UDC 629.7

S. S. PASICHNYK, N. V. BEZRUKAVYI

INCREASING THE 18-100 FREIGHT-CAR TRUCK SHEAR STIFFNESS

Institute of Technical Mechanics
of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine
15 Leshko-Popel St., Dnipro 49005, Ukraine; e-mail: pasichniksergey@gmail.com

Although a large number of truck models have been put into service on the 1520 mm gage railways over the past ten years, the problem of an insufficient shear stiffness of a freight car truck still remains topical. This problem is a consequence of attempts to keep a sufficient degree of unification of new truck models with the 18-100 truck because this greatly simplifies the introduction of new trucks and allows one to make the best use of the existing maintenance and repair infrastructure. However, this also results in that new designs inherit many drawbacks of the 18-100 truck. One of its critical drawbacks is a low connectedness in a horizontal plane, which reduces the critical speed and increases truck component wear. A solution to this problem may be an auxiliary stiffening frame. This paper presents a new design of an auxiliary stiffening frame for the 18-100 truck. The design increases the truck shear stiffness, thus improving freight car dynamic performance and service life.

Mathematical simulation, oscillation theory, and elasticity theory methods were used to design an auxiliary stiffening frame installable between the 18-100 truck side frames without any significant changes in the freight car basic design. The physical and mechanical properties of the auxiliary stiffening frame's structural materials were selected. Loads on the auxiliary stiffening frame were determined and then used in the calculation of the stresses that develop therein in motion. It was found that the proposed auxiliary stiffening frame with resilient polyurethane inserts increases the truck shear stiffness by 0.5 MN/m.

The proposed improved design of the 18-100 truck increases its shear stiffness, improves freight car dynamic and operational performance, and reduces truck component wear. Besides, the auxiliary stiffening frame is simple in design. Because of this, its introduction will bring considerable economic benefits.

Keywords: *freight car, truck, freight car truck shear stiffness.*

1. Ushkalov V. F., Lashko A. D., Mokrii T. F. Freigt-car truck retrofit as a way to upgrade the freight-car running gear. Vestnik Nauchno-Issledovatelskogo Instituta Zheleznodorozhnogo Transporta. 2013. No. 5. Pp. 8-15. (in Russian).

2. Kondratenko V. G., Budyukin A. M., Smirnov A. A. Features of design solutions for 2 tf axle load trucks. Special Equipment and Technologies of Transport. Collected articles. St Petersburg, 2020. Pp. 71-76. (in Russian).

3. Ushkalov V. F., Mokrii T. F., Malysheva I. Yu., Bezrukavyi N. V. Improvement of the running gear of a prospective freight car. Teh. Meh. 2017. No. 4. Pp. 79-88. (in Russian).
https://doi.org/10.15407/itm2017.04.079

4. Verygo M. F. On vehicle-rail interaction. Zaliznychnyi Transport. 2001. No. 5. Pp. 71-74. (in Ukrainian).

5. Safronov O. Sulym A. Khozia P., Vodianykov Y., Stoletov S. Effect of design features of bogies models 18-4129 and 18-9817 with axle load of 25 tf on dynamic parameters of wagons. Transport Systems and Technologies. 2019. V. 1. No. 3. Pp. 171-188. (in Russian).
https://doi.org/10.32703/2617-9040-2019-33-1-15

6. Ushkalov V. F., Mokriy T. F., Malysheva I. Yu., Pasichnik S. S. Effects of hirizontal rigidity of elastic adapter in axle-box assembly of bogy on dynamic qualities of open car. Teh. Meh. 2016. No. 4. Pp 85-93. (in Russian).

7. Potapenko O. O., Mohyla V. I. Systematization and Classification of friction wedges for freight-car truck shock absorbers. Visnik of the Volodymyr Dahl East Ukrainian National University. 2017. No. 4(234). Pp.

189-194. (in Ukrainian).

8. Orlova A. M., Rudakova E. A., Shevchenko D. V., Gusev A. V., Popovich S. I., Savushkin R. A. Analysis of techniques for calculating the horizontal stiffness of freight-car suspension springs. Izvestia of St. Petersburg University of Means of Communication. 2019. No. 16(2). Pp. 191-201. (in Russian).

9. Babii O. A. Reduction of Rail Damage Accumulation Intensity in Sharp Curves. Ph.D. thesis. Khabarovsk, 2006. 138 pp. (in Russian).

10. Orlova A. M. Substantiation of the feasibility of a reasonable horizontal stiffness of a three-piece truck. Bulletin of Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan. 2004. No. 5. Pp. 157-161. (in Ukrainian).

11. Ukrainian Standard GOST 33211:2017. Freight Cars. Strength and Riding Quality Requirements. (GOST 33211-2014, IDT). Introduced on July 1, 2017. Kyiv: Ukrainian Research and Training Center of Standardization, Certification, and Quality, 2017. 58 pp. (in Ukrainian).

Received on June 2, 2020,
in final form on September 24, 2020