Final Design Review

HARRIS

Group 12: Bevel Gear Test Bed

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Overview

- Introduction
  - Problem Statement
  - Product Specifications
- Design Overview
- Component Connections
- Calculations
- Current Cost Analysis
- Conclusion
- Future Plans
- Acknowledgements

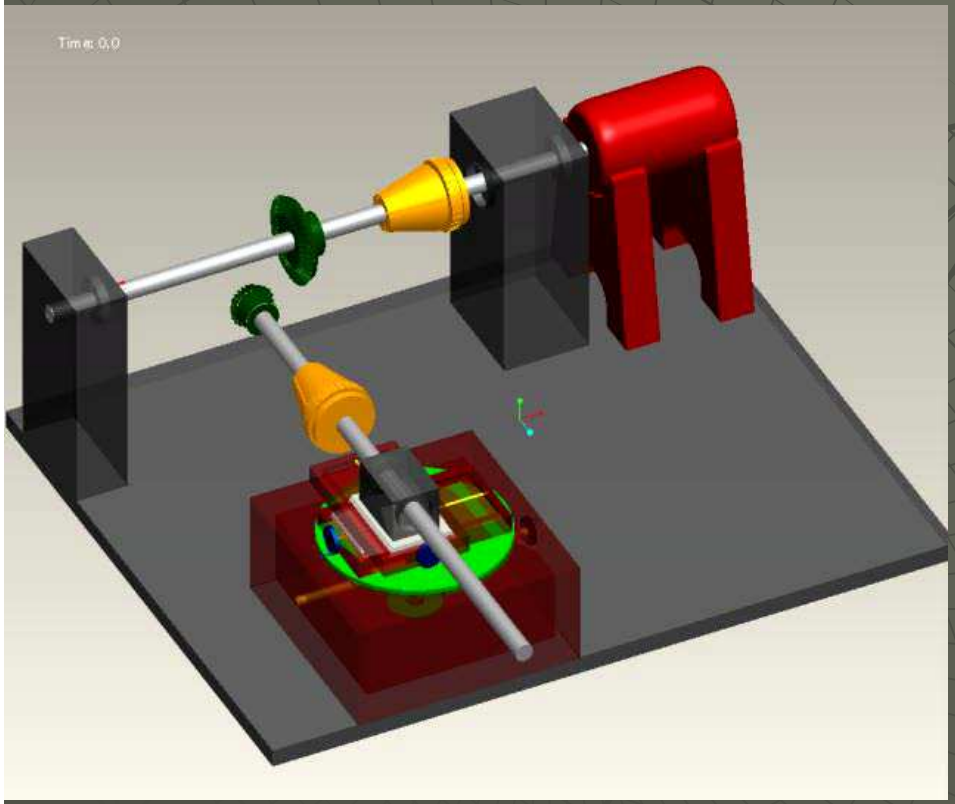
Problem Statement

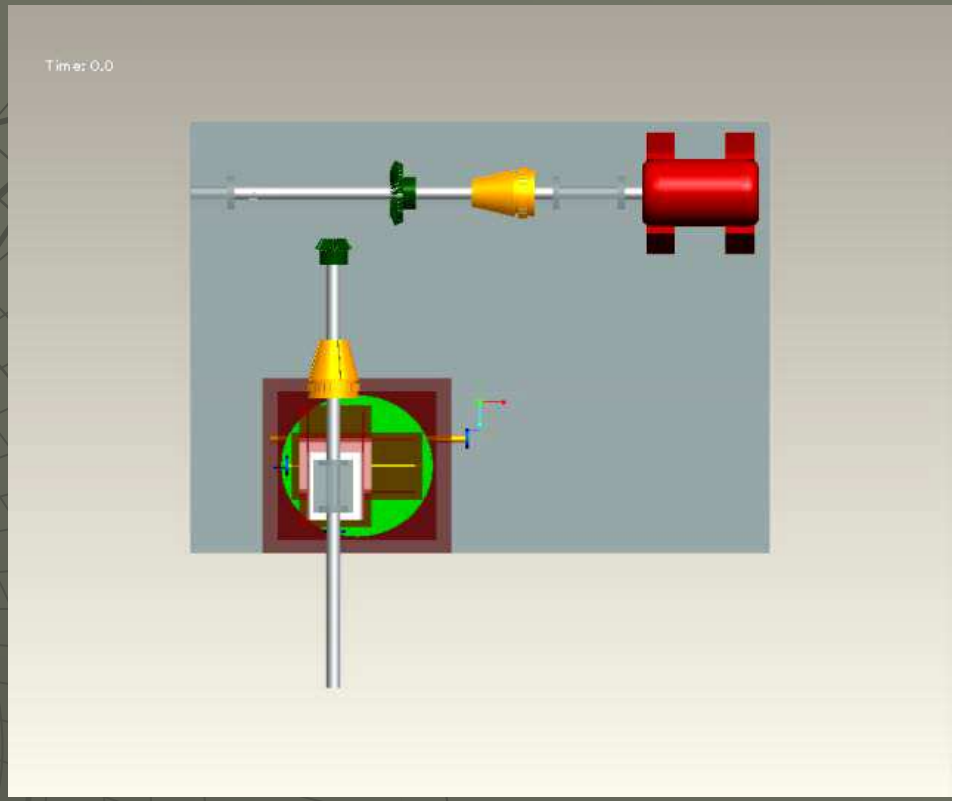
- Harris Corporation ran tests on bevel gears needed for a project
  - They did not achieve the expected standards
- Possible problems
  - Misalignment
