Scissor Lift Shopping Cart

An Assistive Grocery Shopping Cart

By: Min, Tyriel, Zev, Jason, Vivian, Lucas

Background Research

Current market products only solve parts of the problem:

- **Traditional scissor lifts** are too large and industrial.
- **Foldable carts** are portable but don’t lift.
- **Products like Shoppacart** lack strength, rely heavily on manual help, and offer little bin space.

Existing Solutions

Concept Viability: Existing products demonstrate that a single scissor design with 1 hydraulic element can provide over 100lb of lifting capacity

Shortcomings:

- All existing solutions with comparable hydraulic scissor lift are classified as lift tables
- Not applicable for carrying a high number of items or items with potential to slide
- High price points of around $1000 for significantly smaller cart

Design Overview

Purpose: Aid individuals with limited mobility in transporting and loading items

Frame Construction:

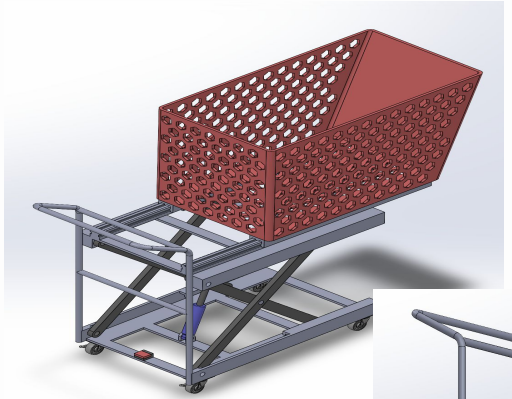
- 2 ft x 3 ft base made of welded steel tubing
- Four 3” diameter swivel casters for maneuverability

Lifting System:

- Foot-operated hydraulic scissor lift with 2.5ft stroke
- Dual scissor-arm with pivot pins, rated for 100 lbs

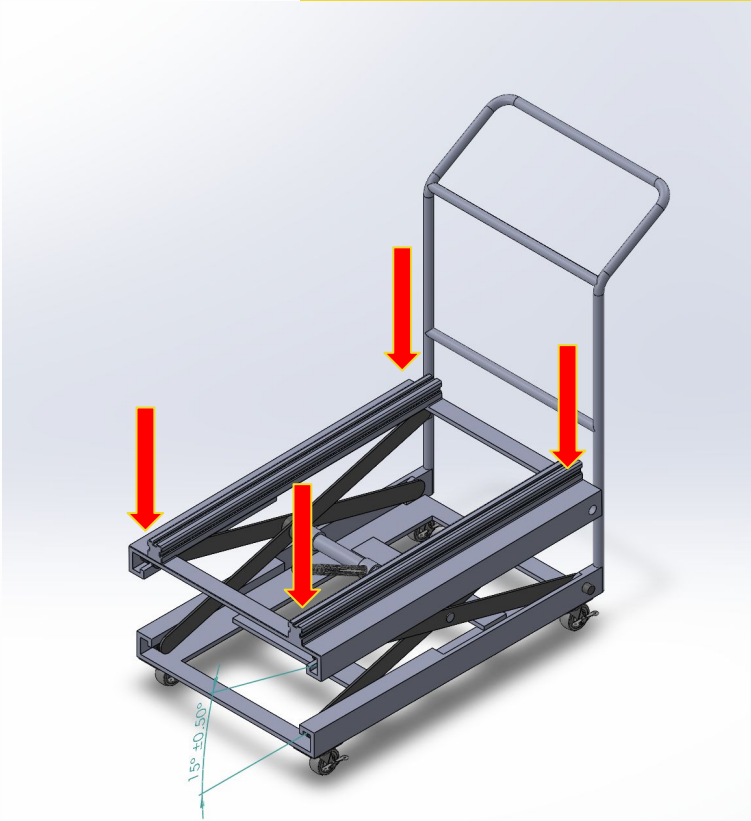
Basket System:

- Mounted Basket (2 ft x 3 ft x 2 ft)
- Slides horizontally on telescoping rails
- Hinged front wall folds down to act as a ramp



Worst Case Loading

- Worst case loading occurs at the minimum lift height
- Vertical component of support force must equal the cart load
- Minimum lift height corresponds to scissor angle of 15 degrees
- Evenly distributed 100 lb load



