Grand Canyon River Outfitters Association (GCROA)

NAU Lower Unit Redesign

The Team

- Katie: Team Leader
- Edana: Analysis
- Ken: Client Relations
- Malia: Communications

Technical Advisors
- Dr. M.R. Mitchell
- Dr. Brent Nelson
- Bryan Cooperrider

Edana, Ken, Malia, Katie, Dr. Nelson

GCROA's Needs

- Noise Reduction
  - Negatively affects river experience by over-riding natural sounds
- Pollution Control
  - Damage to the Canyon's ecosystem
- Durability
  - Strikes with river rocks damage the outboard prop and drive mechanism

Objectives

1. Redesign the lower unit to accommodate an electric motor and make it more robust for the challenges of the Colorado River.
2. Collaborate to design and build a universal quick release mount to join the lower unit and the power head.

Project Division

- University of Utah:
  - Designing electrical system; specifying electric motor
- NAU & Arizona State University:
  - Develop two different designs of lower unit for noise reduction and enhanced durability
- Collaboration:
  - Universal mounting plate

Lower Unit Constraints

- Interfaces with the existing engine saddle and the power head that UU is designing
- No significant increase in the overall drag
- Off-the-shelf components and standard machining techniques

Above: Saddle and bowl
Below: Oval aluminum tube stock

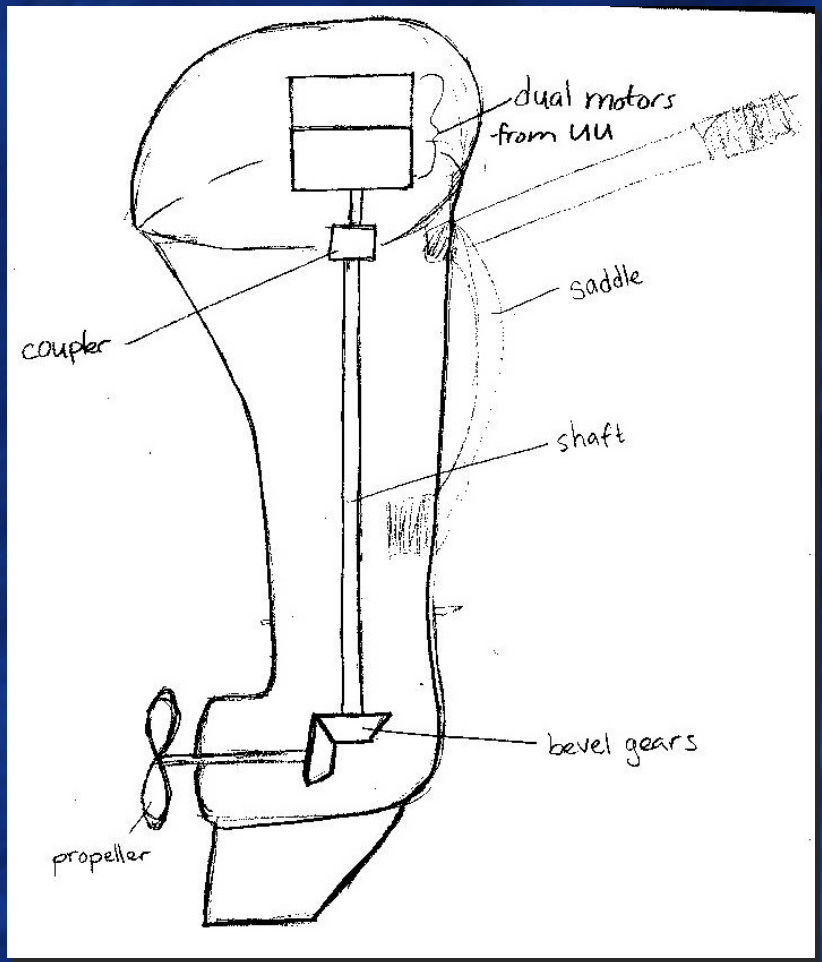
How NAU Senior Design Works
(Capstone)

Two semester design project:

- First Semester: Develop three distinct design solutions for lower unit.

- Second Semester: Finalize analysis of selected design and construct a prototype.

