

Bi-directional Offset Lifting Bar

Danfoss Turbocor

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

Team 5

Devin Stubbs
Yoel Bugin
Coert Maraist
Gabriel Omoniyi
Luke Leelum

Outline

- Background
- Project Description
- Current Setup
- Concepts & Decisions
- Risks and Challenges
- Risk Mitigation
- Schedule and Project Plan
- Summary



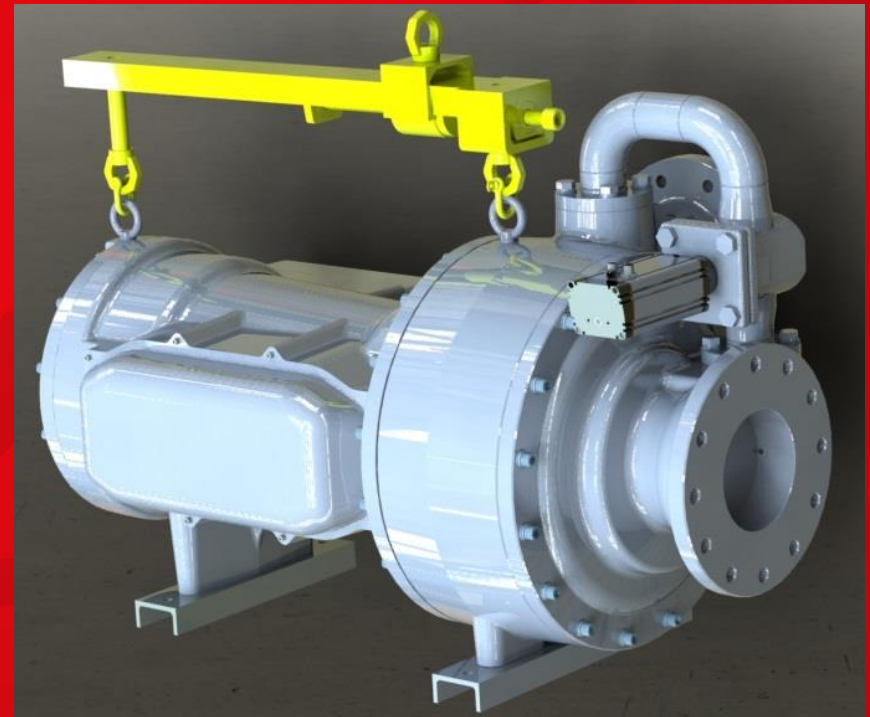
Background

- Danfoss Turbocor is the world leader in oil-free centrifugal compressors used for cooling applications
- All compressors must be tested prior to distribution
- Since Chiller 3 was built Turbocor has developed a new line of VTT Compressors which have a greater height than can be installed with the current gantry and hoist system
- Turbocor asked Team 5 to develop a lifting bar that can be used with the current facility crane hoist and gantry



Project Description

- A better lifting system must be designed and implemented in order to conveniently install the compressor for testing
- Lifting bar to include:
 - Auto-leveling
 - Adjustable lifting positions
 - 1 Ton load capacity
 - Less than 500lb operating weight
 - OSHA Compliant



Current Hoist and Gantry

- Crane hoist hangs below gantry
- Wasted space
- Can't be used for VTT Compressor

