Sportsmobile West – Ford Transit RB "Pop-top"

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Abstract

Sportsmobile has been in the business of creating vans with integrated "pop-top" roofs for many years. Ford recently came out with a new "Transit" body style to replace the E-Series vans Sportsmobile had been making. Because the body style changed, a new "Pop-top" assembly had to be designed. The team was assigned the take of designing a Pop-top assembly for the new Ford Transit RB van.

The requirements for the new Pop-top assembly were as follows:

- Must be able to raise a load of at least 150 lbs
- Must be able to support a load of at least 600 lbs when in lowered position.
- Must be able to support 300 lbs on the rail assembly while the top is in the raised position.
- Limit power consumption.

* All weights are in addition to the weight of the fiberglass top, canvas sides, and other necessary hardware

Concept

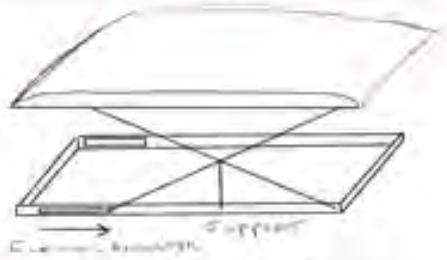

Figure 1 - Initial Concept Drawing

The team originally came up with 5 different concepts. The concept chosen was based on a scissor lift. The rail assembly is made of sheet metal, and the assembly is powered by two electric linear actuators.

Design

Figure 2 -Solidworks Model Design

FEA Analysis

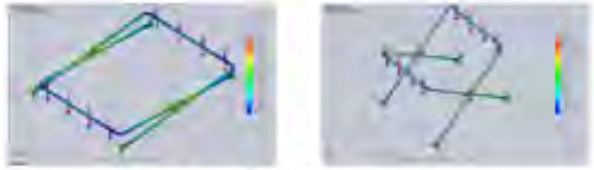

Figure 3 - Open and Closed FEA

600 lb Load on Tubes-Closed
Factor of Safety: **1.31**
Max Stress: **69ksi**
Max Displacement: **2.8 in**

265 lb Load on Tubes-Open
Factor of Safety: **3.57**
Max Stress: **25ksi**
Max Displacement: **1.02 in**

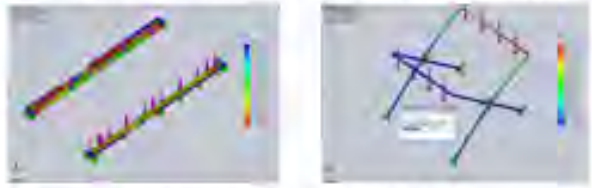

Figure 4 -Load Placed on Rails and Buckling

600 lb Load on Rails
Factor of Safety: **2.80**
Max Stress: **31ksi**
Max Displacement: **0.07 in**

Buckling Study-Open 265 lbs
Factor of Safety: **21.601**

The lowest resulting Factor of Safety for the critical components was 1.31 with the 600 lb load on the tubes. However, realistically in this case, the fiberglass top will be resting on the frame of the van, reducing the stress on the tubes. Because the testing showed it would not fail in this worst case scenario, the design was approved.

Testing

Figure 5 -Completed Assembly

Figure 6 - Static Load Testing (600lb load)

Figures 7 & 8 - Deflection Testing

Testing took place at the Sportsmobile West Facility in Fresno. The testing procedure was to start with no additional weight and increase the load after each successful test until static closed, static open, and lifting requirements were met. The assembly was tested with a maximum of 600 lbs (the max weight the design was required to handle in the closed position), where it not only passed the static load test, but also was able to lift the load without excessive deflection or failure. After load testing, the team conducted fatigue and deflection studies to ensure the assembly would last over time. The teams design met or exceeded all initial design requirements.

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