UND Formula SAE

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LEADERS IN ACTION

What is Formula SAE?

“The Formula SAE competitions challenge teams of university students to conceive, design, fabricate, develop and compete with small, Formula-style vehicles.”

- International student design competition organized by SAE International
- Primarily engineering & business aspects
- 13 competitions worldwide
  - Australia, Austria, Brazil, Canada, Czech Republic, Germany, Hungary, Italy, Japan, Spain, UK, US (x2)
  - We attend Formula SAE Lincoln in June
- 8 events in competition
- Regarded highly in automotive industry.

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Formula SAE Events

- 3 Static Events
  - Business Presentation (75 pts)
  - Cost and Manufacturing (100 pts)
  - Engineering Design (150 pts)
- 5 Dynamic Events
  - Acceleration (100 pts)
  - Skidpad (75 pts)
  - Autocross (125 pts)
  - Endurance (275 pts)
  - Fuel Efficiency (100 pts)
- Total of 1000 points

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Who We Are

- UND Student Organization
  - 30 Students, Freshman to Graduate, All Majors Welcome
  - Primarily Engineering
    - 18 Mechanical Engineering students working towards Senior Design credit.

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What We Do

- Compete in Formula SAE Competition
- Community Outreach
  - FIRST Robotics
  - FIRST Lego League
  - Rydell Car & Bike Show
  - UND STEM Day
  - SCCA Racing
  - Host Guest Lecturers
  - High School Career Fairs
  - *And Much More!*

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Changing the “Formula”

Past cars have largely been derivations on the same platform.

UND15, 16, 17, and 18 are all centered around the same formula:

Weight: 500lbs
Weight Distribution: 50/50 F/R
Power: 80HP
High Center of Gravity

By UND18, this formula has been well developed, and we are still not reaching our goals.

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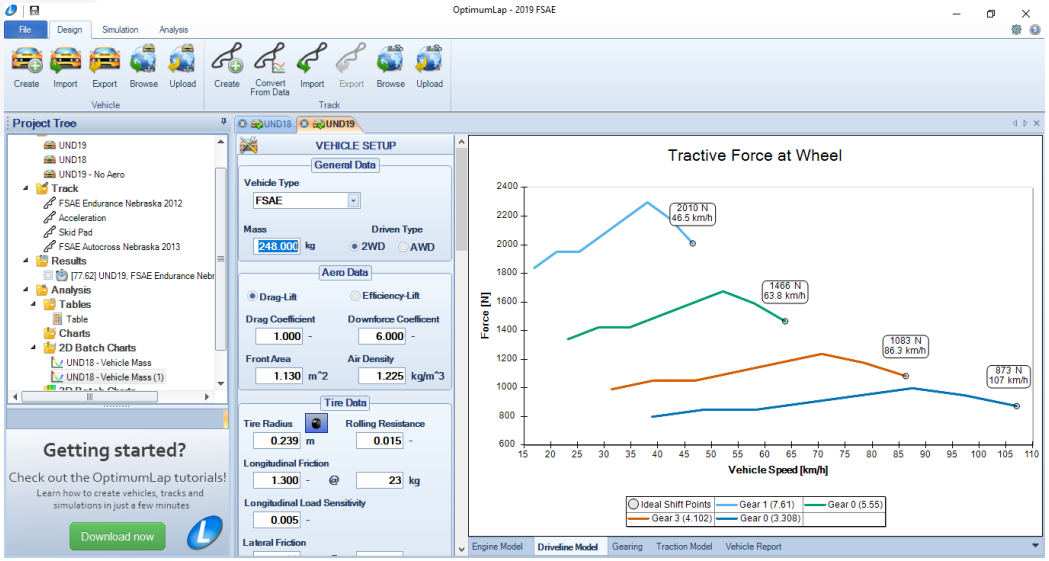
Changing the “Formula”

After Lincoln 2018, the team began investigating vehicle parameter effects on overall performance.

This development took place on both OptimumLap and an in-house MATLAB laptime simulator.



Accel & Skid Pad Event Simulation

University of North Dakota Formula SAE

James Meyers

07/01/2018

The intention of this script is to allow a team to simulate the performance of a Formula SAE car in the acceleration and skidpad events.

Overall Assumptions:

No CG, aerodynamic, rolling resistance, or inertia effects.

Constant Tire Coefficient of Friction.

Uniform tires.

Notes:

For loop isn't particularly fast to analyze for the acceleration event but it does not appear to be possible to vectorize.