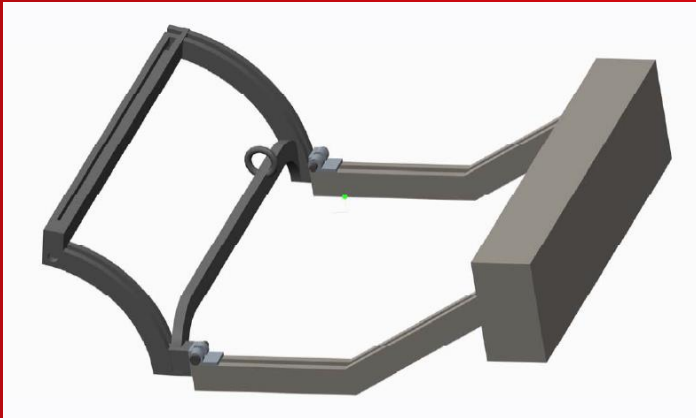


Current VTT Lifting Bar

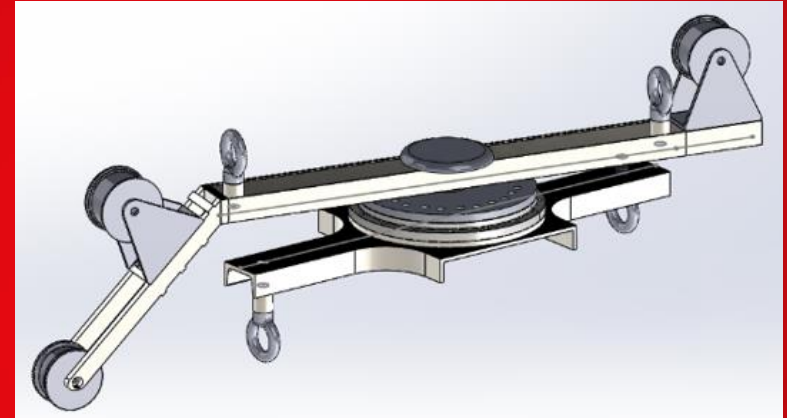
- Non-adjustable lifting hook positions
- Non-adjustable lifting point for variable center of gravity
- Suboptimal vertical height between lifting points



