

Bi-directional Offset Lifting Bar

Danfoss Turbocor

Instructors - Dr. Helzer & Dr. Gupta
Advisor - Dr. Hollis

Team 5
Devin Stubbs
Gabriel Omoniyi
Luke Leelum
Yoel Bugin
Coert Maraist

Outline

- Project Description
- Concepts
- Final Design
- Risks and Challenges
- Risk Mitigation
- Schedule and Project Plan
- Summary

Project Description

- Newly developed VTT Compressor too large for existing test rig
- Must increase lift height of compressor for testing
- Offset lifting bar to include:
 - Auto-leveling
 - Adjustable lifting positions
 - 1 Ton load capacity
 - Operating weight less than 500 lbs
 - Safe Operation – must meet OSHA certification

Possible Solutions

- Counterweight Design (Fig.1)
- Two Points of Lift with Anchor (Fig.2)
- Redirection of Lift (Fig.3)
- Increase Hoist Height

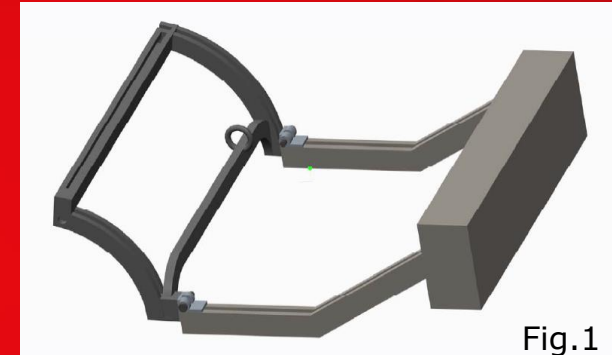


Fig.1

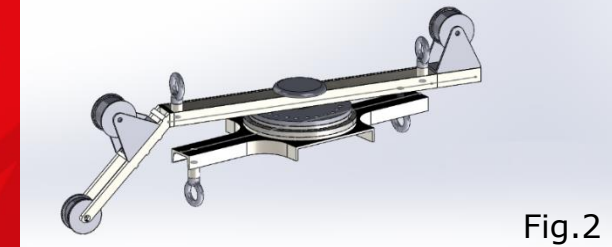


Fig.2

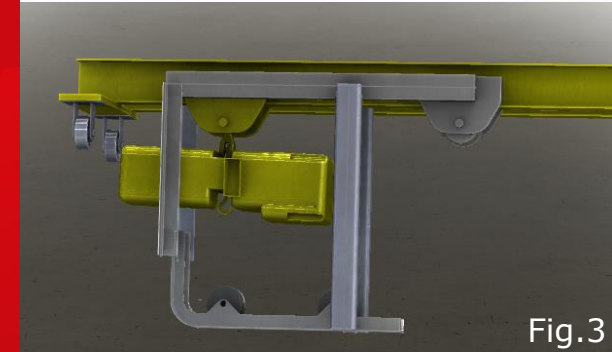


Fig.3

Current Hoist Setup (Fig.4)

