Formula Student Automotive Engineers (SAE)

Formula Roots

Auburn University Formula SAE (AUFSAE) unveiled its first racing vehicle in 1996. At the time the team had relatively few members, the budget was small, and the car was basic in its design approach. The charter members of AUFSAE lacked many of the tools the 2016 team employs today. This scarcity of resources, however, did not stop the inaugural team from designing and fielding a racing vehicle. Despite two decades of separation, both the past and current teams share the drive to be the best formula team in the country.

The Design

The goal of any racing team is to win, but in the FSAE world, "winning" means more than just going fast. "Winning" means having a fast car, an innovative design proven to work, and a professional business and vehicle design presentation. In FSAE competitions entries are judged based on the completeness of the team and the team's presence as a professional organization, not just which team sets fastest lap times.

Every year, AUFSAE competes in two international FSAE events that challenge cars fielded from colleges around the world to compete in different categories. Some of these categories are static challenges – design presentation, business presentation, marketing plan – while others are dynamic challenges, including highest fuel economy, fastest acceleration, and quickest auto-cross lap time. As such, each team must create its vehicle and present itself to be the best-rounded organization possible to secure a top spot in competition.

Of course, FSAE competitions are not without rules. Though the specific regulations vary between countries, each and every vehicle that enters an FSAE competition must conform to safety, noise, vehicle size, and vehicle engine displacement and other restrictions. As of July 2015, FSAE rules mandated that each vehicle driven by a gasoline engine could not employ a power plant that exceeded 610 cubic centimeters and emitted more than 110 decibels of exhaust noise. Based around these parameters alone, the 2015 AUFSAE team knew that a winning vehicle would have to be extremely light and equally nimble to make up for the inevitable power limitations resulting from the engine displacement rules.

Challenges AUFSAE Faced in 2016

Without a doubt, the largest challenge facing AUFSAE's 2016 racing vehicle is the design, fabrication, and implementation of a full aerodynamics package.

Previous iterations of the AUFSAE vehicle always maintained design philosophies that centered on a light scale-weight and higher horsepower numbers. In fact, the racing vehicle built for the 2014 competition season weighed in at only 384 pounds – the lightest vehicle AUFSAE has ever produced – and managed a 0 to60 mph time of less than three seconds.

Photo: A member of Formula SAE competing in a race driving the vehicle design and built by Auburn University Students.

It became clear after the 2015 FSAE competition at Michigan International Speedway that a light scale-weight and high horsepower figures would not be on the cutting edge of competition in the years to come. With this in mind, the 2016 AUFSAE team set out to design the first aerodynamics package employed on any AUFSAE vehicle to wear the Orange and Blue.

When it came to actually designing and fabricating an aerodynamics package, the AUFSAE team was quite literally starting from scratch. Senior designer Michael Moritz was elected to lead the aerodynamics project for the 2016 race vehicle starting summer of 2015. Of course, designing a completely novel, yet integral part of the race vehicle's chassis was no quick job. Michael and a small team of designers spent hundreds of hours over the summer researching design approaches, running computer simulations, and mining data from the 2015 vehicle's in-car sensors.

To the lay observer, in-vehicle data analytics may not appear to be a huge factor in designing what is basically a component that bolts on to the outside of the vehicle. However, thanks to a generous data acquisition software sponsorship from Bosch Electronics, Michael and his team were able to incorporate a range of data on the vehicle's performance into their design calculations. This advanced method of acquiring data enables AUFSAE engineers to streamline vehicle component design tests so that new components like the aerodynamics package may be tested in computer-driven testing programs before spending time and materials to tune and perfect the final component on the vehicle.

The Final Vehicle

The final iteration of AUFSAE 2015 was not the fastest car to come from the War Eagle Motorsports shop. It was, however, one of the most innovative designs the team has created to date.

In keeping with the designs proven effective by the 2013 and 2014 AUFSAE vehicles, the 2015 AUFSAE vehicle employs a bonded-carbon-fiber monocoque chassis designed and built by Auburn students. A Formula-1 inspired design, this chassis combines a tubular steel sub-frame that incorporates the engine as a structural member to aid in weight reduction as well as component access. The monocoque weighs only 52 pounds, yet makes up almost 2/3 of the vehicle's overall structure.

To power the 2015 race vehicle, AUFSAE once again sourced a power plant from Yamaha's R6 sport bike. Though the Yamaha mill is a stout design from the factory, the power-train team tore the engine down to bare metal for a complete performance-oriented rebuild. The 2015 race vehicle also has a custom-designed intake manifold made from 100% carbon fiber. This allows for a lighter-weight drivetrain with a slightly-lowered center of gravity overall.

The result of the extensive engine tuning was, of course, increased exhaust noise. In previous years, managing the amount of exhaust noise had never been a problem for AUFSAE, as each car's design incorporated an off-the-shelf sport bike muffler. For the 2015 vehicle, the team determined that a retail performance sport bike muffler would restrict the power output of the engine to unacceptable levels. Since running the engine un-muffled would violate FSAE noise restrictions, AUFSAE team-member and Auburn student Daniel Hardin designed and fabricated a muffler specifically for the 2015 vehicle's performance and entry requirements.

Impact of the Work and the Future of AUFSAE

The hard work and dedication that members of AUFSAE bring to the organization go beyond just the race track. Yes, every student on the team gets to say that they helped to build an internationally competitive racing vehicle, but they also get to use the skills they learned while on the team as resources in the real-world and on the job market.

When a member of the AUFSAE team sits down for an interview with a potential employer, they bring with them a skillset developed for a specific purpose and experience gained from hands-on work with an internationally-recognized organization.

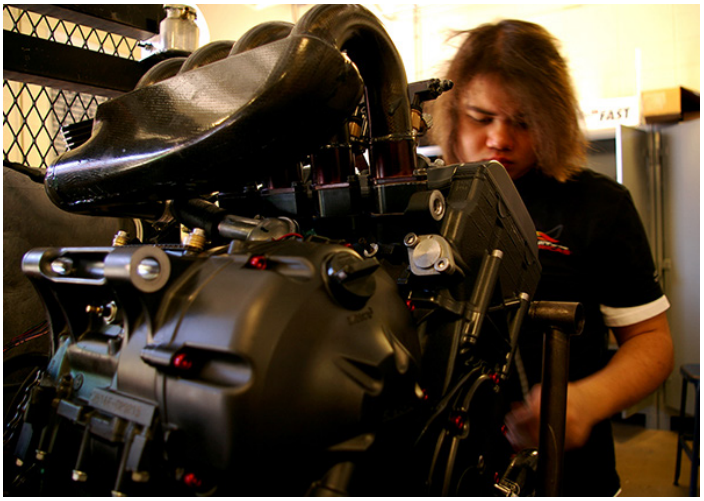

Photo: A member of Formula SAE working on an engine.