Contents of Work Package 4-WP10: Optimized Design for Vehicle Body Applications

4-WP10: Optimized Design for Vehicle Body Applications

Coordinator of the WP

University of Pardubice, responsible person: prof. Ing. Bohumil Culek, CSc.

Participants of the WP

SVOS, s.r.o. Ing. Jaroslav Černý

Main Goal of the WP

Based on experimental measurements and numerical FEM analyzis, to develop a new supporting frame of spetial vehicle that would meet the strength and fatigue requirements for the considered extraordinary load.

Optimization of Strength of the structure of the rear door of a passenger car.

Partial Goals for the Current Period

4-WP10-001 - Computational analysis of FEM Solidworks Simulation (strength check). Implementation of FEM analysis in the design of the supporting frame of a special vehicle. Strength optimization of the frame.

4-WP10-002 - Realization of driving tests – strain gauges measurement of deformations. Preliminary evaluations of test records.

4-WP10-003 - Cad import and meshing. Optimization based on one linear static load case.

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Official 4-WP10 Deliverables:

- 4-WP10-001 | **Functional sample of load-bearing part of the special vehicle**, G-funk, XII./2025, SVOS 0.9; UPa 0,1
- 4-WP10-002 | **Report of Analysis of Special Vehicle Support Frame Strength**, O, XII./2025, SVOS 0,2; UPa 0,8
- 4-WP10-003 | **Optimally lightweight tailgate structure of a passenger vehicle**, G-funk, XII./2025, SkodaAuto 0,8; CTU FME 0,2;

Activities in 4-WP10: Optimized Design for Vehicle Body Applications

4-WP10-001:

- A simulation model of the supporting frame of a special vehicle was created. The model was used to check the strength of the frame in the area of the front partitions under the drive unit and the front winch holder (design variant number 4). Computational analyzes were performed in Solidworks Simulation (MKP). The results of the strength calculations resulted in proposals for structural modifications of the winch holder and reinforcing ribs to meet the strength requirements. The frame was designed according to strength calculations and subsequently manufactured in SVOS, spol. s.r.o.

