FORMULA TECHNION 2015

Suspension & Steering Teams

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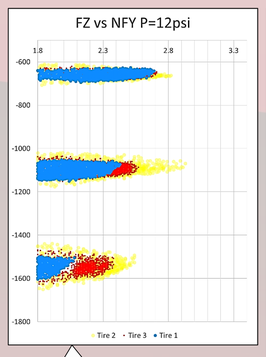
Wheel Assembly - Objectives & Requirements

- Choosing optimal tires for the car, while emphasizing coefficient of friction and performance on a skid-pad track.
- Increase reliability and strength of uprights and wheel hubs, that failed at the '14 car.
- Reduce total weight of the wheel assembly.
- Adjustable camber angle and adjustable axial position of the brake caliper.

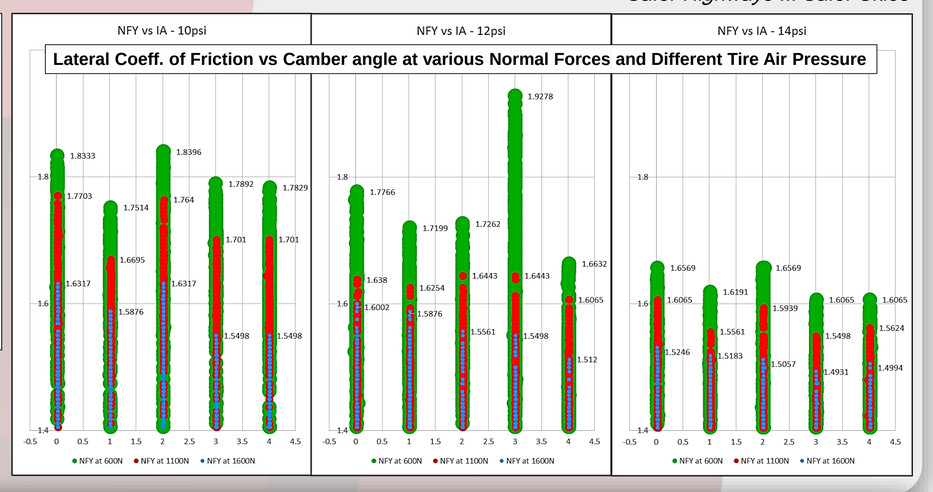
Wheel Assembly - Tires

- Analysis of the tire testing raw data, which was supplied by Calspan to the FSAE.
- Tire selection emphasized the friction coefficient, especially lateral friction, to improve tire performance during turning.
- The chosen tires are <u>Hoosier 20.0×7.5-13 .</u>
- Results of testing data analysis – used while designing the suspension system:
  1. Preferred Camber (Inclination) Angle: (-1°)÷(-2.5)°.
  2. Preferred tire air pressure: 12 psi .
  3. Average radial stiffness : 118,560 N/m .

Calspan – Safer Highways ... Safer Skies



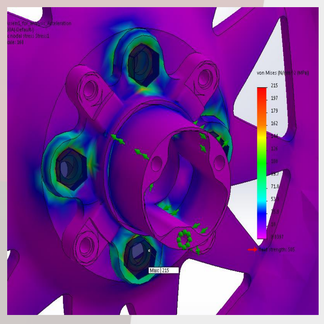
Lateral Coefficient of Friction, for 3 different tire models, at 12 psi.

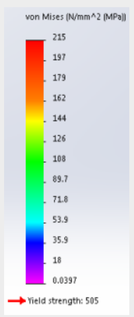


Wheel Assembly – Wheel Hubs & Uprights

<u>Wheel hubs:</u>

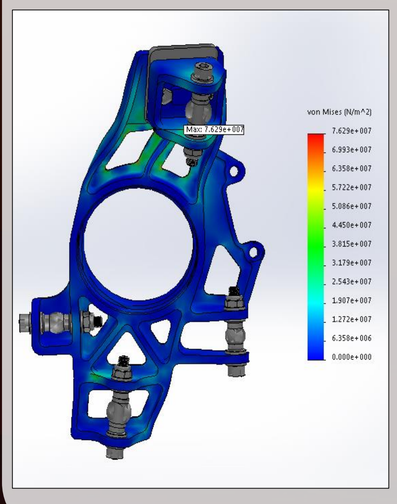
- Wheel hubs are CNC fabricated from Aluminum 7075-T6.
- Extensive, high quality SolidWorks Simulation® analyses were preformed for the wheel hub. These assembly simulations included the wheel rims, bearings , brake disc, and fasteners.
- Static and fatigue strength were evaluated, for various driving scenarios.

