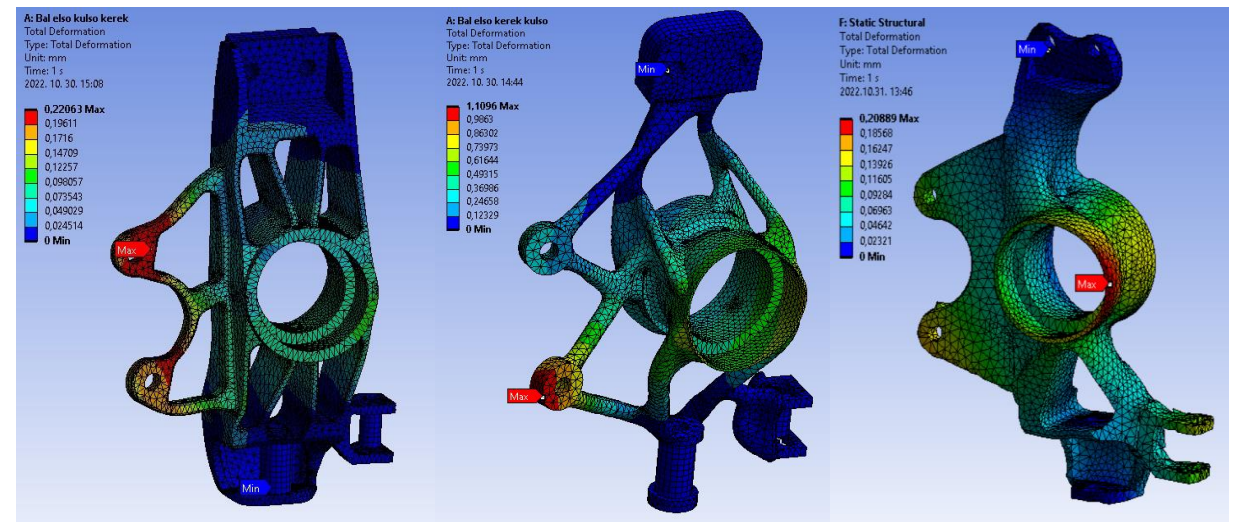


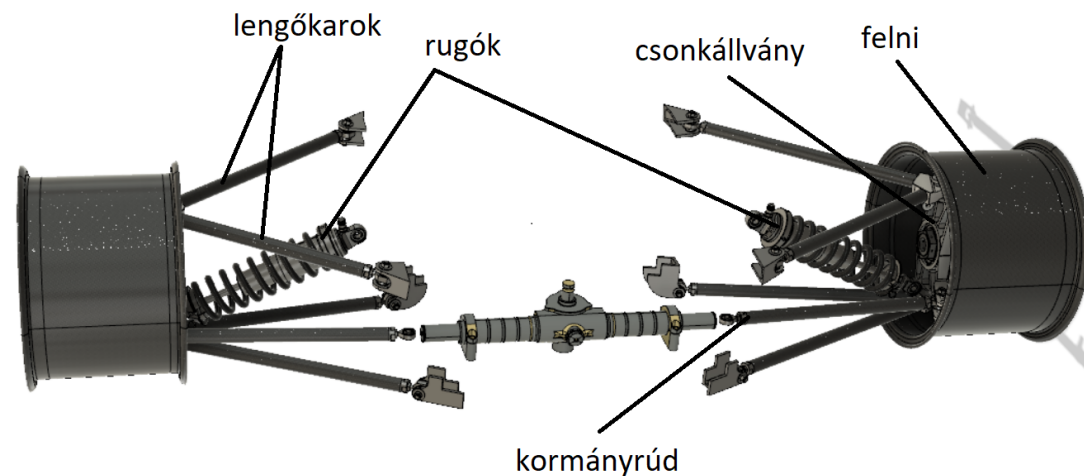
# STRUCTURAL OPTIMIZATION OF RACE CAR'S UPRIGHT

APPLICANT: MIHÁLY CSÁNYI  
CONSULTANT: DR. ILDIKÓ MOLNÁR  
INSTITUTION: ÓBUDA UNIVERSITY  
FACULTY: MECHANICAL ENGINEERING  
E-MAIL: CSANYI.MIHALY00@GMAIL.COM  
PHONE: +36 20 340 9900



# PROJECT OBJECTIVE

- ▶ In my research, I subjected the upright of the suspension system of the university's Formula Student race car to various development methods
- ▶ My primary goal was to reduce the weight of the upright while maintaining and improving its structural strength



