



Formula Sun: Solar Car Aeroshell



Project Description

Problem: To increase their performance and competitive edge in the American Solar Challenger (ASC), the Aggie Solar Racing Team needs a new aeroshell that is an improvement over the previous shell design, Astra 2020.

ASC Constraints:

- >4 m² solar panel space
- Must not exceed 5 m x 2.2 m x 1.6 m in size
- Allows greater than 100 mm of ground clearance
- Allows 100 degrees of driver visibility
- Windshield has an impact strength greater than or equal to 30 kJ/m²
- Canopy must be positively latched

Functional Requirements:

- Decrease drag force experienced by car
- Excess top area for optimal solar panel placement
- Minimize weight
- Fit current chassis design
- Easy to construct

Performance Review

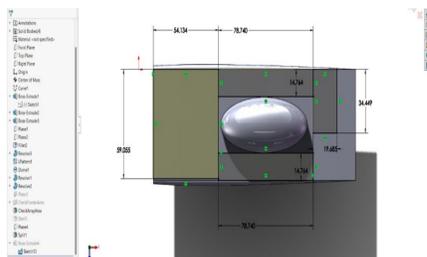


Fig. 3 Solar Panel Inspection

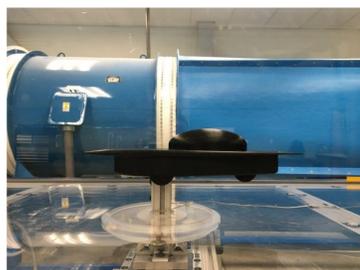


Fig. 4 Wind Tunnel Testing

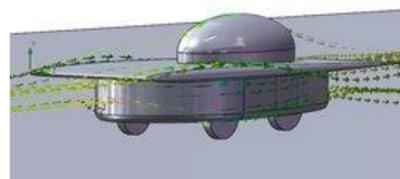


Fig. 5 CFD Simulation

Requirement/Constraint	Target	Threshold	Predicted Performance	Actual Performance
Solar Panel Surface Area	5 m ²	4 m ²	5 m ²	5.4 m ²
Reduced CdA	0.2377	0.2641	0.2377	0.2308
Minimal Weight	69 lb	70 lb	60 lb	66.2 lb
Compliant with ASC Regulations				
• Sizing requirements	5.0 m L x 2.2 m W x 1.6 m H		5.0 m L x 2.2 m W x 1.6 m H	4.6 m L x 1.6 m W x 1.3 m H
• Ground Clearance	> 100 mm		100 mm	197 mm
Manufacturable				
• Manufacturing takes a minimal amount of time	85 working days	150 working days	85 working days	150+ working days
• Smooth Finish	16 μin	32 μin	16 μin	16 μin

Design Description

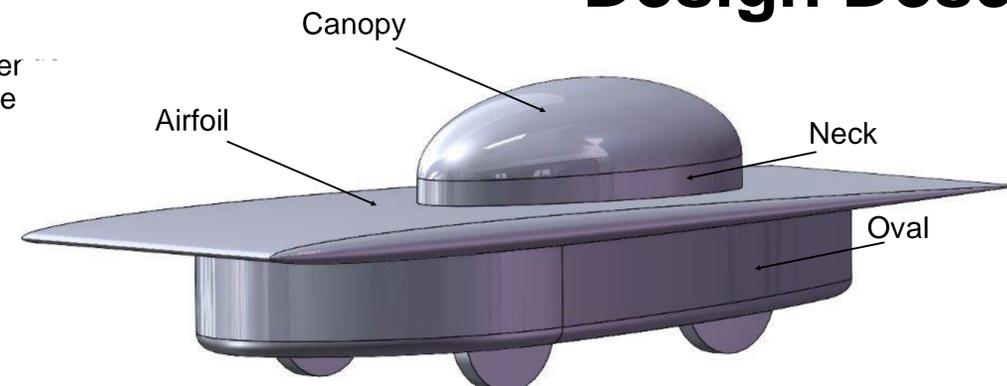


Fig. 1 James Bond Design

The aeroshell design features four major sub-assemblies: the canopy, the collar, the airfoil, and the oval (see Fig. 1).

Additionally, to improve aerodynamics and manufacturability, the aeroshell is constructed from pre-preg carbon fiber composite panels. The panels are joined together to form the aeroshell as shown in Fig. 2.



Fig. 2 Aeroshell Composite Panels

Conclusion

Requirements/Constraints Fulfillment

- The aeroshell design meets all requirements and constraints as outlined in the performance review with exception to being manufacturable within Spring semester.

Lessons Learned

- Start the build process earlier
- Plan for when things go wrong
- Presenting the Aggie Solar Team with a finished, functional product is more important than a complicated design

Recommended Future Work

- Formula Sun recommends the Aggie Solar Racing Team finish putting the aeroshell together using the constructed composite panels and build plan.



Fig. 6 Autoclave Composite Curing



Fig. 7 Assembled Aeroshell Bottom