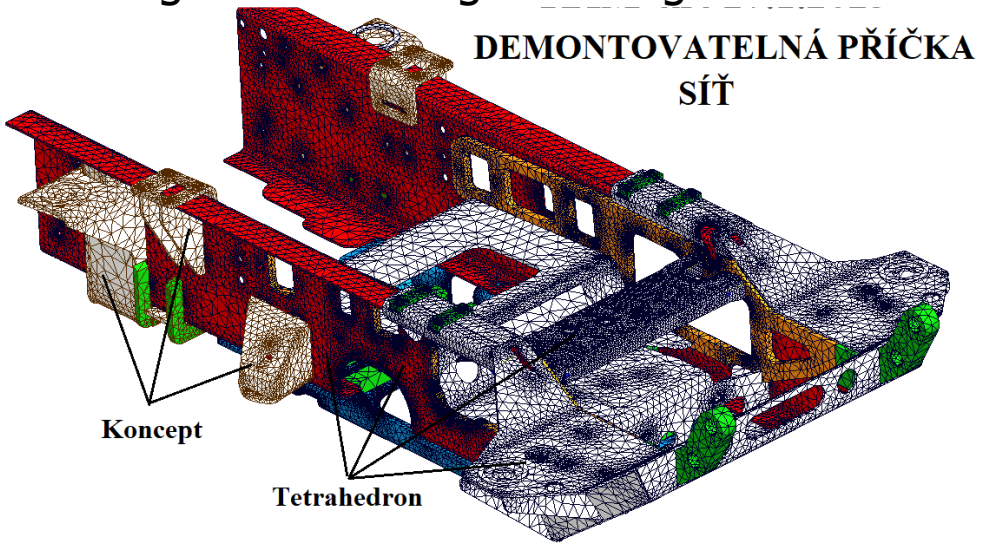


Fig. 1 Computational model-network

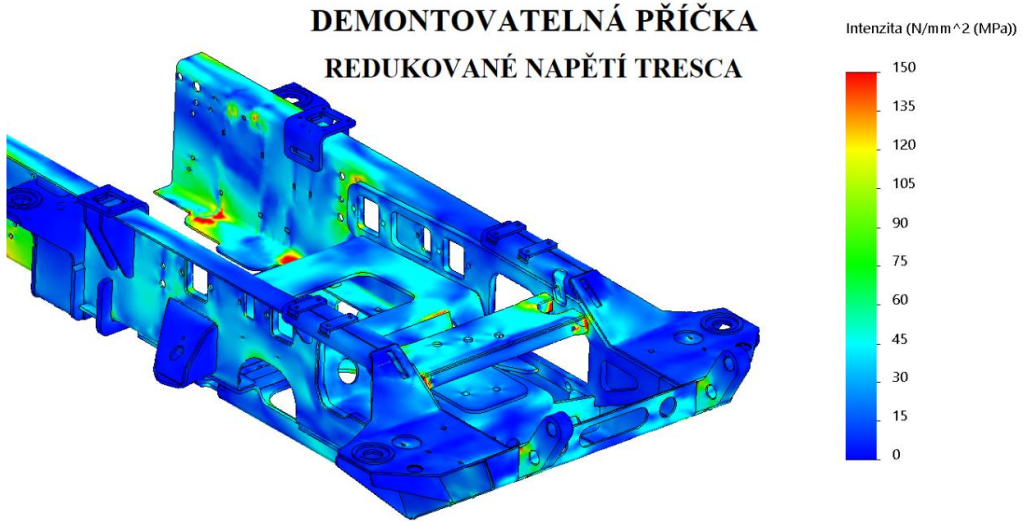


Fig. 2 Reduced mechanical stress - Tresca

Activities in 4-WP10: Optimized Design for Vehicle Body Applications

4-WP10-002:

- The driving tests on different track surfaces for the purpose of measuring mechanical stresses at selected locations (in accordance with FEM calculations). Preliminary analyzes of experimental measurement results were performed.