Component Design Analysis

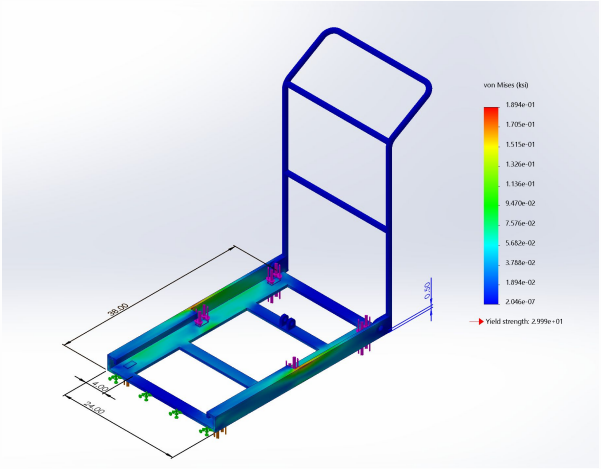
Scissor

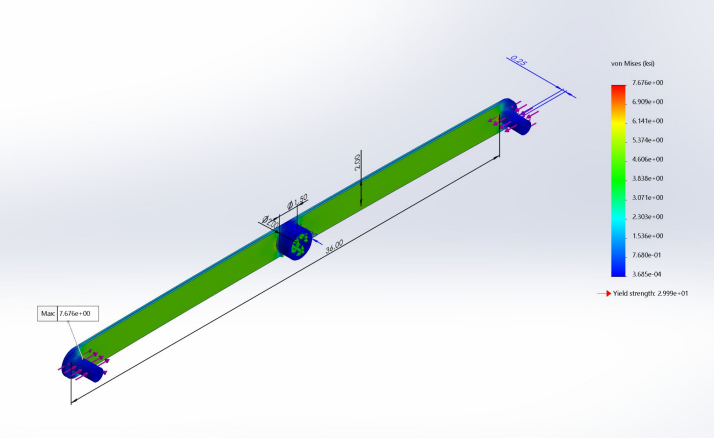
Thickness Changed from 1in to 0.25in

Stress Concentration FOS: over 200 for hand calculation and 5.2 for FEA

Buckling FOS: 23 out of pin plane

Fatigue: FOS: over 100





Base Plate

Thickness Changed from 1in to 0.5in

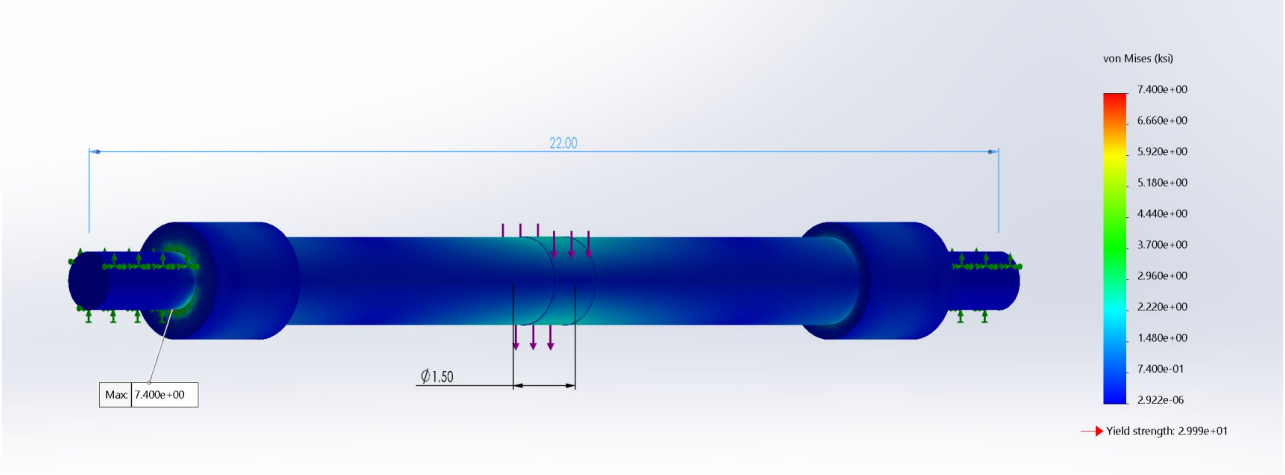
Stress Concentration FOS: 6.7 for hand calculation and over 200 for FEA