Shaft Drive



Simplest Solution

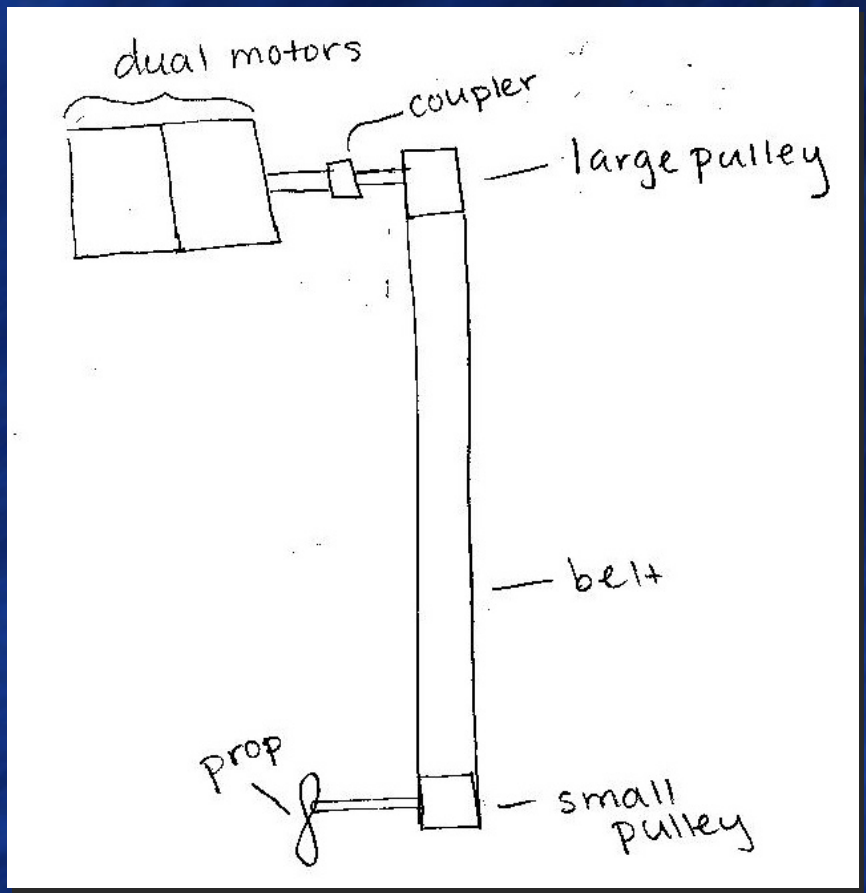
Configuration:

- Retain gears and change prop pitch

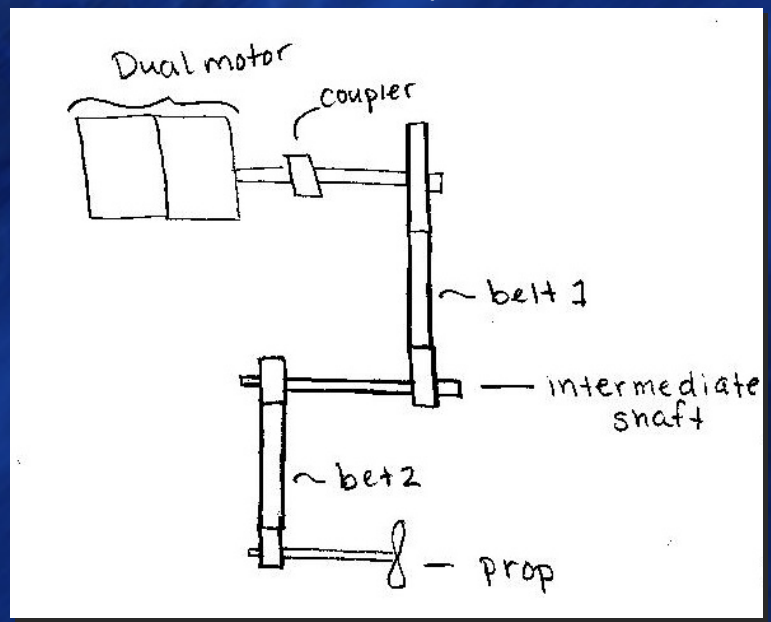
Concern:

