MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
VOLODYMYR DAHL EAST UKRAINIAN NATIONAL UNIVERSITY
Department "Logistics management and traffic safety in transport»

RPE "ZARYA"

REGIONAL BRANCH «DONETSK RAILWAY»
PJSC «UKRZALIZNYTSIA»

EASTERN INTERREGIONAL DEPARTMENT
OF UKRTRANSBEZPEKA

GLOBALIZATION OF SCIENTIFIC AND EDUCATIONAL SPACE. INNOVATIONS OF TRANSPORT. PROBLEMS, EXPERIENCE, PROSPECTS

Certificate UkrISTEI 302 of April 23, 2021

THESIS OF XIII INTERNATIONAL SCIENTIFIC AND PRACTICAL CONFERENCE

21-26 May, 2021
Vlora (Albania)

ORGANIZING COMMITTEE

Recommended for publication by department "Logistics management and traffic safety in transport", Volodymyr Dahl East Ukrainian National University (protocol 24 from May 13, 2021)

Globalization of scientific and educational space. Innovations of transport. Problems, experience, prospects: thesis, 21-26 May, 2021, Vlora (Albania) / Executive editor: Chernetska-Biletska N. – Severodonetsk: Volodymyr Dahl East Ukrainian National University, 2021.

CONTENTS

RESEARCH OF DYNAMIC LOADING AND STRENGTH OF A LONG-BASE FLAT CAR WITH RESILIENT ELEMENTS IN THE LONGITUDINAL BEAMS

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Efficient transportation is the key factor of economic development of European countries; its main component is railway transport. The railway network in Europe maintains effective cooperation and development of all countries in Europe. It is important to mention that the leading position of railway transport can be maintained by introducing modern efficient rail vehicles.

The most required type of rail vehicles for international transportation is the flat car. Flat cars are used for transportation of the freight which does not requiring protection from atmospheric fallout. Particularly in the international transportation these cars are used for all types of containers. The main bearing element of a flat car is the welded frame.

Long-base flat cars can provide more efficient service as each can transport four 20-ft containers. However, due to their elastic-yield structures they suffer from large vertical loads. It causes accumulation of fatigues stresses in the bearing structure and damage. Therefore, there is a need to implement new alternative solutions aimed at lower dynamic loads of the bearing structure in operation [1 – 3].

Thus, the dynamic loads on the bearing structure of a flat car can be decreased, and the fatigue strength can be increased during operational modes with application of resilient elements. They are placed in the main bearing structures, the longitudinal beams. It requires replacement of the main longitudinal beams of the frame with ones of the U-like profile.

The dynamic loading on the bearing structure of the improved flat car was determined by means of the mathematic modelling. The research was made in the XZ plane coordinates.

The maximum vertical acceleration of the bearing structure of an empty flat car was about 2 m/s^2 (0.2g), and that of the bogies – about 8.29 m/s^2 (0.8g). This solution can decrease the vertical accelerations on the bearing structure of a flat car by about 15% in comparison to that of the prototype car. The motion of the car was estimated as excellent [4, 5].

The study deals with the research into the fatigue strength of the bearing structure of a flat car. The calculation was made with the finite element method in the SolidWorks (CosmosWorks) software. The

maximum equivalent stresses were in the contact area between the bolster beam and the diagonal braces; they amounted to 254.0 MPa. The maximum displacements were in the middle part of the longitudinal beams and amounted to 12.6 mm. Thus, the strength of the bearing structure of a flat car was provided [4, 5].

The study presents the numerical values of the accelerations in the bearing structure of a flat car and their dislocation fields. The difference between the results of the mathematical and computer modelling of the dynamic loading of the bearing structure of a flat car was about 12%.

The research deals with the fatigue strength and natural oscillation frequencies of the bearing structure of a flat car. It was found that the fatigue strength of the bearing structure at a test base of 10^7 was provided.

The research may be useful for those who are concerned about designing innovative flat cars and improved operational efficiency of combined transportation.

References:

1. Panchenko S. Determining the load on the long-based structure of the platform car with elastic elements in longitudinal beams / S. Panchenko, O. Fomin, G. Vatulia, O. Ustenko, A. Lovska // Eastern-European Journal of Enterprise Technologies, 2021, №1/7 (109). – P. 6 – 13. doi: 10.15587/1729-4061.2021.224638
2. Vatulia G. Optimization of the truss beam. Verification of the calculation results / G. Vatulia, S. Komagorova, M. Pavliuchenkov // MATEC Web of Conferences, 2018, 230, 02037 doi: 10.1051/matecconf/201823002037
3. Krason W. FE numerical tests of railway wagon for intermodal transport according to PN-EU standards / W. Krason, T. Niezgoda // Bulletin of the Polish Academy of Sciences technical sciences, 2014, Vol. 62, Issue 4. – P. 843 – 851. doi: 10.2478/bpasts-2014-0093
4. Vagoni vantazhni. Zagalni vimogi do rozrakhunkiv ta proektuvannya novikh i modernizovanikh vagoniv koliyi 1520 mm (nesamokhidnikh): DSTU 7598:2014, 2015. – 162 s.
5. Vagony gruzovye. Trebovaniya k prochnosti i dinamicheskim kachestvam: GOST 33211-2014, 2016. – 54 s.