

# **VIRTUAL ROPS TESTING ON SUSPENDED AGRICULTURAL TRACTOR**

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# Abstract & Keywords

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- *This paper is devoted to the agricultural tractor's rollover protective structure. The ROPS Code 4 testing procedure for small-sized suspended tractor has to be performed by technical experiment, but numerical simulation can significantly affect the number of testing. For that reason, the whole procedure is simulated by using finite element method software Ansys. A complex simulation contains models of rubber silent blocks and spring-damper suspension units. The protective structure is accepted for laboratory tests and ways of optimization or possible critical regions are proposed. Based on the results, presented approach has good correlation with technical experiment, thus can be used as powerful tool in the development phase.*
- **agricultural tractor, rolling over protective structure, ROPS, virtual ROPS, cabin**

# Introduction

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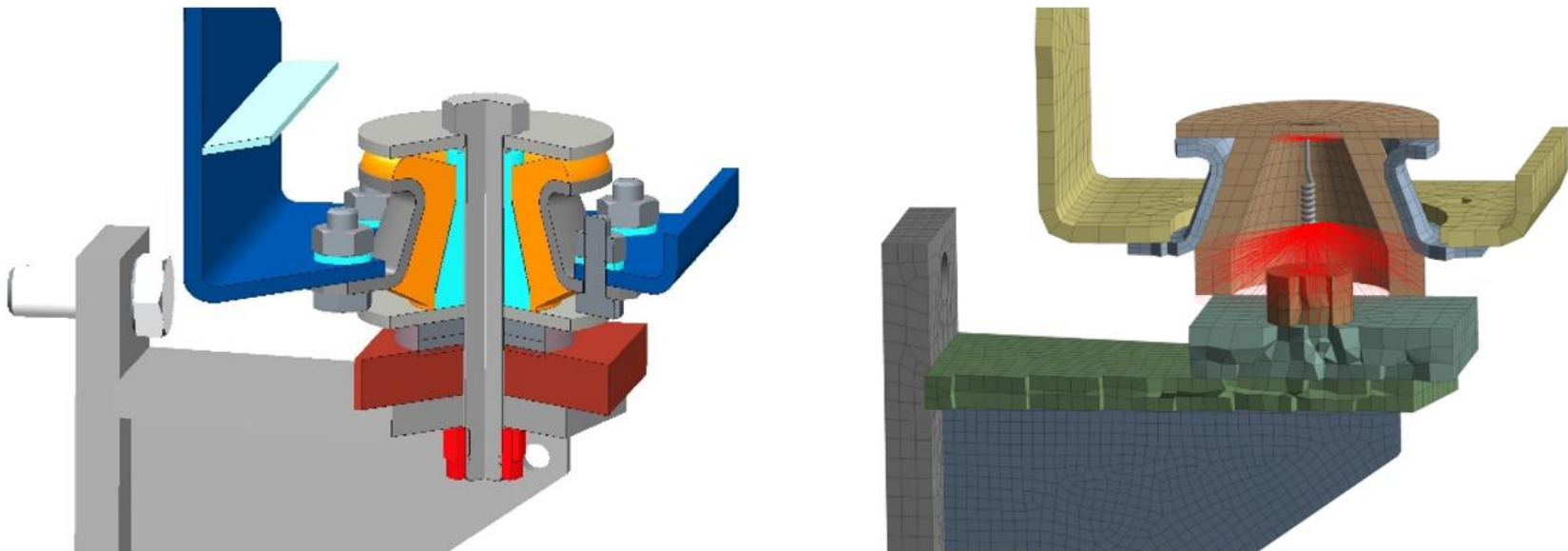
- A high **risk of overturning** exists during the work of an agricultural tractor
- OECD Code 4 testing procedure was introduced to ensure the driver protection
- Simulations of this procedure using FEM are being done to save resources in the design phase



