

THE QFSAE REPORT



SOLID MODEL OF THE 2010 CAR

MID SEASON REVIEW

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QUEEN'S FORMULA SAE



FORMULA SAE

For those of you who need a refresher, Formula SAE (FSAE) is a competition organized and sponsored by the Society of Automotive Engineers. The competition is open to engineering faculties worldwide and consists of the design, construction, and testing of an open-wheel race car. The cars are constructed according to engine and frame limitations that promote engineering creativity. All cars must pass through a 100 point technical inspection before being allowed to compete. The cars are built over a time period of one school year which consists of 8 months. There are currently 500 teams and 7 different competitions worldwide which makes Formula SAE the biggest and most prestigious engineering student design competition in the world. The Queen's team of 12 puts in over 10000 hours to get the car rolling each season.



The 2009 Endurance course at Michigan International Speedway

RECENT HISTORY

The Queen's team has been steadily increasing their competition result over the past several seasons with a 16 place jump to 55th at last year's Michigan competition. The Queen's team delivered a high performance car and brought home a 30th place finish in the design event. A lack of driving time was the main reason for a drivetrain failure in the endurance race, bringing a disappointing end to an otherwise successful weekend. Many design changes are in place for the new car, allowing the team to build a smaller, lighter, faster car in a shorter amount of time. The team is also hoping to showcase the new car on the world stage at Formula Student UK in July 2010. Turn the page to find out more about the 2010 car!



The 2009 Queen's car in action behind Victoria Hall

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QUEEN'S FORMULA SAE



2010 GOALS

2010 is a breakthrough year for the Queen's Formula SAE team. The goal of the 2010 team is to build a lighter, stiffer, easier to drive car, and to complete it earlier than ever before. With this ambitious goal the team has scheduled every week of the year and what needs to be accomplished. Managing the project to this new level forces team members to be accountable for meeting deadlines. It is with this attitude that the Queen's team looks forward to the 2010 racing season with dedication and enthusiasm.

CURRENT STATUS

The design of the 2010 car is now complete with the team fully into the fabrication stage. Suspension component machining has begun and the roll hoops of the chassis are finished. The team hopes to complete the frame before second semester – a new record! The team is currently on schedule for a March 1 first drive – snow permitting. We are looking forwards to the longest pre-competition testing phase in recent years to implement a new sensor array to tune the car to perfection. As previously mentioned, the team also hopes to attend two competitions in order to better demonstrate the true performance capabilities of the 2010 car.

2010 TECHNOLOGY

Engine

The 2010 engine package features an innovative rapid prototyped intake system to deliver maximum air to the CBR600 F4 engine. Engine management will be taken care of by two brand new TEC GT's from Electromotive and tuned on the Queen's dynamometer. A 4→2→1 exhaust manifold design will build torque early in the power curve and a two stage dry sump system will provide lubrication. A custom radiator and fan setup will be implemented with a duct to increase cooling efficiency. An all new

traction control unit has been developed with the hope of reducing lap times.

CHASSIS

The chassis for the 2010 car is a Chromoly space frame designed to be as light and stiff as possible within the competition rules. The chassis tightly packages all components of the car and features a new pullrod design for the suspension, integrated steering rack mounts, and better packaging of the rear suspension. CNC cut chassis tubes provided by VR3 engineering are currently being assembled into the 2010 chassis. Rear pivoting remote reservoir master cylinders from Tilton have been purchased and will take a staggering 5" off the front of the frame!

SUSPENSION

The 2010 suspension kinematics has been analyzed in Optimum K to produce the best conditions possible for our Goodyear Eagle D2692 tires. Significant design effort has gone into reducing the wheelbase on the 2010 car to the competition minimum 60" to create a car with much more aggressive turn-in response and a reduced moment of inertia. Pullrods have been used in the front suspension to further lighten the assembly and lower the center of gravity of the car. A front driver adjustable antiroll bar will also be implemented to reduce track tuning time. Part count has been reduced significantly in the unsprung mass, leading to weight savings of >6lbs and a stiffness increase of approximately 400%.

DRIVETRAIN

The 2010 drivetrain features weight savings of over 30% and integrates a Salisbury style limited slip differential with a custom aluminum housing. Equal length, single piece driveshafts are utilized to transmit the torque to the wheels. The Queen's team will cut their own splines for drivetrain components on the new 4 axis mill in McLaughlin.

Turn the page for some design highlights!



QUEEN'S FORMULA SAE

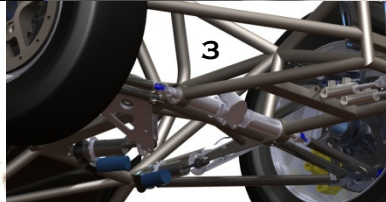


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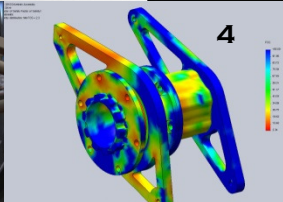
- 1: Rear assembly screenshot
- 2: Driver interface screenshot
- 3: Front suspension arrangement
- 4: Finite Element Analysis conducted on 2010 drivetrain
- 5: Traction control simulation graph of rear wheel speed vs. front wheel speed
- 6: Traction control predictive tire tractive effort surface
- 7: Exploded view of 2010 drivetrain design
- 8: FLUENT computational fluid dynamics analysis conducted on the 2010 throttle design



