Contents of Work Package 2-WP09 Vehicle bodies and frames

2-WP09: Vehicle bodies and frames

Coordinator of the WP

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Participants of the WP

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Main Goal of the WP The main goal is to optimize the processes of the ligthweight structural parts design. Two functional samples - design of bus-body (2-WP09-002) and desing of an off-road vehicle chassis (2-WP09-03), represent the adaptation of advanced approaches to reach the increased operational safety and pay-load simultaneously. Based on the previous experience with the high strength steels application, the research aimes to decrease the time to implementation by reliable tests using the functional samples at defined load conditions. Deadline for the both functional samples is 12/2020.

Partial Goals for the Current Period

2 – WP09 – 001 Presentation of the article in Perners Contact

Design of the bus body using the lightweight constructions made of high-strength materials. Presentation at a conference or in a periodical. Deadline 10/2020

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The essence of the 2-WP09 solution is the design and verification of the application of high-strength and lightweight materials in the construction of bus bodies and frame constructions of special vehicles. So far, several designs of structural elements of bus bodies and chassis frames of special vehicles have been designed and manufactured. Both cases were tested on a dynamic stand in the form of functional samples. The tests were focused on verifying the fatigue strength of the functional samples produced in this way. The result of the tests of the bus body structural parts are the characteristics of the mechanical stress σ - the number of cycles N until the failure. In the case of a special vehicle frame, it is the dependence of the loading force F - the number of cycles N until the fault occurs. In both cases, the tests continued until complete fracture in order to obtain information about the cracks propagation and about the structure residual life after the crack occurred. Thus, with the help of theoretical calculations, simulations and experimental research using the dynamic stand, the 2-WP09 solution aims to optimize the structures of bus bodies and frames of special vehicles in order to reduce their weight.

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Fig. 1 - Fatigue test of the special vehicle frame

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Fig. 2 - Fatigue test of the structural part of the bus body

Activities in 2-WP09 Vehicle bodies and frames

In 2020, the strength computational optimization of the frame of a special vehicle was performed - see Fig. 3. The frame was installed to a dynamic stand and subjected to experimental fatigue verification - see Fig. 4. Signals of hydraulic cylinders – see Fig. 5. The results of this experiment are shown in Fig. 6