# Methods

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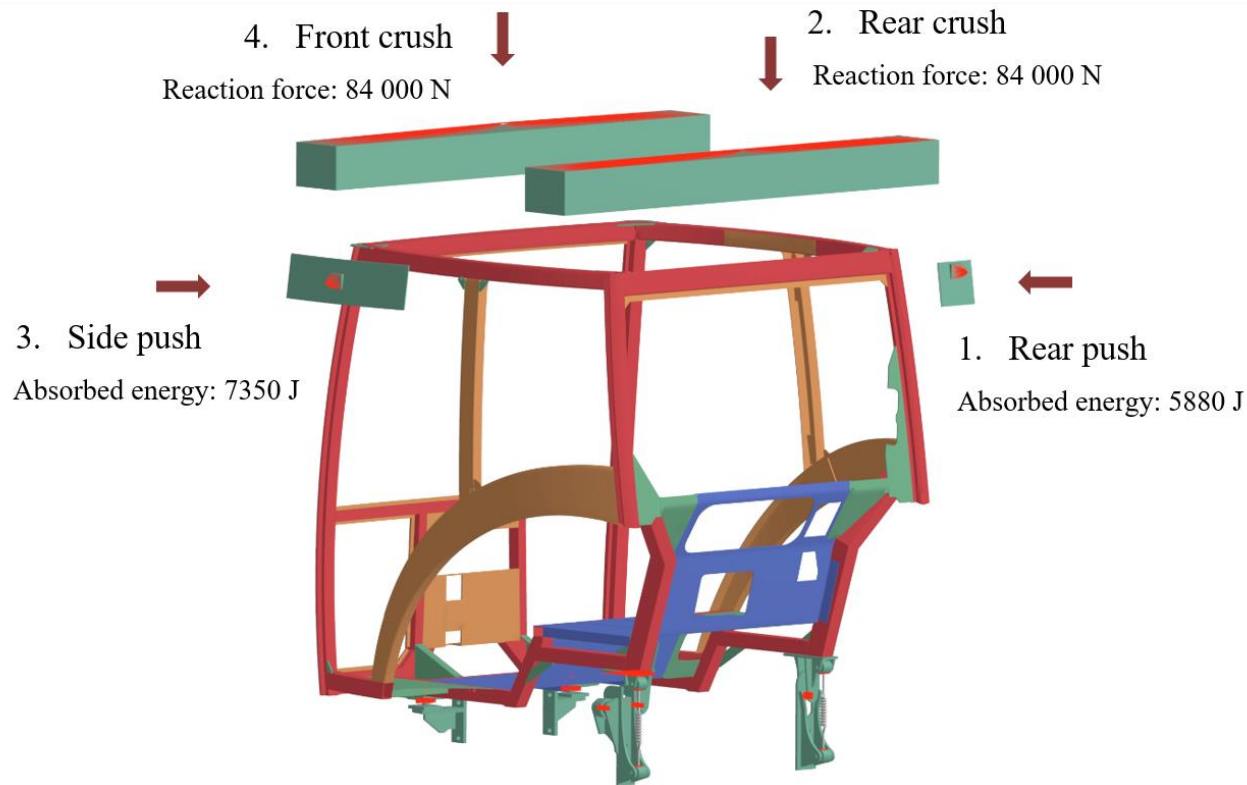
- Suspension elements and their connection had to be properly modelled – ansys virtual springs with a non-linear stress-strain characteristic were used
- Tubular steel was modelled as surface bodies



*Section of the axially oriented rubber silent block used in the front (left) and its simulation model (right).*

