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A UNIFIED MACHINE FOR TECHNOLOGICAL ELECTRIC TRANSPORT LADDER-BACKBONE LOAD-BEARING SYSTEM

Nikolay Mikhailovich Filkin
Kalashnikov Izhevsk State Technical University, 7 Studencheskaya St., Izhevsk, 426069, Udmurt republic, Russian Federation, fnm@istu.ru
Sergey Nikolaevich Zykov
Kalashnikov Izhevsk State Technical University, 7 Studencheskaya St., Izhevsk, 426069, Udmurt republic, Russian Federation, zsn@istu.ru
Aleksandr Ivanovich Korshunov
Institute of Mechanics Ural Branch of Russian Academy Science, 34 T. Baramzinoy St., Izhevsk, 426001, Udmurt republic, Russian Federation, maguser_kai@istu.ru
Petr Mikhailovich Zavialov
Kalashnikov Izhevsk State Technical University, 7 Studencheskaya St., Izhevsk, 426069, Udmurt republic, Russian Federation, zpm@istu.ru
Pavol Božek
Slovak University of Technology, Faculty of Materials Science and Technology, Institute of Production Technologies, J. Bottu 25, 917 24 Trnava, Slovak Republic, pavol.bozek@stuba.sk

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Abstract: Frequently in a process of developing new specialized models of wheeled vehicles, the task of integrating a multitude of design criteria for parts, assemblies and mechanisms arises. Using a comparative analysis of various design solutions allows to determine the most optimal options for their design. The authors compare two possible layout drawings of the UMTET load-bearing frame: a simple ladder frame and a combined ladder-backbone load-bearing system. Based on the presented design and layout and weight characteristics, as well as the results of the estimated numerical strength analysis, it is concluded that there are certain advantages of using a combined ladder-backbone frame for the UMTET design.

1 Introduction

The article is a continuation of the previous article with the title *"A UNIFIED MACHINE FOR TECHNOLOGICAL ELECTRIC TRANSPORT LOAD-BEARING SYSTEM"*. The UMTET load-bearing system like any other wheeled vehicle has a whole range of static and dynamic loads during operation [1-10].

2 UMTET standard rolled profile combine ladder-backbone frame

The construction (Figure 1) is a complex space system consisting of a main frame and the subframe that are designed to provide the basing and assembly of all parts and assemblies of UMTET.

The advantages of combined ladder-backbone frame:

- Providing the required geometric dimensions (width - 1180 mm, length - 3200 mm, height - 530 mm);
- the design is developed from standard steel profiles (St40), which significantly reduces the cost of production;
- the possibility of assembly and basing most of the UMTET units and assemblies (Figure 2) and mounting traction batteries of various sizes;
- relatively small mass of the load-bearing system (170 kg).

Disadvantages:

- Specialized equipment is required for the manufacturing, which increases its cost.

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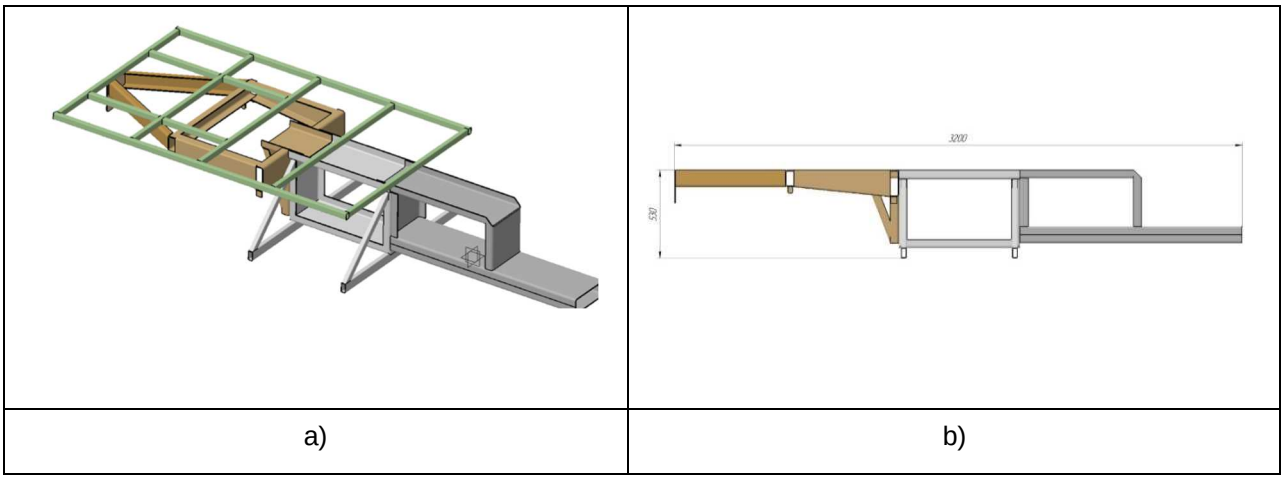