- Optimizing the power output
- Does not resolve prop shaft bending issue

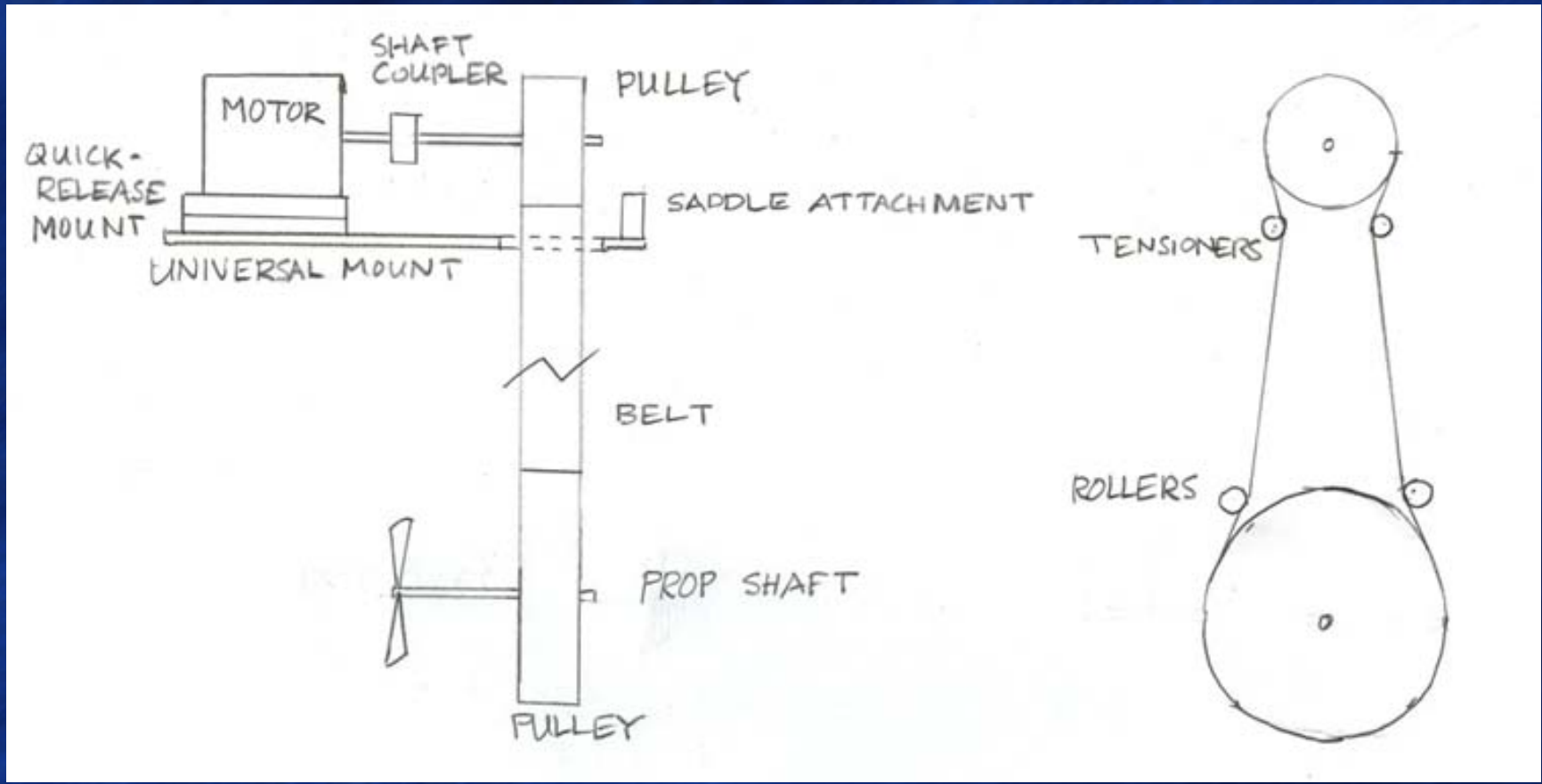
Direct and Intermediate Belt Drive



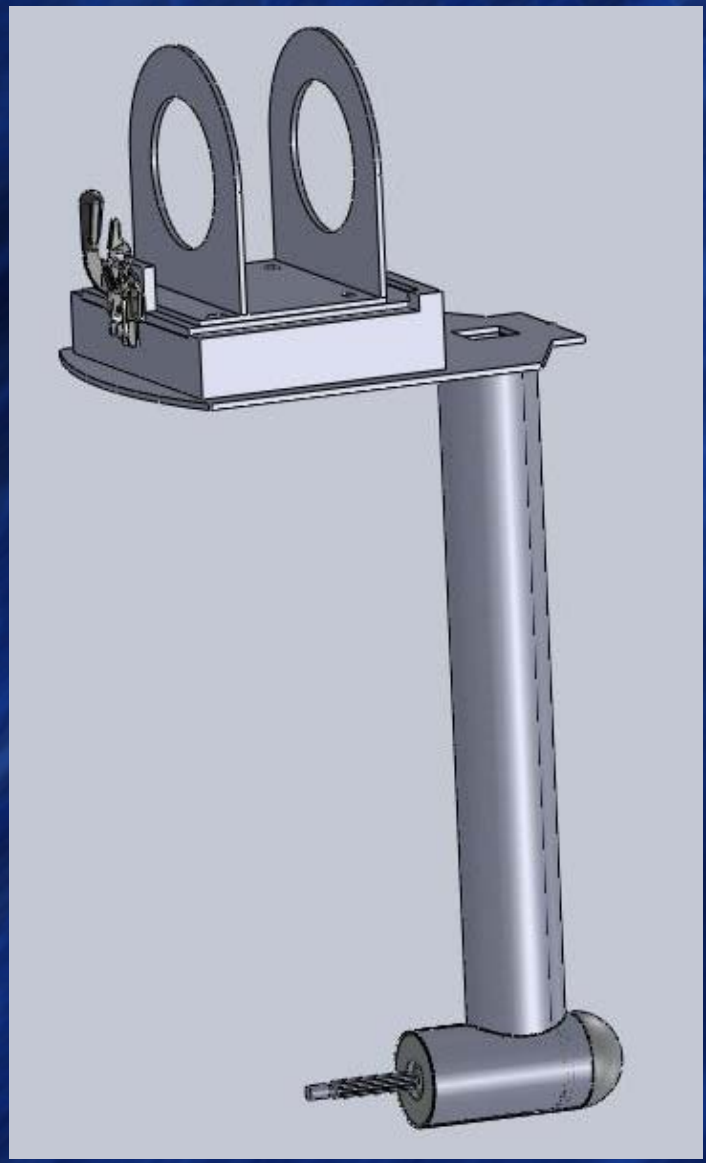
- Quiet
- Less maintenance
- Efficiency:
  - 97% efficient (Belt Selection and Application for Engineers Edited by Wallace D. Erickson New York and Basel 1987)