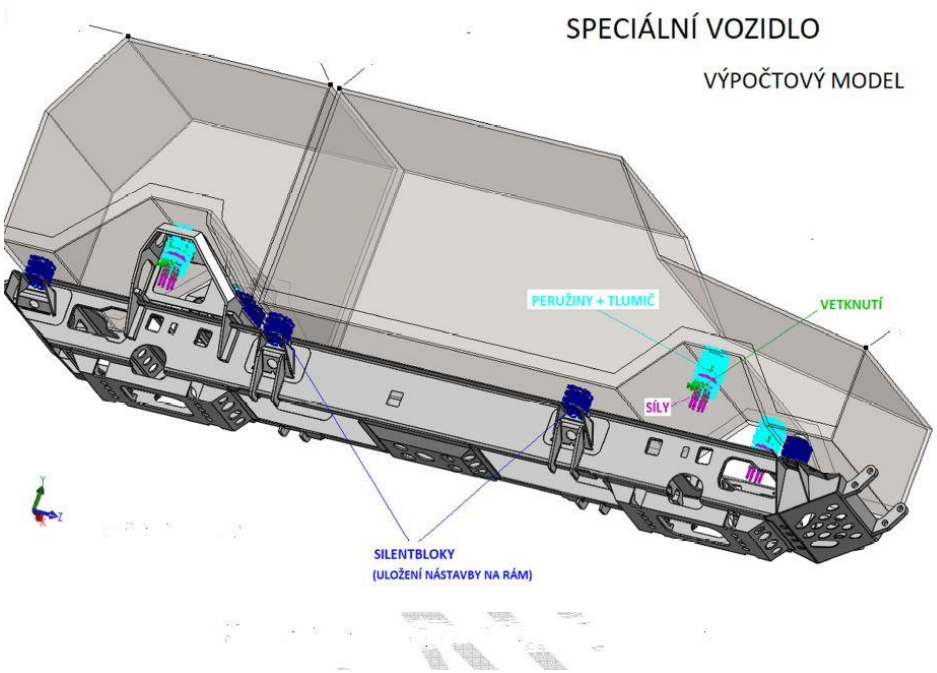
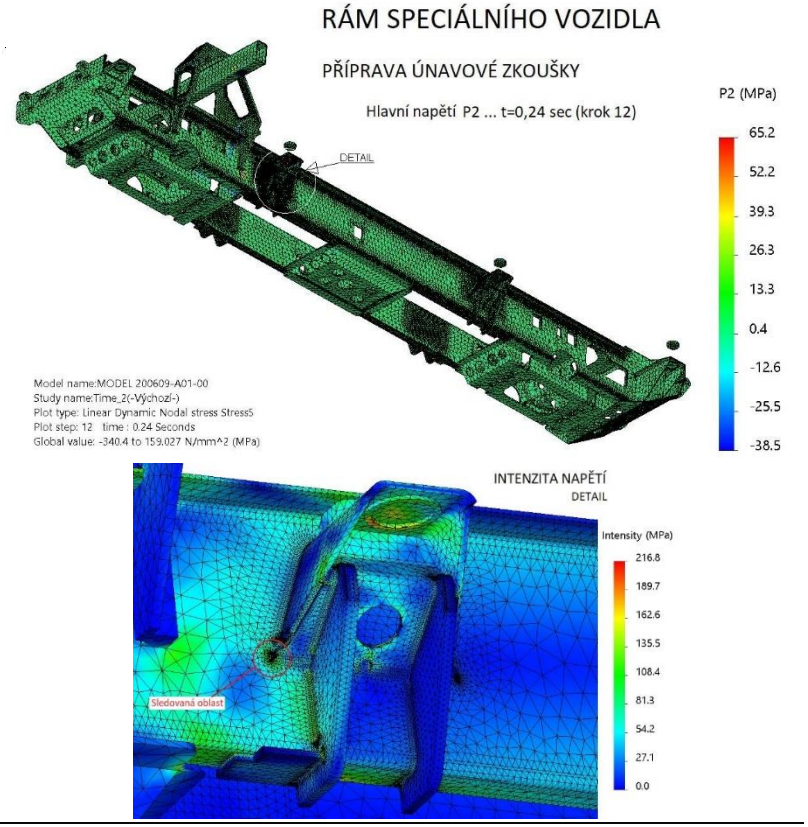


