FORMULA TECHNION 2016

Suspension & Steering Teams

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Objectives & Requirements

- Design of a suspension system for a high-downforce FSAE car.
- Increasing the maintainability, and reliability of critical components that failed in 2015.
- Reduction of the total production costs.
- High adjustability for all the dynamic parameters, to allow tuning the car for different race courses and dynamic events.
- Suspension geometry suited for high lateral-acceleration (~1.4 g's), and tight tracks.
- Increase the reliability of the A-arm system.

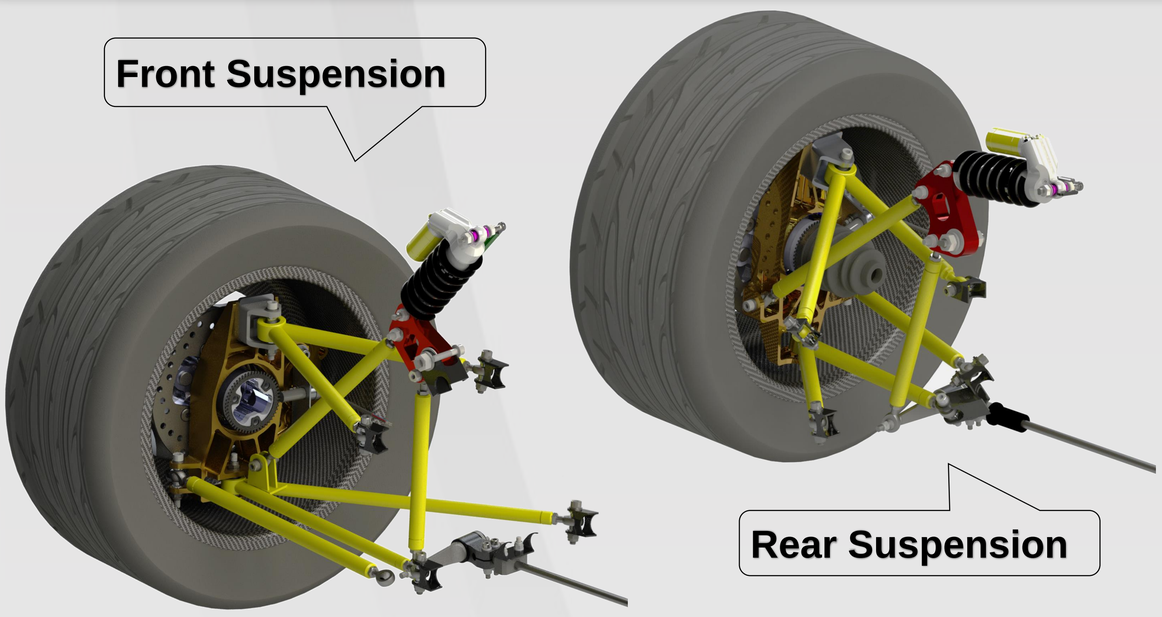
Design Process & Primary Characteristics

Geometry:

- 2015 geometry design concept preserved, with few modifications.
- Adjustable, negative Camber angle along entire suspension travel.
- Geometry parameters were partially compromised in order to lighten peak loads on the A-arms and rods.

	Front	Rear
Roll center height (from ground)	15 mm	45 mm
Center of gravity (from ground)	305 mm	
Static toe-in	-0.2°	+0.2°
Static camber	-1°	-2°
Mechanical trail	29.5 mm	35 mm
Caster angle	7.9°	7.7°

Sub-System Description



Components:

- Non-parallel double A-arm suspension with Push-rods, front and rear suspension.
- Front and rear rockers (bell cranks), designed to achieve high motion ratios.
- 4-way adjustable Ohlins TTX25 MKII dampers, with linear springs and 57mm travel.
- Anti-Roll mechanism, consisting of torsion bars and adjustable blades.