Load competition parameters

```
iterations = 75; % How many segments do you want to break accel into?
```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Vehicle Simulation

From last semester's simulation work, the high level design goals for UND19 are as follows:

Total Weight: 400lbs

Weight Distribution: 45/55 F/R

Power: 40hp

With targets set by high level vehicle simulation, UND19 is projected to be faster than UND18 in 4 out of 5 events.

	FSAE Endurance 2012		Acceleration		Skid Pad		FSAE Autocross 2013	
Vehicle	UND19	UND18	UND19	UND18	UND19	UND18	UND19	UND18
Lap time [s]	70.77	72.58	4.53	4.30	5.38	5.44	57.68	58.42

UND18 beats out UND19 solely in the acceleration event, which was expected due to the downsized engine.

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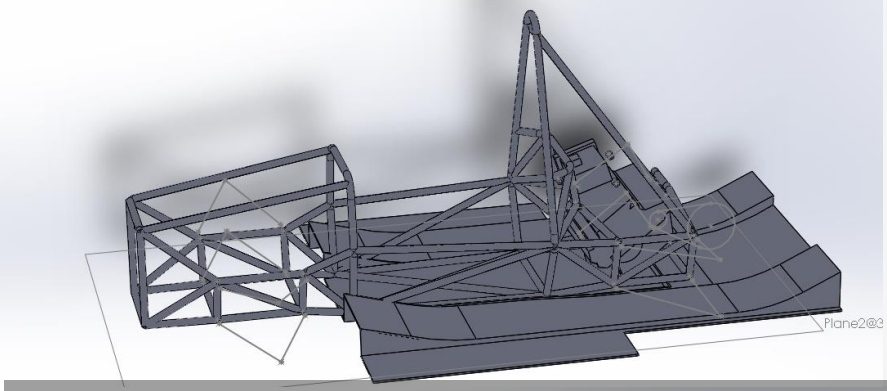
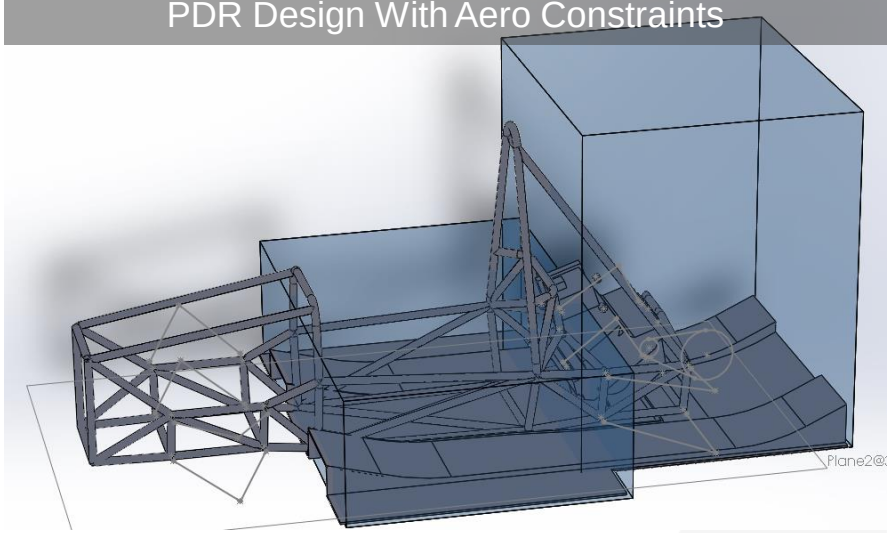
Undertray/Diffuser Initial Design

- Completely new component of vehicle.
- Undertray/Diffuser generates a low pressure area on the bottom and rear of the vehicle.
- Conform Research Model to Vehicle Dimensions
- Constraints
  - Clearances
  - Proper Thickness
  - Volume
  - Mass

Original PDR Design



PDR Design With Aero Constraints



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Design Decision Process

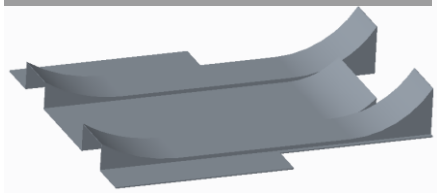
Design Types:

- Original PDR Design
- No Gurney
- No Side Flaps
- No Mid Diffuser
- Outlet Closer to Front
- Strait Diffuser
- Less Radius, More Angle, Straight
- Less Radius, More Incline, Closer Outlet, Straight
- Continued Even Closer Outlet
- Uniform Diffuser
- Inlet More Aggressive
- Taller Tunnel