Fig. 3 - optimization of the frame



Activities in 2-WP09 Vehicle bodies and frames

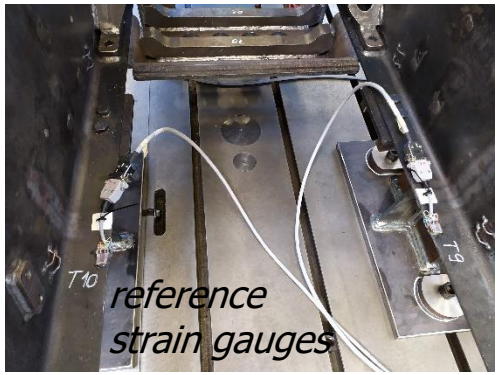


Fig. 4 - frame installed at the dynamic stand

Activities in 2-WP09 Vehicle bodies and frames

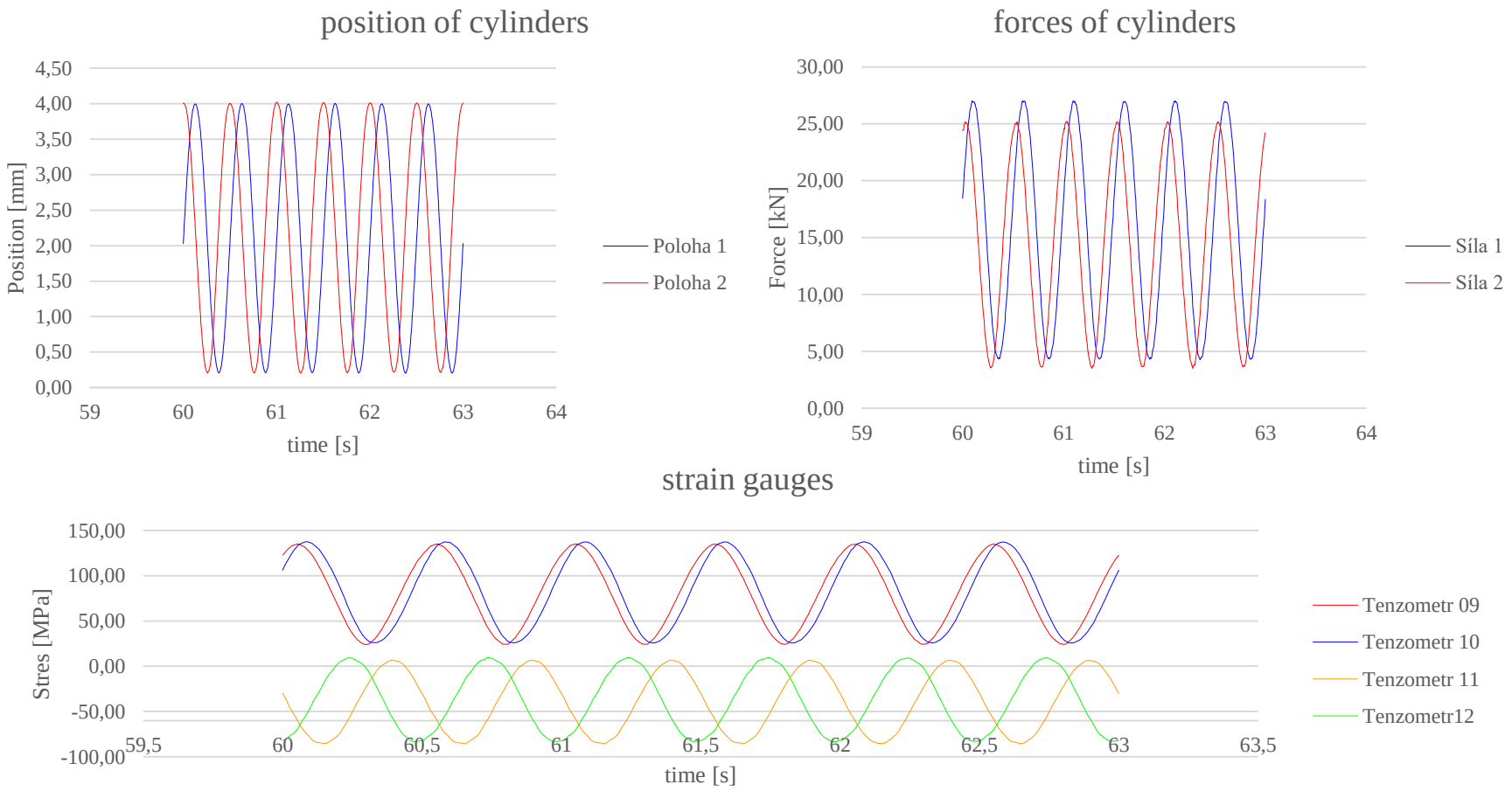


Fig. 5- signals of hydraulic cylinders

Activities in 2-WP09 Vehicle bodies and frames

The purpose of this activity was to verify the dynamic strength of a functional sample of the chassis frame of a special vehicle. The functional sample was computationally strength-optimized using multi-body simulations. Its computationally determined critical point - see Fig. 4 - was monitored visually and using reference strain gauges during the fatigue test. The test results showed that the mentioned critical point is right in terms of dynamic strength. On the contrary, the fault occurred in another place of the frame - see Fig. 6. This place will be structurally modified. This will create a new functional sample, which will be subjected to fatigue tests again.

