Lifting Mechanism for Flywheel Casing

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Mission

- Design a safe and efficient lifting mechanism for flywheel casings used in disassembly and maintenance.
- Prioritize operator safety, ensuring secure handling of heavy components when in close proximity.
- Focus on creating a durable, easy to use solution that meets industry safety standards.
- Present a design review to stakeholders showcasing functionality.
- Validate safety and reliability of the design using industry standard analytical tools.
- Build functional prototype and conduct testing to ensure performance meets design specifications.

Research

- Analyzed a variety of flywheel lifting solution from industry competitors, including hydraulic, electric, and manual systems, which offer unique safety features and user experiences (Baroiu, 2011).
- Identified opportunities for innovation and differentiation in response to market trends, including the use of robotic and automated systems.

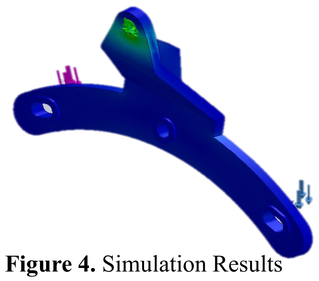
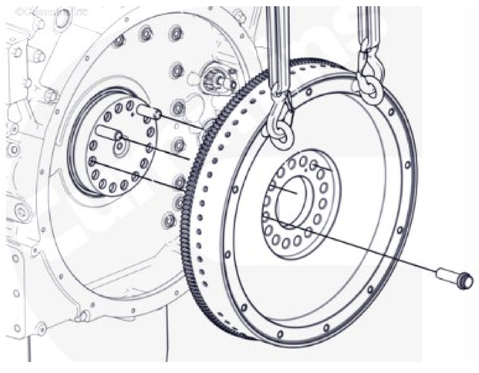


Figure 4. Simulation Results



Final Design

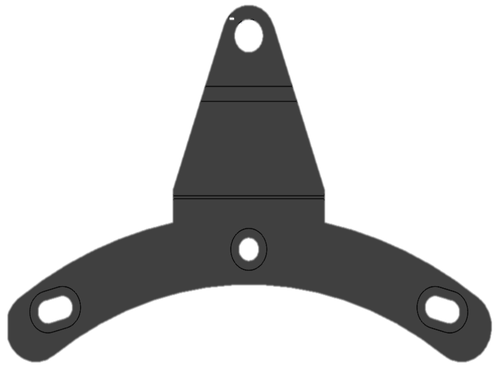


Figure 1. Front View

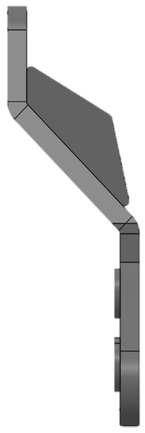


Figure 2. Side View

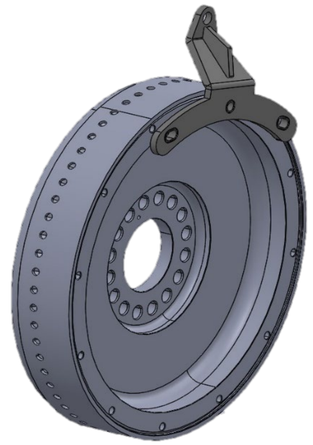


Figure 3. Assembly

Design Structure

•Dimensions: 16.45-inch length, 11-inch width, and ½-inch thickness to support the flywheel's weight.
•Material: ASTM A36 Steel Plate with a shear modulus of 79.3 GPa, modulus of elasticity of 200 GPa, and yield tensile strength of 250 MPa.

Key Design Features

•Novel Connection: A rounded surface reduces stress concentration, evenly distributes weight, and securely fastens to the flywheel.
•Welded Tab Reinforcement: A welded tab on the back of the attachment reduces stress in critical areas and enhances structural stability.
•Center of Gravity: Designed to maintain stability and prevent tilting by offsetting the flywheel's center of gravity during lifting.
•Adaptability: Longer slots accommodate various flywheel sizes.
•Compact Design: Thin and efficient design without compromising strength or stability.

Finite Element Analysis

•Findings: Optimal thickness of ½ inch, with maximum stress at the crane attachment point measured at 279 MPa.
•Simulations: Von Mises stress analysis conducted with a safety factor of 2, ensuring structural integrity under load.

Cost Breakdown

•Material costs: A 48-inch x 48-inch sheet of ½-inch ASTM A36 Steel Plate was purchased for $300. For this design, the material required is 16.45 inches x 11 inches, which is approximately 6% of the total sheet area.

Structural Integrity and Safety

The design prioritizes strength and reliability, supported by comprehensive structural analysis including deformation, normal stress, bending stress, shear stress, and failure modes. These considerations ensure the lifting mechanism meets industry standards and exceeds safety expectations.

Concept Development

Design Process:

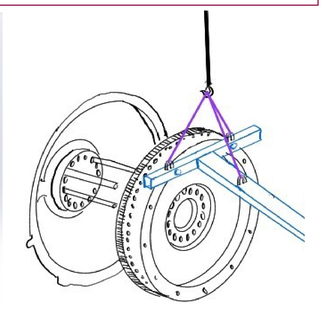
- **Concepts were generated through stakeholder feedback, design evaluations, and brainstorming sessions.**
- **Each concept was evaluated based on factors such as cost-effectiveness, simplicity, stability, and safety.**
- **Final design was selected by stakeholders.**

Design Concept Considered:

- **Counterweight Mechanism: Uses a counterweight to balance flywheel and prevent tilting.**
- **Rail-Based Vertical: Provides vertical lifting stability by guiding the lifting action along a fixed rail.**
- **Hydraulic Lift System: Ease of control and ability to handle heavy loads with precision.**

Key Design Factors:

- **Ensuring the lifting mechanism can accommodate different flywheel sizes and weights.**
- **Maintaining stability and safety during lifting operations.**
- **Addressing the center of gravity to prevent flywheel tilting.**
- **Minimize thickness and bulk of the design to ensure ease of use in tight spaces.**
- **Consider durability and lifespan of mechanism.**



References

- Baroiu, N. (2011). THE SHAPING OF SOME LIFTING AND TRANSPORTATION SYSTEMS, USING AUTODESK INVENTOR. January.
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