Orbital Test Stand
Engineering Analysis and Design Selection

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Orbital
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Presentation Overview

- Introduction
- Winch Concept
    - Part Selection
    - Mounting Strategies
- Interior Wheel Concept
    - Part Selection
   - Mounting Strategies
- Conclusion

Introduction

- **First:** Thank you for presenting this problem/project to NAU.

- **How we got here:** The five of us requested the Orbital Test Stand project (out of about 13 projects) at the beginning of the semester.

- **Where we are at now:** We have completed three presentations and submitted three reports to Professor Kosaraju.

- **Where we are going**: Hopefully, we will be moving forward with one of the two designs you hear about today.

DESIGN #1

WINCH

Winch Design
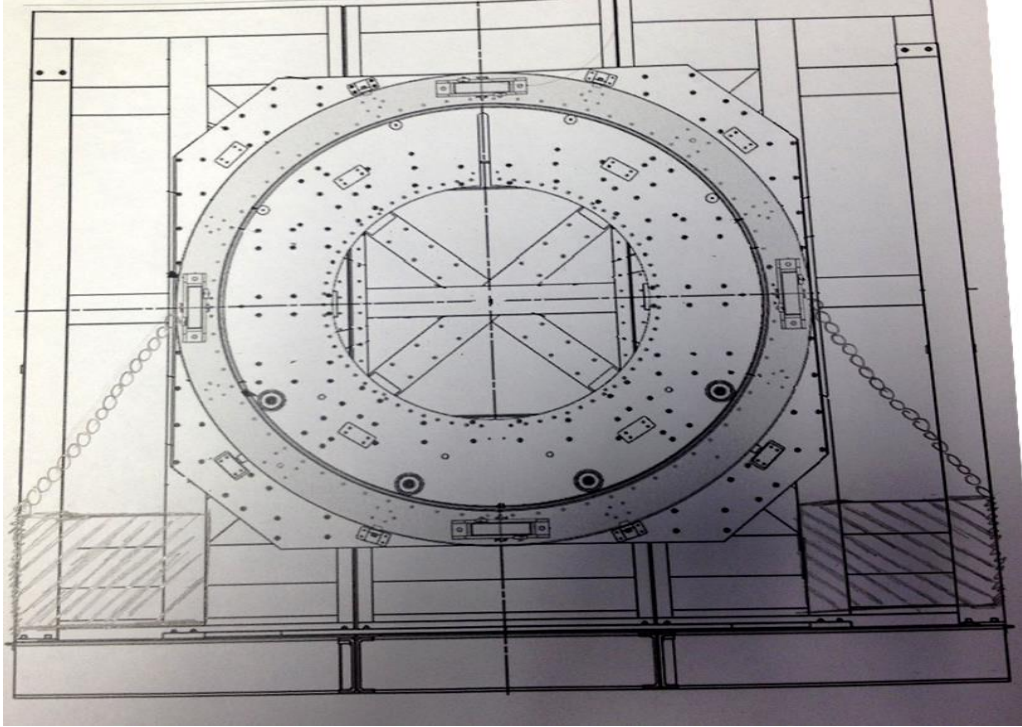