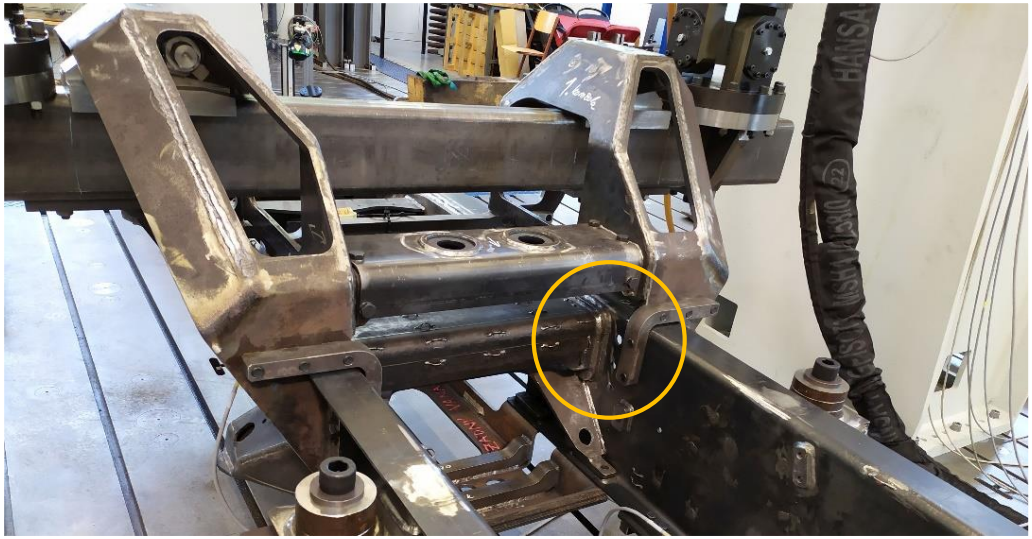


Fig. 6 – critical point

Activities in 2-WP09 Vehicle bodies and frames

Another activity was experimental research of welded versus riveted sheets of bus bodies. The research was carried out on a dynamic stand - see Fig. 7. This was solved in connection with the dynamic strength of bus bodies. The results in the form of fatigue characteristics are shown in Fig. 8.

