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ИЗВЕСТИЯ

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ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК

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DETERMINATION OF RAIL VOLTAGES AFTER IMPACT OF MOBILE COMPOSITION

Abstract. The results of measurements of edge stresses and stresses in the neck of a rail in a curve with a radius of R = 380 m, obtained during tests on the effect on the path of locomotive CKD6-2108, freight gondola cars 12-9941 and 12-9920, on the section of the Almaty-Chu railway line are presented. The dependences of stresses in the edges of the sole and neck of the rail on the speed of the tested rolling stock are obtained. The possibility of a transition from stresses to lateral forces is considered.

Keywords: railway track, rail, edge stresses, stresses in the neck of the rail, vertical and lateral forces, the tested rolling stock, curve of small radius.

In connection with the ever growing need to increase the capacity of the existing network of railways in the Republic of Kazakhstan (especially the areas bordering China and Russia), the issue of increasing the safety of operation of freight trains of increased mass and length is relevant. The commissioning of heavy trains is a complex task related to the use of more powerful locomotives, increased axle loads, reconstruction of the track infrastructure and power supply, and improvement of the technology of the transportation process.

In addition, increasing the speed of train traffic with increasing traffic density requires increasing the strength and stability of the road. The use of reinforced concrete sleepers and rails of heavy types causes along with the reinforcement of the path to increase its rigidity. Increased rigidity of the track increases the influence of unevenness on the rails and wheels of the rolling stock on deformation and the forces of interaction of its elements. It is established that the disorders of the existing track with reinforced concrete sleepers accumulate more intensively than those with wooden sleepers, especially in the presence of unevenness on the rails.

The reinforcement of the upper structure of the track - laying of heavy-type rails, crushed stone ballast, reinforced concrete sleepers - is associated with an increase in its rigidity. If the wheels of the rolling stock and the track had no irregularities, then the tougher path would have basically positive qualities (would cause less resistance to the movement of trains, less bending stresses in the rails, etc.). But the presence of uneven rolling, welds, slides on wheels, unevenness in the joints and welding places of rails, as well as saddles, wave-like wear and other unevenness on rails significantly worsen the interaction of the elements of the track and the rolling stock.

The accuracy and correctness of the accepted experimental methods for evaluating the force impacts of wheels on the rail track is of paramount importance for analyzing the safety of the use of freight train trains. Edge stresses are the main parameters by which the strength of the rail is determined. They characterize the effect of vertical and lateral forces, as well as the moments from the application of lateral loads and the displacement of the position of the conditioned center of the contact spot between the wheel and the railhead.

In this paper, the results of measurements of edge stresses and stresses in the neck of a rail in an external rail thread with a curve of radius R = 380 m, obtained during testing of freight cars and diesel locomotives in the section of the Almaty-Chu railway line are presented.

The measurements were carried out in accordance with [1] with the help of a strain gauge measuring and computing system (Figure 1) consisting of certified and certified measuring instruments of the world's leading manufacturers, which makes it possible to produce precision (high-precision) measurements of stresses and relative deformations in the elements of the track and span structures of bridges From the impact of the rolling stock simultaneously in 16 sections with the length of the measuring path up to 500 m.

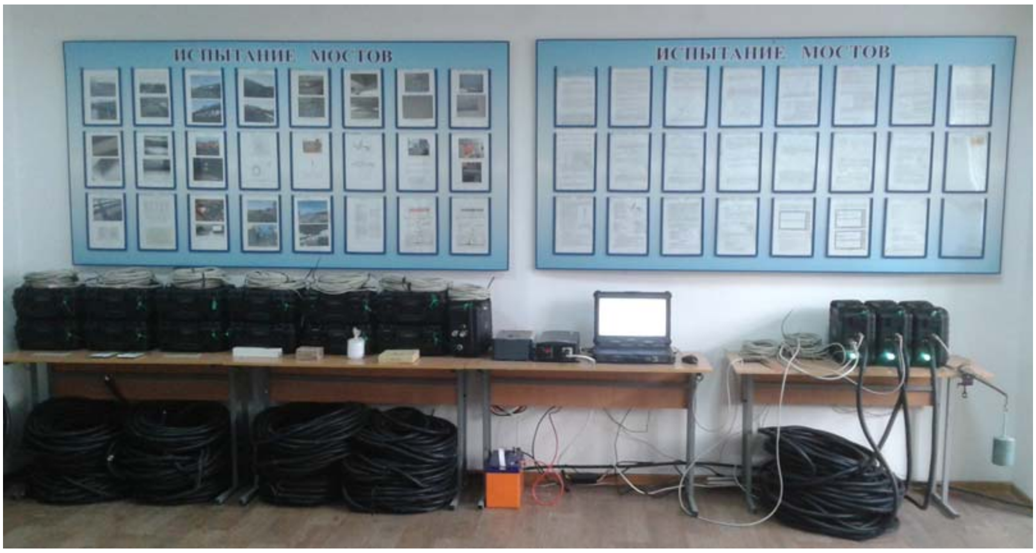

Figure 1 – Tensometric measuring and computing complex for measuring relative strains and stresses in structures

The complex was tested at a number of facilities of JSC "NC" KTZh "and showed good results when evaluating the effectiveness of reinforcement of railway bridge structures with a composite material [2, 3] and determining the influence of the dynamic effect of rolling stock on the railway track and span structures of bridges [4-6].

