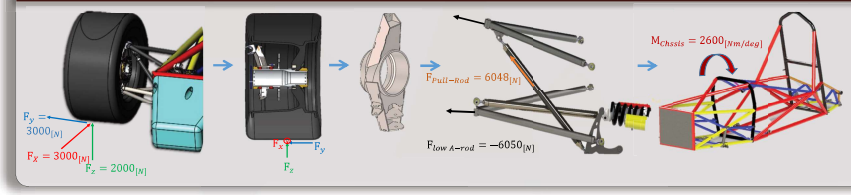
FORMULA TECHNION 2018

Structural & Mechanical

Structure Forces Flow

Compliance Under Cornering & Braking



Part	Compliance
Upright	$0.16mm$
Pull-rod	$0.53mm$
Rocker	$0.3mm$
Chassis	$\text{tg}(0.33°) \cdot 200mm = 1.15mm$
Total	$2.14mm$

$$\Delta x_{spring} = \frac{\tan(1.2)}{roll\ angle} \cdot \frac{0.3}{M.R.} \cdot \frac{630}{\frac{1}{2}\frac{axel}{width}} = 10.55mm$$

$$Compliance\ Ratio = \frac{2.14}{10.55} = 0.2$$

Wheel Assembly

System Requirements

- First time using 10'' O.Z Racing rims instead of 13'' in previous years
- 2.2 Factor of Safety

	FT17 (13")	FT18 (10")	Weight Reduction	Δ in %
Wheel rim	$2.45_{[Kg]}$	$1.66_{[Kg]}$	0.79[Kg]	32%
Upright	$742_{[gr]}$	$328_{[gr]}$	414[gr]	55%
Wheel Hub	$465_{[gr]}$	$356_{[gr]}$	109[gr]	23.5%

Design

General Specs-

- OZ Racing 10" (10C) single nut rims
- Hoosier 18.0X7.5 tires

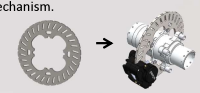
Design

Uprights

Mfg. method: Self-jigging design for welding of Titanium GR5 sheet metal.

Braking Disc

Mfg. method: Laser cutting of 4mm Thickness 1010 Steel With floating disc mechanism.

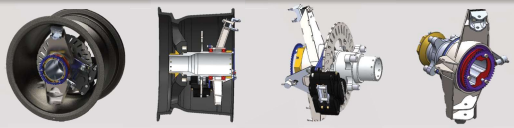


Analysis

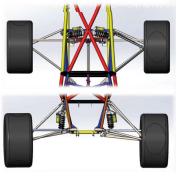
- Extensive SolidWorks® **Stress analysis:**

- **Lumped heat capacity analysis** for the brake rotor: (Max. Temperature of 454C)

Final Design



Pull-rod Suspension System



System Requirements

- Total weight of 7.8 Kg
- A-arm safety factor: 3
- Rocker safety factor: 2

Design

Rods :

- **Magnesium** pull-rods & tie-rods
- **Steel** A-rods

Rockers:

- Water-jet 2mm **Titanium** GR5 sheet metal
- Topological Optimization

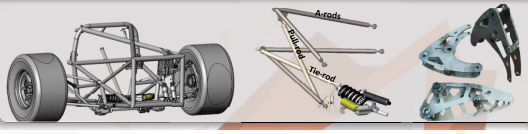
System:

- Damper & spring located inside the chassis, horizontally

Analysis

- MATLAB calculation of forces in tubes, by given normal and friction forces on wheel, **in different driving situations**
- **Strength distribution on rockers** simulation, under maximal forces and according to the required F.O.S

Final Design



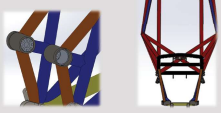
Chassis

System Requirements

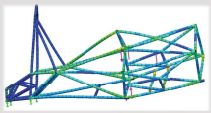
- Tubular Space Frame
- Total Weight: 21.5 Kg Including brackets
- Torsional stiffness: Over 2000 Nm/degree
- Stiff engine mounts

Design

- Front leaning Bracing
- Multiple members side impact structure
- Narrow Hoop, Wide center structure
- Aluminum Inserts for Engine mounts



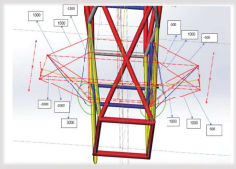
Analysis



$$\sum_{i=1}^{3} T_{i\ torsional} = 3 \cdot 500[N] \cdot 0.470[m] = 705[N \cdot m]$$

$$\theta_{max} = 0.27°$$

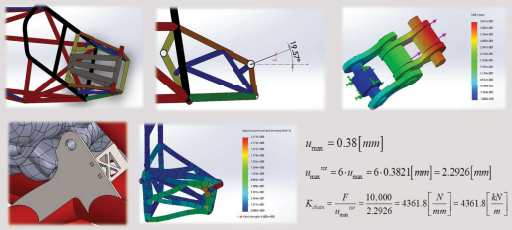
$$k = \frac{705}{0.27} = 2618\left[\frac{N \cdot m}{\text{deg}}\right]$$



Max. Load forces scheme

Stress Analysis for Max. Load forces

Analysis & Engine Mounts



$$u_{max} = 0.38[mm]$$

$$u_{max}^{tot} = 6 \cdot u_{max} = 6 \cdot 0.3821[mm] = 2.2926[mm]$$

$$K_{chass} = \frac{F}{u_{max}^{tot}} = \frac{10,000}{2.2926} = 4361.8\left[\frac{N}{mm}\right] = 4361.8\left[\frac{kN}{m}\right]$$

Final Design

Aerodynamic structure

System Requirements

General:

- Total Weight: 11.5 Kg
- Connections: rigid to the chassis
- Factor of safety: 1.5 for general design, 3 for composite materials connections

Undertray and side wings:

- Floor of the car
- Carrying the cooling system

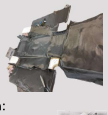
Rear wing:

- Supports the head restraint
- Supports the intake manifold
- DRS

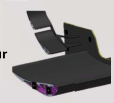
Design

Shared features:

- Wet lay-up of carbon T-300 CC90 and epoxy 520
- Sandwich structure with: honeycombs, 3D printing and Polyurethane

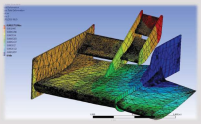


First year manufacturing composite materials in our workshop



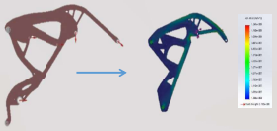
Analysis

Front wings' deflection:



ANSYS structure simulation

Swan-neck Rear wing connection:



Topological optimization using SolidThinking®

Final Design

Weight: 2.5 Kg | **Weight:** 4.5 Kg | **Weight:** 4.5 Kg