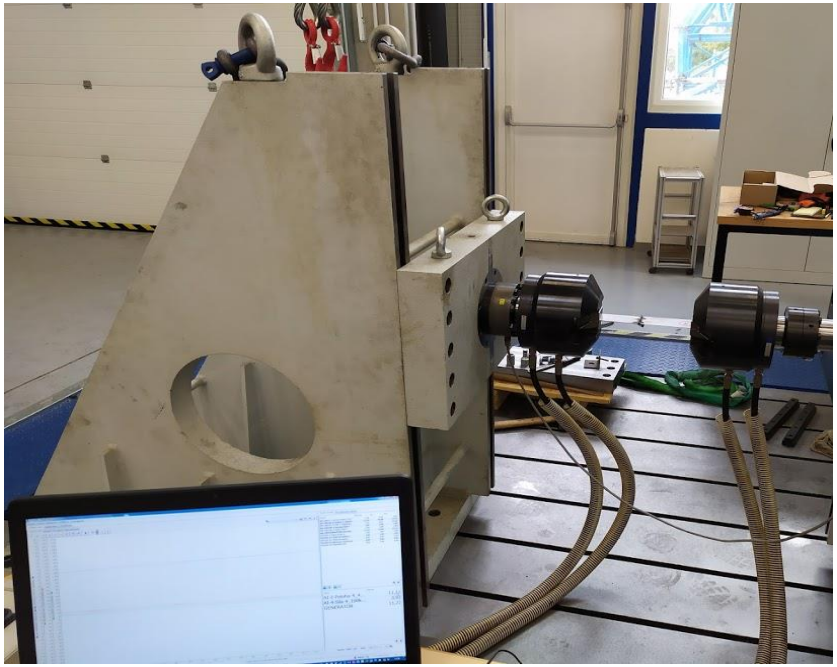


Fig. 7 – dynamic testing of welded versus riveted sheets

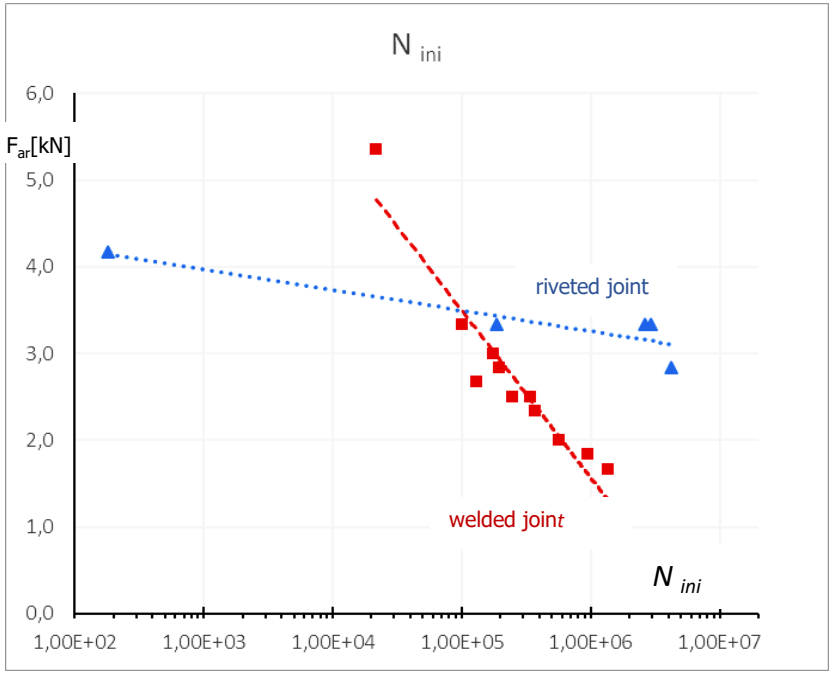


Fig. 8 – results of dynamic testing of welded versus riveted sheets

Activities in 2-WP09 Vehicle bodies and frames

Another activity was experimental research of samples of light structures on a dynamic stand, using the tensotast system and equipment for bending under rotation. Various hollow samples of high-strength materials were tested - see Fig. 9, 11. The results are shown in Fig. 10, 12.

