

Background

- ❖ Recumbent bicycles have three wheels and are typically hand powered
- ❖ Many existing vehicle racks require assistance to load and unload the recumbent bicycle
- ❖ Craig Hospital loans a variety of bikes to their alumni



Delta

Tadpole

End User Input

- ❖ Prefer dependability over convenience
- ❖ Delta configured bikes are more common than tadpole
- ❖ Individuals may have limited dexterity
- ❖ Many delicate components in steering mechanisms that should be avoided for mounting

Key Specifications and Requirements

- ✓ Compatible with Class 3+ vehicle trailer hitch
- ✓ Users shall load and unload their recumbent bikes without assistance
- ✓ Fits bikes as long as 7' and as wide as 3'
- ✓ Loaded bike shall not exceed 80 lb
- ✓ Bike shall be loaded and unloaded from a wheelchair
- ✓ The rack must be weather resistant
- ✓ Project must remain in the CU-provided budget
- ✓ Fits both tadpole and delta configurations
- ✓ Is safe to drive with rack on public roads
- ✗ The rack must not obstruct trunk access

1-UP Wheel Rack

Commercially available component mounted to vertical collar

Ratcheting mechanism to guide vertical wheel and prevent pivoting

Pulley

Guides the winch cable and prevents cable from slipping during vibration

Vertical Collar

Sliding guide for bicycle during loading process

8 skateboard wheels, 78A durometer for compliance

Horizontal Collars

A500 carbon steel tubing equipped with ratcheting straps for users with limited dexterity

Adjustable position to accommodate range of bicycle widths

Battery and Electric Winch

2000 lb ATV winch mounted to hitch member

12 V, 18 Ah battery capable of 20 loading/unloading cycles

Frame Assembly

5-piece A500 carbon steel welded assembly with STEEL-IT[®] protective coating

Class 3 Trailer Hitch

2"x2" vehicle hitch mount selected to fit most vehicles

Safety Factor and Frame Calculations

Using beam calculations:

- ❖ Maximum displacement of vertical member: 0.35"
- ❖ Factor of safety: 2.6
- ❖ Using maximum acceleration and bike weight of 80 lb

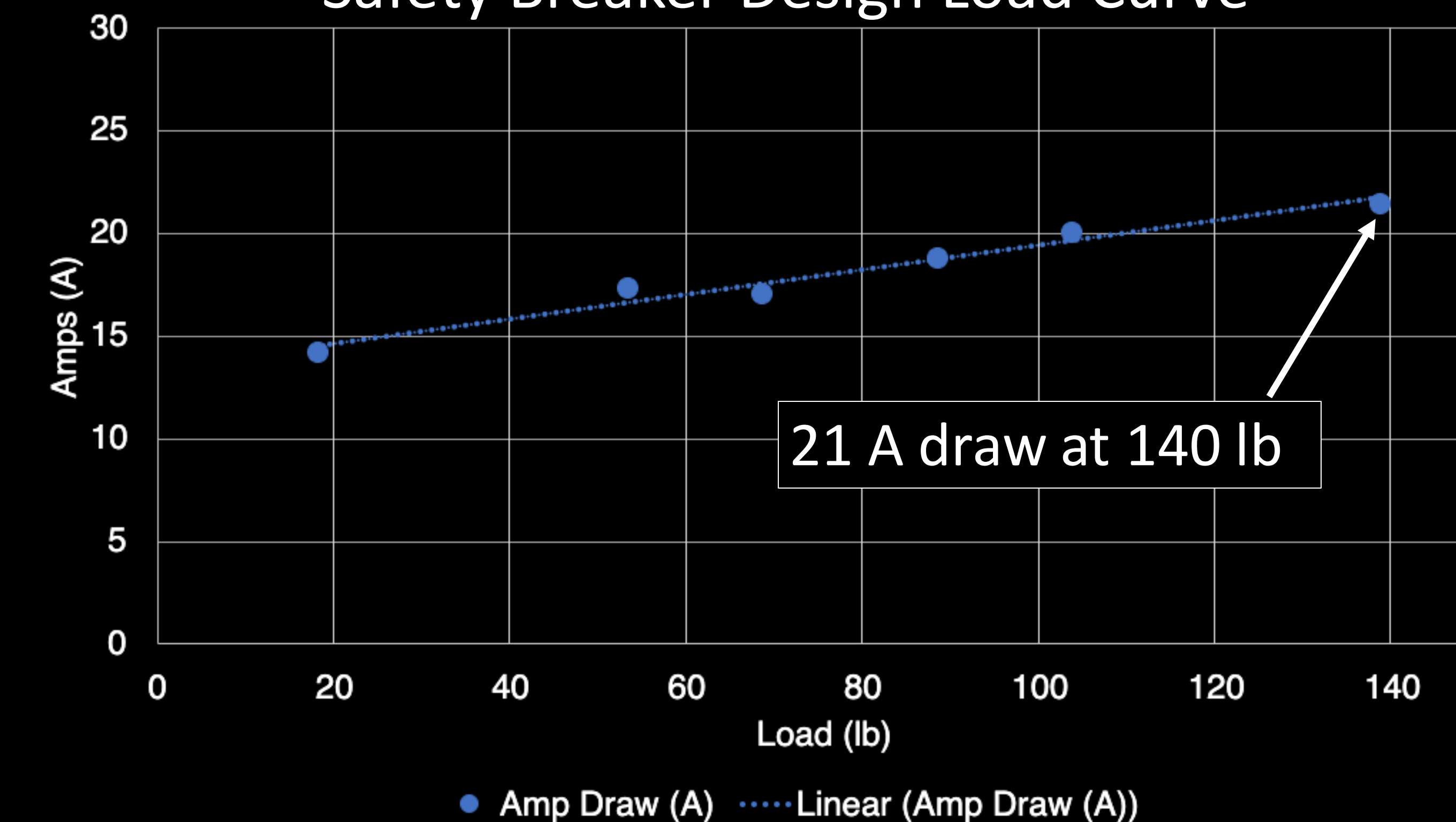
Design Testing and Results

Maximum acceleration experienced near vehicle hitch (g)

X	Y	Z
1.1	4.3	0.8

- ❖ An accelerometer was used to determine the forces our rack would experience
- ❖ Four vehicles were used driving over potholes, speedbumps, and rugged terrain

Safety Breaker Design Load Curve



Safety breaker justification:

- ❖ 2000 lb winch has potential to harm user, bicycle, or rack
- ❖ 140 lb load selected as threshold to trigger breaker
- ❖ Selected breaker with current trip curves and testing

Loading and Unloading Process



Step 1: Ride bike up with singular wheel to assembly
Strap the winch through front wheel



Step 2: Use remote to pull front wheel up until it reaches height of vertical collar and attach to the collar



Step 3: Continue to raise bike until back wheels are off the ground



Step 4: Strap bottom wheels to horizontal collars with ratcheting straps