McGill Engineering Formula SAE Update

January 2007

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McGill has a Racing Car?!? Who we are…

The McGill Racing Team is a group of approximately 30 undergraduate students from a diverse number of faculties who volunteer their time outside of class to participate in one of the most prestigious engineering competitions for students in the world. Students gain practical experience in leadership, teamwork, communication skills and engineering application. The team is an invaluable resource to the McGill community for recruitment and marketing, a provider of capstone engineering projects and research opportunities as well as an excellent extra-curricular program for students.

McGill Car at the September University of Toronto Shootout

We participate in several public and private displays in Montreal and abroad and are continuously striving to produce a winning car and to represent our school to the degree it deserves. Without a doubt we are the largest group who publicize McGill Engineering in off-campus events, such as the F1 Grand Prix and Montreal International Auto Show. This goes hand in hand with helping students apply their knowledge learned in the classroom while having fun and working together on a remarkable and exciting project.

The 2006 season and the MRT8

Last year's competition took place at Ford Motor Co. Michigan Proving Grounds, a state of the art outdoor alpine test facility located in the heart of the North American automotive industry. This year approximately 140 teams from competing universities around the world converged for the coveted world championship. The teams compete in static and dynamic events and the cars are scored on performance, design, cost, presentation, even fuel economy. Unfortunately the team had a DNF (did not finish) in the gruelling endurance race with only one lap remaining. This placed us 71st overall in the competition and while the team was somewhat disheartened we were very proud of what we had learnt, how far we had come as a rookie team and the setback served only to increase our tenacity to engineer a better car for the coming year.

May 2006 – The International Formula SAE Competition, 140 teams, hundreds of industry leaders, thousands of engineering students, 1 prize

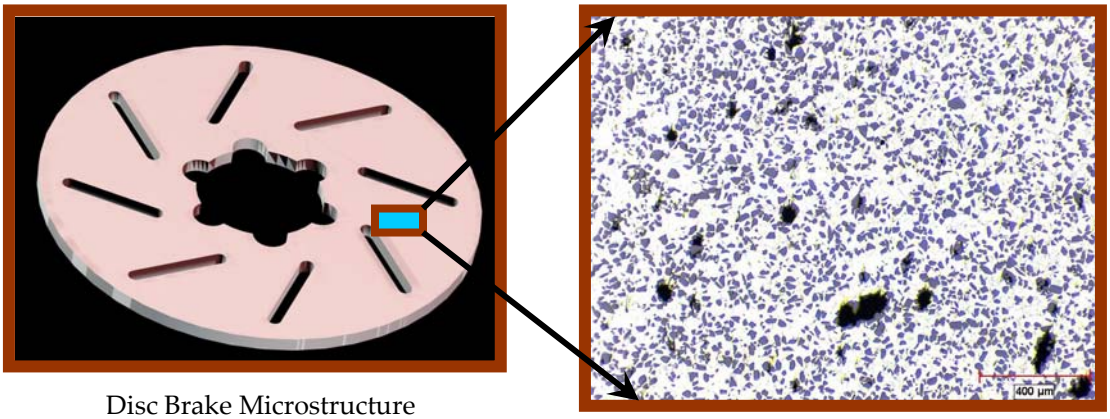
The MRT9 – 2007

Our newest offering was conceived in just four months in our spare time. We have now entered the production cycle of our project which should take us through to the middle of this semester - then we can begin testing a final assembly and preparing for the competition.

Unique highlights of the car include

Three piece composite wheels - These were designed by undergraduate students in **mechanical engineering**. They reduce unsprung weight by 2 kg from each wheel. This aids in acceleration, braking, cornering and fuel economy. No road going vehicle has ever implemented fully composite wheels in a production car. In this regard we are among the first to attempt this ultra-lightweight design.

Metal Matrix Composite - Undergraduates in **materials engineering** are developing casting methods for an alloy of aluminium and silicone carbide for use in our brake discs. This reduces weight by approximately 65% over steel discs and reduces the rolling inertia of the wheels and unsprung weight of the car – again important factors for improving performance and economy

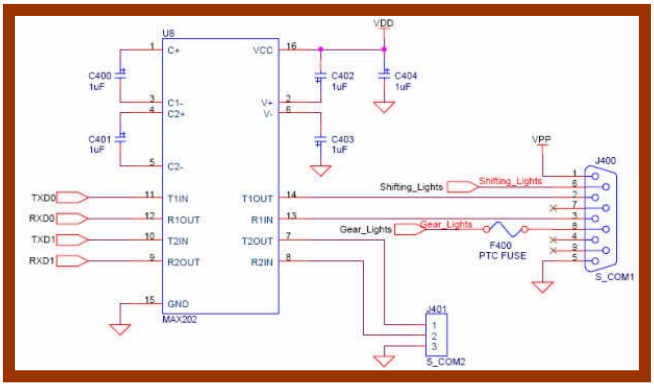


Disc Brake Microstructure

E-85 Bioethanol fuelled engine –. E-85 burns more cleanly than gasoline and is a much more **environmentally friendly** fuel. Our engine has been developed to run on ethanol as this fuel provides a very high octane rating that is useful in turbocharged applications such as ours. As with the composite wheels we are pioneering experiments with using emerging technology by implementing ethanol in small displacement, high compression ratio engines where it is normally not very well suited. You may find out more about the benefits of our fuel here: http://www.e85fuel.com/information/environment.php

