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MAE 157 Project Proposal

Introduction

Lightweight structures are meant to maximize their strengths as materials based on criterion such as stress, deflection, and stiffness. The motivation behind this project is that most heavy duty car jacks that are able to lift trucks are large and unwieldy, requiring to be wheeled around on rollers and not normally able to be casually stored in smaller vehicles. Scissor jacks are common in most cars, but rare to find in larger trucks. These conflicting factors prompted us to create a lightweight structure that can be analyzed and designed to minimize the total mass. For the structural designing process of the scissor jack we will utilize material learned throughout the course to ensure that our scissor jack is lightweight, portable, easy to use, and most importantly will ensure convenience for unconventional vehicles, such as trucks. It is crucial to make sure that the scissor jack has the security and dependency needed. It will be accomplished in our design process, which will adhere to solving common flaws such as problems with reliability and control with heavier vehicles.

Project Objectives

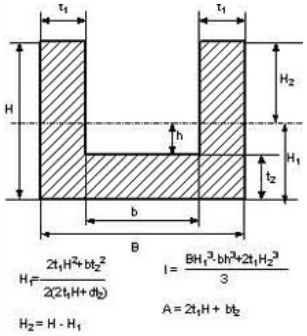
The goal for this project is to design a scissor car jack with the lowest possible mass in order for functionality and ease of portability while also being able to lift 1/4th of any retail vehicle (as you'd need 4 contact points to lift the entire vehicle off the ground), with a mid-size truck being the largest.

Proposed Approach

We will be using the methods of analyzing beams and bars for this analysis, and validating using FEA software.

Structural Analysis

- We will be performing our analysis on a structure that resembles this lift using beams of this cross section:



- Analysis will be done at both full extension and full retraction of the beam.
- The beam will be made of steel, and the ends will be simulated as pins.
- Beam will have uniform thickness, and thus a fixed cross sectional area throughout the beam.

Failure Criteria

- Analysis will be done with ¼ the mass of the average mid-size truck as the loading force.
- We will be analyzing the failure criteria of the beams via the yield criterion, buckling criterion, deflection criterion, and stiffness criterion.

Design for minimum mass

- From these failure criteria find the minimum dimensions of cross sectional area, as well as the minimum length in order to meet the desired requirements
- Using the minimum length and cross sectional area of each beam, calculate the minimum mass of the lift

List of tasks

- Finding the minimum dimensions for each of the yield criterion (Curtis, Denesse, Allison)
- Using those dimensions to calculate the minimum mass of the scissor lift (Curtis, Denesse, Allison)
- Make a model in solidworks using these dimensions (Curtis)
- Validate the these results using Solidworks simulation (Matthieu)