Winch Requirements

- 8 kip capacity
- Two-way function
- 141 foot cable length (3 x Perimeter)
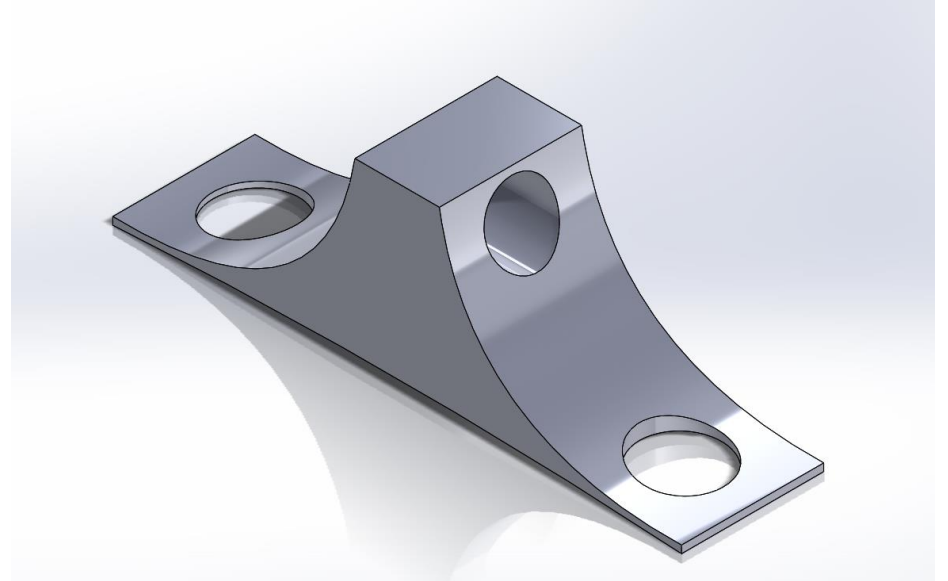- Electrical Power preferred
- 540 lb x 153 = 82,620 lbf-in Torque

Ramsey Patriot Winch

- 15 kip capacity
- 24 9/32 x 8 ½ x 11 LWH
- 5.5 Hp
- 0.2 RPM for 10 kip load
- Torque = 1,733,160 lbf-in
- Ns = 21
- Modification to increase cable length
- USD 1,800

Mounting Bracket

- Bolted or Welded onto ring

- 2 parts directly opposite each other on ring

- Winch cable connects through top hole

Braking/Locking Mechanism

- Provides heavy friction against underside of ring

- Pneumatic jack provides force pushing rubber surface against plate

- Estimating μ of 0.4 to 0.6
  - $W = 570 = \mu \times F_{JACK}$

- Factor of Safety = 2.5

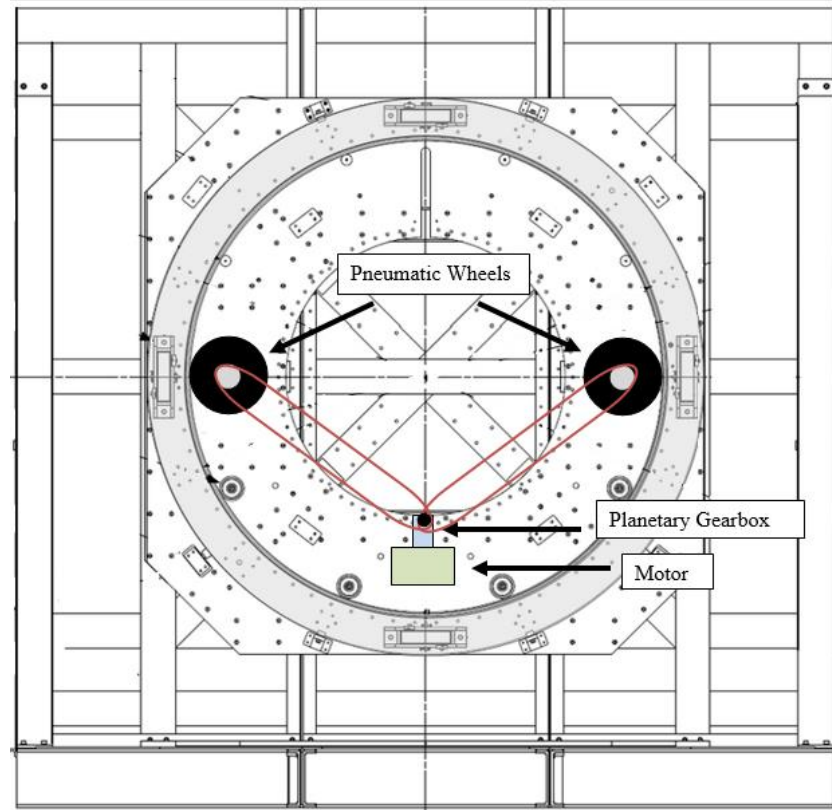- F_{JACK} must be 2000lb to 3500 lb
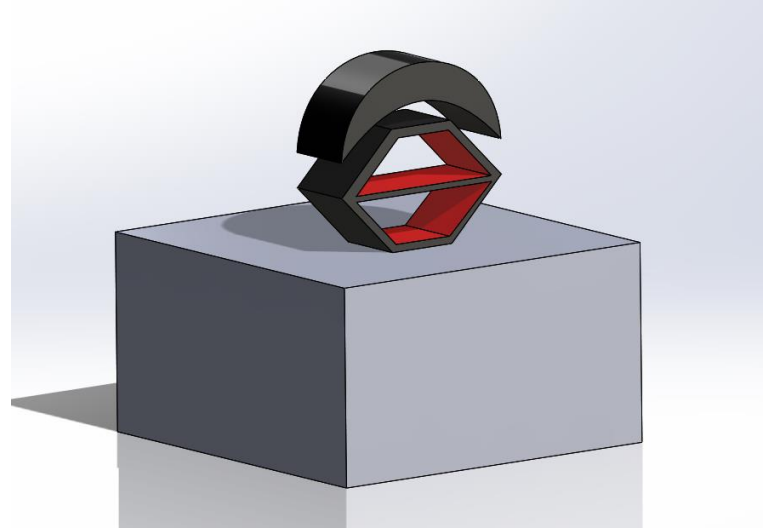
Floor Mounting