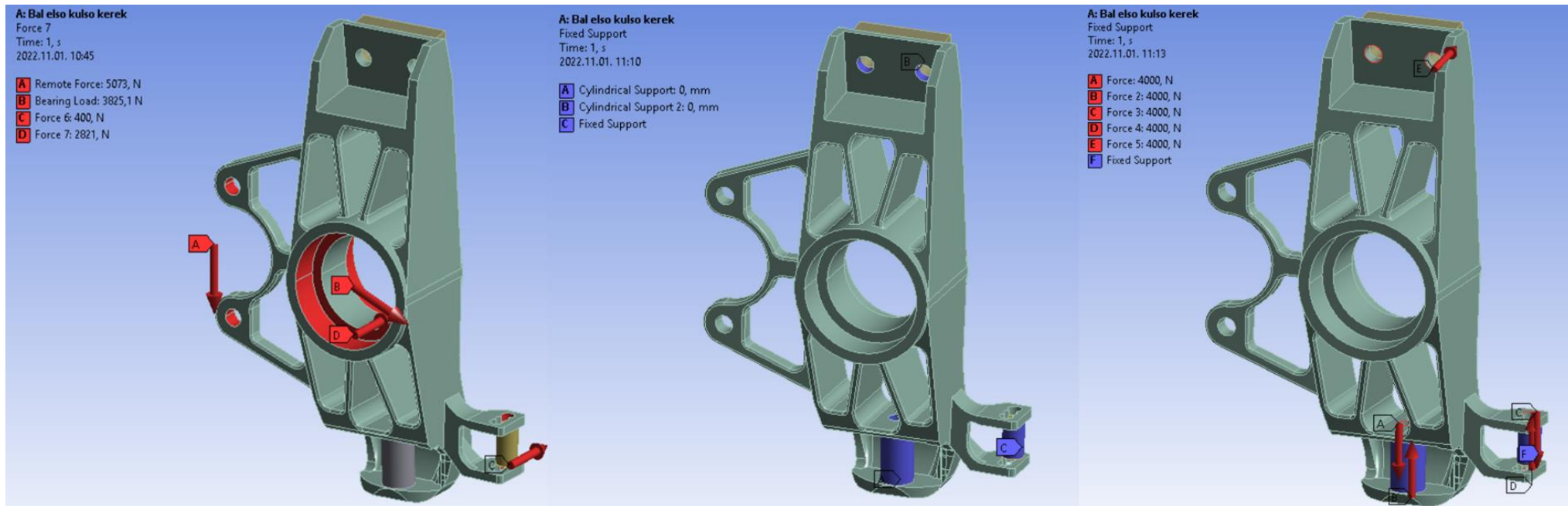
# MODEL STRUCTURE

- ▶ Parameters of the original uprights:
  - ▶ Mass: 530 gram
  - ▶ Material: Aluminium 6061
  - ▶ Density:  $2,7 \frac{\text{g}}{\text{cm}^3}$
- ▶ Applied optimization methods:
  - ▶ Generative design
  - ▶ Topology optimization (Shape optimization)
- ▶ The initial and optimized models were examined in static structural finite element simulation using Ansys program



# FINITE ELEMENT SIMULATION (ANSYS MECHANICAL)

- ▶ I examined the maximum deformations and stresses that arise during right-hand turns
- ▶ The input loads, constraints, and settings were defined based on preliminary simulations



# RESULTS

## ► Mass reduction:

### ► Generative design

- 530 gram -> **327 gram**
- Nearly 40% (**38,3%**)