Fig. 3 Measuring the tension in the wheel suspension

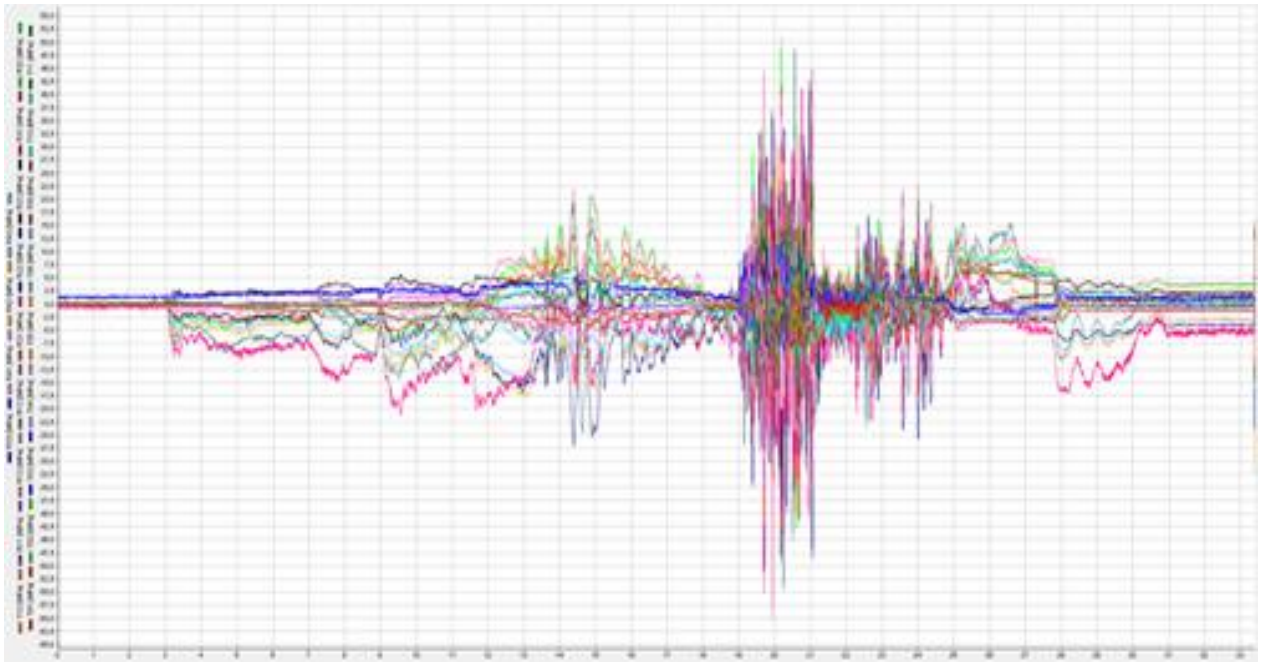


Fig. 4 Demonstration of the recording of the measured mechanical stress on the structure of the support frame

Activities in 4-WP10: Optimized Design for Vehicle Body Applications

4-WP10-003:

- CAD import (step file creation) and meshing was solved, use of Abaqus pre-processing, in-house script in development
- Optimization based on one linear static load case (definition of the Beam-based Topology Optimization, interpretation, verification)

Fig. 5 Strength calculation model of the rear door of a passenger car

Fulfillment of goals and deliverables of 4-WP10: Optimized Design for Vehicle Body Applications

Current State of Deliverables and Fulfillment of Goals

- 4-WP10-001 | Functional sample of load-bearing part of the special vehicle , G-funk, XII./2025, SVOS 0.9; UPa 0,1 – **is proceeding according to plan:**
  - FEM analysis of the chassis frame of a special vehicle (UPa, SVOS)
  - Structural modifications of the winch holder and reinforcing ribs (UPa)
  - Fabrication of a special vehicle frame, completion of whole car (SVOS)
- 4-WP10-002 | Report of Analysis of Special Vehicle Support Frame Strength , O, XII./2025, SVOS 0,2; UPa 0,8– **is proceeding according to plan:**
  - Depending on FEM calculations, identification of measurement points, gluing of strain gauges and acceleration sensors (UPCE)
  - Driving tests on the SVOS test track (UPa, SVOS)
  - Driving tests on the military area Vyškov (UPa, SVOS)
  - Preliminary evaluation of test records (UPa)
- 4-WP10-003 | Optimally lightweight tailgate structure of a passenger vehicle, G-funk, XII./2025, SkodaAuto 0,8; CTU FME 0,2; – **is proceeding according to plan**:
  - CAD import and meshing, Beam-based Topology Optimization.

Fulfillment of goals and deliverables of 4-WP10: Optimized Design for Vehicle Body Applications

List of Due Deliverables and Their Added Value

- **4-WP10-001** – Modification (reinforcement) of the chassis frame of a special vehicle, installation of the front winch SuperWinch Talon 18.

This major modification of the frame together with other modifications:

- Damper consoles
- Reinforcing ribs of the front part of the frame
- Torsion element of the hatch hinge

leads to an increase in the useful properties of the special vehicle and thus to its greater competitiveness.

Current contribution of 4-WP10: Optimized Design for Vehicle Body Applications

Assessment of the Contribution of Deliverables

- The solution to the dynamic strength of the frame of a special vehicle using high-strength steel can be used in the construction of the load-bearing parts of any means of transport.
- Optimizing the structure of the rear door of a passenger car results in a reduction in weight and thus a benefit to environmental protection.

Continuity within this project can be seen in these WP: 3-WP10, 4-WP05, 4-WP9, 4-WP10 and potential for other projects is in Transport 2030.

Current contribution of 4-WP10: Optimized Design for Vehicle Body Applications

Assessment of the Formal/Administrative Goals of the Work Package

Asseeement of formal and economic tasks in 2023 is not at risk.

