web of semantic
Journal of Interdisciplinary Science | ISSN: 2960-9550
Research Article Peer-review, Open Access

Assessment of the Technical Condition of the Weight Checking Wagon

Adilov N.B[1], Toshtemirov H.SH.[2]

Abstract

When carrying out strength calculations of the metal structure of a weighing wagon, it is necessary to take the wall thickness into account, taking into account its reduction by the value of the average wear value. Thus, it is necessary to subtract the average amount of wear from the value of the size of the sheets of elements. In this way, it will be possible to determine whether the design of the weighing wagon with existing wear will withstand the loads required by the standards.

Keywords: railway, six-axle semi-wagon, freight wagon, longitudinal beam, pivot beam, end beam.

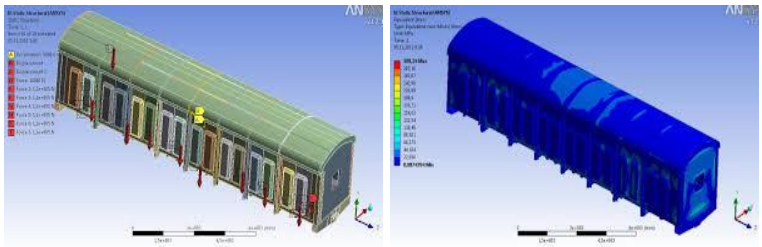
[1,2] *Tashkent State Transport University (Tashkent, Uzbekistan)*

Introduction. One of the conditions for the gradual development of railway transport in the Republic of Uzbekistan is to replenish the fleet of domestic wagons with modern wagons manufactured in accordance with world standards, to extend their service life in order to optimize the operation of existing wagons [1-3].

The wagon fleet is one of the most essential components of railway rolling stock, as it plays a key role in ensuring efficient transportation by rail. It consists of a wide variety of wagons designed for different purposes, depending on the type of cargo or passengers being carried. Freight wagons are used to transport goods such as raw materials, industrial products, agricultural produce, and liquids, and they include types like open wagons, covered wagons, tank wagons, and flat wagons. Passenger wagons, on the other hand, are designed to provide comfort and safety for travelers over short and long distances. Each type of wagon is specially constructed to meet technical, safety, and economic requirements, allowing railways to operate reliably and efficiently. Together, these wagons form a versatile and indispensable system that supports trade, industry, and passenger mobility across regions and countries. For the implementation of the transportation process, UTY JSC has a fleet of freight wagons in the amount of 20.28 thousand freight wagons, including insulated wagons. The fleet of freight wagons includes universal and specialized wagons.

The volume of work on the dispatch (loading) of goods in tons is determined on the basis of applications from shippers [4-6]. To date, accurate measurement of the mass of rolling stock using railway scales

located at the stations is a very important task. In particular, inaccurate measurement of the weight of the rolling stock by scales adversely affects the following important aspects of the organization of the safety of cargo transportation: 1-travel documents; 2-factors of the economic component; 3-control of the load falling on the rails from each wheel pair; 4-intensity of wear of rails, etc.



To date, the country's railway system is equipped with special weight-checking wagons that are intended to periodically verify the accuracy of railway scales installed at stations. These wagons play an important role in ensuring correct weight measurements, which are essential for safe train operation, fair freight charges, and compliance with technical standards. According to established instructions and regulations, the railway scales are checked four times a year using these certified weight-checking wagons. During the inspection process, the wagons pass over the scales, and the measured values are compared with their known reference weights. If the results meet the required accuracy standards, the inspection is considered successful, and a special certificate is issued for the railway scales. This certification confirms that the scales are reliable and approved for continued use in railway operations. [7].

The technical condition of the metal structure of the wagon type 640-VPV-271, which is operated at the Bukhara regional railway junction and is specifically designed for checking railway scales, was thoroughly analyzed. Since this wagon performs an important and responsible function in ensuring the accuracy of railway weighing equipment, special attention was paid to assessing the reliability and strength of its structural elements. In order to compare the obtained results with normative parameters and to use them in further strength calculations, the values of the loads and impacts acting on the elements of the wagon's metal structure during operation were determined.

The weighing wagon of model 640-VPV-271 located at the Bukhara regional railway junction was manufactured in 1965, which indicates a long period of service. The date of its last scheduled depot repair was April 28, 2013. The total weight of the wagon is 123 tons. Taking into account its age, operational conditions, and significant mass, the analysis of its technical condition is essential for ensuring safe operation, maintaining measurement accuracy, and extending the service life of both the wagon and the railway scales it is used to verify.

Previously, before determining the wear values of body elements of weighing wagons, schemes of measurement sites were drawn up, shown in Figures (1-4).