Before the tests, a road-measuring car passed through the site. Based on the results of the measurements, the service responsible for the state of the road issued an act on the readiness of the path to testing and the permissible speeds of traffic on the site.

The experimental train consisted of a diesel locomotive CKD6e-2108 (maximum static load 23 tons per axle), freight gondola cars 12-9941 (static axle load 23.5 tf) and 19-9920 (static axle load 25.0 tf), an electric locomotive VL80s (axial load 24.0 tons).

Arrivals along the measuring section of the road were made in a "shuttle" way with control from the cabs of the locomotive and an electric locomotive during daylight hours. A direct move made the movement of the composition from Chu to Almaty, the reverse – from Almaty to Chu. When moving in direct motion, the mobile units of the experimental train were located as follows: a 6-axle locomotive CKD6e-2108, an empty gondola car 12-9920, a laden gondola 12-9920, a laden gondola 12-9941, an empty gondola car 12-9941, an 8-axle VL80s electric locomotive. When moving backward, the mobile units were located, respectively, on the contrary, that is, without the reorganization of the rolling stock.

Figure 2 shows the graphs of the maximum edge stresses from the effects of a laden gondola 12-9920 in the speed range from 25 to 80 km/h. At the outer edge of the rail sole, the maximum value (106 MPa) was recorded when the track was passed at a speed of 40 km/h from Almaty to Chu (reverse), the smallest - 63 MPa, at the same speed, but the composition passed from Chu to Almaty. At the inner edge of the rail foot, the highest value (75 MPa) was also observed at a speed of 40 km/h in the reverse flight (Almaty-Chu), but the smallest (55 MPa) was recorded at a speed of 80 km/h, both for forward and reverse The course.

It should be noted that at a speed of 25 km/h, at the inner edge of the rail foot, the quantitative values of the stresses at the straight (58 MPa) and at the reverse (62 MPa) passage of the experimental composition were insignificant, but exceeded the fixed minimum of the maximum observed voltages at a speed of 80 km/h.

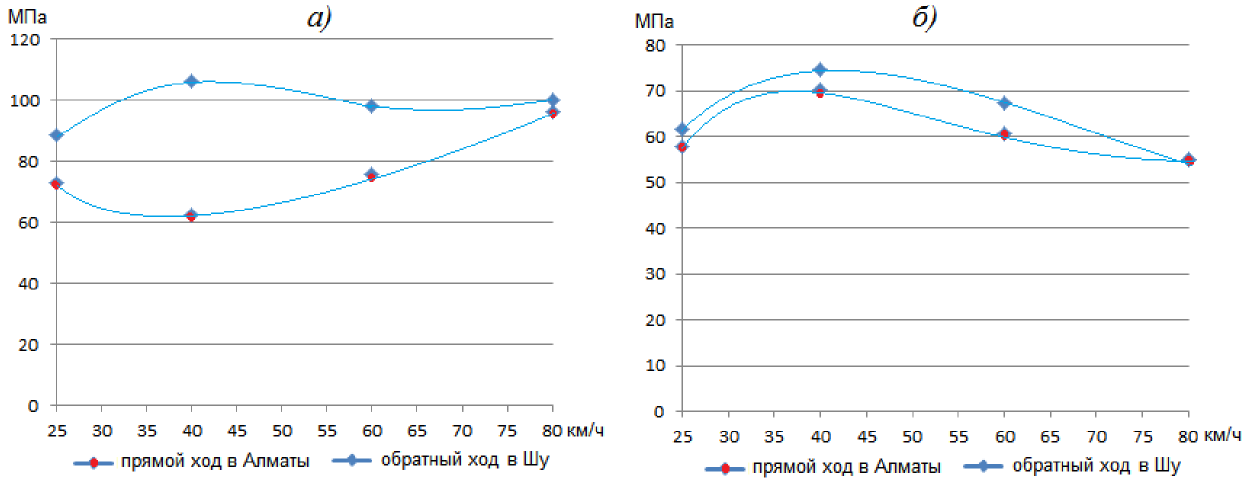

Figure 2 – Maximum stresses from the effects of a laden gondola 12-9920:
a) - the outer edge of the rail sole, b) - the inner edge of the rail sole

Several differ, both in the quantitative values of the stresses and in the nature of the curves, the graphs obtained when passing the laden gondola 12-9941 (Figure 3). The maximum value of the stress in the outer edge of the rail sole (103 MPa) was also observed at a crew speed of 40 km/h during the return pass. Given that the difference between the axial loads is 6%, and the difference between the stress values (106 and 103 MPa) is only 2.8%, it can be concluded that the gondola 12-9920 has less impact on the way than the gondola 12-9941.