### ► Topology optimization

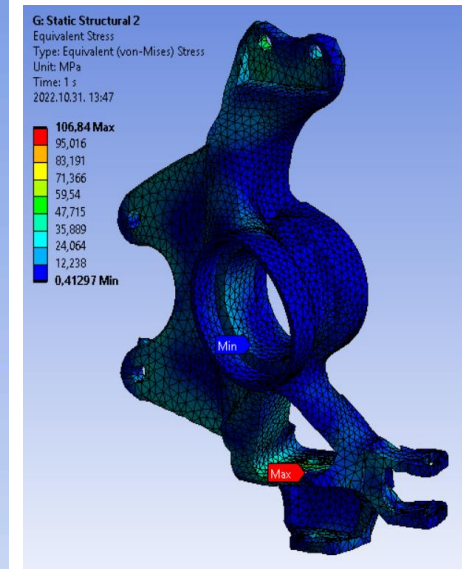
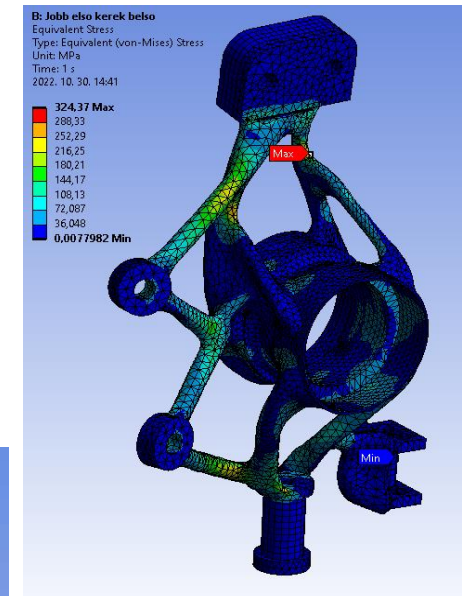
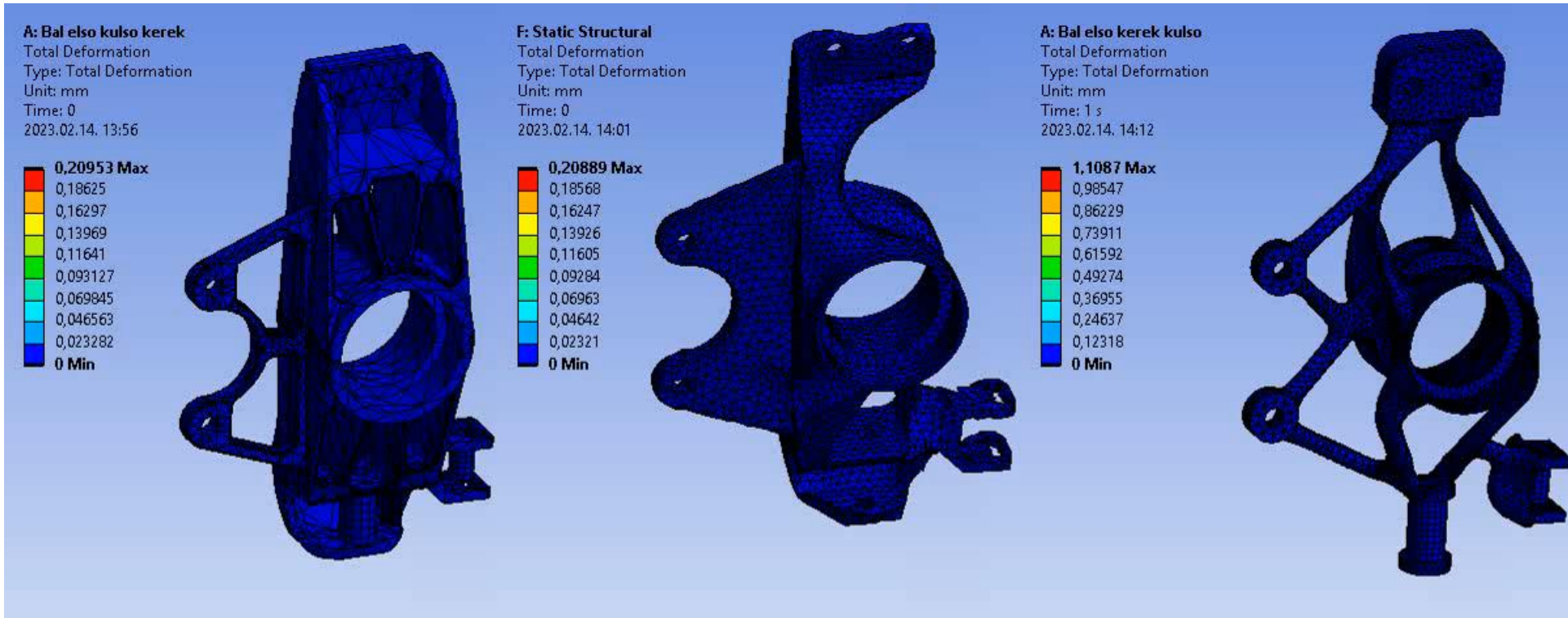
- 530 gram -> **428 gram**
- Nearly 20% (**19,2%**)

ANSYS	Category	Mass [g]	Material	Maximal stress [Mpa]	Minimal safety	Deformation [mm]
Generative design	Left front outer whell	327	Titan Al6-V4	569	1,55	1,1
Generative design	Right front inner wheel	327	Titan Al6-V4	324	2,7	0,78
Generative design	Left rear outer wheel	327	Titan Al6-V4	551	1,6	1,31
Generative design	Right rear inner wheel	327	Titan Al6-V4	308	2,87	0,73

ANSYS	Category	Mass [g]	Material	Maximal stress [Mpa]	Minimal safety	Deformation [mm]
Shape optimization	Left front outer whell	428	6060 Aluminium	158	1,74	0,21
Shape optimization	Right front inner wheel	428	6061 Aluminium	107	2,57	0,11
Shape optimization	Left rear outer wheel	428	6062 Aluminium	100	2,75	0,19
Shape optimization	Right rear inner wheel	428	6063 Aluminium	74	3,71	0,11

# RESULTS

The videos show the results of the static simulation of the left front upright, while the pictures depict the results of the static simulation of the right front upright



# CONCLUSION

- ▶ Safety takes precedence over weight reduction in vehicle development, therefore an upright created through shape optimization is a better choice
- ▶ To gain a more precise understanding of the structure of the bodies, I also performed transient finite element simulation, in which I examined the acceleration after full braking in the turn:

