

# Adaptive CycleBoard

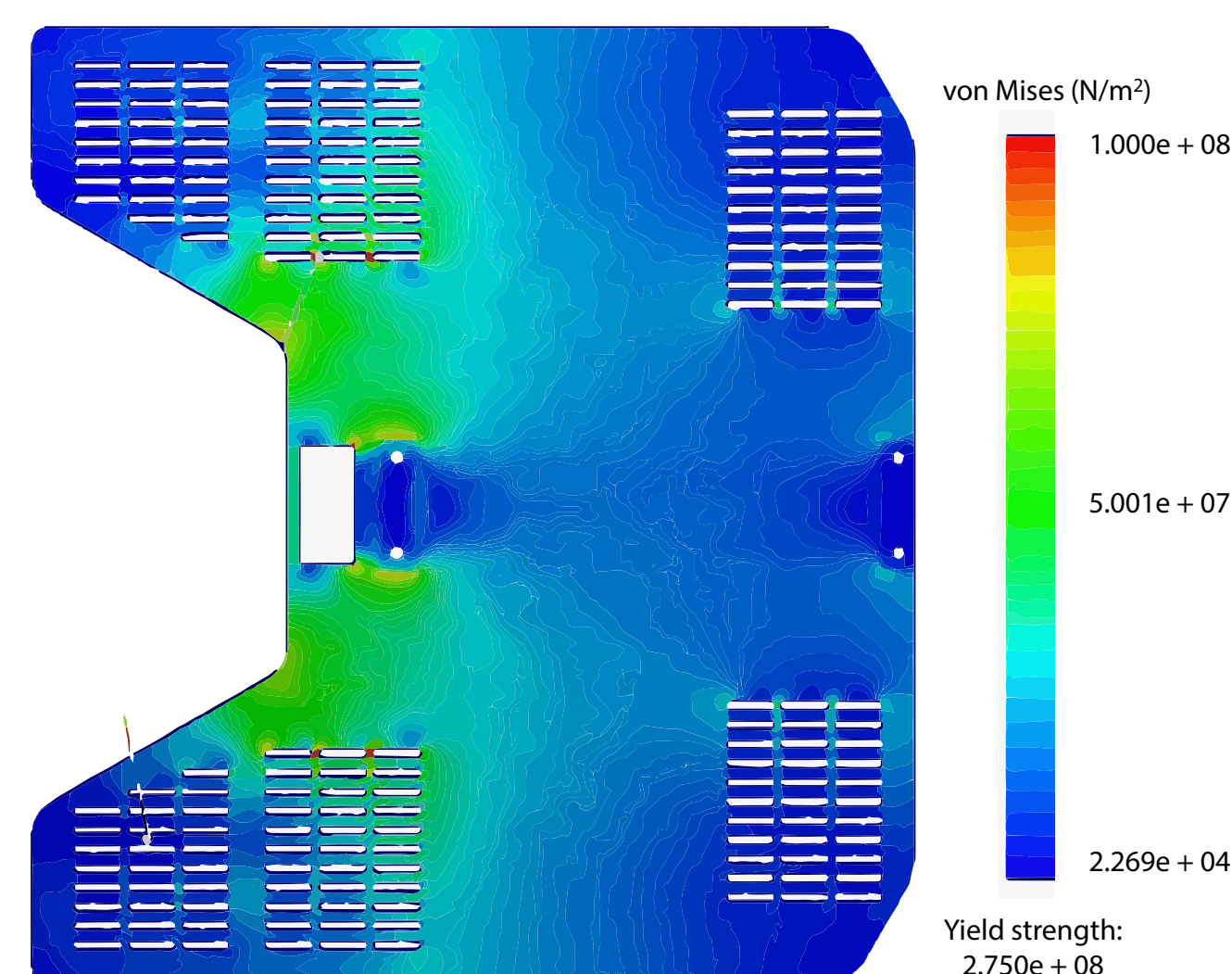
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## Introduction

Current wheelchair power assist devices are not equipped to handle uneven terrain and expose manual wheelchairs to excessive force and wear. The Adaptive CycleBoard is designed to adapt an off-the-shelf CycleBoard electric scooter with a platform to hold personal wheelchairs, ensure sufficient stability for safety, reduce wear and dirt build up on wheelchair wheels, and modify motor control to allow zero-speed power and reverse capabilities. We hope to enable adults living with paraplegia to increase their independence and ability to recreate outdoors.

## Plate & Suspension



The plate has 186 slots to secure different sized wheelchairs as illustrated below. It's machined out of 6061 aluminum with a stress safety factor of 2.2 when the maximum weight limit (300 lbs) is applied. Two air springs with Schrader valves are used for the suspension, allowing easy adjustment to the rider's weight using a standard bike pump.