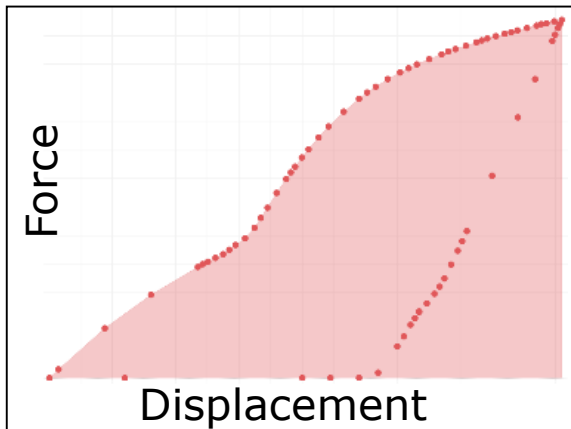
# ROPS Code 4 procedure – 4 loadings

■ The loading on the cabin frame is applied via „pushers“

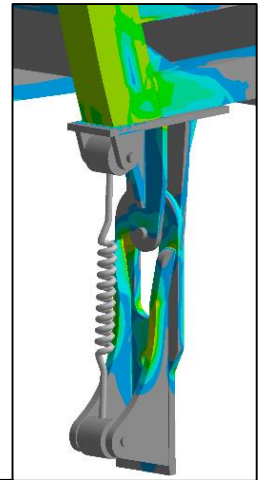
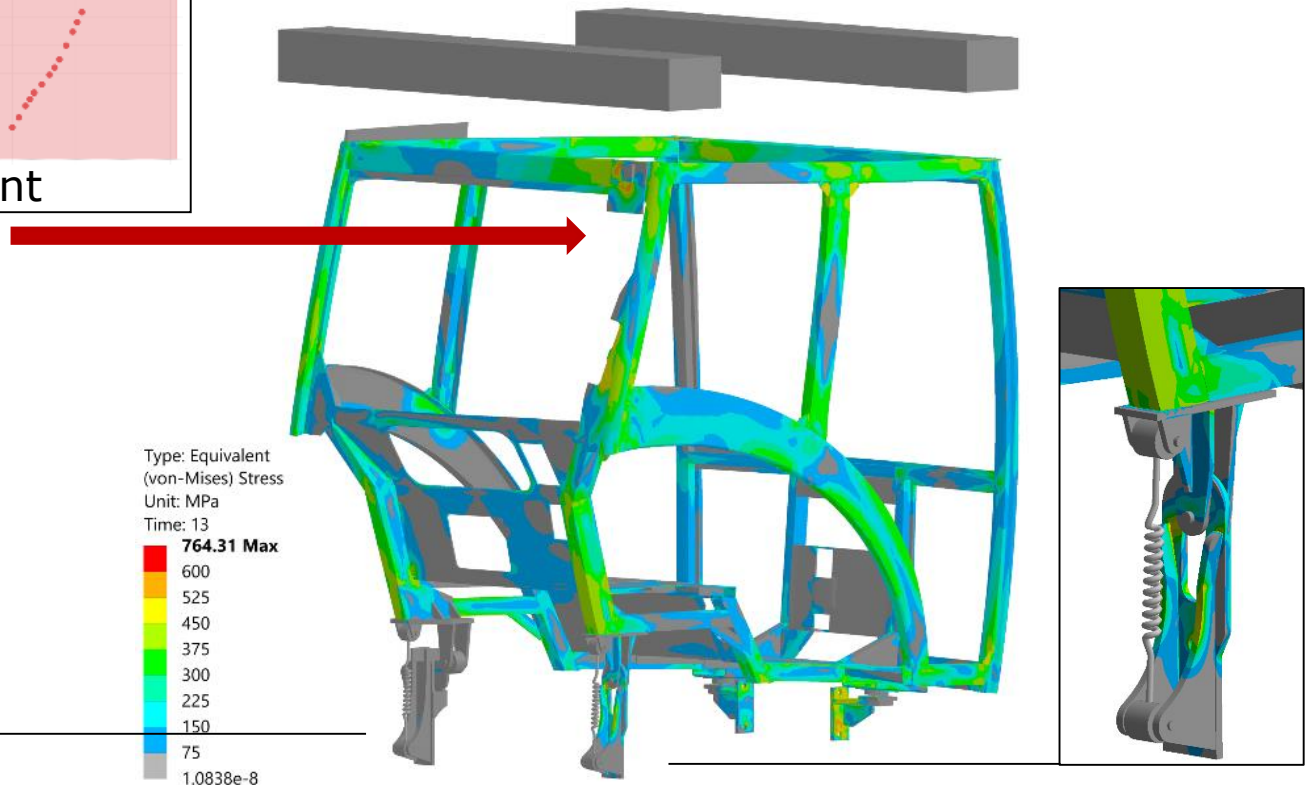
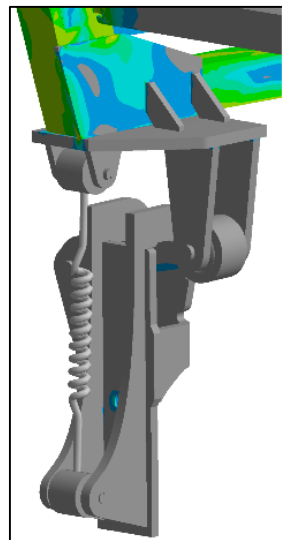


*Geometry used for the simulation. Different colours are assigned to different materials. Pushers with procedure rank number and corresponding **requirement** are shown. Also, red areas where constraints by means of Remote Points were applied can be seen.*