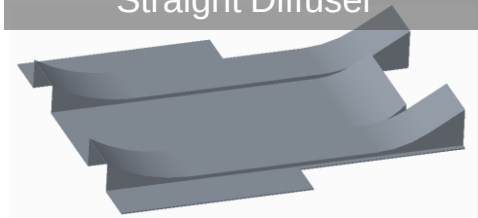
Original PDR Design

Outlet Closer To Front

No Gurney



Straight Diffuser

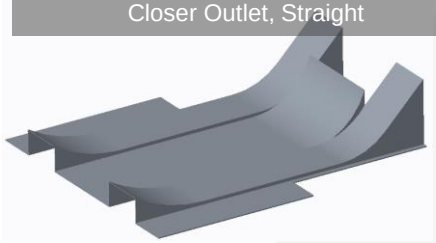


No Side Flaps

Less Radius, More Angle, Straight

No Mid Diffuser

Less Radius, More Incline, Closer Outlet, Straight



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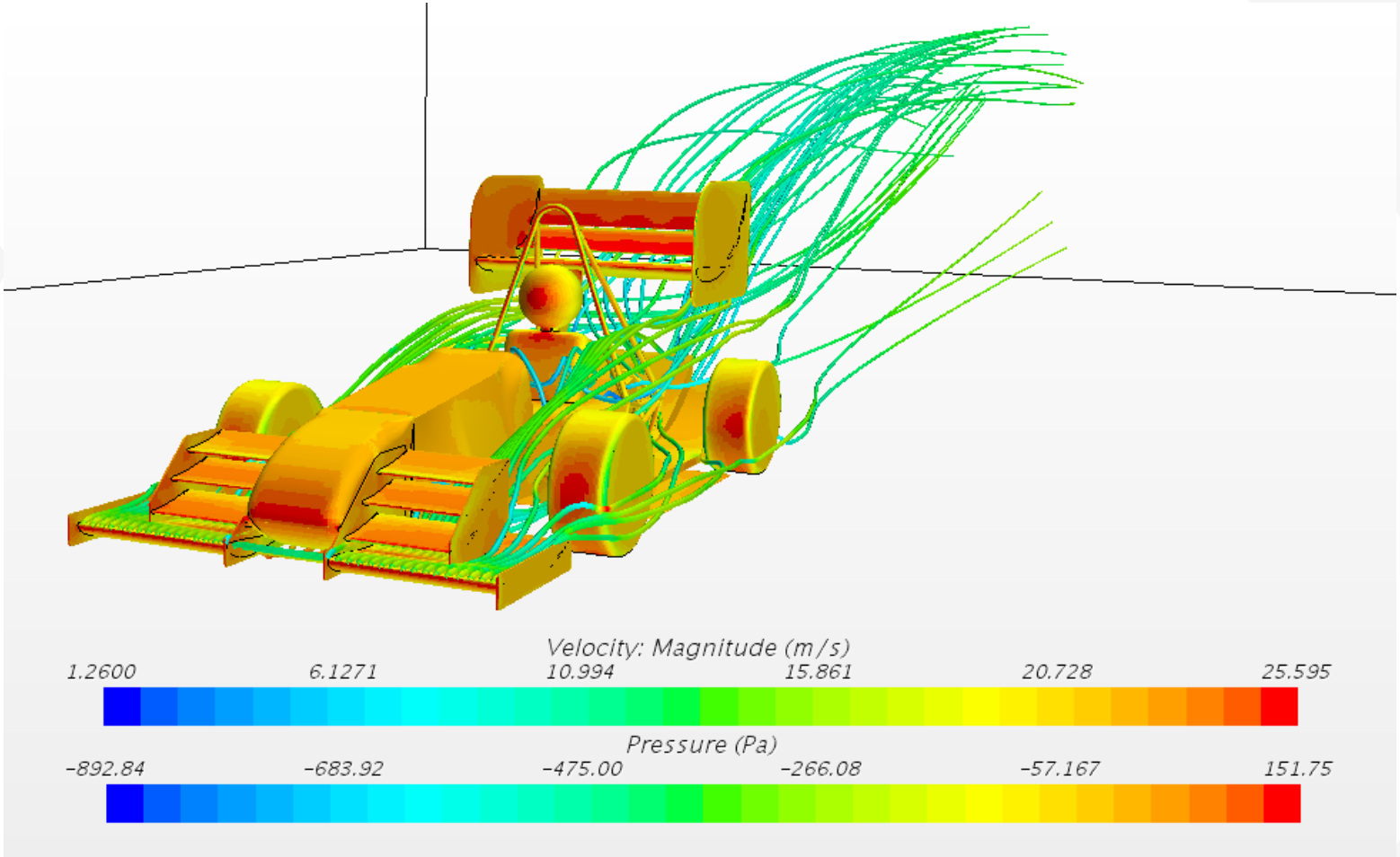
Aerodynamics