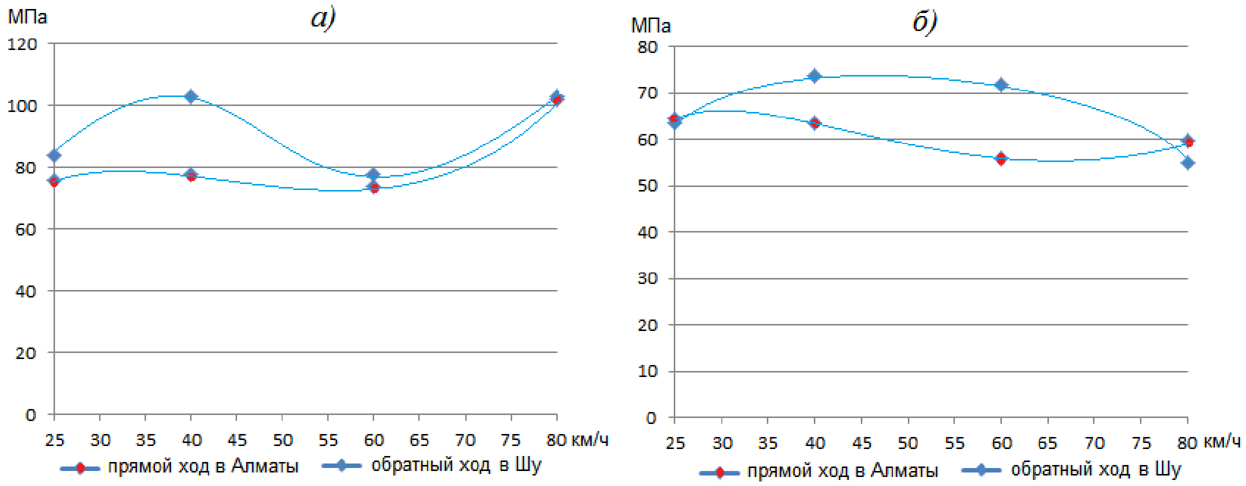

Figure 3 – Maximum stresses from the impact of a laden gondola 12-9941
a) - the outer edge of the rail sole, b) - the inner edge of the rail sole

Figure 4 shows the graphs of the maximum edge stresses when exposed to an empty gondola car 12-9920. In this case, the highest stresses (34 MPa in the outer edge at the forward stroke and 26 MPa in the inner edge at the reverse stroke) are fixed at a speed of 60 km/h (in the case of a laden gondola - 40 km/h). Moreover, increasing the speed of the crew to 80 km/h (regardless of the direction of travel) leads to a reduction in stresses in the outer edge to 27, in the inner to 21 MPa.

The stresses in the edges of the rails bottom, obtained when passing through the measuring section of the empty gondola car 12-9941, are shown in Figure 5. The largest values of the stresses in the outer (40 MPa at a speed of 40 km/h) and in the inner (32 MPa at a speed of 80 km/H) of the edges of the rail sole, were observed during the reverse course of the rolling stock. The lowest values of stresses (23 MPa in the outer edge with a straight pass, 24 MPa with the return passage in the inner edge) are fixed at a speed of 25 km/h.

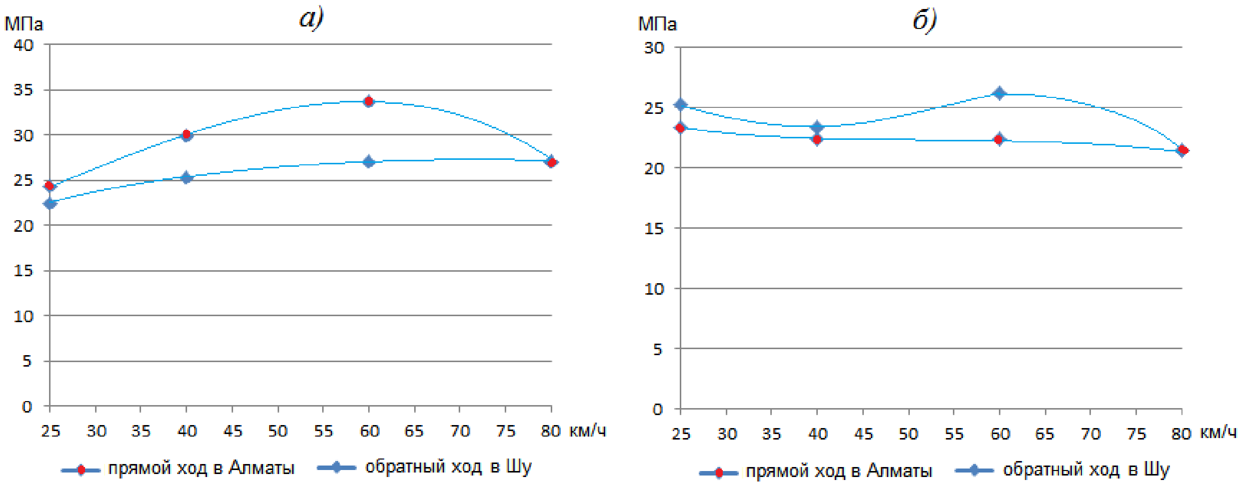

Figure 4 – Maximum stresses from the action of an empty gondola car 12-9920:
a) - the outer edge of the rail sole, b) - the inner edge of the rail sole