Fatigue FOS: 7

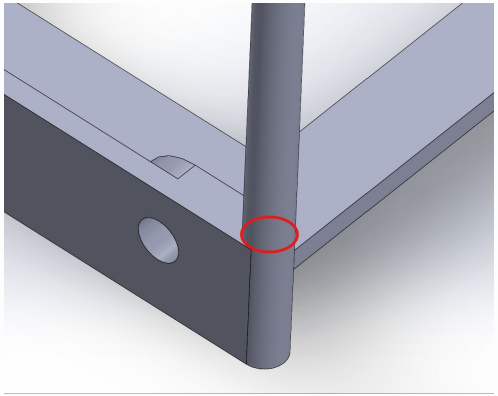
Central Beam Design Analysis

- The most critically loaded component
- Critical diameter changed from 1 in to 1.5 in

Stress Concentration FOS: 6.6 for hand calculation and over 200 for FEA
Buckling FOS: 23 out of pin plane
Fatigue: FOS: 6.1 for hand calculation

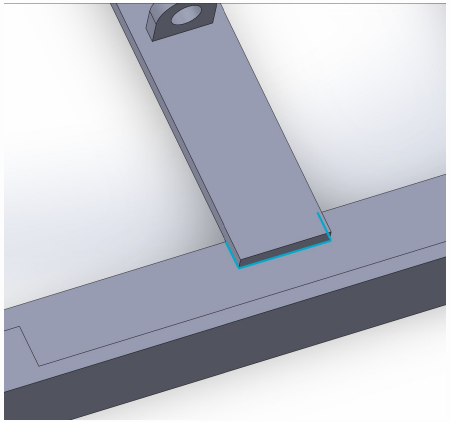


Welds



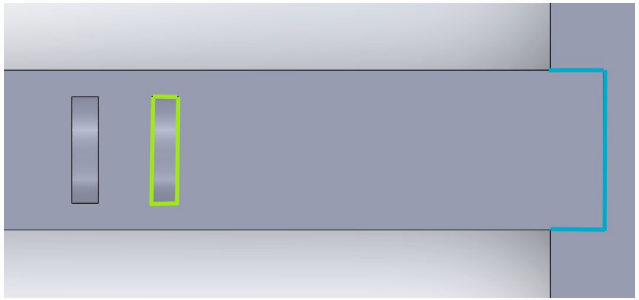
Push Bar to Base Plate Weld

- Static FOS: 18
- Fatigue FOS: 3
- Combined shear = 2.70 ksi



Cross Panel Weld

- Static FOS: 211
- Fatigue FOS: 58
- Direct Shear = 0.132 ksi



Power Screw Mount Weld

- Static FOS: 145
- Fatigue FOS: 40
- Combined shear = 0.192 ksi

(High safety factors due to the minimum thickness chosen after stress concentration analysis)

Critical Bolt Analysis

Bolt Details

- 0.5 inch dia., Grade 1 (Sy = 36 ksi)
- Used at all pivot and mounting joints
- Load transfer is primarily shear

Static and Fatigue Load Results

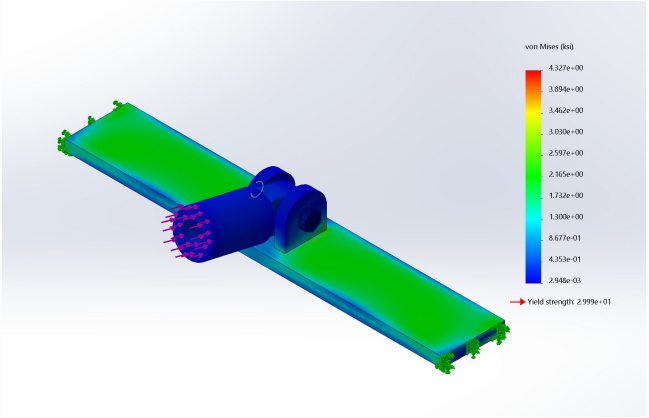
- Scissor Pins: V = 0.025 kips → τ = 0.127 ksi → All FOS > 130
- Mount Bolts: V = 0.386 kips → τ = 1.968 ksi → All FOS > 8

