


Ladder Lift

Team Members: Kyle Windsor and Thomas Breitenstein





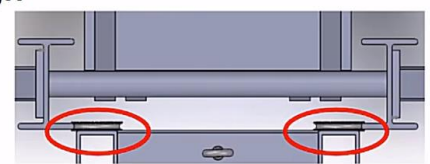
Ladder Lift

Thomas Breitenstein & Kyle Windsor




Design

- The lifting frame utilizes attached rollers that ride on the inside groove of the ladder frame for stability
- Bucket is bolted to the metal lifting frame using $\frac{1}{4}$ " size bolts
- Guard rails implemented on three sides of the bucket that are a minimum of 42 inches high to satisfy OSHA codes
- Chain on back side of the bucket area to allow for easy entry and exit from bucket while maintaining safety



Introduction

- Traditional ladder has been a crucial tool to the construction industry for many years and tends to be the most common method of ascension
- Many construction sites also utilize large industrial lifting systems such as scissor or bucket lifts which lack maneuverability and ease of use
- Construction industry is continuously evolving but minimal advancements in safety and efficiency have been made regarding the traditional ladder
- Designed ladder lift system is capable of being quickly assembled and moved easily




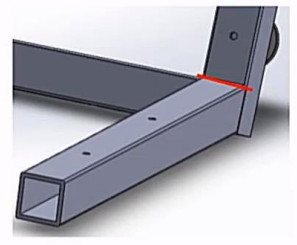
Calculations

Splice Plate Bolts

- Bolt calculations were performed for splice plate area due to it being highest area of potential failure for the ladder lift system
- Results were formulated based on a two bolt configuration
- Determined bolt material grade and size was ASTM A490 $1\frac{1}{8}$ " - 7 UNC

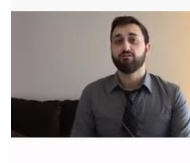

Weld Calculations

- Weld calculations were performed on the lifting frame due to it being the focal point of the load
- Calculations were performed with double the intended load in order to have a safety factor of 2
- Determined weld size and type were $\frac{5}{32}$ " fillet weld





Abstract

- Leading cause of death in construction environment is falls from great heights
- Designed ladder lifting system is able to greatly reduce the risk of falling in comparison to a traditional ladder
- Operator fatigue is lowered as there is no need to physically climb a ladder and allows for more energy to be expended on the required task



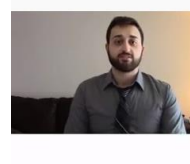
Safety

- Outriggers at the base of system to help prevent the risk of slide-out failure
- System is based on a working angle of 75 degrees to follow the OSHA standard known as "4 to 1 rule" for traditional ladders. For every 4 feet of height, the ladder system must be 1 foot from the structure.
- Implementation of guard rails surrounding the bucket area of the system that are a minimum of 42 inches in height to satisfy OSHA code 1926.502B1



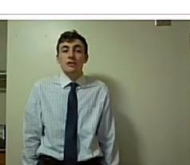

Hypothesis

- Primary goals of providing safe method of ascension while maintaining similar characteristics such as maneuverability of a traditional ladder
- Objective of ladder lift system was to have a minimum lifting capacity of 350 pounds to allow average worker, tools and other required materials to be lifted safely with no potential failure
- Operation speed that is equivalent to that of a person climbing traditional ladder to maintain efficiency



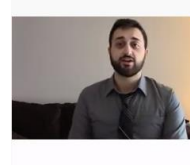
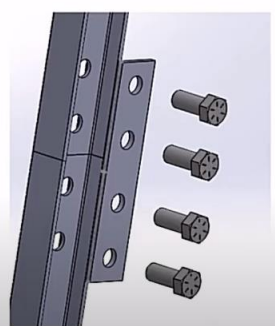
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Design

- Ladder is composed of modular sections that allow for easy setup, breakdown and storage
- Modular sections are 10 feet long and are capable of being put together using the designed splice plate attachment
- Max height of the ladder lift system is three modular sections (30 ft) to avoid failure
- The system is made primarily of 6061 aluminium do to its high weldability and strength to weight ratio.
- The parts that undergo the most stress like top plate and splice plate are made of 1045 carbon steel



Conclusions/Recommendations

- Primary goal of research/design phase achieved as a system that combines the characteristics of both a traditional ladder and scissor lift was developed
- Design limited due to the cost and size constraints that were put in place to make the system affordable and minimize space that it would occupy
- Development of a second edition of the system that is larger and includes the separate platform to lift a bulk amount of large materials