The 2007 Powertrain Assemblv

Engine Control Unit - Developed by a team of **electrical engineering** students this engine management computer is being designed from square one. It will control all functions of the engine timing as well as function as a data acquisition unit that can interpret movement, speed and rotation of suspension components and allow the team to analyze real world test data performed on the finished car. This data will allow us to confirm our design theories and help us to optimize the setup of the car for competition.

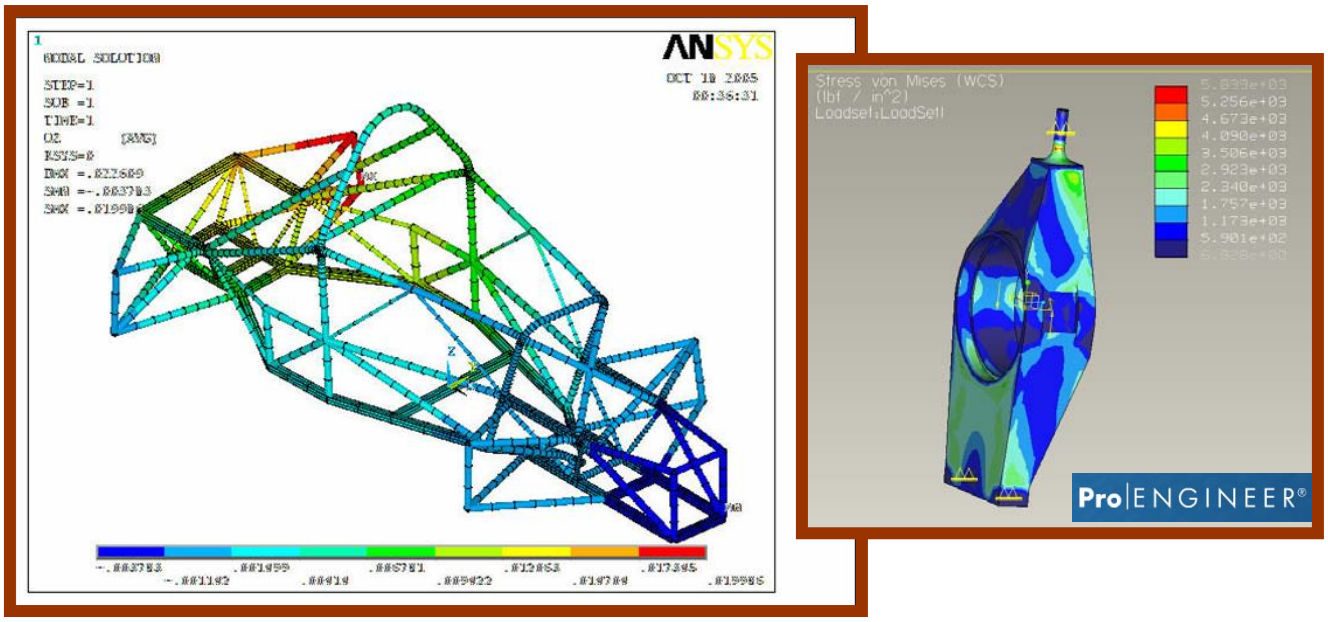


ECU and sample circuit diagram

Are students learning from this project?

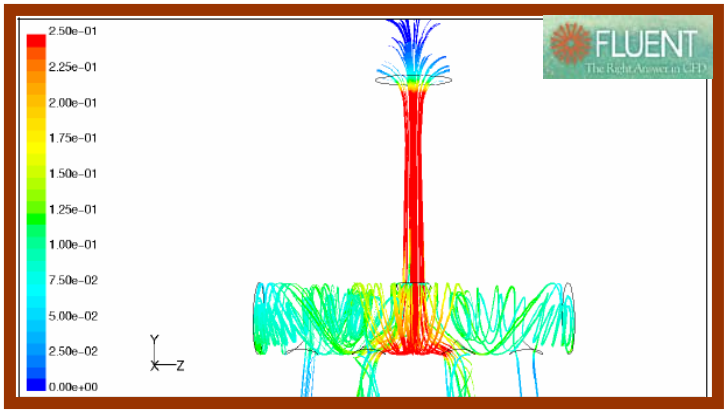
Yes. Every aspect of what we do involves the application of the knowledge learned in the classroom to a real world project. To name a few of many examples:

Solid mechanics and stress analysis – This has application to the dozens of loading situations that occur on a vehicle chassis. This includes calculations for yielding, failure, buckling, and torsion effects on the steel frame, brackets, engine mounts and suspension components of the car as it is loaded statically and dynamically. One of the major aspects is applying finite element software to estimate the stiffness of the frame as well as failure modes for highly stressed components.



