# Carbon Fiber Monocoque Chassis Redesign

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## Abstract

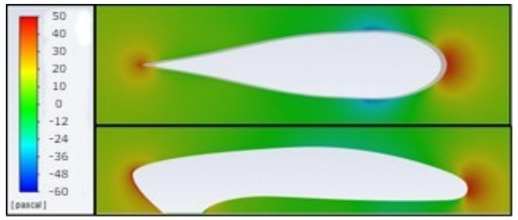
- Increased desire for lowering carbon emissions caused by automotive OEMs to increase fuel efficiency of their vehicles.
- NIU Supermileage focuses on developing a prototype vehicle to compete for fuel efficiency.
- The project goal was to develop a carbon-fiber monocoque vehicle to achieve 2000 mpg.
- The car's aerodynamics and weight were optimized through CAD and ANSYS CFD simulation.
- The fabrication consists of vacuum infusing carbon fiber layers in negative high-density foam molds to then embed a Nomex honeycomb panel for structural support, resulting in a rigid monocoque chassis.

## Introduction

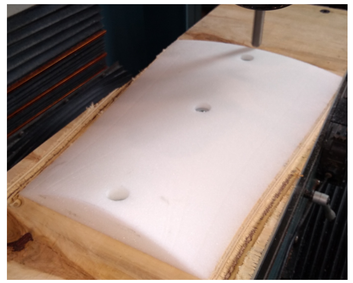
- NIU Supermileage has been around for 11 years and still employs the the original vehicle design with an aluminum frame and carbon fiber shell.
- Although the vehicle is highly successful, the goal was to develop a monocoque chassis that will increase efficiency through weight and geometry optimization.
- The redesign spanned a wide range of mechanical engineering foci including CAD, parametric design studies using computational fluid dynamics and finite element analysis, and design for intricate yet feasible mold fabrication.
- The new vehicle design maintains compatibility with Supermileage subsystems in addition to decreasing the coefficient of drag, minimizing weight, increasing driver visibility, and maintaining a high degree of safety.

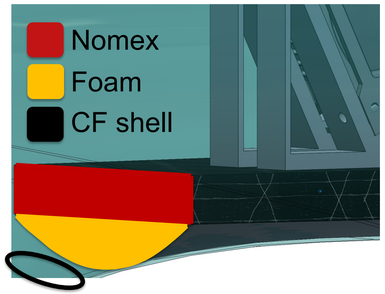
## Methods and Materials

Design optimization took place through ANSYS Fluent CFD simulations.



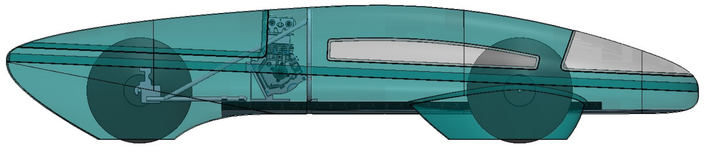

The vehicle will be fabricated using a vacuum infusion method. The layup will consist of carbon fiber twill weave, soric matrix, foam & Nomex honeycomb.






## Results

CAD of the designed carbon fiber monocoque chassis.



**15%** frontal area reduction; **3%** side area reduction
**28%** body weight reduction; **11%** total wt reduction

## Discussion

- Molds are still being fabricated by Navistar
- Team has developed all subsystems for once the vehicle is fabricated.
- The team has created a vehicle that is highly modular in that new components may be added easily, and complete subassemblies can be redesigned without a problem. To accomplish this before, the old frame would have to be completely redesigned and fabricated, but that is no longer a problem.

## Conclusions

- Increased fuel efficiency through weight reduction and aerodynamic optimization.
- Original body weighed 36 lbs, and the new chassis will weigh about 26 lbs (**~28%** body weight reduction)
- Significant improvement considering the previous total vehicle weighed 95 lbs (**~11%** total wt reduction)
- **20%** better turning radius (32 ft to 24 ft)
- New vehicle will lay the groundwork for years of even more success at competition.

## Acknowledgements

- Dr. Pohlman and Dr. Schroeder for their constant support.
- Mash Angolkar and Mitchel O'Day for securing monetary and in-kind support at Navistar.
- Jaimi Smith for his time and design expertise to allow for mold fabrication of the vehicle at Navistar.
- Chris Sorich, Bill Popek , and others for mold fabrication at Navistar.
- Mike Reynolds, Jeremy Peters, and Greg Kleinprinz for their support in the NIU Machine Shop.
- Joey Cross, Thomas Corbett, and Josh Helsper for additional support in archived Supermileage information and CFD support.