# Results – first load step



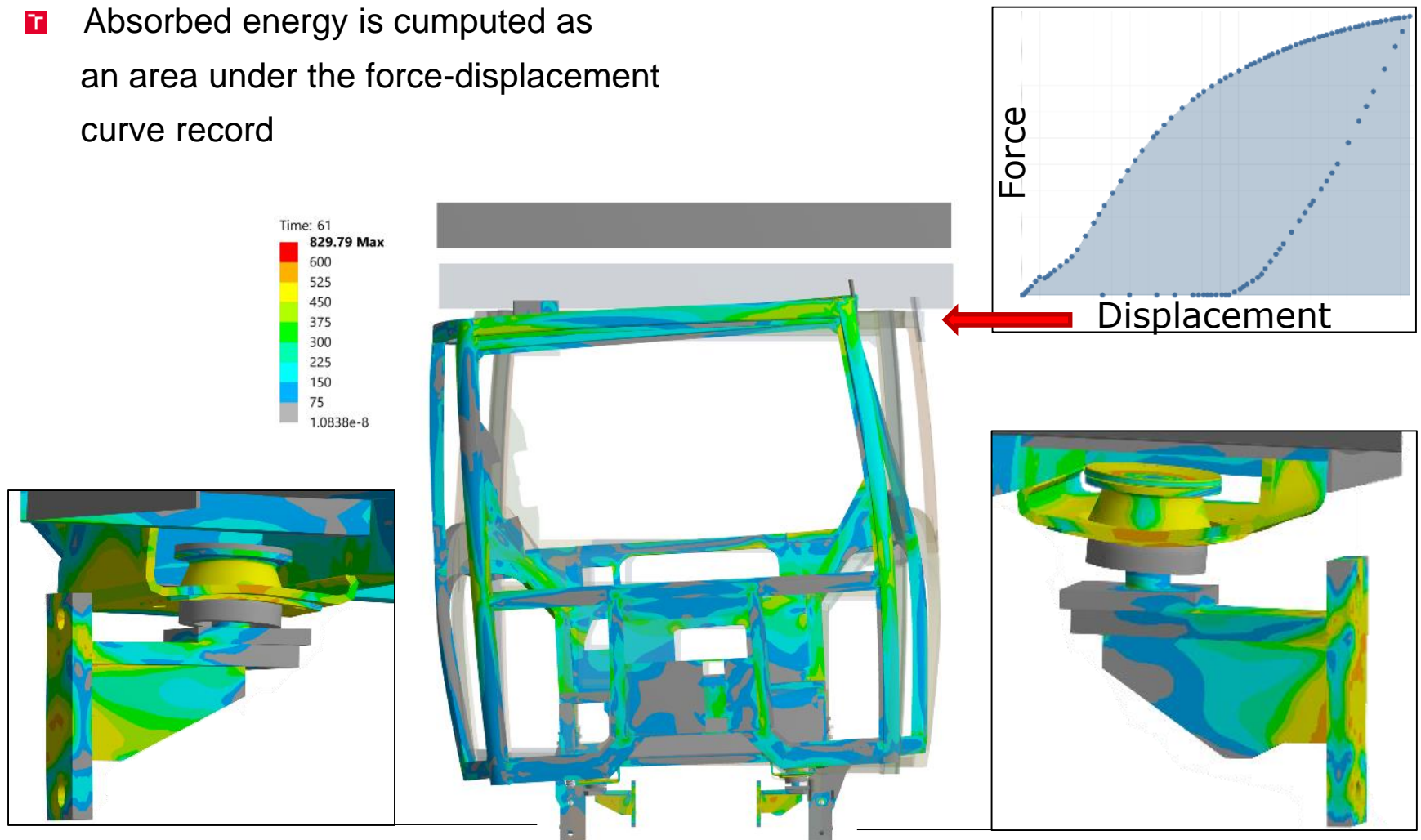
- The first and the third load steps, where certain absorbed energy is required were found to have significantly higher impact on the structure.



*Equivalent stress during the rear pushing with recorded absorbed energy diagram.*

# Results – third load step

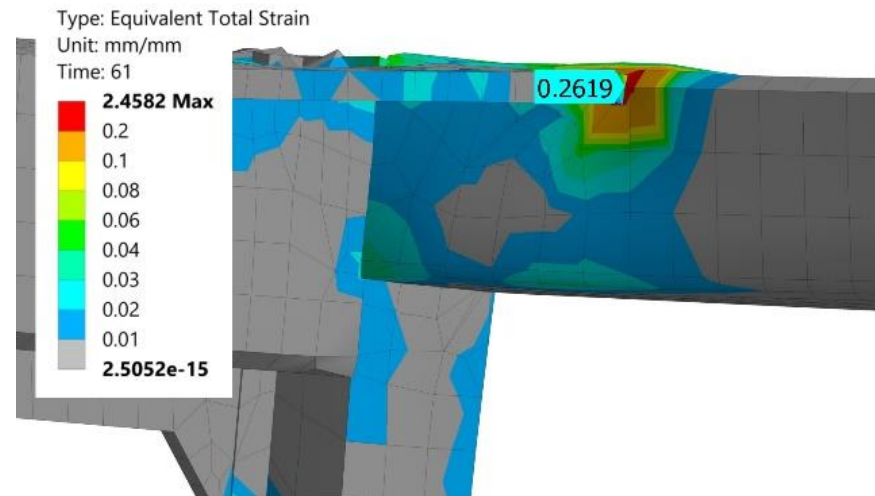
- ▣ Absorbed energy is computed as an area under the force-displacement curve record



*Equivalent stress during the side pushing with recorded absorbed energy diagram.*

# Conclusion

- The deformed shape matched the shape of experimental results
- The structure passed all four steps of the procedure
- The possibility to use the spring-damper element as a structural part is investigated



*Equivalent total strain exceeded 26 % in one of the top corners of the cabin frame. The simulation result is confronted with experimental testing of the frame.*





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**Thank you for your attention.**

# References

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- [1] Scarlett, A. OECD Tractor Test Codes - current development of ROPS testing procedures. Scarlett Research Ltd.