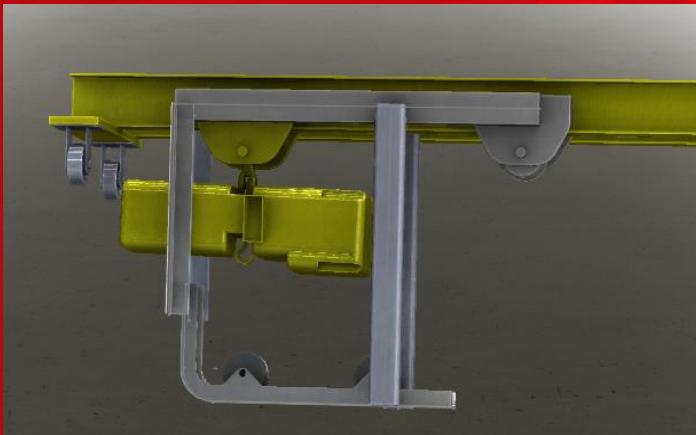
Possible Solutions



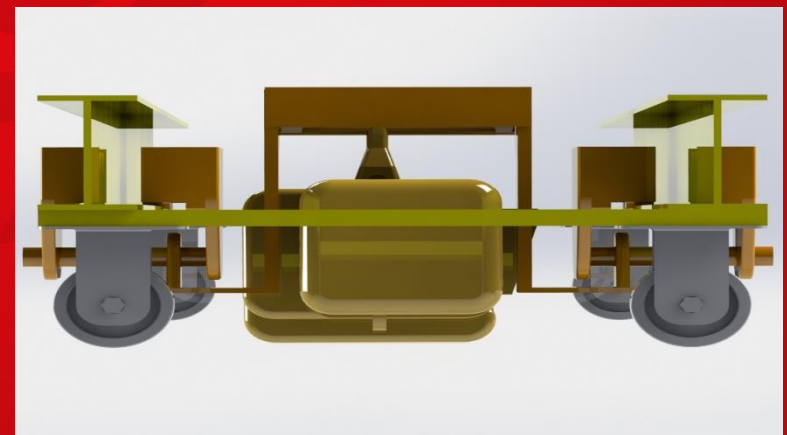
Counterweight lifting bar



Two Points of Lift with Turntable



Redirection of Lift by Pulleys



Redesigned Gantry System

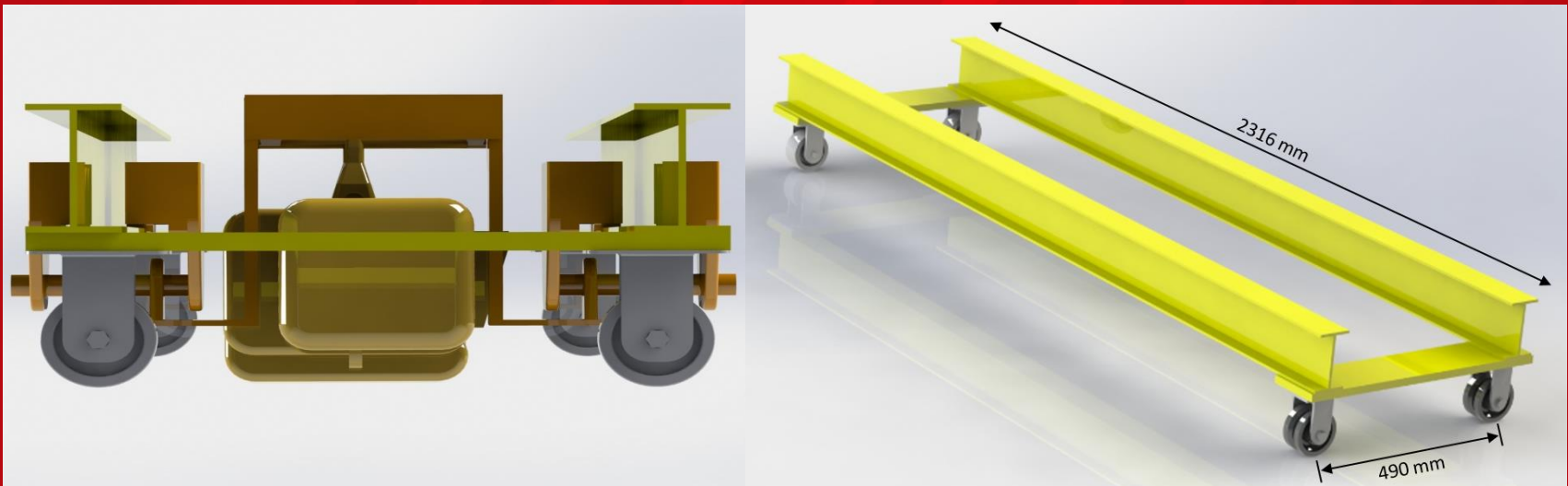
Decision Matrix

- Weighted from 1-10 (Unsatisfactory – Satisfactory)

Design	Safety (30%)	Performance (25%)	Cost (20%)	Implementation (15%)	Durability (10%)	Total
Counterweight	2	5	3	6	6	3.95
Two Points of Lift	4	6	1	3	5	3.85
Redirection of Lift	6	9	7	8	7	7.35
Redesigned Gantry	9	9	5	8	9	8.05