- ½'' steel plate

- 4 holes for mounting winch to plate

- 8 holes for mounting plate to floor

- Floor bolts shear before winch bolts
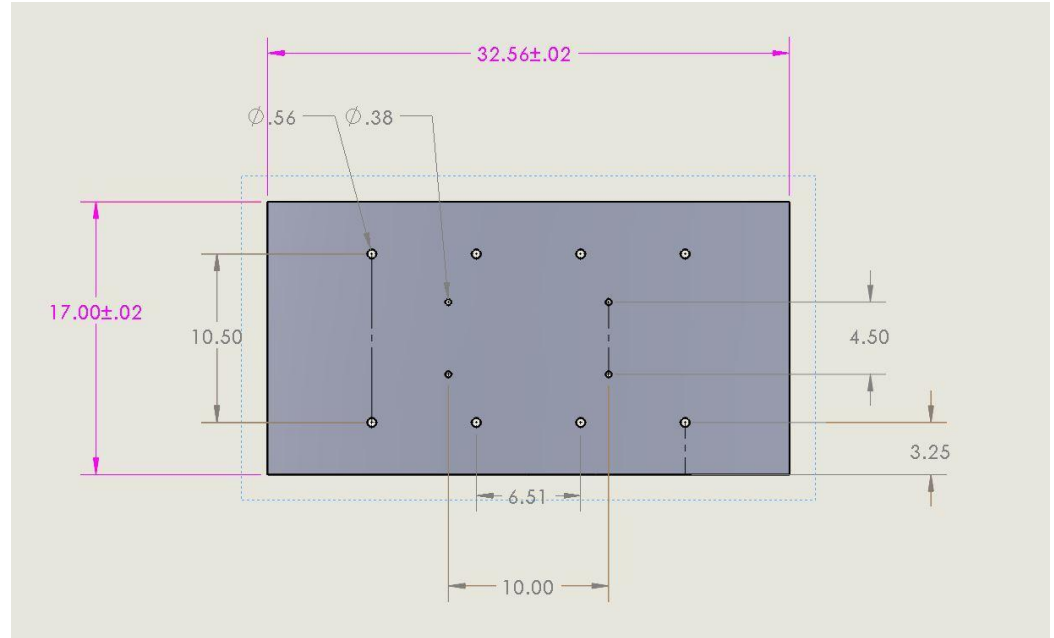
DESIGN #2
INTERIOR WHEELS

Interior Wheels Design

Interior Wheels Concept

Loaded with half fairing
- Moment = 4,275 lbf-ft
- Off-center load = 570 lbf @ full radius