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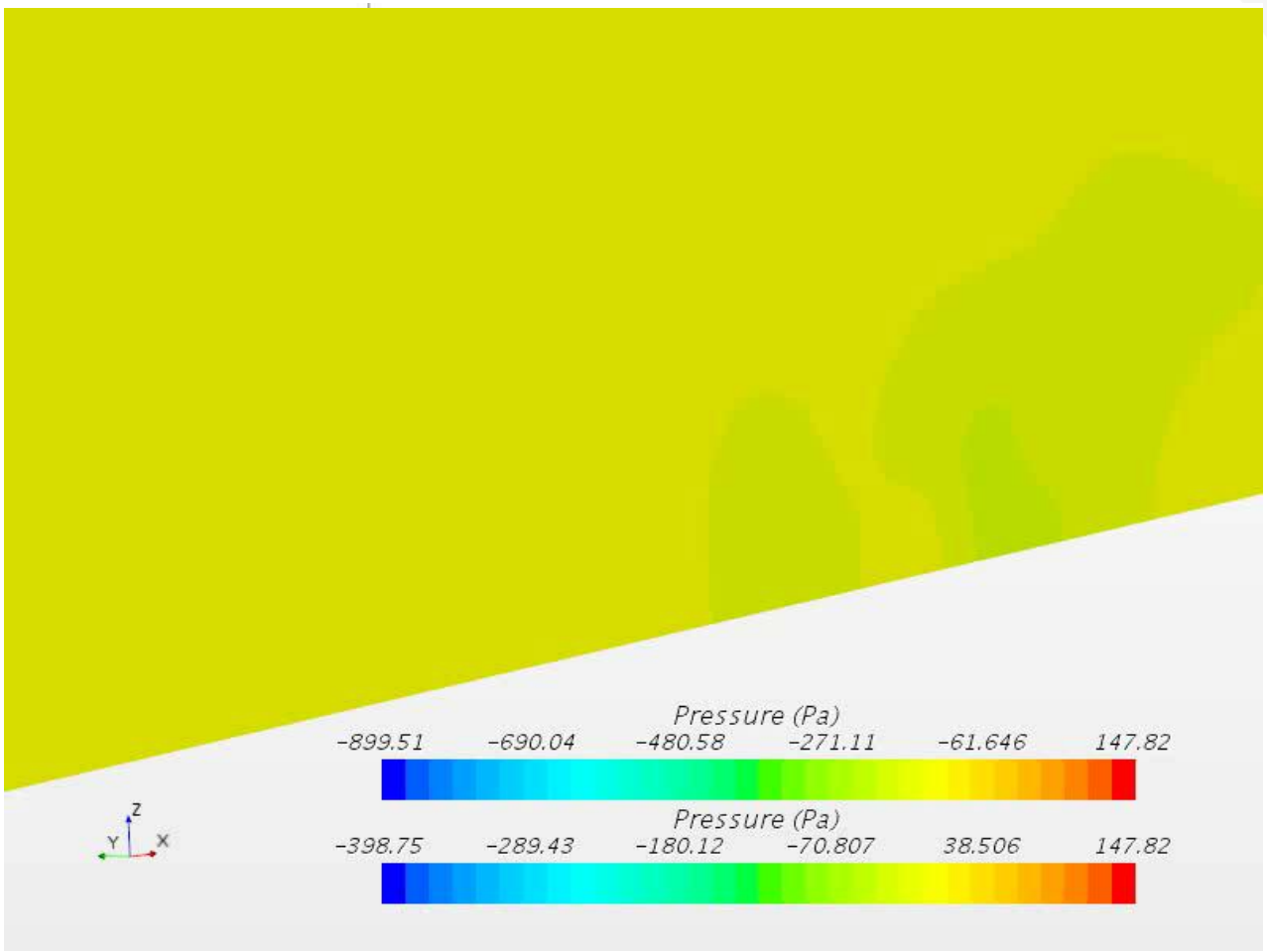
Aerodynamics