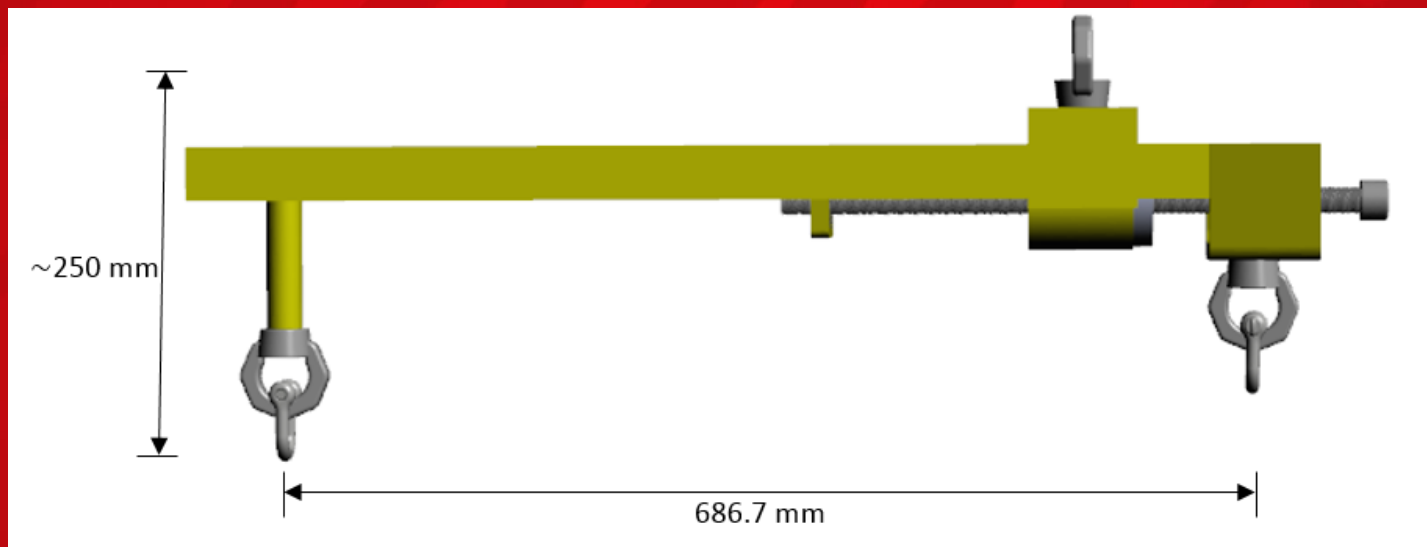
Concept Solution

- Redesign gantry with further spaced I-beams
- Designed trolley to suspend crane hoist between I-beams
- Increases available lifting height of VTT Compressor



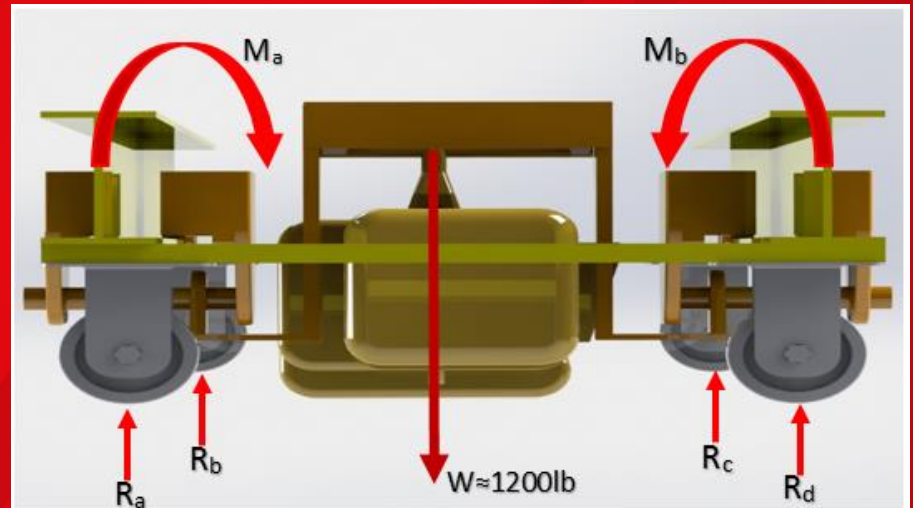
Concept Solution

- Redesigned lifting bar compliments redesigned gantry
- Power screw adjusts point of lift for variable center of gravity
- Adjustable position for lifting hooks
- Minimize vertical distance between lifting points



Potential Challenges / Risks

- Subjecting I-beams to a Moment of $\sim 1300 \text{ N}\cdot\text{m}$
- Gantry:
 - Trolley System
 - Material Strength
 - Track Alignment
 - Vertical Clearance
- Lifting Bar:
 - Moving parts concentrate points of failure
 - Material Strength
 - Bending Moments
 - Multiple Points of Lift
 - Power Screw Binding



Risk Mitigation

- Safety is paramount!
- Preliminary FMEA – Failure Mode Effects Analysis
- Complete FEM Analysis – Finite Element Method Analysis
- Prototype Field Testing
 - Dummy weight to test for structural integrity
 - Realistic center of gravity to test lifting bar design
- Full Turbocor Implementation
 - Installation of gantry system in Chiller 3 test rig
 - Lift VTT Compressor to testing position with new lifting bar