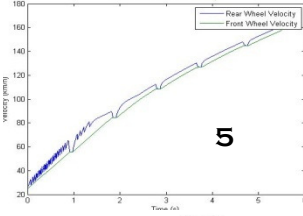
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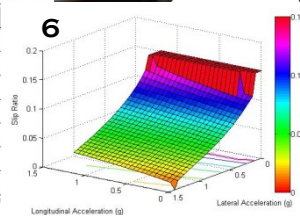
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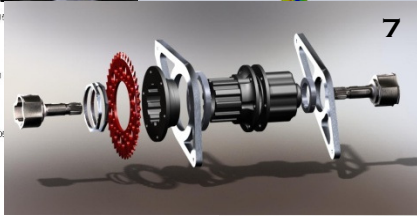
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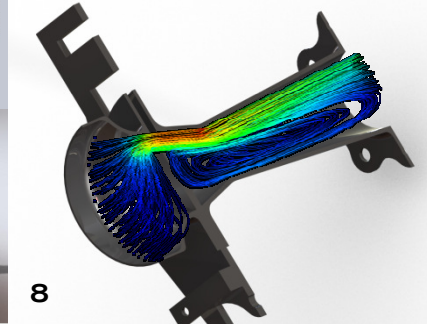
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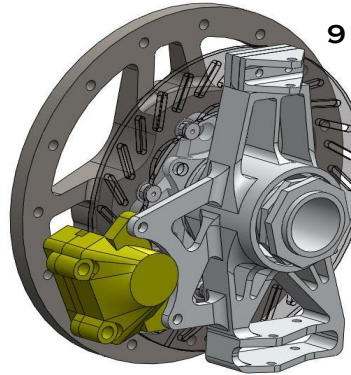
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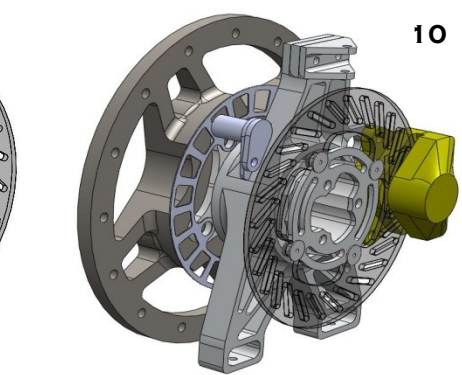
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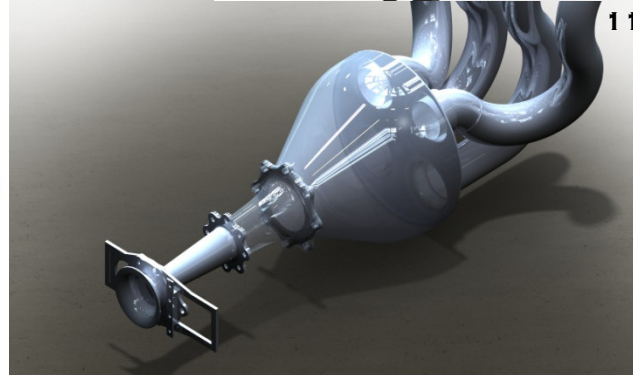
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- 9: Front wheel package assembly
- 10: Rear wheel package assembly

- 11: Intake manifold and throttle assembly
- 12: Dynamometer setup in McLaughlin Hall



QUEEN'S FORMULA SAE



FUNDING

On an administrative level, the Queen's team has significantly increased the support for the team both through community awareness and financial and in-kind contributions to the team. This season alone has brought in new funding with a value of \$33 000, as shown below.

- \$7000 - MBNA
- \$5000 – Vale Inco
- \$4000 increase in faculty funding
- \$8500 in tooling donated by ISCAR
- \$5000 in material donated by Bombardier Aerospace
- \$2000 in high performance oil donated by Universal Contract Logistics of Belleville
- \$2000 trailer donated by 1000 Islands RV
- Machining services donated by ALZAR of Ottawa

The Queen's team is still aggressively recruiting new partners for the 2010 racing season. As can be seen in the budget outline to the right, the team has not met their fundraising goals for the year. In light of this, we are reaching out to any Alumni, private, or corporate potential partners who are interested in allowing the team to perform to their full potential. If so, please contact us and review the sponsorship package at www.qfsae.com/partners.html.

BUDGET OUTLINE

Monetary Funding:

Dean's Donatiion	\$8000
MBNA	\$7000
Vale Inco	\$5000
Opt Out Fees	\$4040
Honda Canada	\$4000
Department of MME	\$2200
Yallowega Belanger	\$1000
Total:	\$31000

Expense Summary:

Engine	\$6915
Suspension	\$7700
Chassis	\$1700
Brakes	\$2400
Electronics/Sensors	\$5700
Shop Supplies	\$2780
Bodywork	\$1870
Travel	\$18040
Total (inc. 15% contingency)	\$54171
Year End Balance:	(\$23171)

IN CLOSING...

Please do not hesitate to contact us with any questions you may have. We would love to provide more details about the car, year plan, or budget to anyone interested. We also need fans at our competitions in the spring! Let us know if you are in the area and we will give you more details, or visit www.sae.org. Look for more details on our [Spring Reunion](#) information session and driving demo. Thanks for reading!