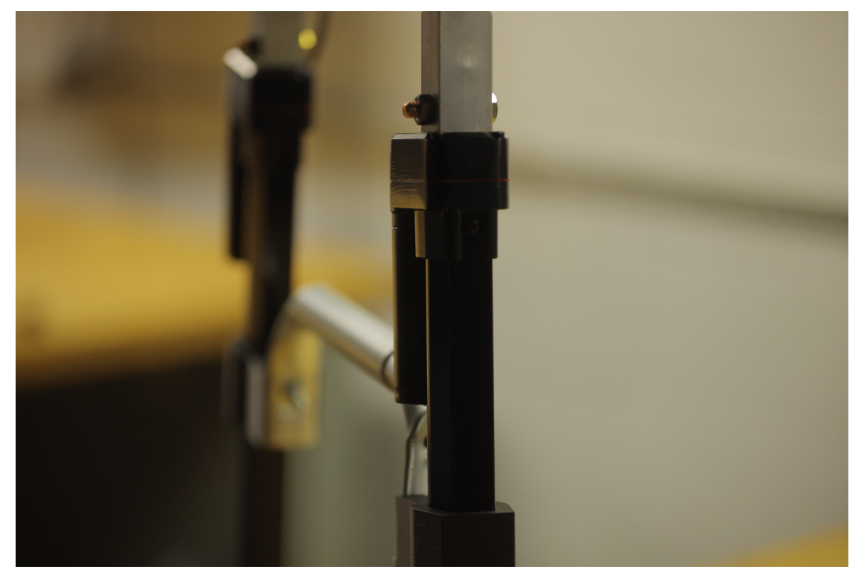


Max Stress



Displacement

Prototype & Test Results



Our Use case:

60 cycles ÷ 28 cyc. per week
= ~ 2 weeks per charge

Operation time

Deploy Time: 20 (s) +- x
Retract Time: 20 (s) +- x

Battery Life

Assumed Usage:
4 full extensions/retractions per day, 7 days a week = 28 cycles per week

Actuator Current Draw:
1.5 A per actuator × 4 = 6 A total

Battery of Choice:
UB1280 8 Ah battery

Energy per cycle: (4 × Full ext. + retr.)
40 s ÷ 3600 = 0.0111 hrs
6 A × 0.0111 h = 0.067 Ah per cycle

Keeping AGM battery above 50%
8 Ah × 50% = 4 Ah usable

4 Ah ÷ 0.067 Ah = **~ 60 Cycles per charge**