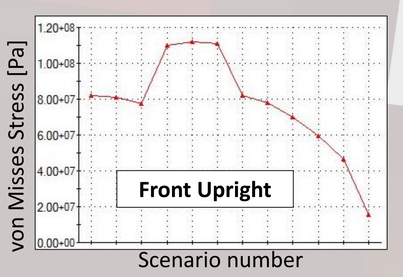


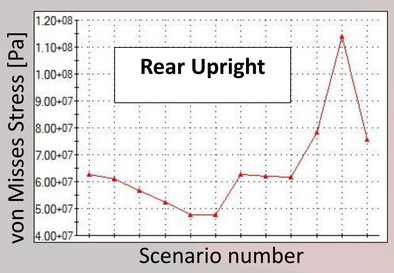


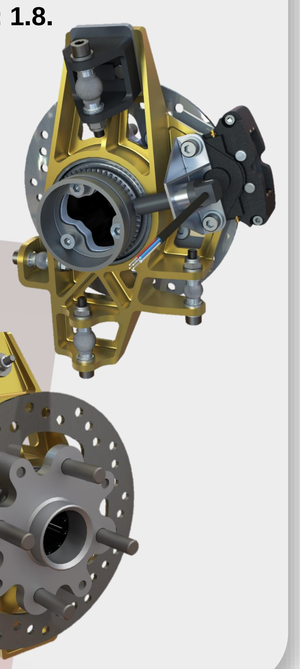
<u>Uprights:</u>

- Shim-Adjustable Caliper Axial Position and Camber Angle (1 Shim = 1 camber deg.).
- In-Assembly Stress Analysis, for various scenarios. Minimal FOS: 1.8.
- Universal Spacers for all Rod Ends and Ball Joints.
- CNC fabricated from Aluminum 7075-T6.









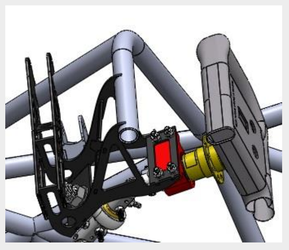
Steering System - Objectives & Requirements

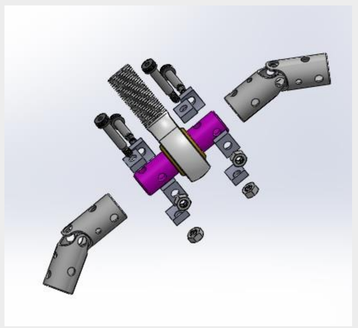
- Design a steering mechanism with high reliability to maintain high performance throughout its lifetime.
- Allow the car to preform a turn with radius of 3 meters.
- Reduce total weight of the steering system.
- Reduce play between components, and its increase over time.
- Steering system based on Rack & Pinion mechanism.

Steering System Description

<u>The system is composed of three sub-systems:</u>

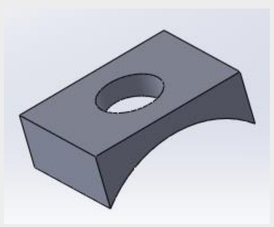
1. Steering column – containing the steering wheel, quick-release mechanism, U-joints and the shaft.
2. Steering column bearings – containing the upper bearing assembly and the intermediate ball joint.
3. Rack and pinion system – composed of rack assembly, radial and linear bearings, pinion and housing.

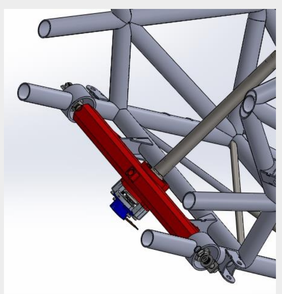




<u>Design Process:</u>

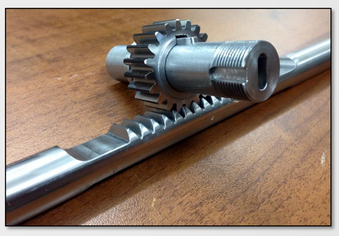
- In order to reduce the weight of the steering system we used a different kind of U-joint which, is much more lightweight.
- The new steering system has shaft stubs instead of splines, in order to transfer the movement of the steering wheel, through the steering column, to the wheels.
- The connection between the U-joints to the shafts has to be done with shoulder screw and a special washer.
- Unlike the 2014 system, this year, a steering sensor was added in order to measure the steering angle and evaluate its performance.
- To prevent the free play which increases with time, we used 'off the shelf' hardened pinion and matched it to a fabricated.





<u>Production & Materials:</u>

- The steering system is composed of 2 U-joint, approximately 60 degrees bent shaft, with shaft-based connections fabricated from AISI 4130 alloy.
- Rack & pinion housing made out of single-piece Magnesium alloy. It allows steering wheel rotation range of ±110 degrees to achieve the desired 3 meter radius turn.



<u>Design achievements:</u>

- 10% weight reduction.
- 38% Ackerman steering for cornering at 3m radius.
- Better steering accuracy and better fit between the rack & pinion mechanism.
- Angular velocity ratio between input and output shafts can be set to a linear ratio, or progressive ratio, depending on driver's preference.

Acknowledgments

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Design by Lucy Berry & Shahar Yehezkel