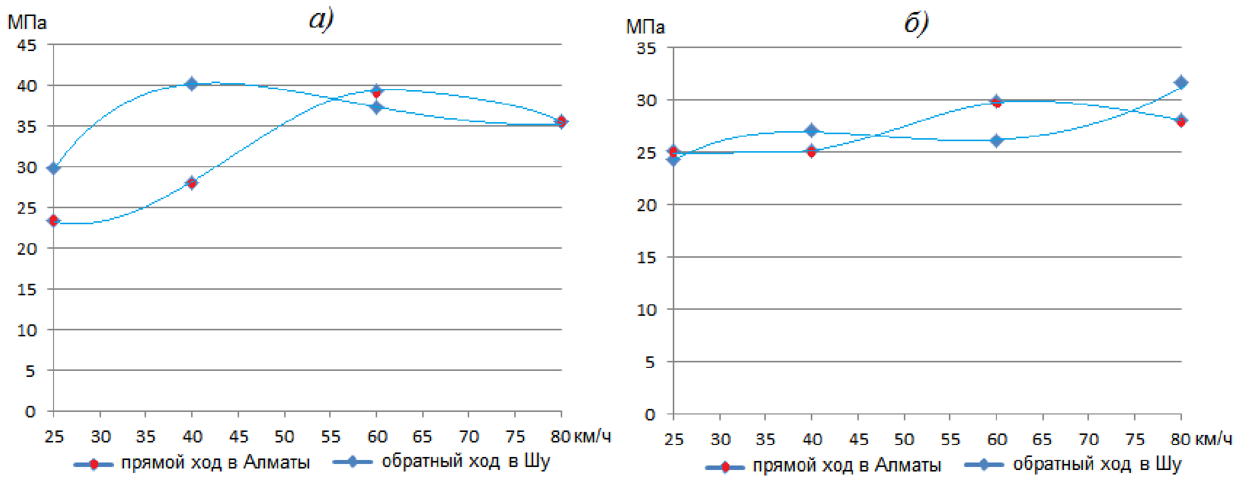

Figure 5 – Maximum stresses from the effect of an empty gondola car 12-9941:
a) - the outer edge of the rail sole, b) - the inner edge of the rail sole

Figure 6 shows the graphs of the maximum edge stresses that occur when passing through the measuring cross section of the shunting locomotive CKD6e. In the outer edge, the dependence is almost linear. The greatest value in the outer edge (107 MPa for the forward and reverse travel) was recorded at a speed of 80 km/h, the smallest (56 MPa at the back pass) - at a speed of 25 km/h. In the inner edge, a maximum (53 MPa) is observed at a speed of 40 km / h and a minimum (44 MPa) at a speed of 60 km/h. With the return pass. At speeds of 25 and 80 km/h, the voltages (50 MPa) are equivalent, both for forward and reverse flight of the crew. At a speed of 40 km/h, the voltage at the reverse travel of the rolling stock (from Almaty to Chu) corresponded to the stresses at speeds of 25 and 80 km/h and was equal to 50 MPa.

From the analysis of the graphs shown in Fig. 7, representing the dependences of the maximum observed edge stresses arising from the passage through the measuring section of the VL-80s electric locomotive, it follows that in the speed range from 40 to 80 km/h, a sharp jump occurs in the outer edge of the rail foot Stresses from 100 to 192 MPa at the forward stroke. And at a speed of 25 km/h, the voltage (110 MPa) exceeded the voltage (100 MPa) corresponding to a speed of 40 km/h. At the reverse stroke, the voltage increases less sharply – from 100 MPa at a speed of 25 km/h to 156 MPa at a speed of 80 km/h.

In the inner edge of the rail sole during a straight run, with an increase in the speed of the composition from 25 to 40 km/h, an increase in stresses from 69 to 72 MPa is observed, with a further increase in speed from 40 to 80 km/h, the stress drops to 47 MPa. When the speed of the convoy increases from 25 to 40 km/h, the voltages increase from 64 to 75 MPa, at a speed of 60 km/h decrease to 73 MPa, and with an increase in speed to 80 km / h, they drop to 47 MPa.