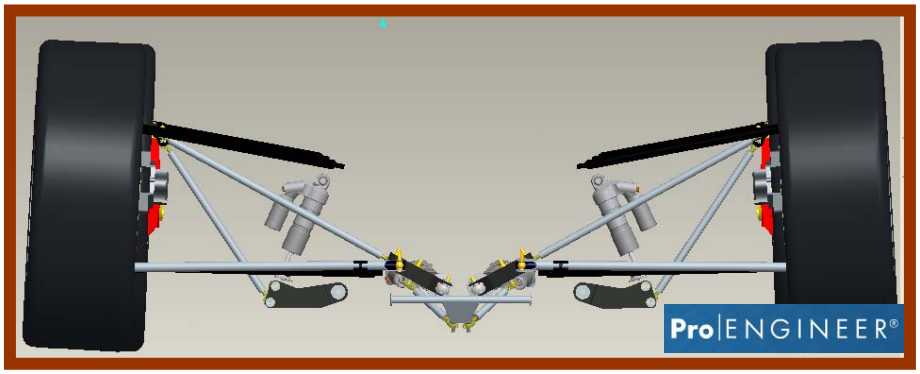
Finite Element Analysis on Frame and Suspension

Fluid Mechanics – The application of flow theory is used to produce the ideal air intake and exhaust exit system. This is done in the design phase to gain every last bit of power from the engine and optimize its performance. Following the design and build a dynamometer and a multitude of sensors are used to test the theory of the students and provide numerical results.



CFD model of Intake and Plenum

Dynamics/Dynamics of mechanisms – This subject can be fielded by mechanical and physics students as they perform calculations and analysis on optimum suspension setups. Using theory and testing methods we can produce a dynamically stable vehicle that handles well and can make the most use of the grip provided by the tires. Cornering forces can reach approximately 1.6 g's in a well developed suspension - twice that of most normal road cars.



Suspension model in ProEngineer

Electrical Engineering – Knowledge learnt in Introduction to Electronics/Microelectronics is used to design various circuits such as discrete analog filters that clarify signals coming from the many sensors on the car. In addition this course was used to help design the McGill PCB layout by applying OrCAD Spice software.

Wheel mounted information display

Students taking Microprocessor Systems became familiar with CrossWorks and readily chose the TMS470 32-bit RISC from Texas Instruments as the car's microcontroller, as it was familiar territory covered in class and included an integrated development environment (IDE) which would help speed up the project. Other courses that were beneficial in the understanding of the car's electrical elements were Intro to Computer Engineering, Computer Engineering and Digital System Design.

Casting of disc brakes at McGill

Materials Engineering - The project of casting brake discs is a wonderful opportunity to apply many materials concepts learnt in courses such as metallographic preparation and analysis, mechanical testing, properties of composites, etc. Also, this project allows students to learn and use different casting techniques. Working with new composite materials is a challenging but fascinating field. Applying our knowledge to a concrete project and seeing how materials engineers are part of production of a new component is an amazing educational experience.

Thank you to our supporters at McGill

Judy Pharo and the student affairs staff – as always the engineering student affairs office is a pleasure to work with

Professor Larry Lessard, Mechanical Engineering team advisor - for his continued support and use of the composites laboratory

Professor Peter Radizewski, Mechanical Engineering Professor and McGill VERT project manager – for his firm belief and support of undergraduate design at McGill

Professor Mihriban Pekguleryuz and Technician Pierre Vermette, Materials Engineering – for their support, knowledge and resources on the aluminium MMC brake discs

Lillian Mitzal, Secretary for the Department of Mechanical Engineering – for your greatly appreciated help with our finances

Special thanks to Gary Savard, John Boisvert and Raymond Lemay, Mechanical Lab Technicians - for their advice, support and expertise

Without the help of these individuals our project would never see fruition. We cannot begin to express our deepest thanks for your support, guidance, expertise and steadfast belief that we are making a significant impact in the McGill community and are a beneficial student program. We look forward to working with you in the future and hope that our project shows itself to be as professional, ingenious and competitive as you teach us to be.

Closing Quote:

"While ostensibly about the design and production of a single-seater racing car, Formula Student is actually more about building future engineering talent, not just in design and manufacture, but in many of the management, marketing and people skills so vital in the modern world, across all sectors of employment.

It provides opportunities for students to develop and demonstrate their skills, enthusiasm, ingenuity and commitment to engineering excellence, and for industry to foster close links with academia to develop the people attributes they need for future success."
- *www.formulastudent.com*

Interested in being a part of our team?

fsae@mail.mcgill.ca – final year projects - general interest - all students are welcome