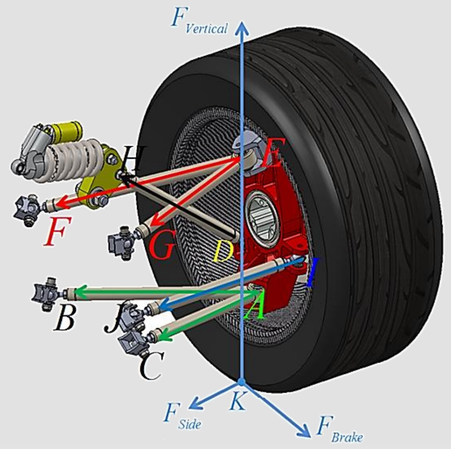
Production & Materials:

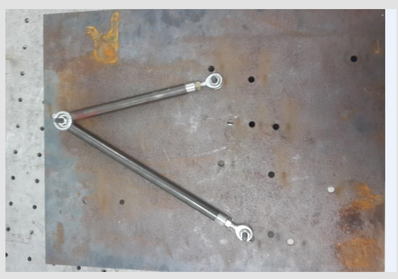
- Two sizes of 4130 steel tubes was chosen to ensure reliability and reduce weight.
- Weldments at rods and A-arms are jig-based, to ensure precision while welding.
- All Weldments work was made by the team members reducing the production costs.
- Rockers and Anti-Roll bars' housings and blades are CNC fabricated.
- A-arms' inserts, ball-joints' housings and spacers are turned on a lathe, therefore significantly reducing the production costs.

Design Process & Primary Characteristics

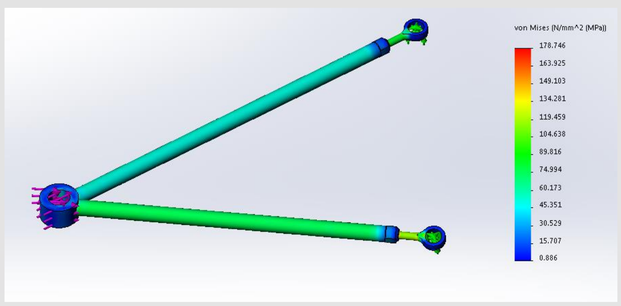
Arms & rods loads:

- Applying Castigliano's second theorem, we proved that the A-arms can be designed to act as a truss, which enabled the use of circular cross section tubes for the suspension's A-arms and rods.
- In previous years the team used magnesium rods for the suspension arms, however ongoing difficulties in pre-determining the quality of the magnesium provided by the team's suspension arm manufacturer, put the choice of this lightweight material into question. To avoid the risk of using material of inconsistent quality (magnesium), the suspension arms are made of 4130 steel tubes.
- Considering the forces acting on the A-arms we used two types of rods - 0.5" diameter and 0.625" diameter. With this configuration we manage to decrease weight while keeping the same factor of safety.





A-arms jig

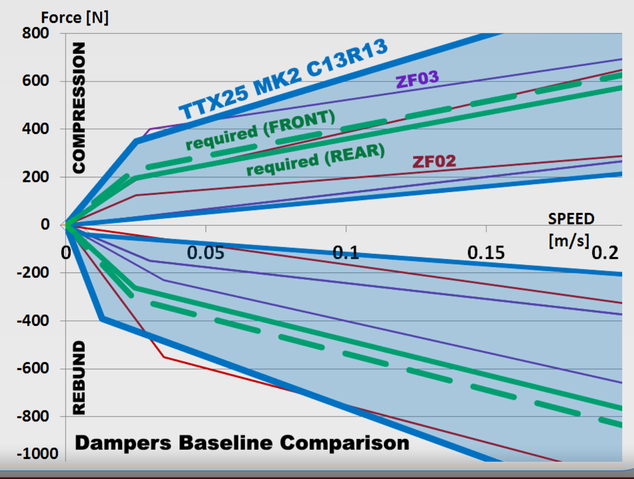


Dynamics:

- Quarter-car dynamical Analysis was preformed, to determine and achieve the desired dynamical parameters, using guidelines by Kaz-Technologies®.
- Dampers were chosen and valved to fit specific requirements, and allow high range of adjustable parameters, (high-speed and low-speed damping, in rebound and compression).
- Simplification of Anti-Roll bars' components resulted in 14% cost reduction.

	Front	Rear
Weight distribution (with driver)	50%	50%
Motion ratio	0.86	0.9
natural frequency	3.5 Hz	4.1 Hz
Rebound Damping ratio	84%	79%
Compression Damping Ratio	63%	60%

2016 ARB housing, with hexagonal grove for torsion bar.



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