Behind every successful racecar driver is a supportive seat, a well thought out steering wheel, and a carefully designed, light weight vehicle. The objective of the Composite Materials Team is to design and construct all of the parts made from carbon fiber composite materials for the Formula Technion racecar. Specifically, the Composite Materials Team will design, fabricate, and manufacture the seat, steering wheel, and body of the Formula Technion Student car in compliance with the Formula SAE regulations of 2015.

Consideration is to be given to ergonomics, functionality, and conclusions derived from the 2014 and 2013 Formula Technion racecars. The structure and capabilities of the materials will be examined to provide optimal strength while maintaining a minimal weight.

Driver’s Seat:
- The vehicle must accommodate drivers whose statures range from 5th percentile female to 95th percentile male and must satisfy the requirements of the Formula SAE Rules.
- The bottom of the seat can not extend beyond the lowest part of the chassis.
- Ergonomic principles must be considered.

Steering Wheel:
- The steering wheel must be attached to the steering column with a quick release mechanism.
- There must be a continuous perimeter that is near circular or near oval with no concave sections.

Car Body:
- Molds and fabrication by hand layup are to be prepared by the Composite Materials Team.
- The body will be attached without a need for tools.

Analysis of strength and deformation was completed on Hyperworks and or Solidworks. Each carbon part must also be evaluated in comparison to AISI SAE 1010 steel. The team used carbon fiber along with an epoxy resin matrix. When paired together they create an exceptionally strong material that remains very light-weight.

Driver’s Seat:
- The stacking sequence optimization of each laminate was evaluated with Hyperworks according to two specific load cases.
  - Lay-Up [0/-45/45-90/-45/45/0] (Symmetric - Midlayer).
  - The structure must accommodate the specific dimensions of each driver and bear their weight and additional forces.

Steering Wheel:
- Together with the Mechatronics Team a functional information panel for the driver was integrated into the front of the steering wheel. Important data such as the engine and oil temperatures and the RPM are displayed. A launch engine and PTT system were incorporated along with a more sophisticated method for changing gears.
  - Dimensions of the steering wheel are derived from ergonomic research and measurements of the driver’s arms.
  - Torque and the various forces applied were analyzed in Solidworks.

Car Body:
- The design of the car was created by the Design and Aerodynamics Teams. The Composite Materials Team analyzed and refined their designs in consideration of engineering and manufacturing principles. Each part has a different optimal lay-up ply optimization.

Achievements
- The seat weighs a mere 1.5 kg, over 20% less than 2014.
- Ergonomic principles are incorporated enhancing driver performance.

Steering Wheel:
- Dramatic weight reduction in comparison to the store bought steering wheel used in 2014.
- Drivers can easily see vital information in real time without removing their eyes from the track.

Car Body:
- Significant reduction in weight of all body parts.
- The body can be attached without tools.

Manufacturing Process and Final Product
The method of hand layup fabrication for the thermoset composites was implemented for the seat and body parts. This process requires laying dry fabric layers, or “plies,” by hand onto a mold tool in order to form a laminate stack. A mold tool is required to give the uniformed resin matrix and carbon fiber the necessary shape during the hand layup process and curing. Epoxy resin is applied to the dry plies after layup is complete and the part is cured in a vacuum. The team used carbon fiber, plain 200 gr due to its high tensile strength and low weight.

The steering wheel is made using the resin transfer molding (RTM) process where a Rohacell core (offset 1 mm) is wrapped in carbon fiber and placed into a closed aluminum mold. A vacuum-assisted process employing a catalyzed, low viscosity epoxy resin is pumped into the mold under pressure, displacing the air at the edges. Combining the Rohacell core with RTM process exhibits excellent strength-to-weight characteristics.

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