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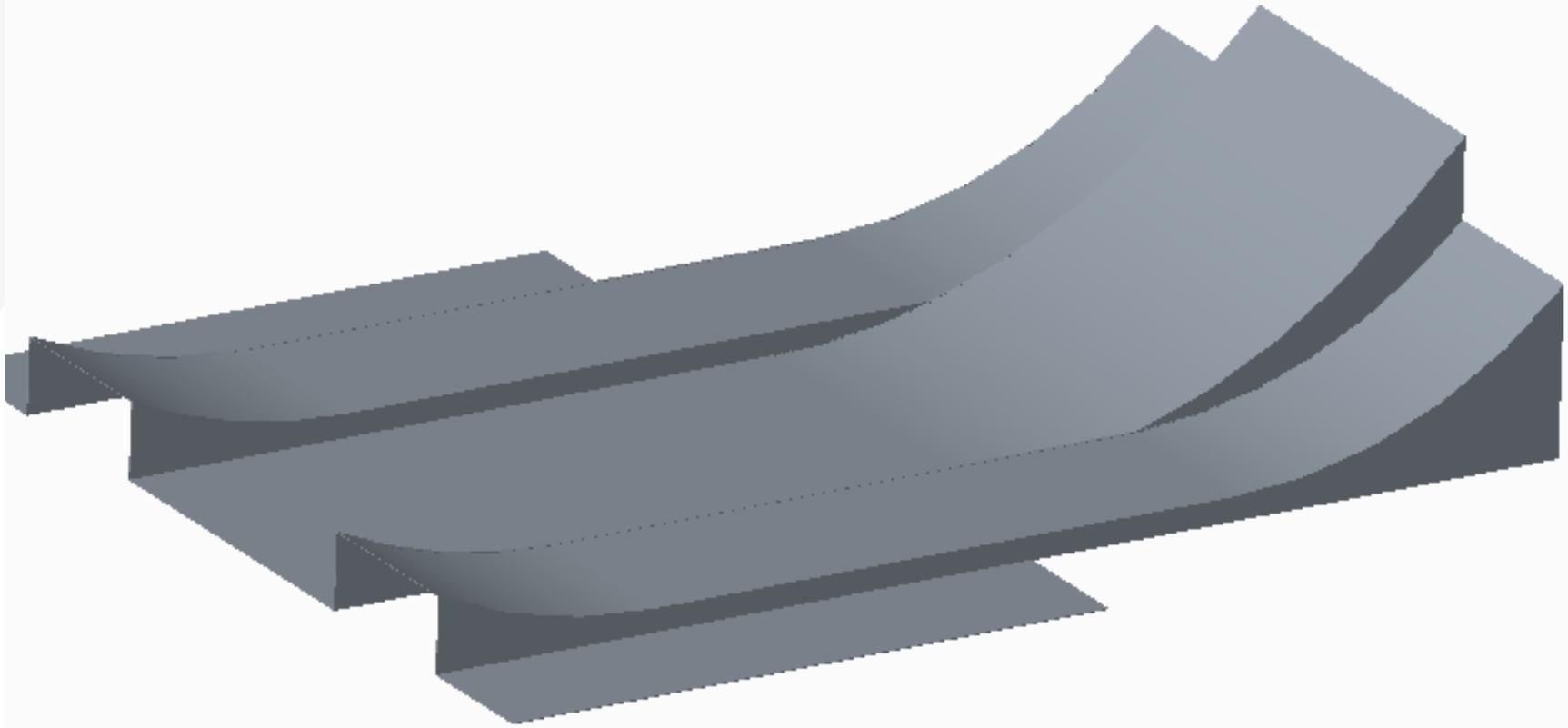
Final Design



