FORMULA TECHNION 2016

Aerodynamics Team

Product Design Course #035353-034354

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Client: Prof Reuven Katz

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Abstract

The **Formula SAE** challenges university students to design and manufacture and race a marketable racing car. The Technion Team consists of several subgroups who, together, designed and built this vehicle.

The **Aerodynamics Team** conducted comprehensive research of the undertray and wings of the car for preliminary modeling. Original design, manufacturability, maintenance and system integration were essential considerations of the design.

Project Objective and Requirements

This years main requirements are to provide the vehicle with a reliable, robust and easy integration aerodynamic envelope.

In addition the team is required to reduce the total weight of the aerodynamic elements while maintaining high performance, a high downforce to drag ratio.

Product Description

The aerodynamic envelope consists of three major components:

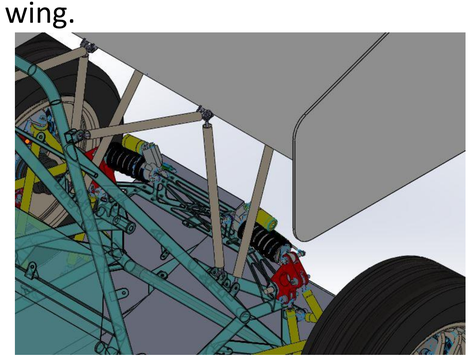
Front Wing: Creates downforce on the front section of the vehicle, thus preventing understeer while turning at high loads. The endplates of the Front & Back wing consist of layers of carbon fibers reinforced with closed form cell (divinycell) between them.

The airfoils consist of layers of carbon fibers, filled with polyurethane.

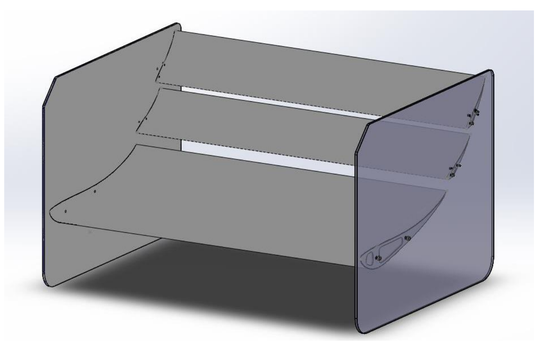
Steel bracket to mount the front wing

Front wing assembled on vehicle

Back Wing: Similar to the front wing, the back wing is located at the rear of the vehicle, creating downforce on the back wheels reducing oversteer and balancing the front wing.



Brackets for back wing

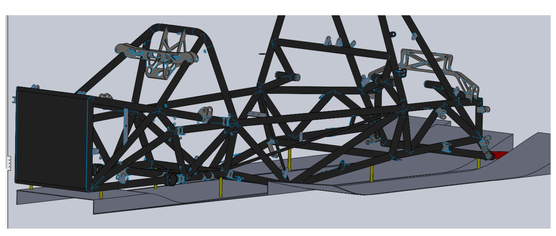


Back wing (CAD model)

Undertray: Covers the entire underbody of the car. The undertray has an excellent Lift to drag ratio, producing high downforce with hardly no drag.

Furthermore, the Undertray is used as the underside of the vehicle protecting it from debris and preventing any leaks from the car to the ground.

The undertray consists of layers of carbon fibers reinforced with divinycell between them.



Undertray with chassis (CAD model)

Undertray, Final product –Carbon With divinycell

Final Product

The entire aerodynamic envelope operates as a single unit, providing balanced down force throughout the vehicle, allowing the drivers to preform extreme maneuvers without loosing traction, grip and speed during the different heats of the competition.

Analysis and Validation

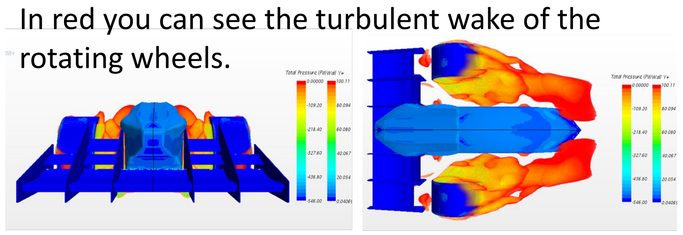
Flow and Strength Analysis

During the design process, CFD analysis was performed using Star CCM+ to determine the aerodynamic properties. Simplified FEA strength analysis were performed, and the final material configuration was chosen with the aid of professional engineers from the industry.

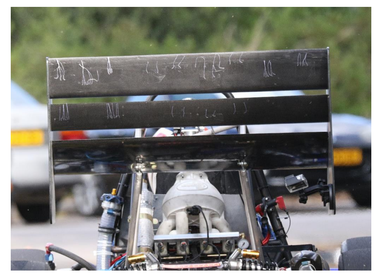
CFD flow Analysis for the wings and undertray was used to optimize geometry and integration.

CFD Flow Vizualization of flow behind front-wing with rotating wheels

In red you can see the turbulent wake of the rotating wheels.

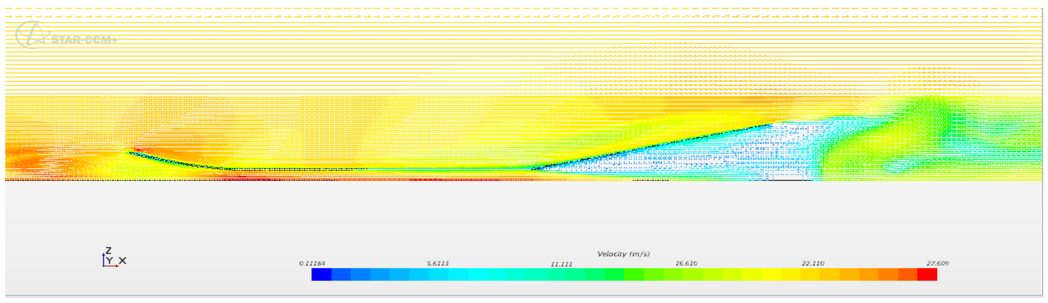


Tufts test- to determine proper linear flow



CFD Flow Visualization of flow through the Undertray

In the image below you can see the acceleration of air flow through the Undertray and that there are no flow separations – Optimal for the undertray's output.



Final Products

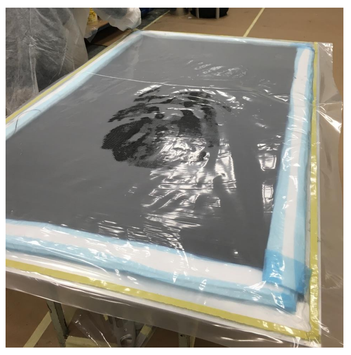
Inserts - Aluminum

Undertray Mold - Styrofoam

An airfoil filled with Polyurethane, for additional stiffness

Full carbon airfoil filled with Polyurethane – With aluminum inserts

Aerodynamic elements prior to final assembly



Vacuuming- Part of the composite material process

Acknowledgements

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