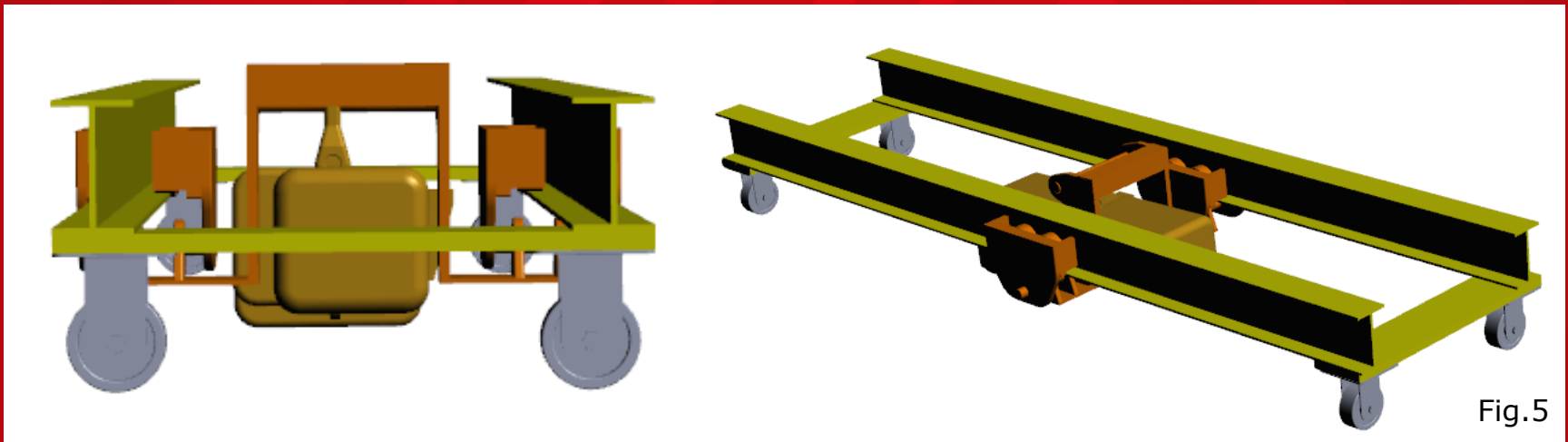


Decision Matrix

Design	Safety (30%)	Performance (25%)	Cost (20%)	Implementation (25%)	Total
Counterweight	2	8	3	3	4.15
Two Points of Lift	4	7	1	3	3.40
Redirection of Lift	6	9	6	6	6.75
Increase Hoist Height	9	9	5	8	7.95

Final Solution: Increase Hoist Height

- Redesigned Gantry System to Suspend Hoist at Higher Height (Fig.5)
 - Safe
 - Within Budget
 - Meets Performance Specifications
 - Must design separate lifting bar for variable center of gravity



Variable Center of Gravity Lifting Bar

- Power Screw Allows Incremental Adjustments
- Multiple Points of Lift to Support All Turbocor Compressors

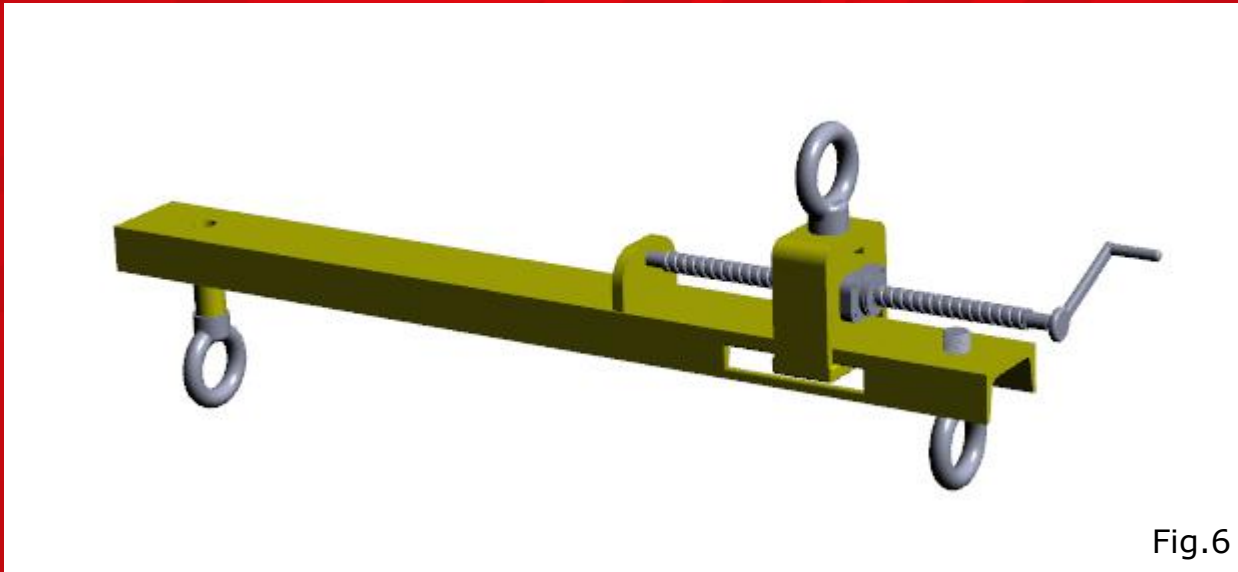


Fig.6

Potential Challenges / Risks

- Unbalanced Moments
- Subjecting I-Beams to Torsional Forces
- Gantry:
 - Trolley System
 - Strength of Steel
 - Track Alignment
 - Vertical Clearance
- Lifting Bar:
 - Moving parts concentrate points of failure
 - Strength of Material
 - Bending Moments
 - Multiple Points of Lift
 - Power Screw Binding

