DEPARTMENT OF MECHANICAL ENGINEERING

TEAM #17

StairSupport

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Problem Definition

Stakeholders
The problem that the StairSupport aims to solve is aiding elderly and injured people with walking up and down stairs.

Impact
Around 30% of current senior citizens find traversing up and down the stairs to be difficult. By 2030, there is a predicted 70 million people ages 65 and older in the US, meaning over 20 million people will struggle to use stairs. This does not include those under 65 who struggle to use stairs.

Customer Requirements
The stakeholders for this project have requested that the design is portable, universal, and helps improve their quality of life.

Design Calculations & Analysis

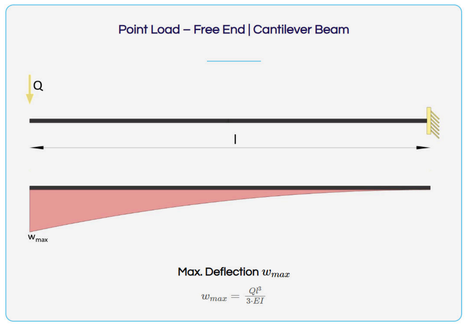
The StairSupport aims to be rigid and stable. For these calculations we used a variety of equations to calculate for maximum deflection and stress in the handlebar, channel slides, and the main horizontal tube.

Deflection Methods
Direct Integration:
E = Elastic Modulus
I = Moment of Inertia
M = Internal Moment

$$EI\frac{dy^2}{d^2x} = M$$

Known Formulas for Deflection (Cantilever Beam):

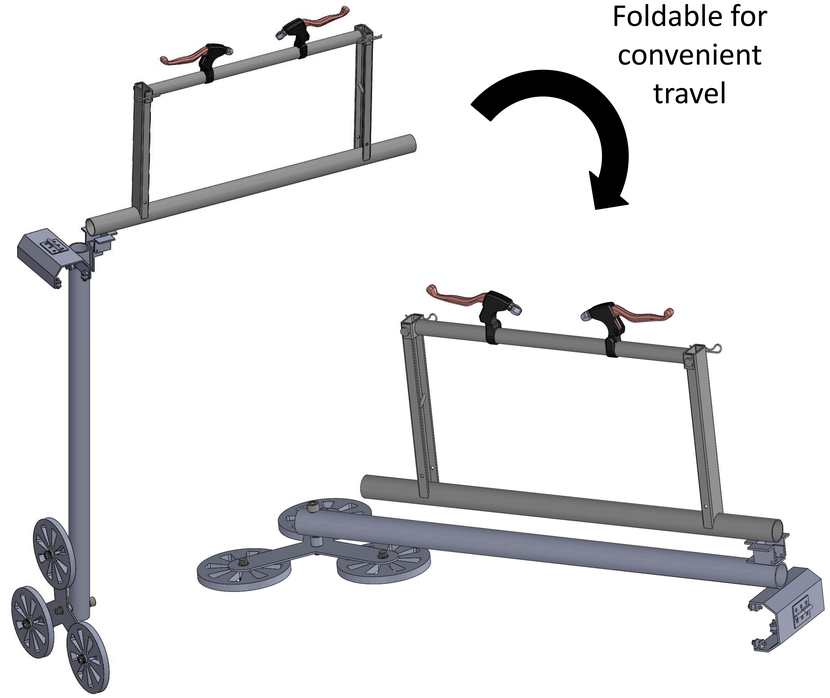
Cantilever Beam: Point Load at Free End



Subassemblies

- Handrail Connection
  - Houses brake pads and rollers
  - Glides along handrail
  - Hinged attachment system
  - Fits to all railing sizes
- Braking System
  - Adjustable heights
    - Lower when going up steps
    - Higher when going down steps
  - Uses a bike brake and cable system
- Vertical Support System
  - Helps prevent rotation about handrail
  - Rolls up and down stairs
  - Provides vertical stability for the user

Final Design



Stress and Catastrophic Failure:
Buckling for Vertical Columns:

$$F = \frac{n\pi^2 EI}{l^2}$$

F = *Force Required to Buckle*
E = *Elastic Modulus (Young's Modulus)*
I = *Moment of Inertia*
l = *Length of the Column*
n = *Buckling Coefficient*

Shear Stress:

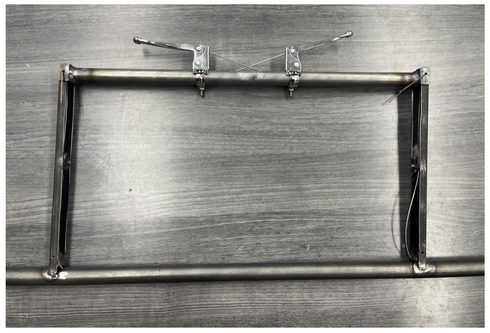
$$J = \frac{\pi}{32}(D^4 - Di^4)$$

D = *Outer Diameter*
Di = *Inner Diameter*
$\tau = \frac{Tr}{J}$
J = *Polar Moment of Inertia*
T = *Torque*
r = *radius of the shaft*

Prototype & Test Results

Handrail Connection

Braking System



Vertical Support System