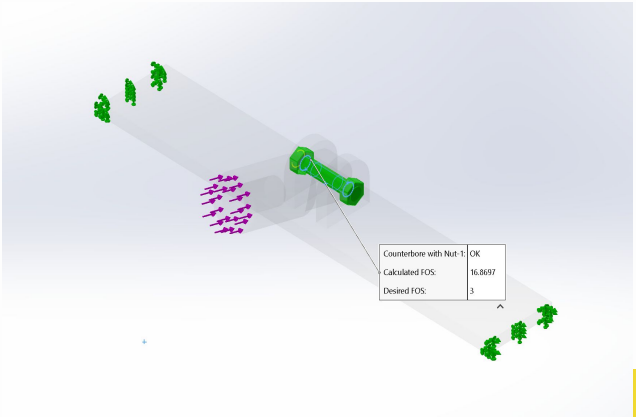
FEA Verification (Mount Bolt)

- Worst case loading → FOS = 16.9
- Mount bolt is critical case, confirms all bolts exceed strength requirements

Conclusion

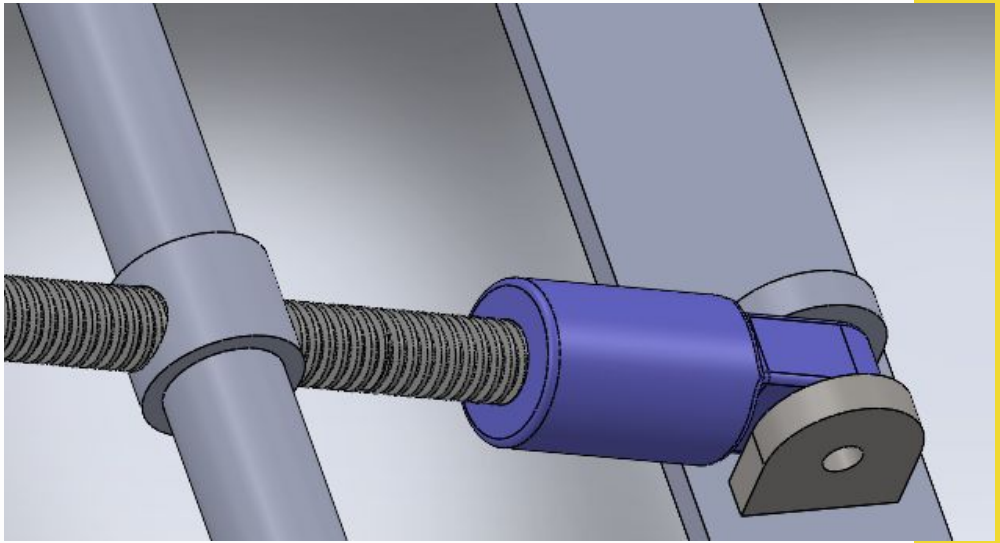
- All bolts safe under static and fatigue conditions
- Large safety margins - bolt size kept for fit and smooth operation





Power Screw

- 1in double threaded ACME Power screw
- Lifting speed of 2 in/s
- torque ~0.083 kip·in
- Efficiency of 29.6%
- Requires motor of at least 0.063 hp



Cost Analysis

Item	#	material	Approx cost
Base Plate	1	304 SS	$40
Top Plate	1	304 SS	$40
Scissor	4	304 SS	$140 ($35/unit)
Push bar	1	304 SS	$20
Central Beam	1	304 SS	$40
Cart body	1	Polycarbonate	$40
Caster wheels	4	Mcmaster part	$24 ($6/unit)
0.5in Bolts	6	Grade 8 Steel	$18 ($3/unit)
1in Diameter ACME Screw	1	Zinc-Plated Carbon Steel	$100
Motor (1hp)	1	N/A	$150-$200
Total Cost			$665

Conclusion

The Scissor Lift Cart fills a critical gap in the market for assistive lifting devices. Combining industrial-grade technology with thoughtful design, our cart offers a safe and easy-to-use option that meets real world needs where current products fall short.

By meeting people where they are, this cart helps lift more than just weight – it lifts limitations.

Thanks!

Do you have any questions?