Selected Design:
Direct Belt Drive

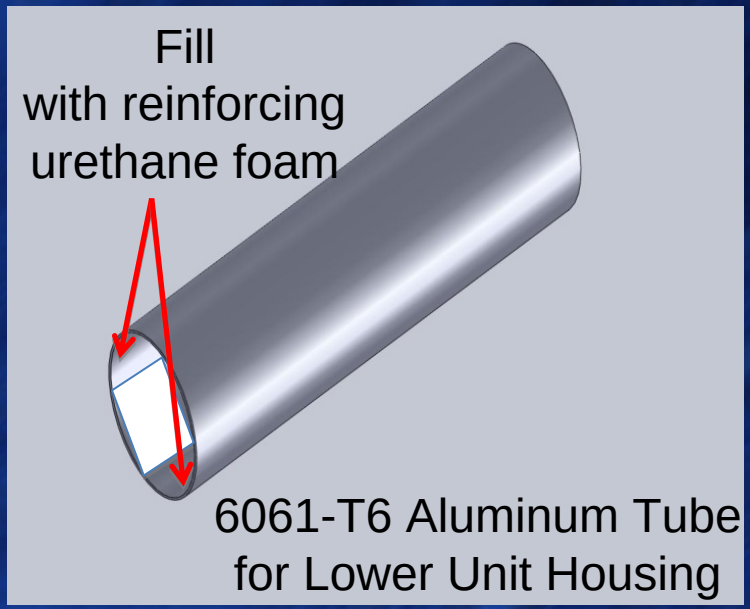


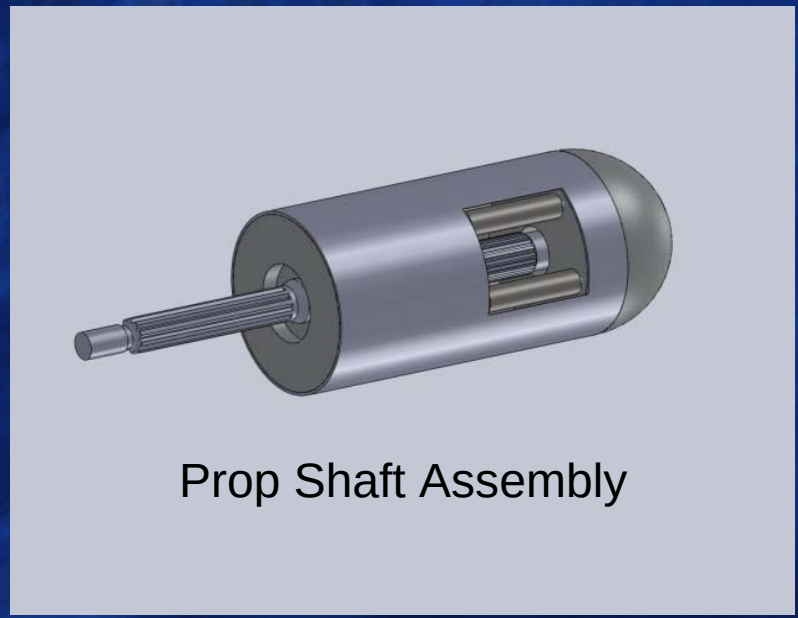
Lower Unit



Lower Unit
Assembly Mock-Up

Lower Unit


Fill
with reinforcing