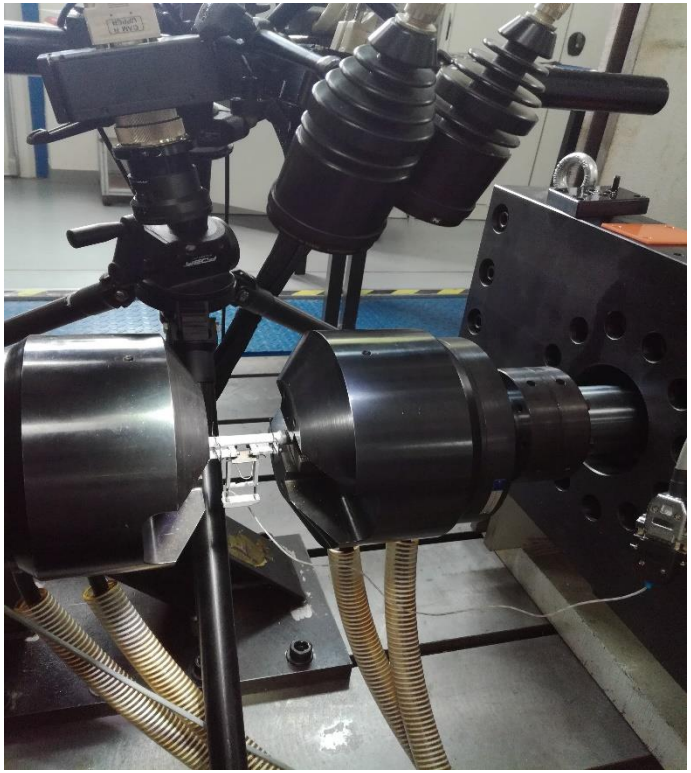


Fig. 9– static testing of lightweight structures

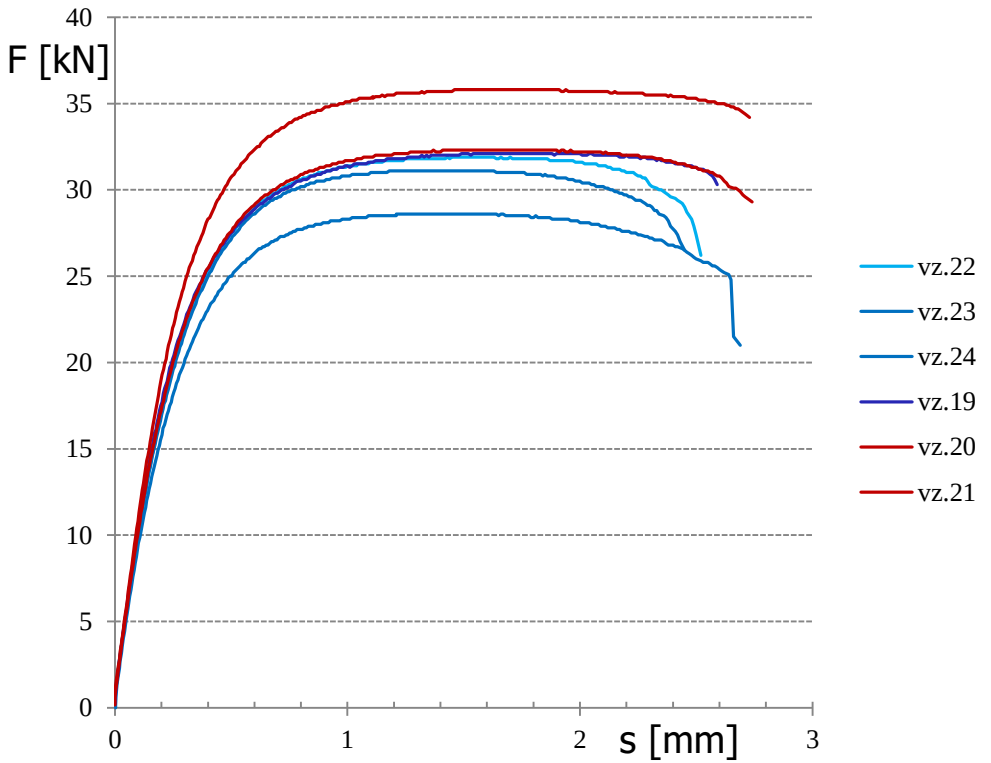


Fig. 10– examples of static tests results

Activities in 2-WP09 Vehicle bodies and frames

Fig. 11
rotating bending fatigue test

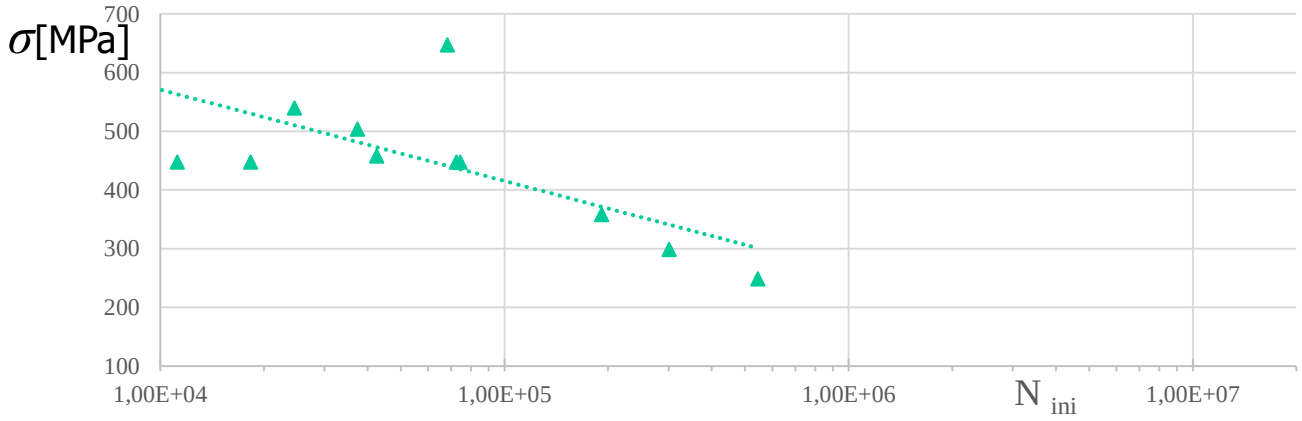


Fig. 12
result of rotating bending fatigue test

Fulfillment of goals and deliverables of 2-WP09 Vehicle bodies and frames

Current State of Deliverables, Milestones and Fulfillment of Goals

2-WP09 tasks are fulfilled according to plan. Two functional samples - design of bus-body and desing of an off-road vehicle chassis were examined. Increased strength and service life along with reduced weight was proven by complex numerical and experimental analyzes. The aimed reduction of fuel consumption can therefore be achieved with a new design.

List of Due Deliverables and Their Added

Two functional samples (2-WP09-002) (2-WP09-003), concerning a special vehicle and a bus body, are made of high-strength materials that will reduce the total weight of these vehicles. This will increase their competitiveness, as lower weight means lower fuel consumption and thus a positive impact on the environment. The project enabled students to participate in the research. Overall, the solution of the project led to a deepening of cooperation between the University of Pardubice and the companies SVOS and Iveco.

Another result of 2-WP09-001 is a contribution to the professional magazine Perners Contact. This will contribute to better information for the professional public.

