Zombie Apocalypse Escape Camper (ZAEC)

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Mission/SOW

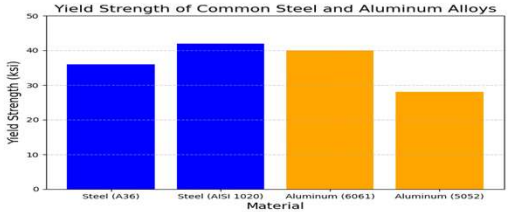
The mission of the ZAEC team is to design an over-cab camper shell exterior that can withstand the conditions of a "zombie apocalypse". Those conditions are described as follows:

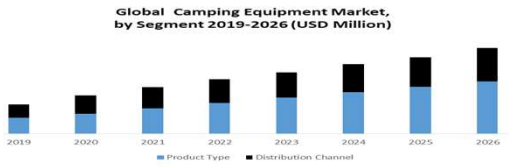
- Experience no deformation when enduring vibrations from uneven roads (approx. 5-30 Hz)
- Have a total gross weight below 1800 lbs
- Limit the drag coefficient to a maximum of 0.8
- Withstand 200 lbs. of outside force with deformation less than 1/16 in

The ZAEC team strived to work collaboratively and efficiently to meet and exceed expectations.

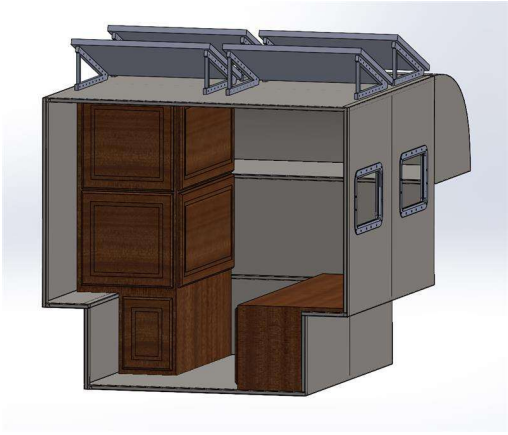
Research

- There is a clear correlation between consumer interest in traditional camping and the demand for solutions that can provide sanctuary during extreme emergencies.
- Galvanic corrosion must be considered when pairing aluminum (0.79) and stainless steel (0.08) due to their significantly different anodic indices.
- Steel/Aluminum construction has cost, durability, and strength benefits. A steel frame with yield strength (53ksi) compared to that of aluminum (40ksi) allows for high strength, while aluminum panels will lower weight.
- 1/8-inch zinc-plated rivets is optimal for the given sheet metal gauge, offering mild corrosion resistance along with a shear strength of 260 lbs. and a tensile strength of 310 lbs.





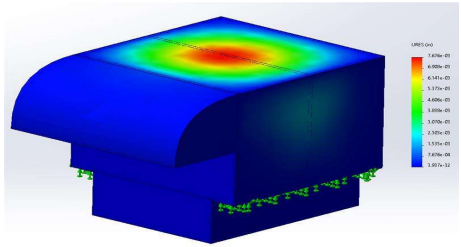
Final Design



- The final design ensures survival, storage, and comfort while addressing all critical factors.
- The shown design balances practicality, durability, and comfort for survival scenarios or off-the-grid outdoor use.
- The camper incorporates a reinforced aluminum frame with a durable shell for strength and longevity.
- The camper is optimized to manage loads, wind resistance, and other forces effectively.
- The design allows for future upgrades or feature integrations for versatility.
- Compact dimensions maximize aerodynamic performance while maintaining adequate usable space.

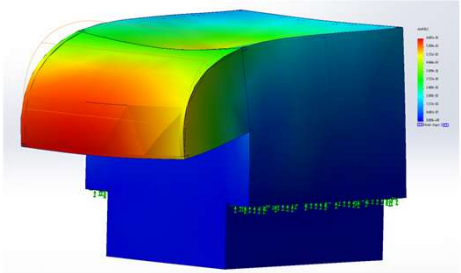
Static Testing

- A 200 lb. static load was applied to the top of the camper to assess its structural integrity.
- The resulting deformation measured 0.00767 in, which is significantly below our target threshold of 1/16 in.
- This confirms that the design ensures stability and durability under expected conditions.



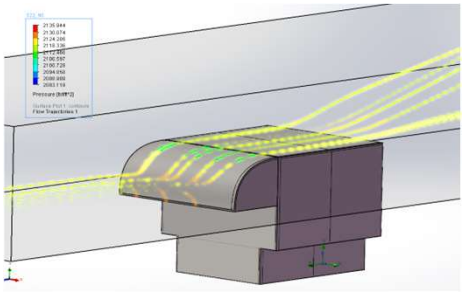
Frequency Analysis

- It is crucial to avoid operating at the natural frequencies, as resonance can cause excessive vibrations and discomfort.
- The lowest frequency the camper will encounter during operation is 42 Hz.
- 42 Hz falls outside the undesired range of natural frequencies, the camper's design ensures a smoother and more stable ride.



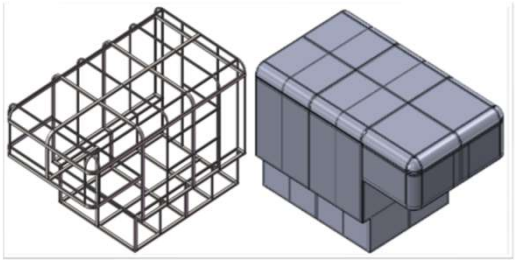
Aerodynamics Testing

- A flow simulation was designed and executed in SolidWorks as a wind tunnel.
- The drag force coefficient was calculated and found to be at a maximum of 0.276.

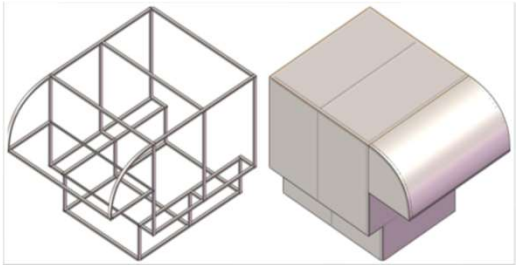


Concept Development

- Before any "apocalypse survival" functionalities, it was imperative to engineer a high-strength, reinforced chassis capable of withstanding dynamic loads and environmental stressors.
- This approach ensures optimal structural integrity, load distribution, and modular adaptability for subsequent feature integration.



- The initial design for the camper shell is shown above.
- The left figure is the frame, while the right figure is the frame covered in a steel shell.
- The shell was redesigned based on the results of SolidWorks simulations (wind tunnel testing, vibrational analysis, static load testing).



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