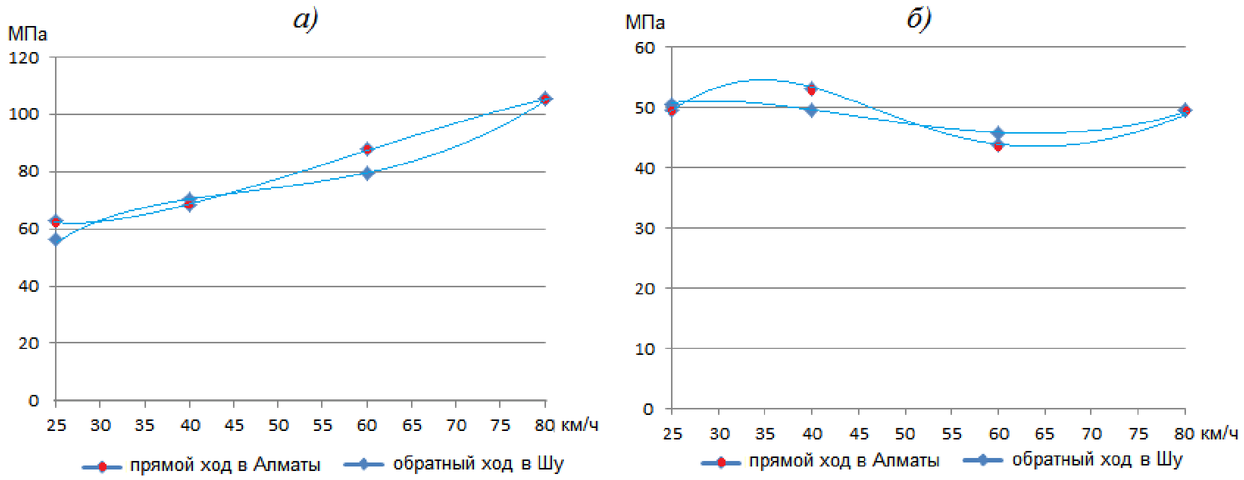

Figure 6 – Maximum stresses due to the effect of the locomotive CKD6e:
a)- the outer edge of the rail sole, b) - the inner edge of the rail sole

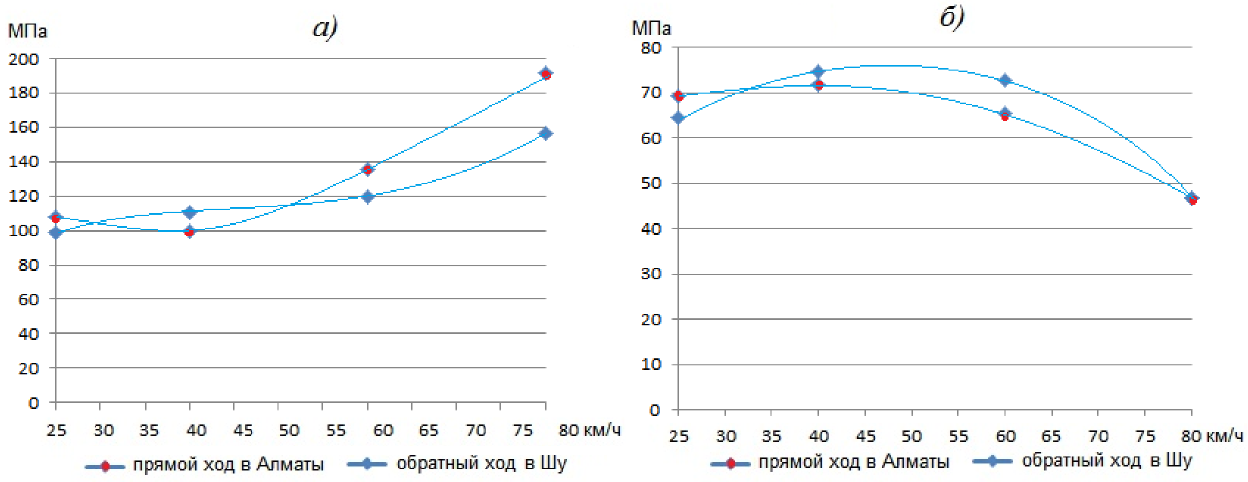

Figure 7 – Maximum voltage from the impact of an electric locomotive VL-80s:
a)- the outer edge of the rail sole, b) - the inner edge of the rail sole