urethane foam
6061-T6 Aluminum Tube
for Lower Unit Housing


Prop Shaft Assembly

Lower Unit Mount

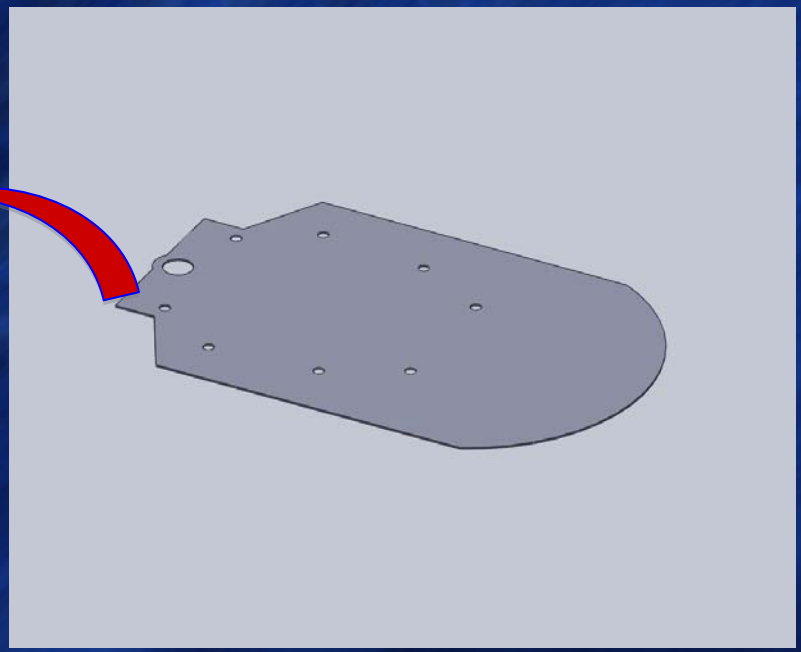
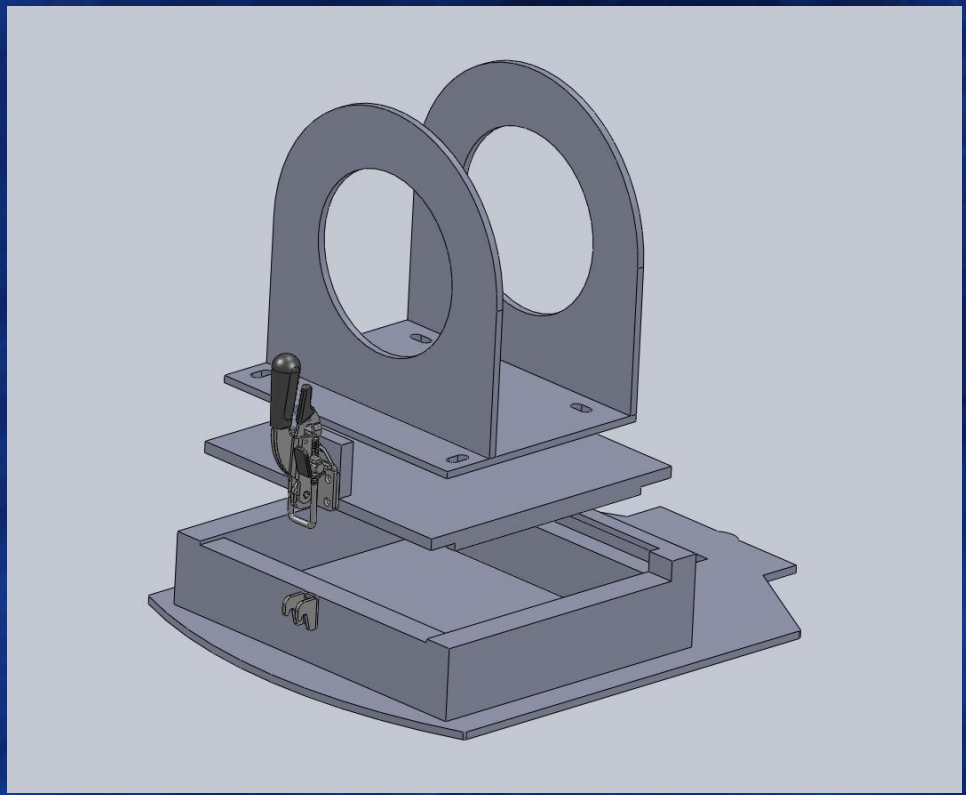