Loaded with full fairing
- Torque = 1,064 lbf-ft
- No off-center load

Motor Calculations

Motor Requirements
- Reversible
- Electric
- Reliable

Anaheim Automation
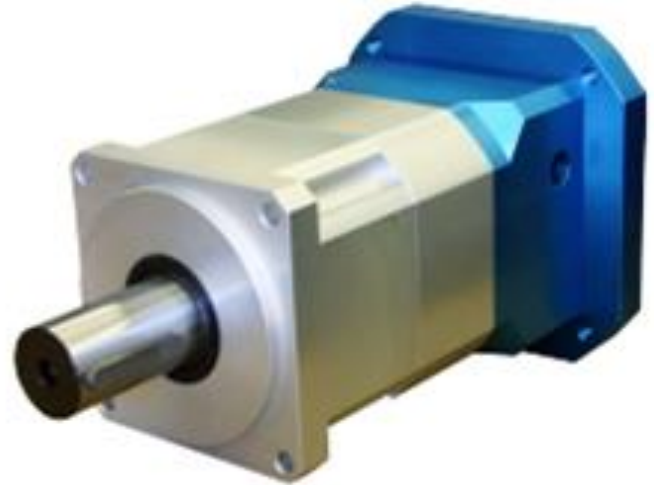- works with selected gearbox
- AC
- reversible
- $25 each

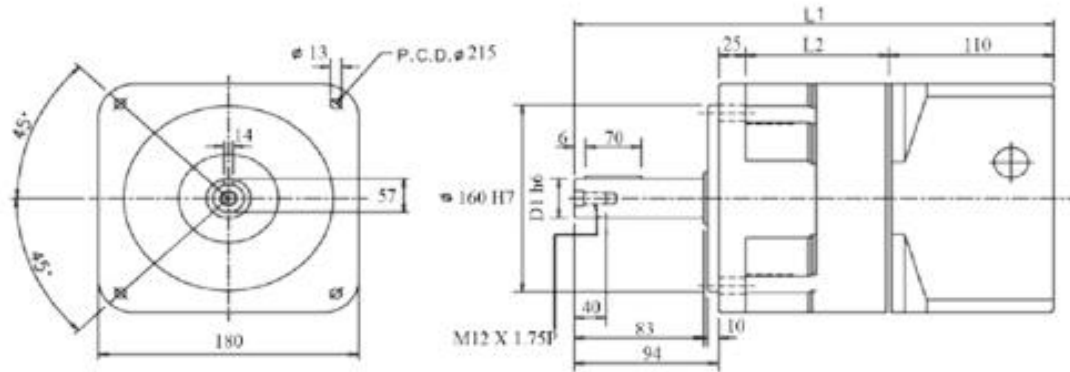| Wheels	Min Torque
2	3634 lbf ft
4	1817 lbf ft
6	1212 lbf ft

Gear Drive

Planetary Gearbox
- Low Backlash
- 70:1 gear ratio
- Max Torque Output: 31456 lb-in

Gearbox Specifications

*All units are in mm

Radial Load:	4946 lbs - Force	Axial Load:	4496 lbs - Force
Operating Temperature:	-15° to 90°C	Noise Level:	64 dB
Efficiency:	3~10: ≥ 97; 12~100: ≥ 94	IP Rating:	IP65

Heavy-Duty Drive Rollers

- 10 in. diameter
- 3 in. width
- 1,000 lbf load capacity
- Cost = $127
- 1 roller per motor

Pneumatic Slick Tire

- 10.1 in. diameter
- 3.7 in. width
- 352 lbf load capacity
- Cost = $20
- 2 wheels per motor

Mounting

Wheel
- Spindle-mounted to backplate

Motor & Gearbox
- Mounted to backplate

Conclusion

- **Two most promising designs**: Winch and Interior Wheels
  - **Winch**: Ramsey Patriot Winch, Mounting Bracket, Floor Mounting, Jack Brake System
  - **Interior Wheels**: Anaheim Automation, Planetary Gearbox, Pneumatic Wheels or Drive Rollers

- **Next for us**: Final Design Selection
  - Complete Engineering Analysis
  - Prototype Construction
  - Full Cost Analysis