

Concept Transporters: Lift Gate Redesign

Mechanical Engineering

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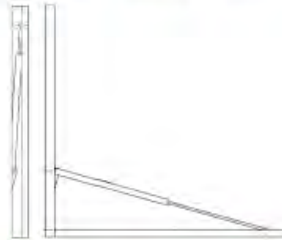
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Abstract

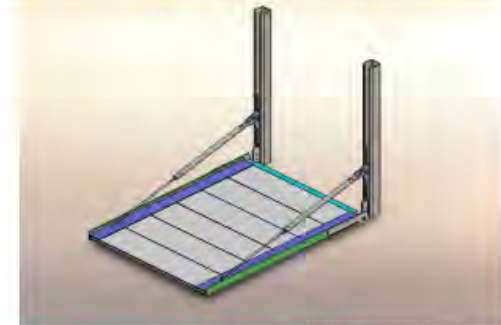
The objective of this project is to re-design and fabricate a lift gate system for Concept Transporters. The current lift gate systems in use take approximately 250 hours of manual labor for fabrication, and the cost of materials used is around \$10,000 to \$12,000. The combination of these two factors total the cost of the final completed liftgate at \$30,000. The goal of this project is to design, and fabricate a liftgate system that costs less than \$30,000 that is also easier to assemble, scalable for various mounting applications, and has lower allowance for user error. For the purpose of this project, a proof of concept was built approximately 1/3 of the size to simulate the full scale assembly.

Tilting Pneumatic Motion

- Linear motion
- Double-acting round body pneumatic cylinder



Solidworks Design



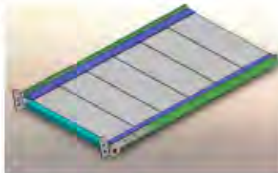
Platform

Full Scale Design

- Custom platform aluminum extrusions
- Weight capacity of 10,000 lbs.
- Weight of approximately 800 lbs.

Proof of Concept

- Formed platform load surface
- Weight capacity of 150 lbs.
- Weight of approx. 50 lbs.



Matlab Calculation

- Factor of Safety of 2
- Operating air pressure of 100 psi

Tilting Cylinder

- Force capacity per cylinder of 107 lbs.
- Force required per cylinder of 99 lbs.
- Actuating stroke of 14 inches.

Vertical Cylinder

- Force capacity per cylinder of 120 lbs.
- Force required per cylinder of 90 lbs.
- Actuating stroke of 18 inches.

Procurement

Pneumatic cylinders and Clevises

- McMaster-Carr

Platform

- Aluminum Angle
- Aluminum Extrusions
- Aluminum Flat Bar
- Steel Round Stock
- DOM Tubing
- Steel Flat Bar
- Steel Tubing
- UHMW

Vertical Pneumatic Motion

Full Scale Design

- Custom hydraulic cylinders
- 110" stroke length
- UHMW slide tubes to prevent friction
- 5,000 lb. weight capacity per cylinder
- 1000 PSI

Proof of Concept

- Standard pneumatic cylinders
- 18" stroke length
- UHMW slide tubes
- 120 lb. weight capacity per cylinder
- 100 PSI

Geometry

- Full scale model scaled down approximately 1/3 of original design
- Angle between lift gate and tilting cylinder consistent between builds
- Approximate tilting cylinder size calculated
- All other components sized accordingly
- Hydraulic cylinders changed to pneumatic double acting cylinders
- Standard parts used to lower lead times

Fabrication

As one of the major criteria for this project was a reduction in fabrication labor, aluminum extrusions will be bolted to one another to create the platform load surface. This load surface is sandwiched between another load carrying extrusion and welded together. A carrying tube is then welded to the platform through which the steel pivot rod is run. This pivot rod is then supported by steel greasable pivot tubes welded to the steel slide tubes. The inner slide tube is resting on UHMW inside the outer slide tube. The tilting cylinders are mounted to a bracket welded to the platform, and a bracket welded to the inner slide tube. The vertical motion cylinders are mounted inside the inner slide tube and bolted to the outer slide tube for actuation. All cylinders are hydraulic and powered by a 220V power unit.

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