Specification	Minimum	Maximum
Rear Wheel Width	15.6"	27.5"
Front Wheel Width	12.5"	24.5"
Wheelbase	11"	24"



## Modified Steering

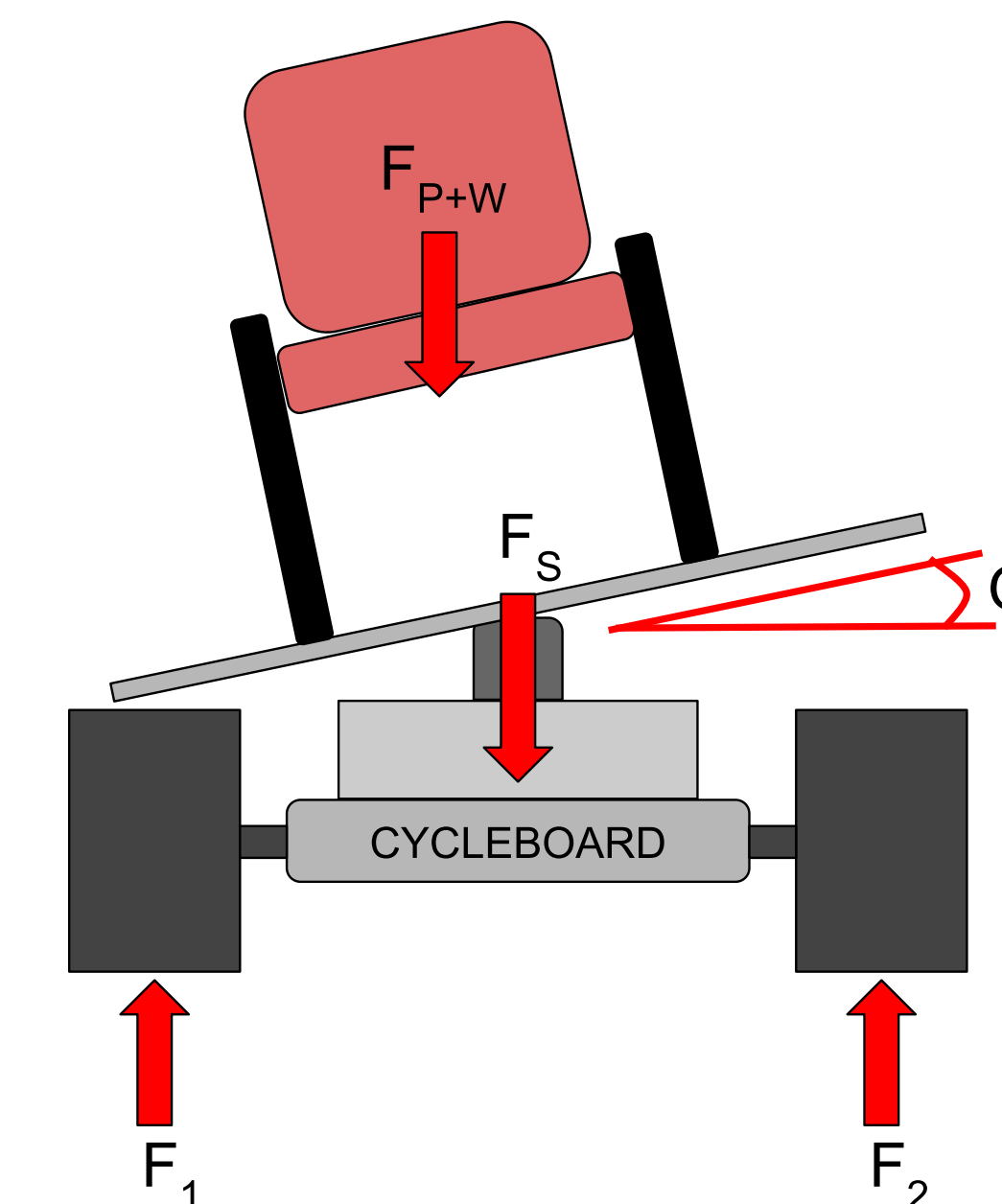
The original CycleBoard scooter rides like a skateboard: you must tilt the base platform and steering column to turn. Many paraplegics have compromised abdomen control which largely complicates their ability to do this.

We have adapted the scooter to use traditional "turn" steering by introducing a machined steering rod that couples the steering column to the original tie rods. The steering column is now fixed, allowing riders to use it as an anchor to pull themselves out of a turn.



## Testing

The biggest safety concern with the system is the possibility of the rider tipping the scooter over. At the maximum combined person + wheelchair weight limit, tipping would begin at 28.8°. Using a safety factor of 2.5, our maximum platform tilt must be less than 11.5°. We also tested our new motor controller to ensure it was well-rated to both the battery and the motor and didn't overheat under load.



## Results

Metrics	Target Value	Test Value
Allowable Torque on Steering Rod	> 20.34 Nm	57.92 Nm
Turn Radius	< 5'10"	4'9"
Turn Force	< 15 lbs per hand	2.25 lbs per hand
Motor Zero Start	Yes	Yes
Motor Temperature	< Δ0.5 °F/min	0 °F/min
Motor Reverse	Yes	Yes
Plate Deflection	< 2 cm	1.5 cm
Max Tilt Angle	< 11.5 deg	8 deg

## Conclusion

The Adaptive CycleBoard scooter has been successfully modified to provide a fun, zero-start mobility device for those living with paraplegia. Moving forward, we hope this project can be further developed so that a rider can safely and easily mount and dismount by themselves, promoting their independence and ability to use it from the ease of their home.