a) b)

Figure 1 UMTET ladder-backbone load-bearing system a) geometric model b) overall dimensions

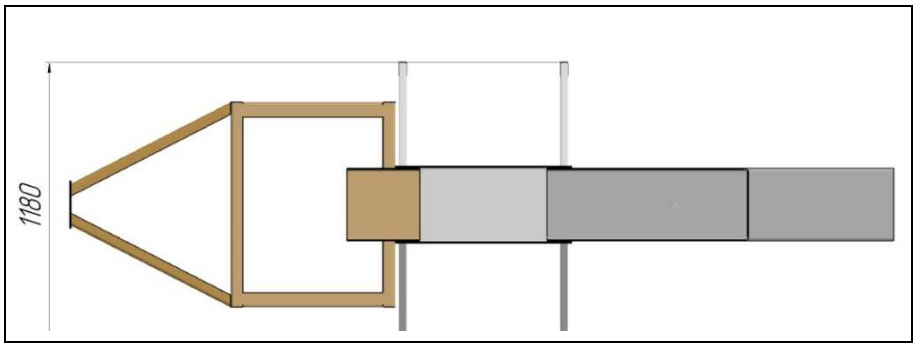


Figure 2 UMTET units allocation zones

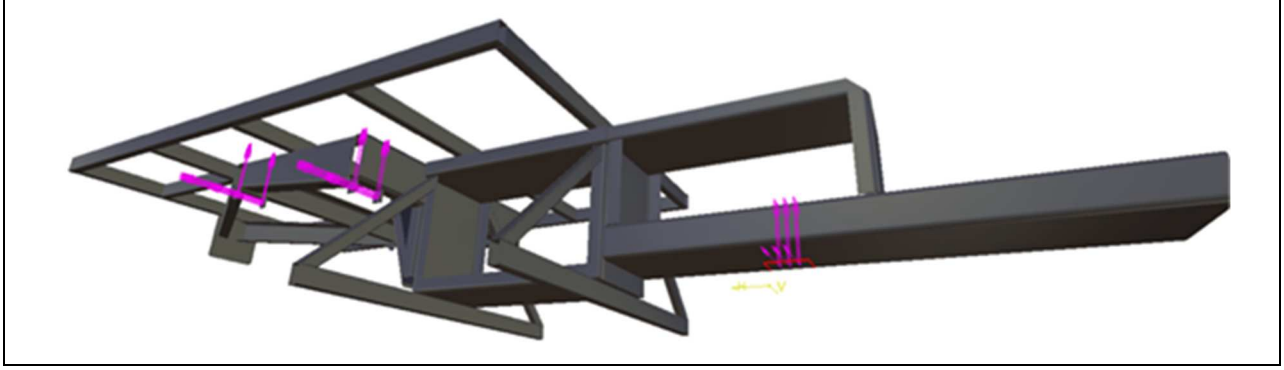
3 UMTET Workload Impact Numerical Strength Analysis

The principles and characteristics of the structure numerical strength analysis are similar to the simple ladder system described above but due to the fact that the geometry, material and layout characteristics are significantly different, Figure 3 shows the relevant material characteristics of the structure under consideration, the mounting zones and the application of forces.