Schedule

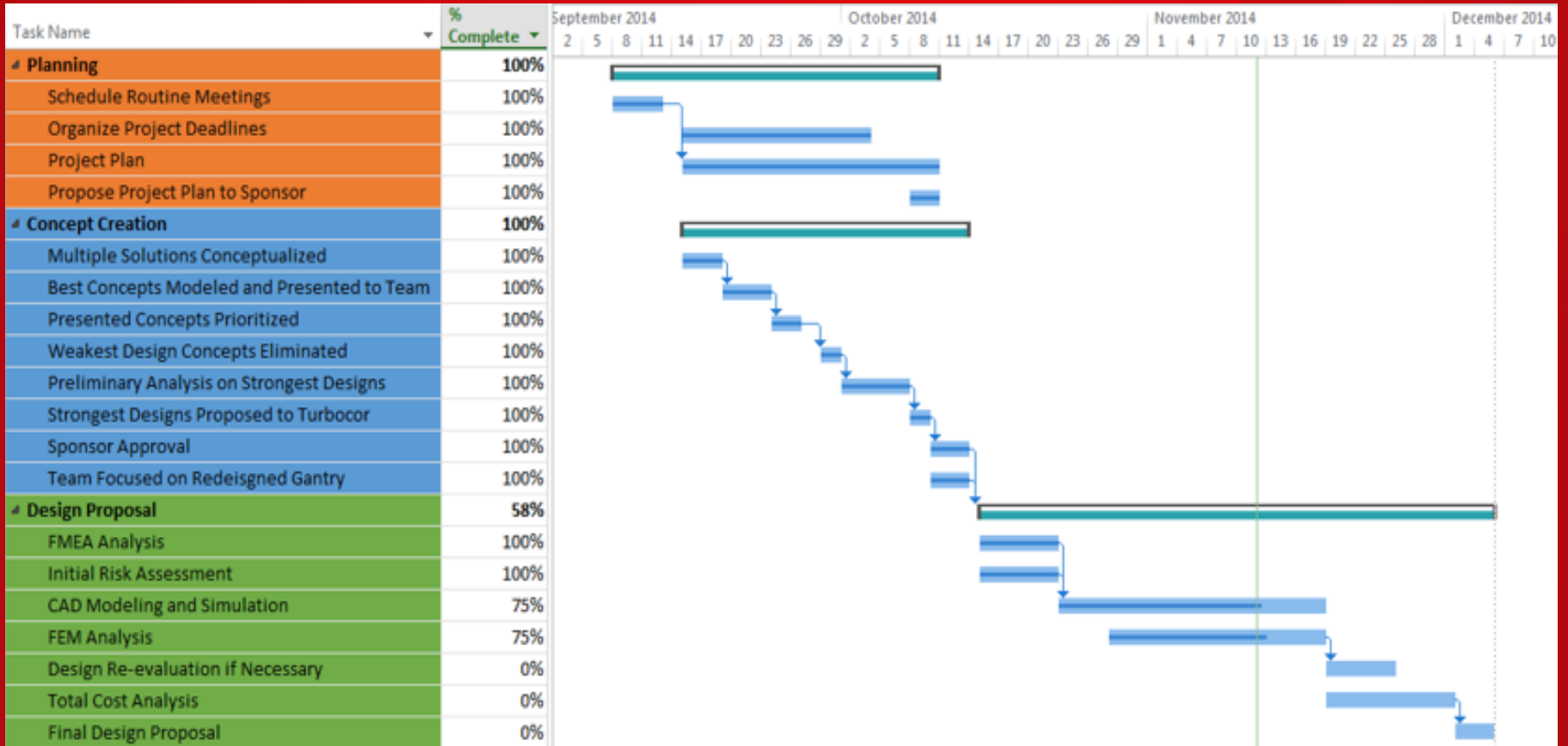
Fall 2014

- Routine meetings and project plan development
- Solution conceptualization and analysis
- Finalized model and cost analysis

Spring 2015

- Parts ordering
- Assembly & 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 will be met

Questions?

More information available online at:

http://eng.fsu.edu/me/senior_design/2015/team05