  - Anodic coating failure
- Our team needs to design a very accurate bevel gear test bed
  - Used to test a variety of bevel gear sizes and materials at different torques

Product Specifications

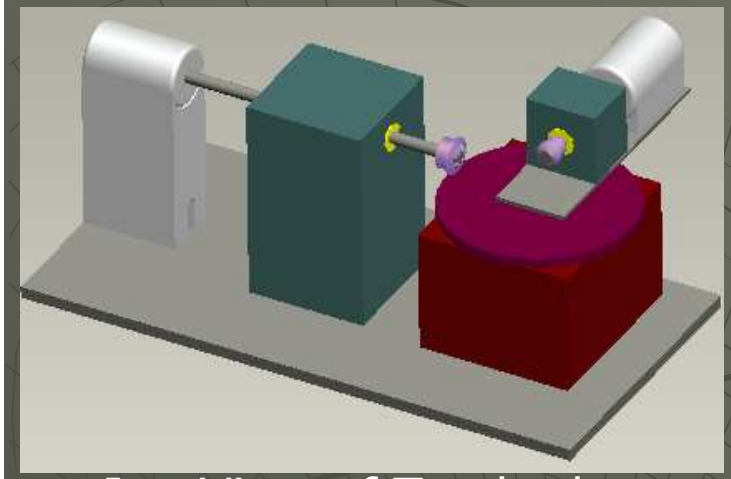
Specifications	U.S. Units	SI Units
Variable Speed	0 rpm – 100 rpm	0 rad/s – 10.4 rad/s
Variable Torque	0 in.-lb - 50 in.-lb.	0 Nm – 5.6 Nm
Mounting Distance Accuracy	+/- 0.001 in.	+/- 0.0254 mm
Variable Shaft Angle Range	+/- 0.5 degrees	+/- 0.00873 rad
Shaft Angle Accuracy	+/- 0.05 degrees	8.727*10^-4 rad
Gear Size Range	1/3 in. – 5 in.	8.467 mm – 127 mm