Photo and CAD provided by UU.

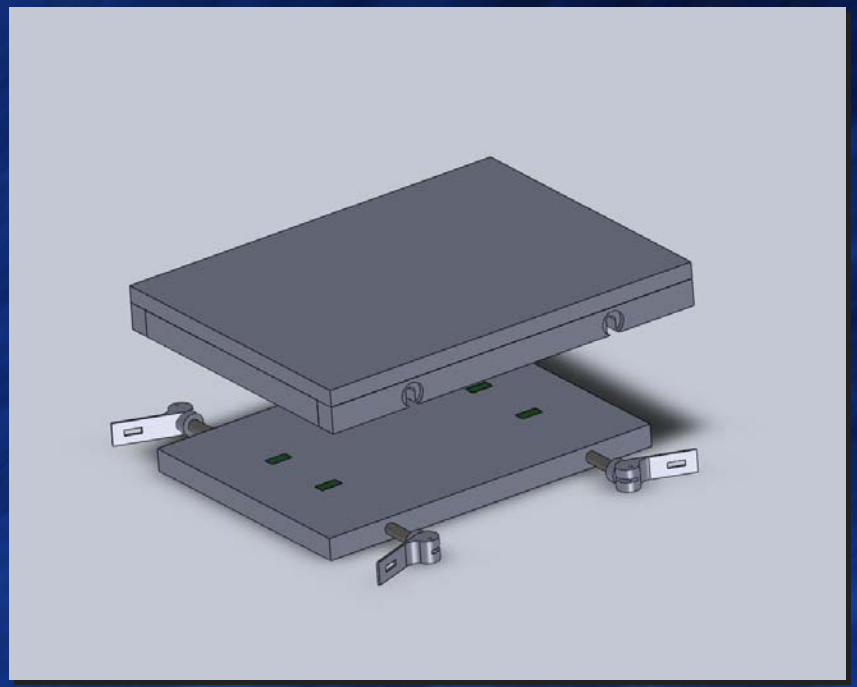
Quick Release Motor Mount:

Toggle Clamp Base



- Toggle Clamp:
  Holds up to 700 lbs
- Features:
  Self-locking Safety Latch
  Inexpensive
  Simplicity

Quick Release Motor Mount:
Fork and Skewer Clamp



- Existing Model:
  - Bicycle wheel quick-release
  - Holds ~2000 lbf
- Features:
  - Safety Lock

Generalized Budget

NAU Lower Unit Prototype Costs	
Mount Assembly Clamps, sheet metal, hardware	$500
Drive Assembly Belt, pulleys, bearings, alligator lacing, tensioners, hardware	$1000
Housing Assembly Aluminum tubing, foam, hardware	$1500
Total	**$3000**

Next Steps

- Continue collaboration with UU
- Complete design analysis of belt drive system
- Order all materials and parts
- Complete SolidWorks 3D modeling
- Manufacture and testing of subsystems
- Manufacture complete prototype

Major Milestones

- Impact Testing of Housing by 1 April 2010
- Final Prototype built by 15 April 2010
- NAU Capstone Conference 23 April 2010
- GCROA Presentation to sponsors in Flagstaff 17-18 May 2010
- GCROA River Trip for final evaluation 19-21 May 2010

Questions?