A WEIGHT-SAVING SIMULATION

Presented by:

INTEGRIS ENGINEERING

EXECUTIVE SUMMARY

On over the road trailers there exists a need for lightweight, robust and durable equipment. Our engineers were recently tasked with removing weight from an Adjustable F-Post style rack that was designed to lengths of various materials of various weights. The reason was the workers compensation claims related to manually handling the excessive weight of the current design~100lbs and were looking to remove extra weight while maintaining structural integrity. Truck drivers are responsible for the installation and removal of the racking throughout their route, so any weight reduction would promote a reduction in workers comp claims. We chose to use simulation in order to determine the proper material properties and specifications rather than the old method of build and weigh, rinse and repeat until a solution is found.

The existing design and parts had been inherited, and therefore design history and weight capacities were unknown and no best practices were in place. All we knew was that the existing design did not have known fatigue failure or other design flaws. It was simply too heavy for their needs.

INTEGRIS engineers had set out to develop these load capacities from industry standards and white paper references. From these references for maximum loads and engineering calculations, our team determined the acceptable loading on the existing design within day to day operation guidelines.

Our team also took these loads and weight reduction goals back to the design board to determine what could be done to meet all the criteria without increase in cost. A reduction in tube wall thickness provided our weight reduction goals without any other design changes. To validate that the new lighter design, our team utilized a combination of closed-form calculations, finite element simulation, and material investigation. Our engineering calculations and simulation showed us that we could use the thinner tube with a slight reduction in load height if the material strength is increased to a higher grade, but common steel grade. This proved to be a cost neutral material change, generating a net savings from the reduced wall thickness, and greatly simplifying the overall engineering process and reducing time required. This also guaranteed that all components remained interchangeable. This is a huge advantage in a large fleet operation, as all the trailers will be able to use both old and new components.

OUR RESULTS

- 25% Weight Reduction
- 10% Cost Reduction
- No change in Strength, Life or Durability
- 0% Failure Rate

CHALLENGES

- Lack of availability of industry standards for design strength and fatigue criteria. It appears as though most manufacturers function on rules of thumb or proprietary engineering criteria.

- FMCSA provides some requirements for strapping strength, but this does not cover all modes of operation and acceleration, and does not differentiate on fatigue/working loading, only ultimate strength of the strapping provision.

- All design changes were to be simple, straight forward thickness changes, dimensional changes, and material changes if necessary, supporting no net cost increase, and simple manufacturability

- Durability – maintain based on existing design, the existing design was near yield in several locations with our strength based loading, which drove our design.

FUTURE PLANS

Further opportunities exist to reduce the weight of the removable and adjustable arms. At this time, the design is limited by one feature which could easily be changed allowing for the use of thinner plates, tube, and smaller welds, reducing both weight and cost.