Interim Design

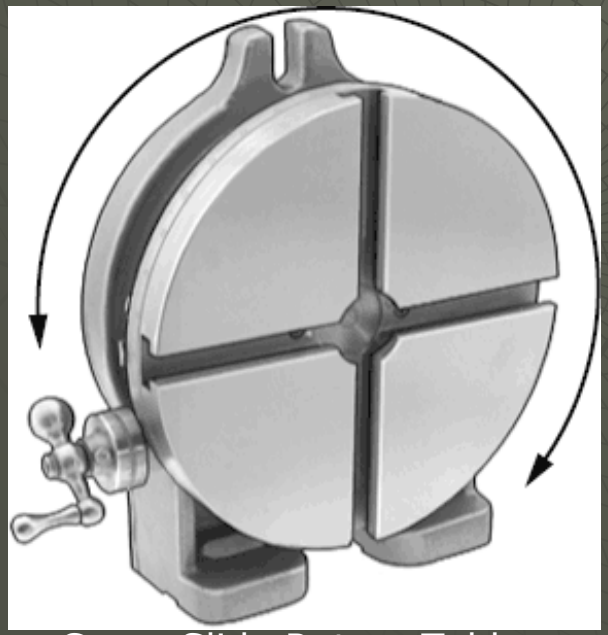




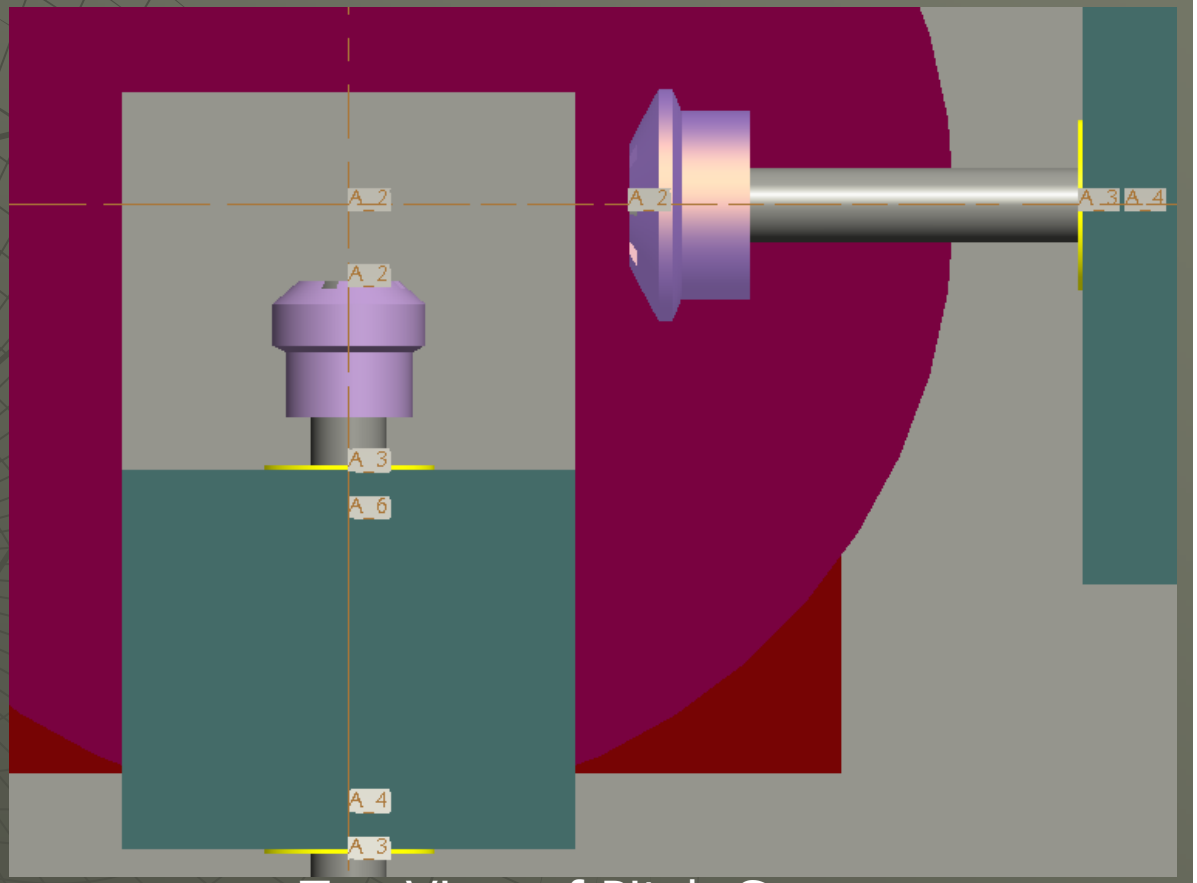
New Design



Iso-View of Testbed

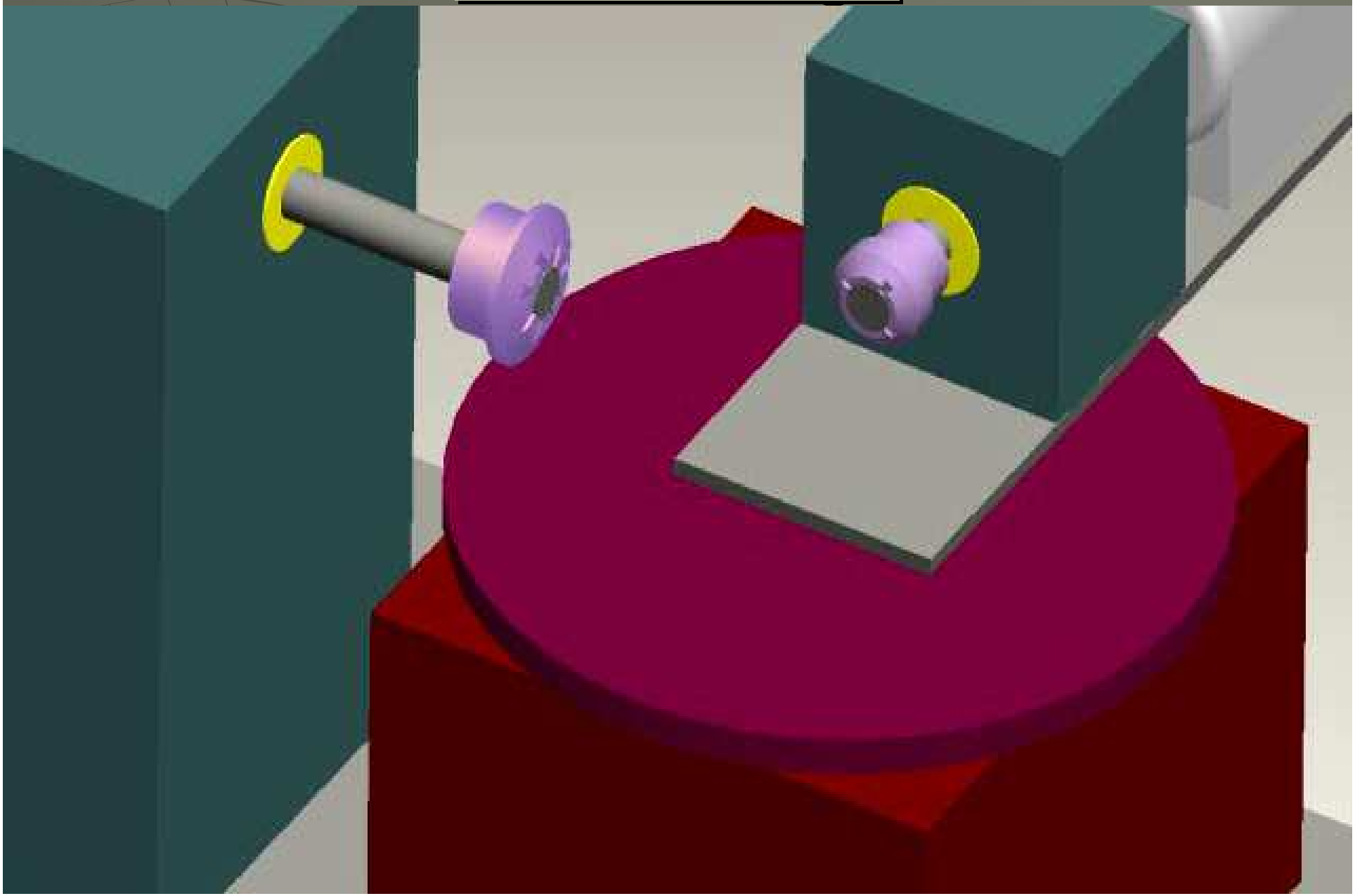


Cross-Slide Rotary Table



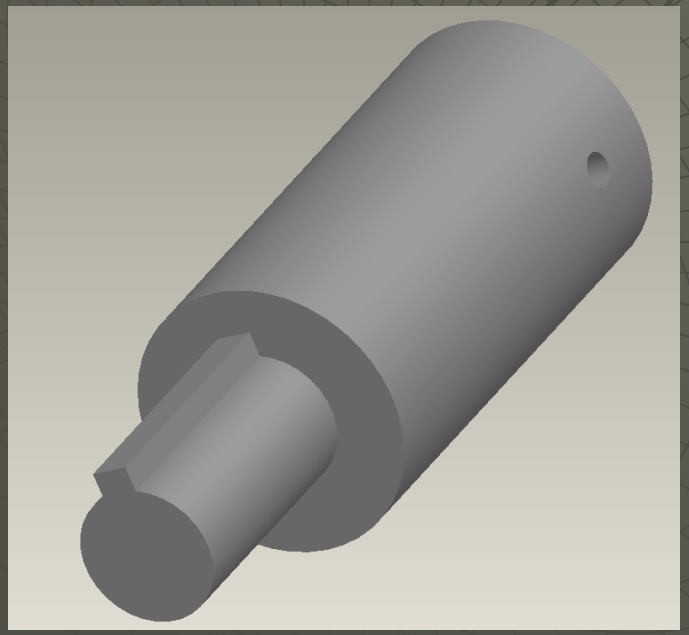
Top View of Pitch Cones

New Design



Connections

- Connection Concepts
  - Shaft Adaptors
  - Gears-to-Shafts
  - Motors-to-Shafts
    - Might Need Flexible Couplings



Shaft Deflection

$$F_\delta := \sqrt{\left(W_{rp}^{\ 2}\right) + \left(W_t^{\ 2}\right)}$$

$$D_{shaft} := 0.5in$$

$$L := C_1$$

$$C_{constant} := 3$$

$$r_{shaft} := \frac{D_{shaft}}{2}$$

(The constant is 3 because the load on the shaft is an end load)

$$I := \frac{\pi \cdot r_{shaft}^{\ 4}}{4}$$

$$E_{steel} := 200GPa$$