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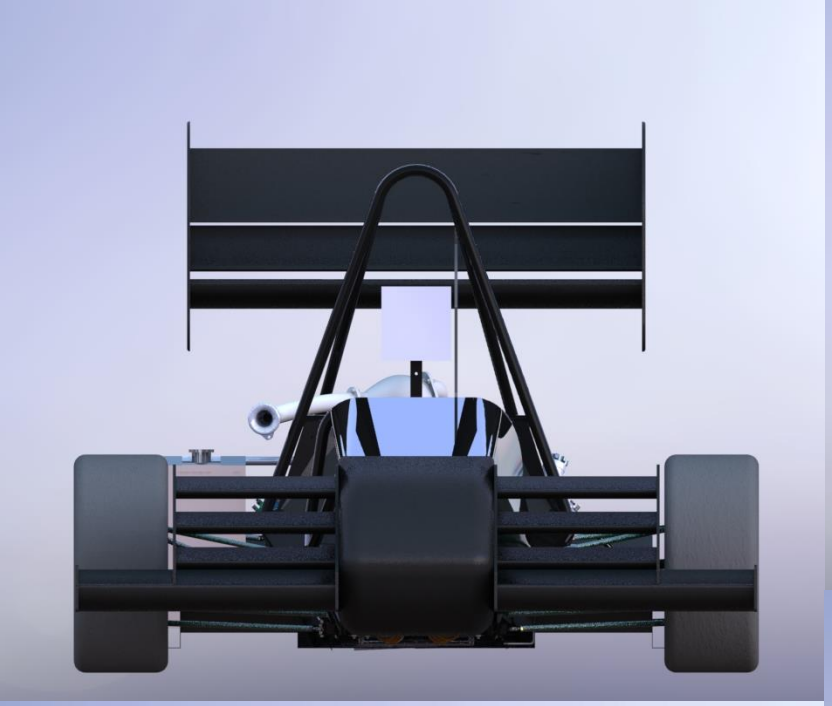
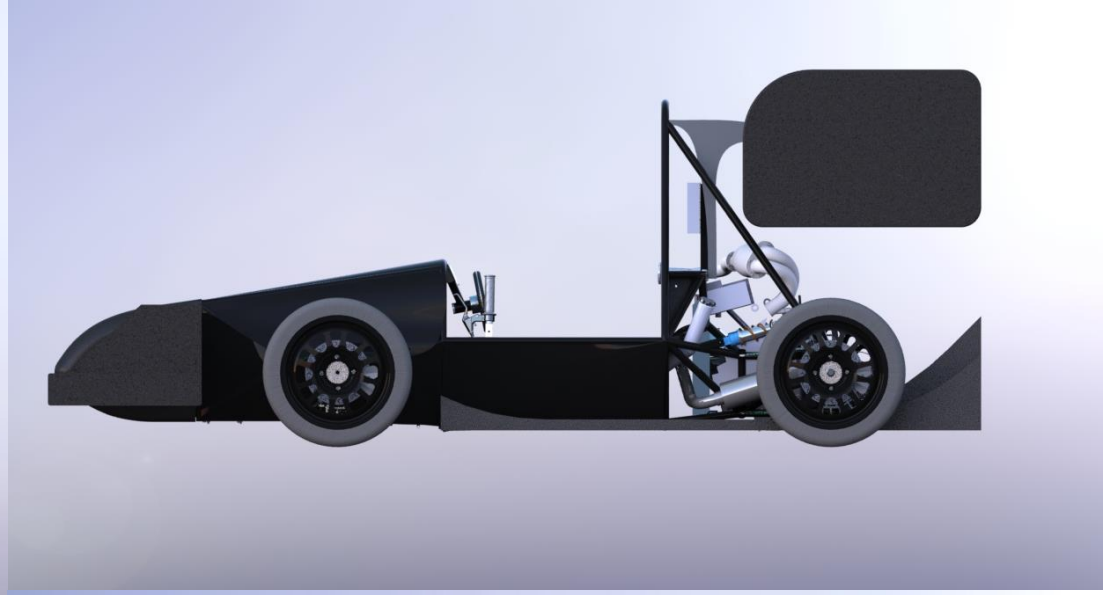