- Vertical load of 30000 N (nominal load-bearing capacity of UMTET) is applied to the framework area of the load platform;
- on the mounting zones of the battery in the middle of the load-bearing system, the load is 6500 N (battery weight);
- The load of 2500 N is applied to the front of the load-bearing system.

Figure 4 shows the results of a numerical analysis, from which it is concluded that there are no failure stresses when specified loads are applied.

Mounting zones



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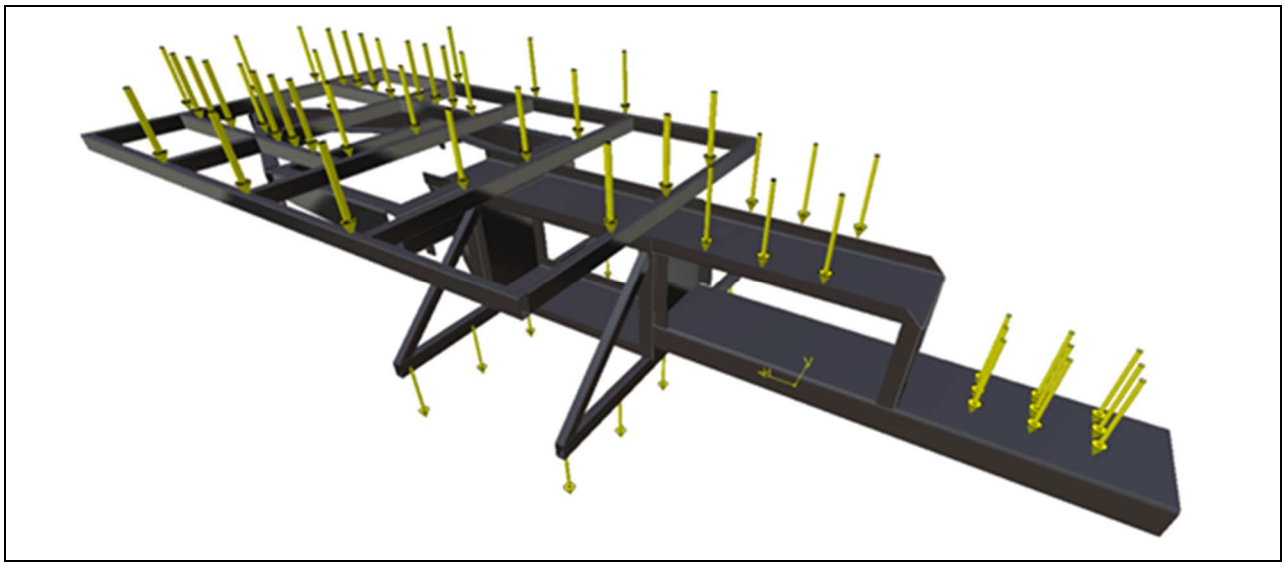

Figure 3 UMTET ladder-backbone load-bearing system calculated numerical model characteristics