Current contribution of 2-WP09 Vehicle bodies and frames

Assessment of the Contribution of Deliverables

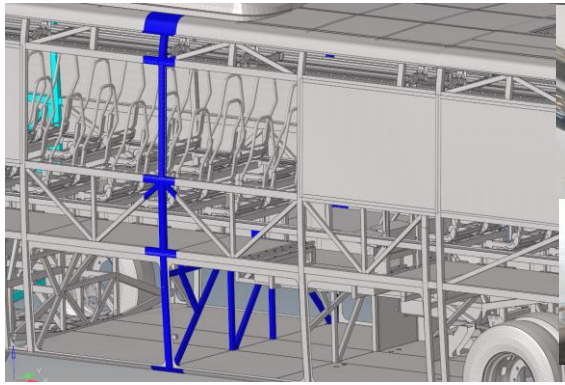
In the previous solution 2-WP 09, the basic phases of application research focused on the use of high-strength steels for the construction of the bus body and the construction of the frame of a special vehicle were processed. The performed research activities led to the creation of functional samples of the frame of a special vehicle and the construction segment of the bus body. In both cases, the research focused on reducing the weight of these vehicles while increasing their dynamic strength and durability. Both weight and strength parameters play a significant role in ensuring the safe operation of these vehicles. At the same time, reducing the weight will lead to a reduction in fuel and thus to a reduction negative impact on the environment of the operation of these vehicles.

The results can be generally used in the issue of fatigue testing of other structures, such as structures developed in 2-WP01, or others. Solution of 2-WP09 can be associated to program of TACR 2020 - Transport, in the issue of traffic safety.

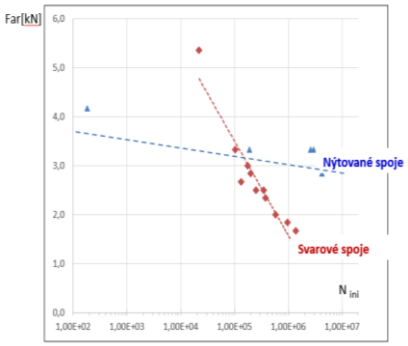
Acknowledgement

This research has been realized using the support of Technological Agency, Czech Republic, programme National Competence Centres, project # TN01000026 Josef Bozek National Center of Competence for Surface Vehicles.
This support is gratefully acknowledged.