A survey of the technical condition of the main bearing elements and structural parameters of the body of this weighing wagon was carried out [8-9]. The measurement results are shown in graphs (2–5).

Methods. The studies were carried out using visual and experimental methods.

Based on the results of wear thickness measurements h^i, the value of the average thickness h^i_{cp} is calculated taking into account the tolerance "δ=0.2 mm" for cleaning, which is determined by the formula:

$$h^i_{cp} = \frac{1}{n}\sum_{i}^{n} h^i - 0{,}2$$

where n is the number of measurements.

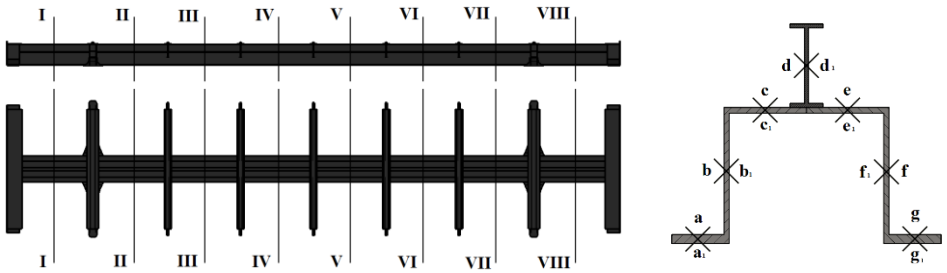


Figure 1 – Scheme of measuring the wear thickness of sheets on the center beam of the frame of the weighing wagon 640-VPV-271

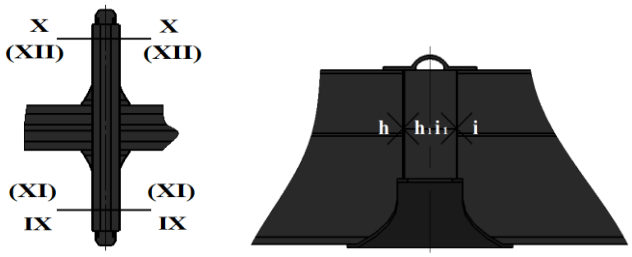


Figure 2 – Scheme of measuring the wear thickness of sheets on the pivot beam of the frame of the weighing wagon 640-VPV-271

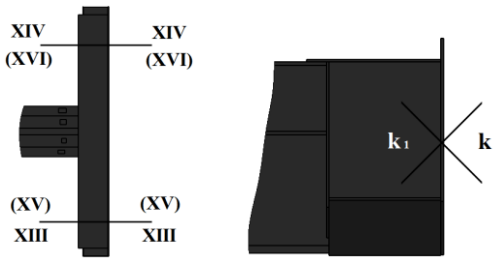


Figure 3 – Scheme of measuring the wear thickness of sheets on the end beam of the frame of the weighing wagon 640-VPV-271

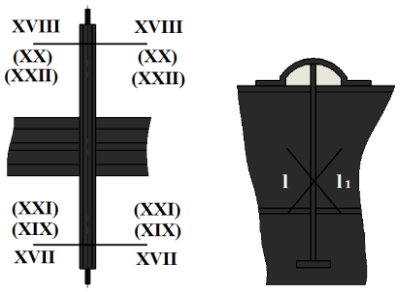


Figure 4 – Scheme of measuring the wear thickness of sheets on the longitudinal beam of the frame of the weighing wagon 640-VPV-271

Table 1. The results of measuring the thickness of wear sheets on the center beam of the frame of the weighing car.

№	Section	Measurement values of the wear thicknesses of the elements of the pivot beam of the body frame, mm													
		a	**a_1**	**b**	**b_1**	**c**	**c_1**	**d**	**d_1**	**e**	**e_1**	**f**	**f_1**	**g**	**g_1**
1.	**I-I**	0,61	0,56	0,63	0,26	0,6	0,65	0,32	0,33	0,56	0,63	0,52	0,43	0,38	0,34
2.	**II-II**	0,58	0,61	0,57	0,43	0,38	0,47	0,28	0,4	0,45	0,66	0,48	0,52	0,43	0,38
3.	**III-III**	0,53	0,49	0,63	0,37	0,57	0,63	0,61	0,37	0,58	0,42	0,51	0,41	0,36	0,42
4.	**IV-IV**	0,62	0,55	0,59	0,68	0,54	0,26	0,33	0,67	0,49	0,39	0,43	0,37	0,71	0,35
5.	**V-V**	0,46	0,44	0,61	0,35	0,55	0,51	0,48	0,26	0,57	0,67	0,45	0,47	0,36	0,29