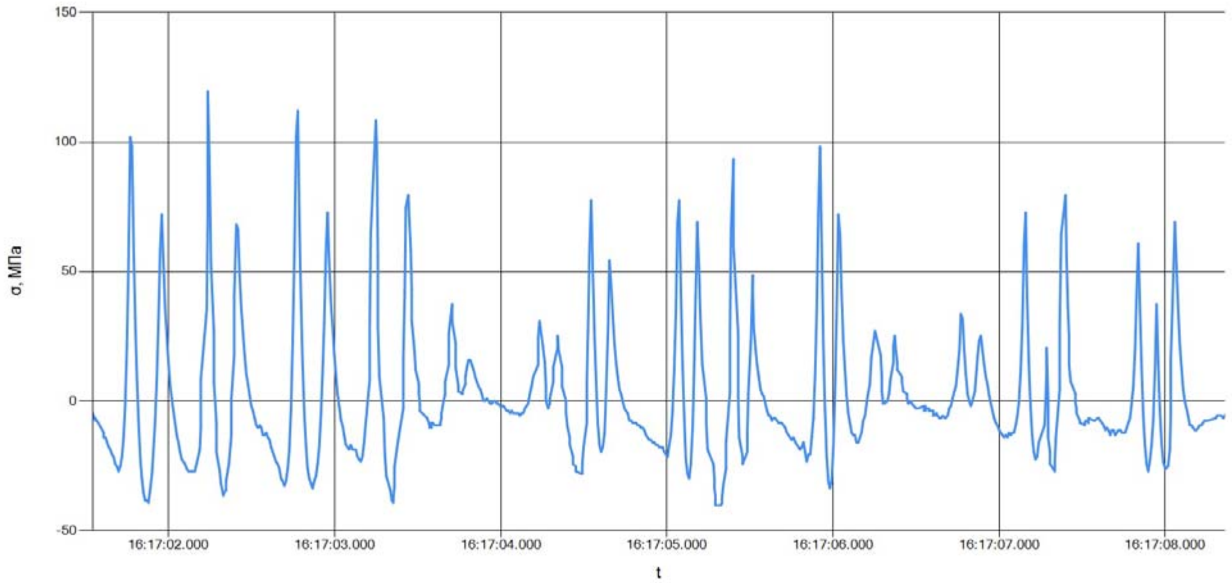

Figure 8 – Diagram of stresses in the outer edge of the rail sole (reverse stroke)

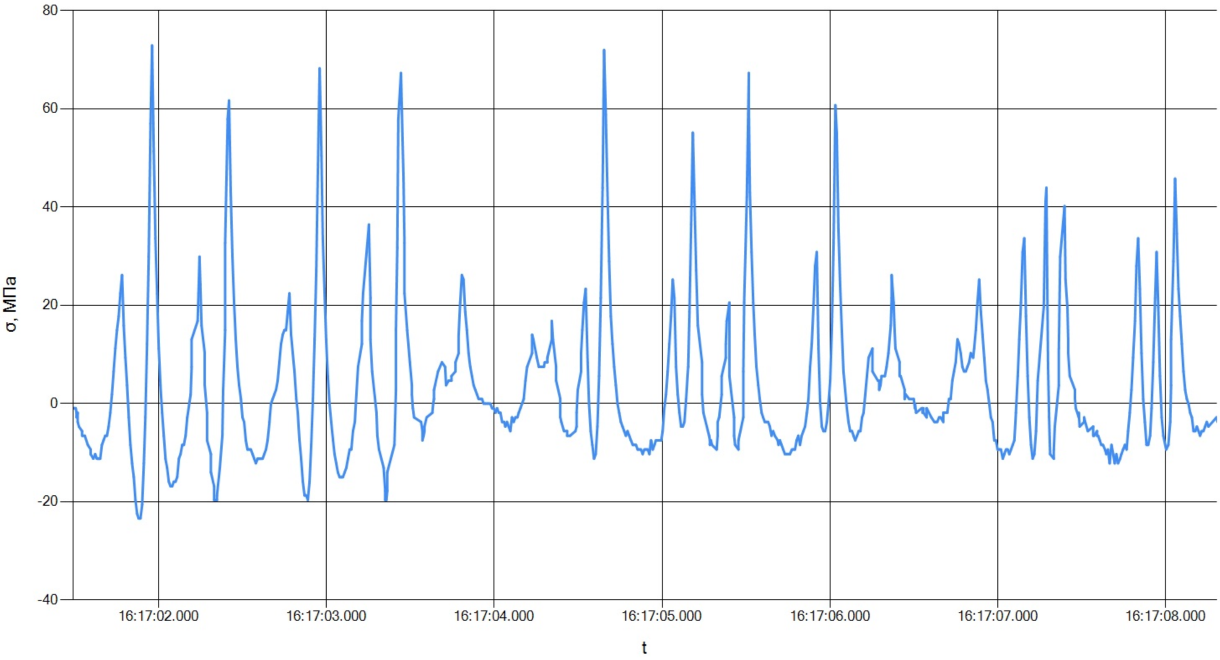

Figure 9 – Diagram of stresses in the inner edge of the rail sole (reverse stroke)