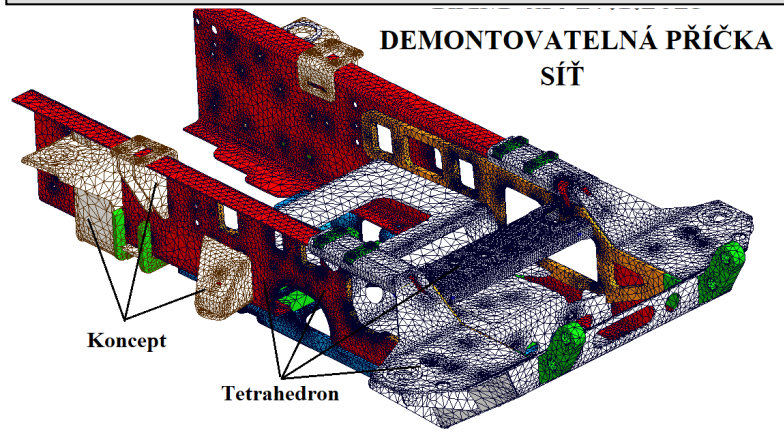
Both the University of Pardubice and the company SVOS are proceeding according to plan.

Current contribution of 4-WP10: Optimized Design for Vehicle Body Applications

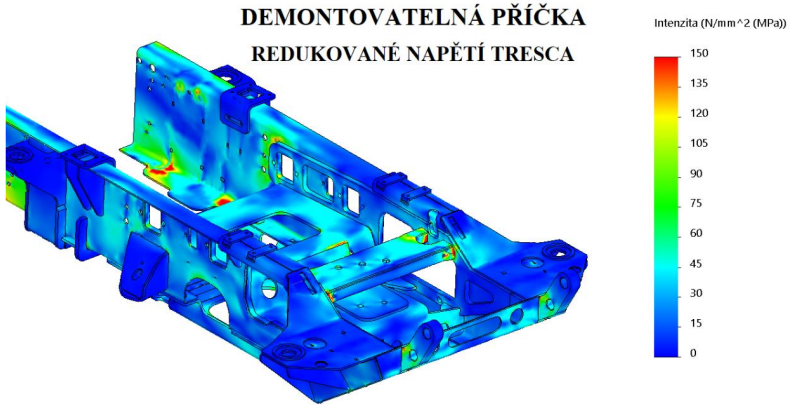
Acknowledgment

This research has been realized using the support of Technological Agency, Czech Republic, programme National Competence Centres II, project # TN02000054 Božek Vehicle Engineering National Center of Competence (BOVENAC).

Current contribution of 4-WP10: Optimized Design for Vehicle Body Applications

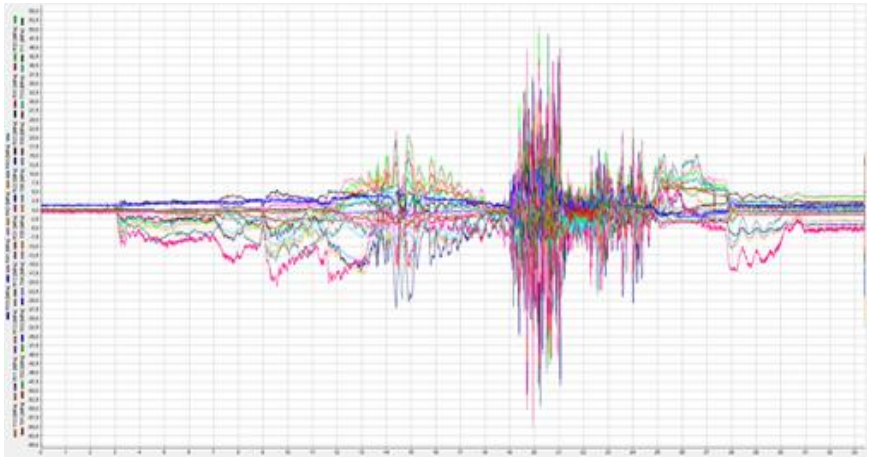


Výpočtový model rámu s přišroubovanou příčkou - síť



Redukované mechanické napětí rámu (Tresca)