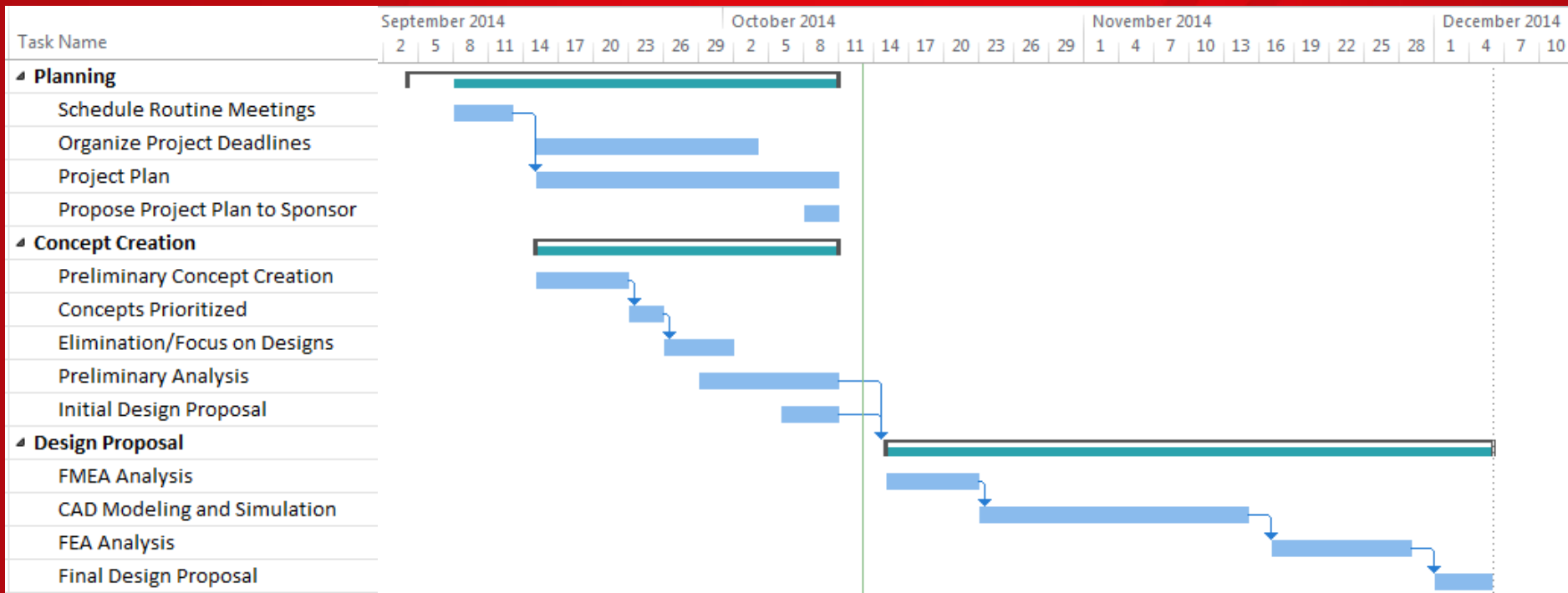
Risk Mitigation

- Preliminary FMEA
- Complete FEM Analysis
- Prototype Field Testing
 - Dummy Weight
 - Realistic Center of Gravity
- Full Turbocor Implementation
 - Chiller 3
 - Lift VTT Compressor

Schedule

- Routine Meetings and Project Plan Development
- Concept Creation
- Design Selection and Analysis
- Design Proposal
- Prototyping
- Prototype Testing
- Full Implementation

Gantt Chart



Summary

- Original Project Description asked for Offset Lifting Bar
- True Goal was to Increase Lifting Height of the Compressor
- Redesigned Gantry System Suspends Hoist
- New Lifting Bar Allows for Adjustable Center of Gravity
- Design Proposal is Safe and Reliable
- Final Project Requirements are met

Questions?