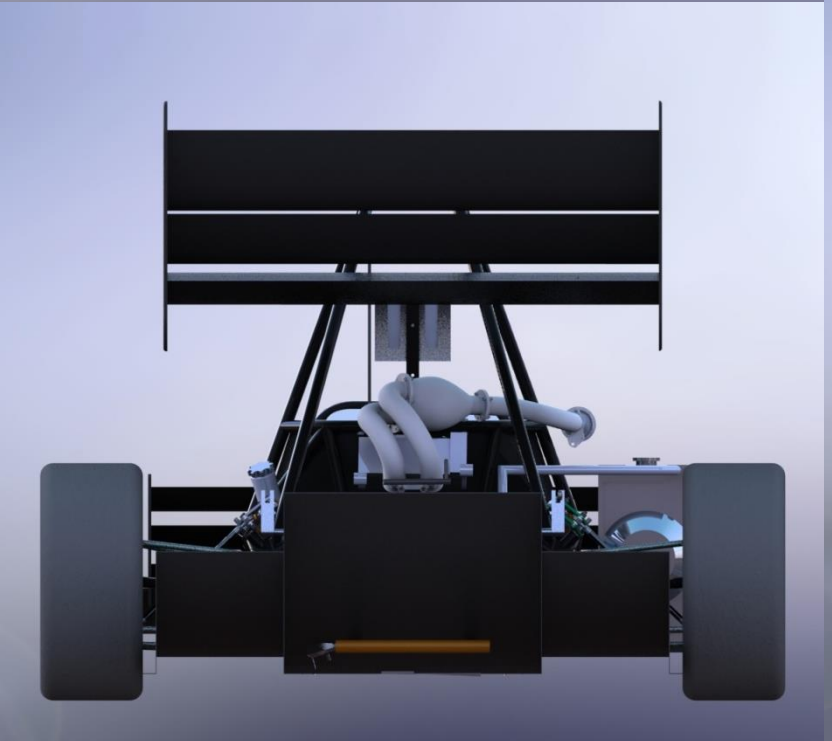
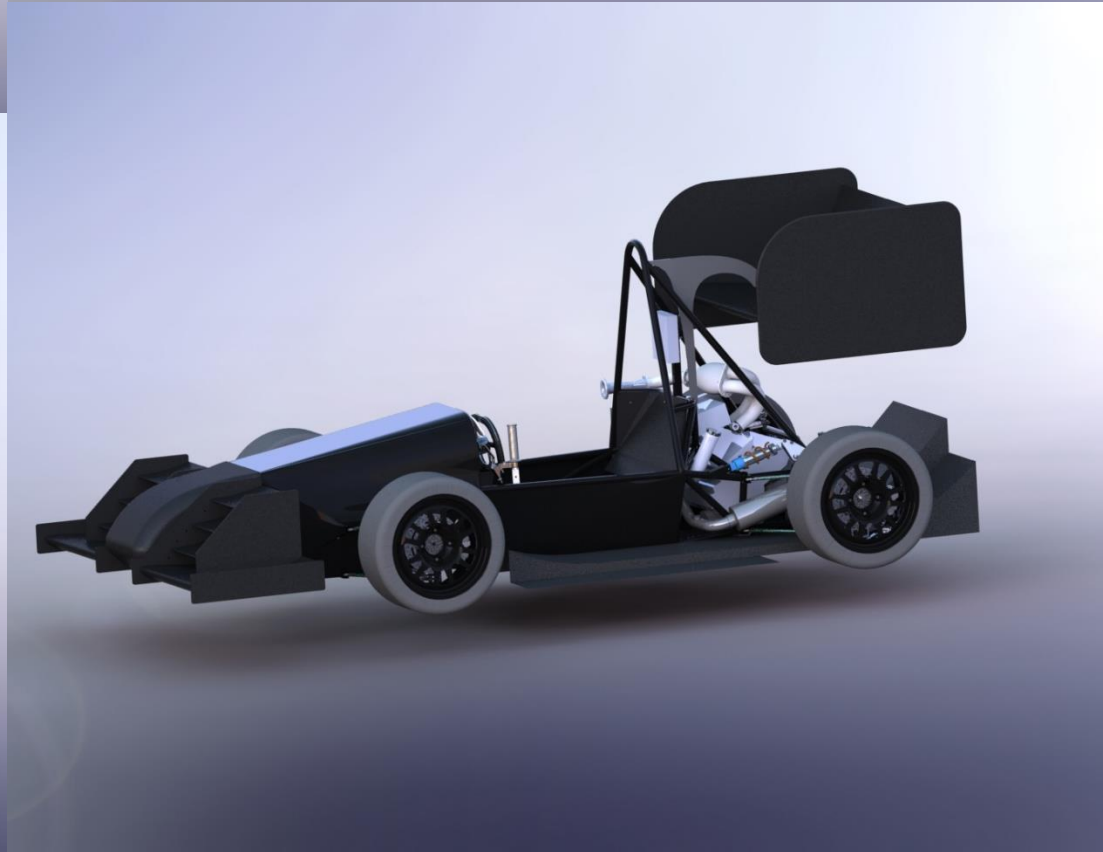
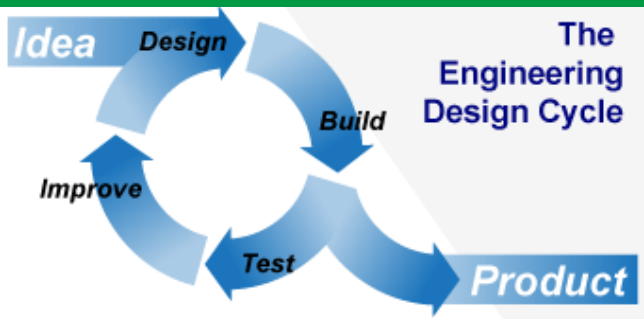








