Technion FSAE Racing

Aerodynamics and Body Team

Original Product Design Course# 034353/4

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Abstract

The **FormulaSAE** teaches university students to design and manufacture a marketable vehicle for racing. The Technion Formula consists of 7 subgroups who, together, designed and built this vehicle.

The **Aerodynamics and Body Team** of the Technion Formula conducted comprehensive research of the outer body, undertray and seat of the car for preliminary modeling. Original design, manufacturability, maintenance, ergonomics and system integration were essential elements in design. A final design was produced and manufactured.

Project Objective and Requirements

The **Technion Formula Teams'** objective is to design, manufacture, market and race a vehicle according to the Formula SAE guidelines.

The **Aerodynamics and Body Team's** objective is to design and manufacture exclusive outer body and undertray and ergonomic seat. The body has to be aerodynamically efficient for the car and integrate with all the vehicle components.

Product Description

Basic requirements

Two types of requirements determine the basic form and dimensions of the body and driver's seat: Requirements set by the FSAE Regulations 2013, and others set by the FSAE Technion Team and advisors. Some typical requirements:

FSAE Regulations:

- The 95th percentile male template has be entered to the car.
- Sharp edges on the forward facing bodywork or other protruding components are prohibited.
- All wing edges including wings, end plates, Gurney flaps, wicker bills and undertray that could contact a pedestrian must have a minimum radius of 1.5 mm

Technion FSAE Team's Requirements:

- Best aerodynamic performance.
- Eye catching and original design of the body
- Total weight of the body shouldn't exceed 12kg.
- Assembly and dismantling of the body's parts might be easy and quick as possible.

To create a product answering all the requirements the following steps were taken:

- Consulting with specialists in following fields: aerodynamics and design of cars; composite materials; tool production; etc.
- Consultation with veteran groups in FSAE racing.
- Several design concepts were created.
- Several experiments to determine material strength and strain.
- The body was divided into several segments to facilitate manufacture and then joined together with structural adhesive (see Figure 1).

Figure 1: Segmentation and joining of the body parts

Figure 2: final model

Analysis and Production

During the design process, calculations of the aerodynamic properties of the body were performed. Simplified CFD and FEA strength analysis were performed with SolidWorks tools, and the final material configuration was chosen with the aid of professional engineers from industry.

Flow and Strength Analysis

A Flow Analysis of the body and undertray was performed (see Figure 3). The results were used to optimize sizes and weights of variuos parts.

Using the dynamic forces of the vehicle and body parameters of the various team drivers to determine pressures exerted on the seat, FEA analyses were performed, and the shape and thickness of the seat was fixed accordingly (see Figure 4).

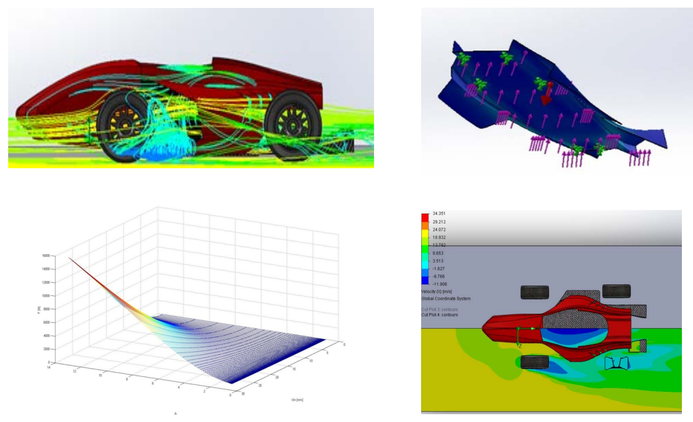

Figure 3: Flow analysis of body and undertray.

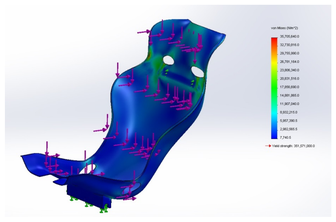

Figure 4: Strength and pressure analysis of the seat.

Tools and body manufacture

Carbon fiber was used to manufacture all of the team products. The production process involved the following steps: 3D modeling of the tools for the final product; machining and joining molds & tools made from MDF (see Figure 5), shaping with a CNC machine; finishing and polishing the tools (see Figure 6); layup and vacuum bagging of the carbon fiber (see Figure 7); and painting for final color.

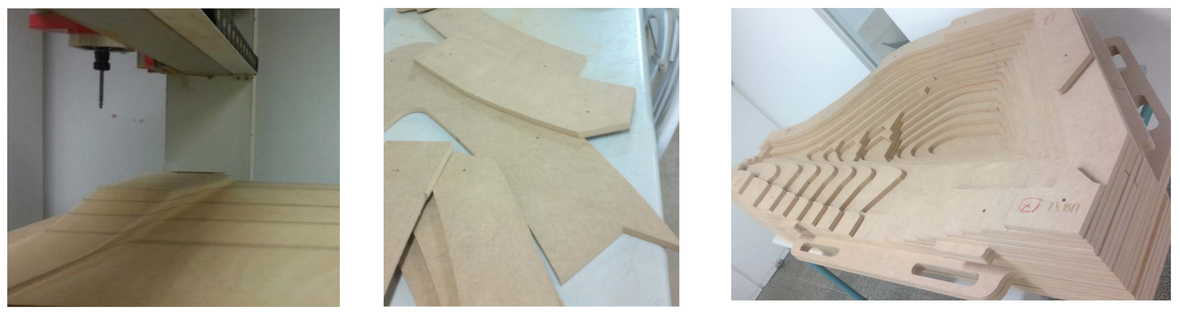

Figure 5: Machining & joining mold parts for the body

Figure 6: CNC shaping finishing and polishing

Figure 7: Layup and vacuum bagging the carbon fiber

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