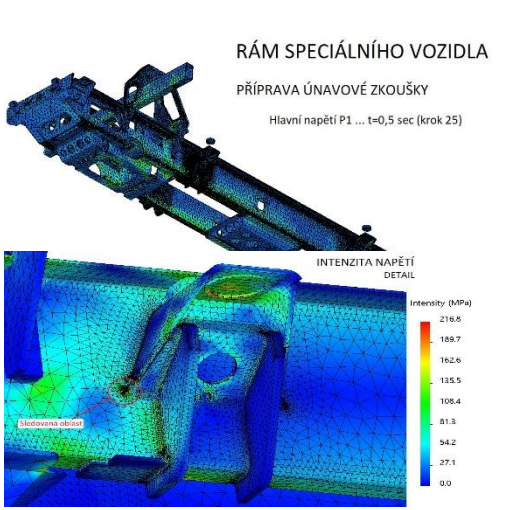
Výtah z prací 2019-2020 na 2-WP09 Karoserie a rámy vozidel





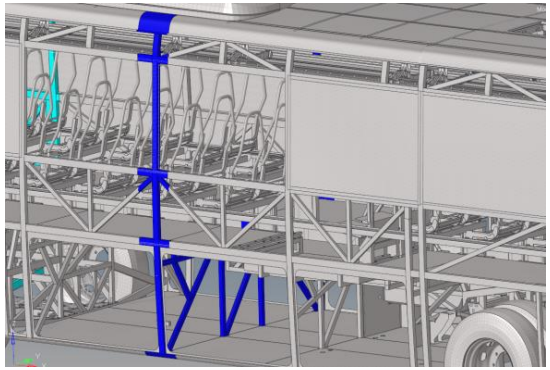


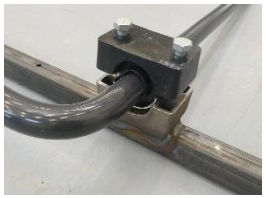
Byly provedeny únavové testy vzorků karoserie autobusu z vysokopevné oceli.

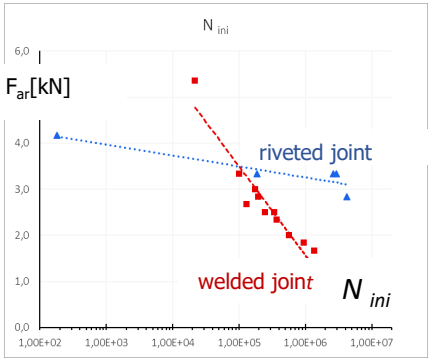



Rám speciálního vozidla byl podroben pevnostnímu ověření na dynamickém stavu.

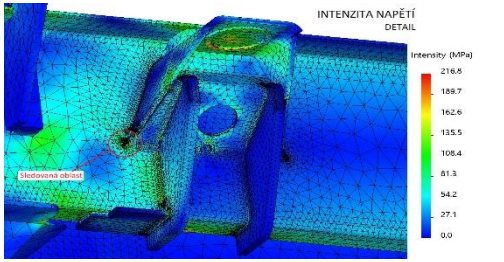
Results of 2-WP09 Vehicle bodies and frames–Achieved 2019-2020

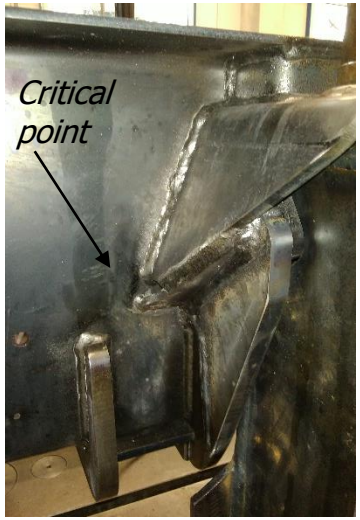


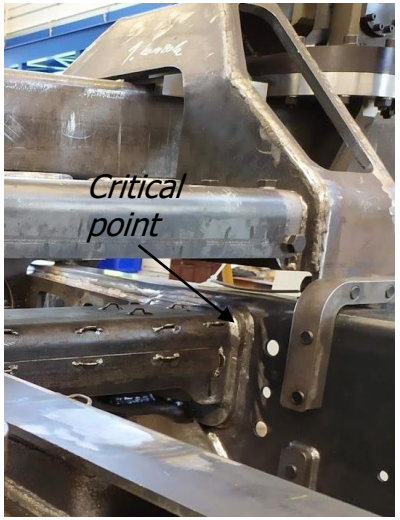




Fatigue tests of high-strength steel bus body samples were performed.







The frame was subjected to strength verification on a dynamic state.