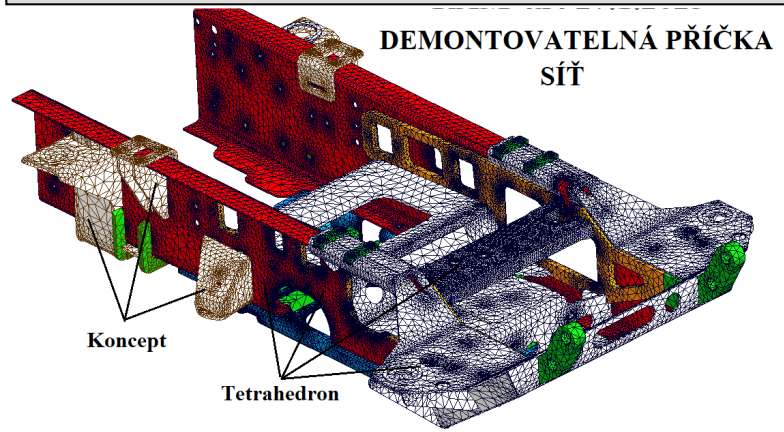
Tenzometrické měření mechanického napětí v pojezdu speciálního vozidla



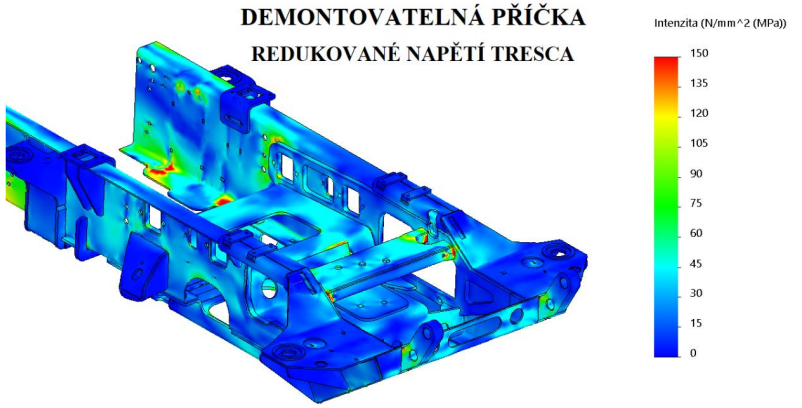
Ukázka záznamu naměřených mechanických napětí na konstrukci nosného rámu speciálního vozidla

Pevnostní výpočtový model pevnosti zadních dveří osobního automobilu

Current contribution of 4-WP10: Optimized Design for Vehicle Body Applications

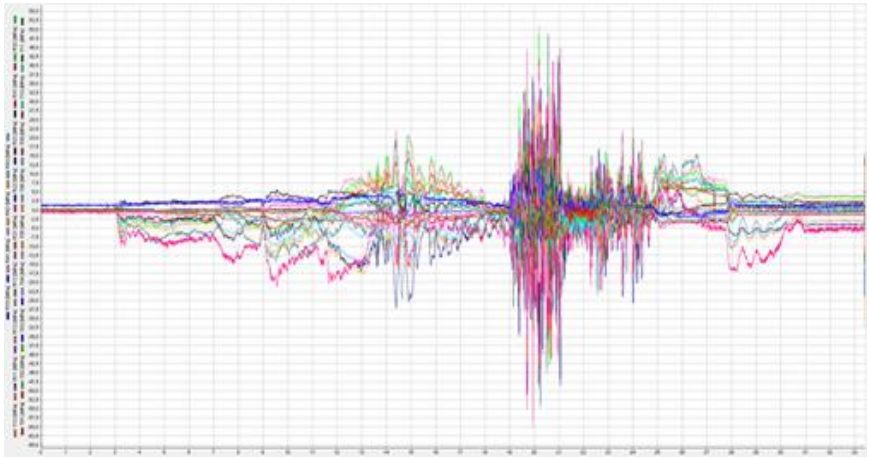


Computational model of a frame with a bolted crossbar - net



Reduced mechanical stress on the frame (Tresca)

An example of tensiometric measurement of the mechanical stress of thestructure of special vehicle



Demonstration of the recording of measured mechanical stresses on the structure of the supporting frame of a special vehicle

Strength calculation model of the strength of the rear door of a passenger car