Academic & Career Opportunities



- Internationally Recognized Project
  - Many Companies Regard Formula SAE Highly
  - Hands On Application of Classwork
  - Project Components Can Often Be Used As Class Projects
- Simulated Industrial Experience
  - Designed to Emulate Small Business
    - Team Broken Down into Subteams with Established Hierarchy
- Opportunity to Work Closely With Industry

Ford
Go Further
CIRRUS AIRCRAFT
JOHN DEERE
HONDA
Bobcat
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Thank You!

Follow our journey on Facebook!

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NDSGC Relevance

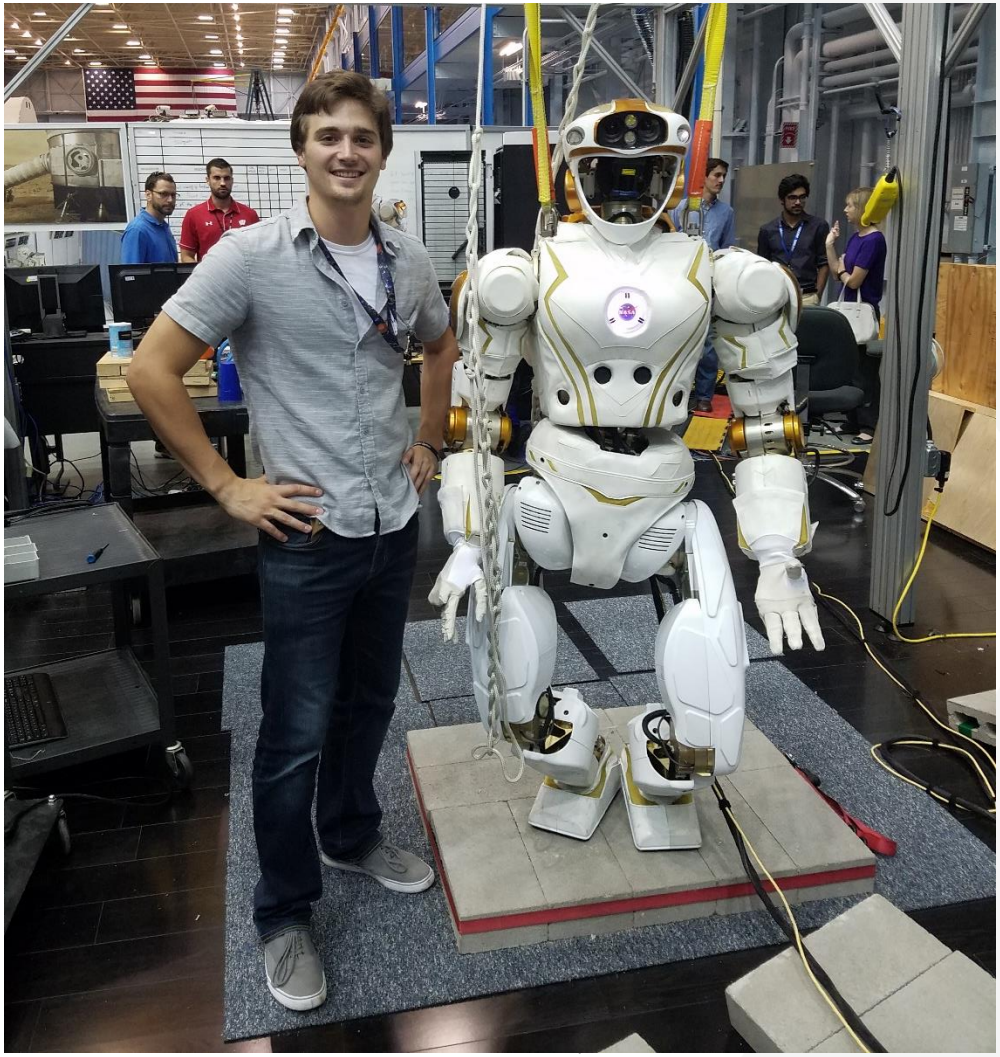
NDSGC

NDSGC Mission Statement "…Our activities will demonstrably increase the qualified STEM and technical workforce that is necessary to accomplish NASA's goals while also contributing to the general education and welfare of the North Dakota populace."

Formula SAE

Complex Engineering Problems
- -Aerodynamics
- -Vehicle Dynamics
- -Ergonomics
- -Safety

Realistic Deadlines
Budgetary Considerations
Management
Outreach



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