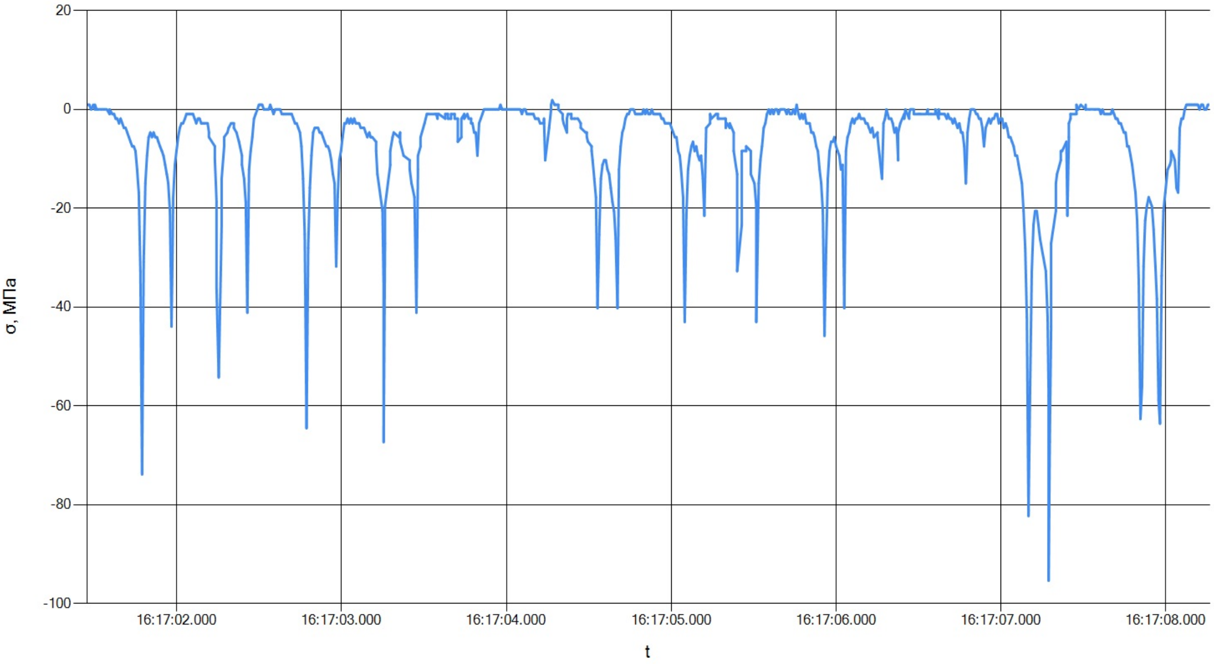

Figure 10 – Diagram of stresses in the neck of the rail (reverse stroke)

Dynamic impact on the rail of an experimental train is clearly illustrated by the following diagrams of stresses in the outer (figure 8) and internal (Figure 9) edges of the rail sole. Composition was held at a speed of 60 km/h from Almaty to Chu (reverse motion). It can be seen that empty gondolas 12-9920 exert less force on the rail than gondolas 12-9941. The impact of loaded gondola cars 12-9920 is almost equivalent to the effect of loaded gondola cars 12-9941. This can be explained by the improved characteristics of the spring suspension of the gondola 12-9920.

Figure 10 shows a diagram of measured stresses in the neck of the rail, and in Figure 11 - the distribution of calculated normal vertical stresses in the rail. It can be seen that the measured voltages are comparable with the design stresses.

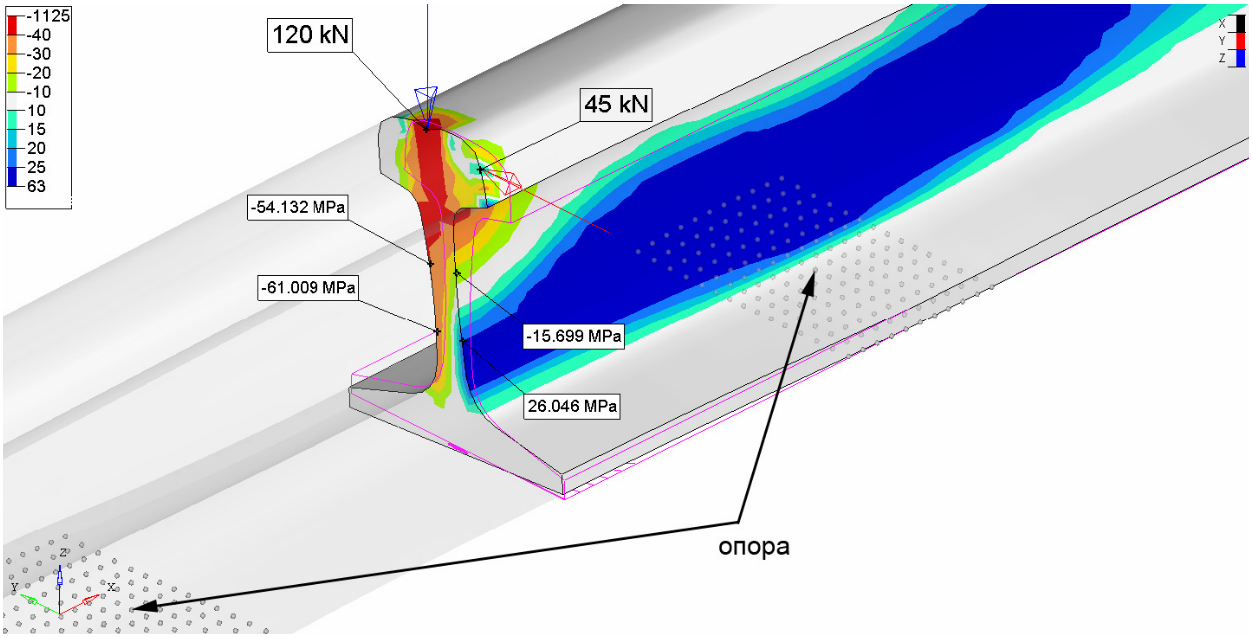

Figure 11 – Distribution of normal vertical stresses in the rail, MPa.
Vertical force 120 kN, lateral force 45 kN, loads between supports

Conclusions. If to judge the impact on the path from the measured edge stresses and stresses in the rail neck in this section, then the 12-9920 (25 ton) gondola cars look more preferable than the gondolas 12-9941 (23.5 tons). This circumstance can be explained by the improved characteristics of spring suspension of gondola cars 12-9920.