$$E_{aluminum} := 69GPa$$

$$Deflection_{steel\_shaft} := \frac{F_\delta \cdot L^3}{C_{constant} \cdot E_{steel} \cdot I}$$

$$Deflection_{aluminum\_shaft} := \frac{F_\delta \cdot L^3}{C_{constant} \cdot E_{aluminum} \cdot I}$$

$$Deflection_{steel\_shaft} = 1.535 \times 10^{-5}\ m$$

$$Deflection_{aluminum\_shaft} = 4.449 \times 10^{-5}\ m$$

Current Cost Analysis

Name	Price Per Unit	Quantity	Total Price
Cross-Slide Rotary Table	$750.18	1	$750.18
Bearings	$9.80	4	$39.20
Shafts	$25.00	1	$25.00
Mounting Plate	$23.33	1	$23.33
Bearing Blocks	$40.00	2	$80.00
Base Plate	$128.30	1	$128.30
Controller	$295.00	2	$590.00
Totals		12	$1636.01

Prices do not include S&H or tax

2 Motors and 3 Gear Sets will be provided by the Harris Corporation

Conclusion

- Resolved and Unresolved Issues
  - Resolved
    - Reduced Cost
    - Achieved Given Tolerances
  - Unresolved
    - Connection Types
      - Shaft Adaptors
      - Gears-to-Shafts
      - Motors-to-Shafts
    - Still Over Budget
      - Budget Extension Proposal

Future Plans

- Preparation for Building
  - Schedule Machining Time
  - Part Ordering
- Building
  - Assemble parts as they become available
  - Incorporating our own machined parts
- Testing
  - Troubleshooting
  - Optimization

Acknowledgements

- Dr. Hollis
  - Calculations Review
  - Design Guidance
- Brent Stancil
  - Providing the motors and gears sets
  - Clarifying Critical Specifications
  - Teleconference Meetings on a Weekly Basis
  - Simplifying our design

Questions