DREXEL UNIVERSITY
School of Biomedical Engineering, Science and Health Systems

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Customized Wheelchair Stabilization Device for Overhead Weight Lifting Movements

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Medical Need

Chris Kaag is a wheelchair user who backward tips when lifting weights overhead

<u>No existing solutions on the market</u>

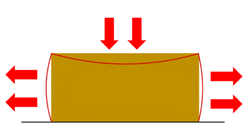
Objective

Build a custom device that:

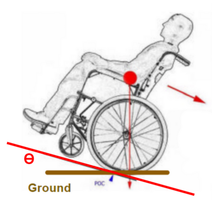
1. **Stabilizes** the wheelchair
2. Is **handicap accessible**
3. **Locks** the wheelchair in place
4. **Allows** overhead lifting without tipping

Design Inputs

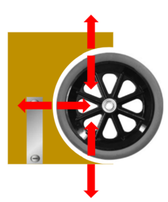
Dimension	Limited to specific customized wheelchair dimensions
Mobility Access	User must be able to operate device with only their upper body



Withstand a load ≥ 490 lbs

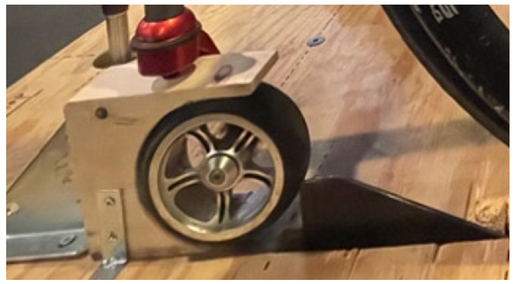


Stabilization angle ≤ 26.84° & Tipping weight ≥ 124 lbs



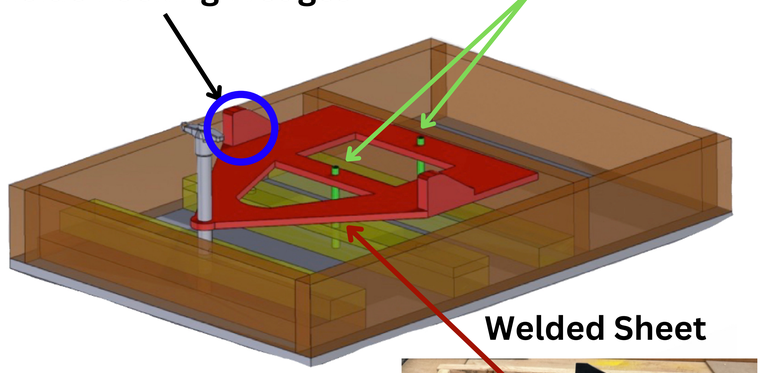
Secure 20% of max load (~100 lbs)

Our Solution

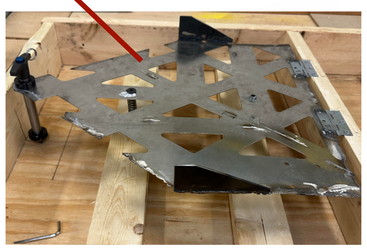


Wheel Inside Locking Wedges

Springs + Support Bars



Welded Sheet



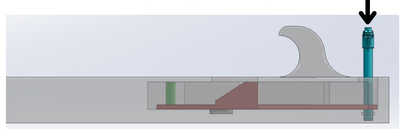
Metal Wedges Welded on Metal Sheet
Lever
Release Pin
Metal Support Bars
Compressible Springs

Pull up

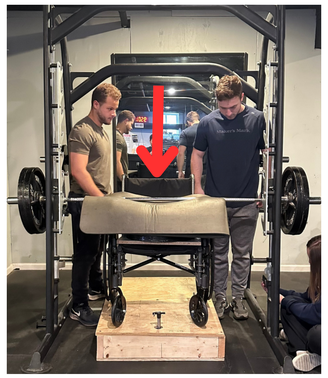
Locked - springs relaxed

Push down

Unlocked - springs compressed



Verification Testing



<u>Vertical Load Test</u>

Load ≥ 490 lbs

Total Weight Applied (lbs)			
240	330	420	490

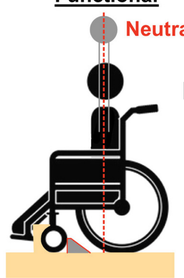
PASS

No bending or cracking

<u>Securement Test</u>

20% of max load (~100)

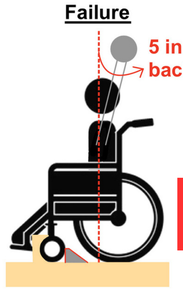
Functional



No movement

PASS

Failure



Wheel slipped out

FAIL

<u>Tipping Weight & Angle Test</u>

Angle ≤ 26.84° & weight ≥ 124 lbs

Angle theta (degrees)			
0 in.	1 in.	2 in.	3 in.
1.8°	2.9°	5.5°	3.1°

PASS

Conclusion

<u>Accomplished</u>

Built a customized wheelchair that prevents backward tipping during heavy overhead weightlifting

<u>Impact</u>

Solution can be adapted for competitive and commercial use, potentially serving up to 2.7 million wheelchair users

Future Revisions

1. A ramp
2. Use metal for the entire design
3. A guide to stop front wheel rotation

QR Codes

Scan QR Codes for References + Video of Solution

Solution Video

References