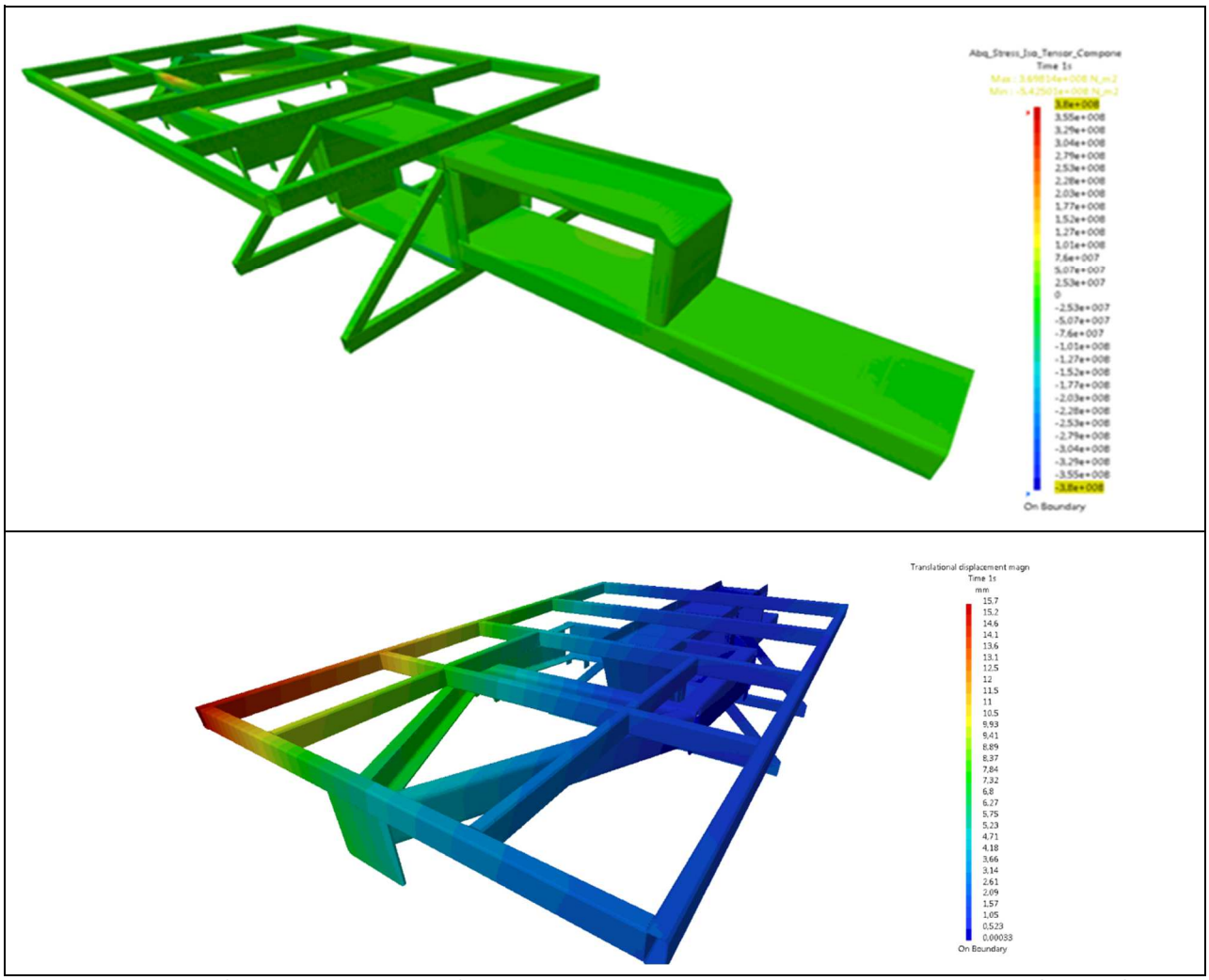

Figure 4 The results of the numerical analysis of the UMTET ladder-backbone load-bearing system under the influence of vertical static loads

4 Conclusion

Estimating and comparing the UMTET ladder and ladder-backbone schemes of load-bearing systems characteristics, the following conclusions should be drawn. With a certain assumption, both options can be used. However, the variant with the combined ladder-backbone load-bearing system is preferable for a vehicle equipped with an electric motor since with sufficient strength characteristics the combined ladder-backbone scheme has more possibilities for the power unit location due to the smaller weight of the construction and the versatility of the battery mounting both with variability of basing of other units and aggregates.

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