6.	**VI-VI**	0,38	0,57	0,59	0,23	0,63	0,38	0,53	0,35	0,46	0,65	0,34	0,47	0,42	0,62
7.	**VII-VII**	0,64	0,55	0,53	0,58	0,52	0,68	0,36	0,32	0,62	0,63	0,48	0,36	0,41	0,54
8.	**VIII-VIII**	0,47	0,42	0,57	0,29	0,48	0,65	0,41	0,47	0,52	0,59	0,42	0,52	0,37	0,37
h^i_{cp}		0,77													

Table 2. The results of measuring the thickness of wear sheets on the pivot beam of the frame of the weighing car

№	**Section**	**Measurement values of the wear thicknesses of the elements of the pivot beam of the body frame, mm**			
		h	**h_1**	**i**	**i_1**
1.	**IX-IX**	0,32	0,23	0,34	0,32
2.	**X-X**	0,37	0,25	0,33	0,35
3.	**XI-XI**	0,42	0,22	0,36	0,27
4.	**XII-XII**	0,34	0,27	0,35	0,31
h^i_{cp}		0,43			

Table 3. The results of measuring the thickness of the sheets on the end beam of the frame of the weighing car

№	**Section**	**Measurement values of the wear thicknesses of the elements of the end beam of the body frame, mm**	
		k	**k_1**
1.	**XIII-XIII**	0,65	0,58
2.	**XIV-XIV**	0,58	0,45
3.	**XV-XV**	0,54	0,58
4.	**XVI-XVI**	0,66	0,51
h^i_{cp}		0,94	

Table 4. The results of measuring the thickness of wear sheets on the longitudinal beam of the frame of the weighing car

№	**Сечение**	**Значения измерений толщин износов элементов продольной балки рамы кузова, мм**	
		l	**l_1**
1.	**XVII-XVII**	0,32	0,82
2.	**XVIII-XVIII**	0,74	0,56
3.	**XIX-XIX**	0,36	0,65
4.	**XX-XX**	0,28	0,43
5.	**XXI-XXI**	0,35	0,37
6.	**XXII-XXII**	0,63	0,43
h^i_{cp}		0,79	

Results and Discussion. From the above obtained data of the five examined wagons, we determine the average wear of the sheets for the elements of the metal structures of the weighing wagon according to the formula [10]:

$$h_{cp} = \frac{1}{n}\sum_{i}^{n} h_{cp}^{i}.$$

The results of calculations of the average wear of sheets are summarized in table 5.

Table 5. Results of average wear thicknesses according to the elements of the weighing wagon 640-VPV-271

№	Wagon model	Center beam	Pivot beam	End beam	Longitudinal beam
1	640-VPV-271	0,77	0,43	0,94	0,79

Conclusion. When performing strength calculations for the metal structure of a weighing wagon, it is essential to take into account the actual wall thickness of the structural elements, considering the reduction caused by wear over time. During long-term operation, the thickness of metal sheets decreases due to corrosion, mechanical damage, and other эксплуатационные factors. Therefore, the average wear value must be determined and subtracted from the original design thickness of the structural elements.

By using the reduced, or effective, thickness values in the calculations, a more realistic assessment of the wagon's current condition can be achieved. This approach makes it possible to accurately evaluate whether the weighing wagon structure, with its existing level of wear, is capable of safely withstanding the loads prescribed by regulatory standards. As a result, informed decisions can be made regarding continued operation, necessary repairs, or reinforcement of the wagon's metal structure to ensure reliability and safety.

References

1. Decree of the President of the Republic of Uzbekistan dated December 2, 2017 No. PP-3422 "On measures to improve transport infrastructure and diversify foreign trade routes".
2. Decree of the President of the Republic of Uzbekistan "On the organization of the Ministry of Transport of the Republic of Uzbekistan" dated February 1, 2019 No. PP-4143.
3. Decree of the President of the Republic of Uzbekistan dated February 1, 2019 No. PF-5647 "On measures to radically improve the public administration system in the field of transport."
4. Business plan of the JSC "UZBEKISTON TEMIR YOLLARI" for 2019.
5. Business plan of the JSC "UZBEKISTON TEMIR YOLLARI" for 2020.
6. Business plan of the JSC "UZBEKISTON TEMIR YOLLARI" for 2021.
7. GOST 30414-96. Scales for weighing vehicles in motion. General technical requirements. - Minsk.: IPK Standards Publishing House, 1997. - 8 p.
8. Ikonnikov E.A. Means for measuring mass and weight verification tools used in railway transport. - M.: Route, 2003. - 40 p.
9. Maintenance and operation manual. Weight checking wagon brand 640 VPV. – 38 s.
10. Yadgor Ruzmetov, Nodir Adilov, and Shokhruk Sultonov. Strength assessment of the body of a weight checking wagon type 640-VPV. E3S Web of Conferences 264, 05021 (2021) https://doi.org/10.1051/e3sconf/202126405021 CONMECHYDRO - 2021.