The increase in the weight norms of freight trains, without the cost of reconstructing the infrastructure, is quite possible with the operation of modernized freight wagons with an axial load of 245 kN (25 tons).

REFERENCES

[1] GOST R 55050-2012 "Railway rolling stock. Norms of permissible impact on the path and test methods". [Text]. M.: Standardinform, 2013. 29 p.

[2] Kuanyshev B.M., Kvashnin M.Ya. Estimation of the effectiveness of reinforcement of railroad bridges with composite material // Bishkek: Bulletin of KSUCTA. 2016. N 1(51). P. 238-244.

[3] Kvashnin M.Ya., Bondar IS, Rystygulov PA, Kystaubaev S.B. Experimental studies of railway bridges reinforced with composite material // Proceedings of the Sixteenth Scientific and Practical Conference "Traffic Safety". M.: MGUPS (MIIT), 2015. Vol. II. P. II-43 - II-47.

[4] Kvashnin M.Ya., Burombaev S.A., Bondar I.S., Zhangabylova A.M. Influence of vibrodynamic effects of locomotives with high axial loads on the railway. Way and beam reinforced concrete. Span structures of bridges // Proceedings of the XII International Scientific and Technical Conference "Modern problems of design, construction and operation of the railway track". Readings dedicated to the memory of Professor G.M. Shahunyants. M.: MGUPS (MIIT), 2015. P. 163-166.

[5] Kvashnin M.Ya., Bondar IS, Zhangabylova A.M. Monitoring the impact of rolling stock on beam span structures of railway bridges // Proceedings of the International Scientific and Practical Conference "Transport Science and Innovations", dedicated to the message of the President of the Republic of Kazakhstan N. A. Nazarbayev "Nurly Zhol – the way to the future". Almaty: KazATK, 2015. P. 275-279.

[6] Burombaev S.A., Kvashnin M.Ya. Diagnostics and monitoring of artificial structures of trunk lines of JSC "NC" KTZh". Almaty: Bulletin of KazATK, 2016. N 3(98). P. 39-58.

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ЖЫЛЖЫМАЛЫ ҚҰРАМ ӘСЕРІНДЕГІ РЕЛЬСТІҢ КЕРНЕУІН АНЫҚТАУ

Аннотация. Қисықтың радиусы 380 м кезіндегі жиектік және рельс мойынтиегіндегі кернеудің өлшеу нәтижелері келтірілген.

Алматы–Чу желісінде орналасқан учаскедегі, СКDе-2108 тепловозының, 12-9941 және 12-9920 жартылай жүк вагондарының жолға әсерін анықтауға арналған сынақ кезінде, қисықтың радиусы 380 м болған кезіндегі жиектік және рельс мойынтиегіндегі кернеудің өлшеу нәтижелері келтірілген. Табан жиегіндегі және рельс мойынтиегіндегі кернеудің сынақ жүргізуге арналған жылжымалы құрамның жылдамдығына тәуелділігі алынған. Кернеуден бүйірлік күштерге көшу мүмкіншілігі қарастырылған.

Түйін сөздер: темір жол, рельс, жиектік кернеу, рельс мойынтиегіндегі кернеу, вертикаль және бүйірлік күштер, сынақ жүргізетін жылжымалы құрам, кіші радиусты қисық.

В. Г. Солоненко, Н. М. Махметова, М. Я. Квашнин, С. Е. Бекжанова

Казахская академия транспорта и коммуникаций им. М. Тынышпаева, Алматы, Казахстан

ОПРЕДЕЛЕНИЕ НАПРЯЖЕНИЙ В РЕЛЬСЕ ПРИ ВОЗДЕЙСТВИИ ПОДВИЖНОГО СОСТАВА

Аннотация. Представлены результаты измерений кромочных напряжений и напряжений в шейке рельса в кривой радиусом R=380 м, полученные при испытаниях по воздействию на путь тепловоза СКD6е-2108, грузовых полувагонов 12-9941 и 12-9920, на участке железнодорожной линии Алматы–Чу. Получены зависимости напряжений в кромках подошвы и шейке рельса от скорости испытываемого подвижного состава. Рассмотрена возможность перехода от напряжений к боковым силам.

Ключевые слова: железнодорожный путь, рельс, кромочные напряжения, напряжения в шейке рельса, вертикальные и боковые силы, испытываемый подвижной состав, кривая малого радиуса.

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