# "K" stations main indicators for freight, train traffic and analysis of wind shear zones in area cross section

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***Abstract:*** *This article carried out the analysis of wind gust zones in the "K" station's main indicators for freight, train traffic and area cross-section. In this context, the possibilities of improving the workflow of the railway station have also been the subject of wind gully analysis, which negatively affects the stagnation of open rolling stock.*

***Keywords:*** *Station, usage indicators, wind Gul, freight train, standing time, number of stops, years cross section, wagon, freight train.*

During the study of the workflow of the "K" Station, an analysis of the main indicators of the work performed at the station between 2022 and 2023 was carried out that is, the amount of freight flows loaded from the station, the amount of loaded wagon flows, the amount of transit recycled wagons, the amount of transit unprocessed wagons and the amount of It will be possible to get acquainted with the analysis of these indicators in the cross section of years from the table in the well (tables 1-2).

*Table 1.*

*"K" Station performance information as of December 2023*

| № | Specification | 2022 | 2023 | | % | | (+,-) | |
|---|---|---|---|---|---|---|---|---|
| | | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 |
| 1 | Load increase in the wagon | 148 | 188 | 187 | 99% | 126% | -1 | 39 |
| 2 | Load increase in tons | 9657 | 11875 | 12172 | 103% | 126% | 297 | 2515 |
| 3 | Unloading on the wagon | 363 | 345 | 365 | 106% | 101% | 20 | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | Stat. weight | 65,3 | 63,2 | 65,1 | 103% | 100% | 1,9 | -0,2 |
| 5 | 1 standing in cargo operation | 19,7 | 14,8 | 14,8 | 100% | 133% | 0,0 | -4,9 |
| 6 | Coaches at work Park | 321 | 541 | 694 | 78% | 46% | 153 | 373 |
| 7 | Sent wagons | 114 | 270 | 221 | 82% | 194% | -49 | 107 |

*Table 2*

*Information on the performance of the main use indicators of the "K" station for 12 months of 2023*

| № | Specification | 2022 | 2023 | | % | | (+,-) | |
|---|---|---|---|---|---|---|---|---|
| | | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 | 2022 report 2023 plan 2023 |
| 1 | Load increase in the wagon | 2499 | 2019 | 2243 | 111 | 90 | 224 | -256 |
| 2 | Load increase in tons | 163259 | 136019 | 139 067 | 102 | 85 | 3048 | -24192 |
| 3 | Unloading on the wagon | 5126 | 4870 | 4907 | 101 | 96 | 37 | -219 |
| 4 | Stat. weight | 65,3 | 67,4 | 65,3 | 97 | 100 | -2,1 | 0,0 |
| 5 | 1 standing in cargo operation | 12,1 | 14,8 | 14,7 | 101 | 82 | -0,1 | 2,6 |
| 6 | Coaches at work Park | 6705 | 8459 | 7845 | 108 | 85 | -614 | 1140 |
| 7 | Sent wagons | 2454 | 2683 | 2631 | 98 | 107 | -52 | 177 |

Analysis of the performance of the "K" Station shows: the increase in freight by wagon: 2499 cars in 2022, the increase in freight plan for 2023 was 2019 cars, and in 2023 the station made a load increase of 2243 cars. This is 111% compared to the 2023 plan and 90% compared to the 2022 report. These figures are as follows in the wagon account: 224 cars more than the 2023 plan, 256 cars less load increased than in 2022. Load increase by ton: 163259 cars in 2022, the load increase plan for 2023 was 136019 cars, in 2023 the station carried out a load increase of 139067 cars. This is 102% compared to the 2023 plan and 85% compared to the 2022 report. These figures are as follows in the wagon account: 3,048 wagons over the 2023 plan, 24,192 wagons less cargo over 2022. Unloading by wagon: the load increase plan for 2022 was 5,126 cars, for 2023 was 4,870

cars, and in 2023 the station made a load increase of 4,907 cars. This is 101% compared to the 2023 plan and 96% compared to the 2022 report. These figures are as follows in the wagon account: 37 cars more than the 2023 plan, 219 cars less load increased than in 2022. In the 2022-2023 lunar cross section, the carriage loading indicators at Station "K" were given in the following Tabular graphs (Tables 3-4 and Figure 1) [13-15, 21-24].

*Table 3.*

*Analysis of carriage loading indicators at Station "K" in the month cross section as of 2022*

| № | Monthly | Total upload 2022-y. | | Including | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Real including inside the station | | Real including inside the station | | % |
| | | Vag. | Tonna. | Vag. | Tonna. | Vag. | Tonna. | |
| 1. | January | 122 | 7889 | 44 | 2575 | 78 | 5314 | 67% |
| 2. | February | 253 | 16532 | 45 | 2710 | 206 | 13822 | 84% |
| 3. | March | 398 | 25715 | 106 | 6025 | 292 | 19690 | 77% |
| 4. | April | 216 | 13840 | 86 | 5096 | 130 | 8744 | 63% |
| 5. | May | 194 | 13013 | 33 | 1876 | 161 | 11137 | 86% |
| 6. | June | 156 | 10474 | 49 | 3094 | 107 | 7380 | 70% |
| 7. | July | 220 | 14559 | 91 | 5645 | 129 | 8914 | 61% |
| 8. | August | 263 | 17433 | 129 | 8295 | 134 | 9138 | 52% |
| 9. | September | 263 | 17234 | 134 | 8204 | 129 | 9030 | 52% |
| 10. | October | 130 | 8166 | 94 | 5024 | 36 | 3142 | 38% |
| 11. | November | 135 | 8745 | 47 | 2764 | 88 | 5988 | 68% |
| 12. | December | 148 | 9657 | 62 | 3780 | 86 | 5877 | 0% |
| | Total | 2498 | 163257 | 920 | 55088 | 1576 | 108176 | 66% |

*Table 4*

*Analysis of carriage loading indicators at Station "K" in the month cross section as of 2023*

| № | Monthly | Total upload 2023-y. | | Including | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Real including inside the station | | Real including inside the station | | % |
| | | Vag. | Tonna. | Vag. | Tonna. | Vag. | Tonna. | |
| 1. | January | 101 | 6335 | 30 | 1456 | 72 | 4878 | 77% |
| 2. | February | 198 | 11517 | 62 | 2984 | 125 | 8531 | 74% |
| 3. | March | 227 | 14725 | 60 | 3416 | 167 | 11309 | 77% |
| 4. | April | 187 | 11751 | 121 | 7232 | 66 | 4519 | 38% |
| 5. | May | 179 | 10951 | 154 | 9223 | 25 | 1733 | 16% |
| 6. | June | 180 | 10887 | 123 | 7011 | 57 | 3876 | 36% |
| 7. | July | 226 | 14263 | 120 | 7055 | 106 | 7208 | 51% |
| 8. | August | 256 | 15512 | 179 | 10274 | 77 | 5238 | 34% |
| 9. | September | 237 | 14536 | 134 | 7506 | 104 | 7030 | 48% |
| 10. | October | 130 | 7745 | 103 | 5932 | 27 | 1813 | 23% |
| 11. | November | 135 | 8672 | 77 | 4728 | 58 | 3944 | 45% |
| 12. | December | 186 | 12172,0 | 141 | 9155,0 | 45 | 3017 | 25% |
| | Total | 2242 | 139066 | 1304 | 75972 | 929 | 63096 | 45% |

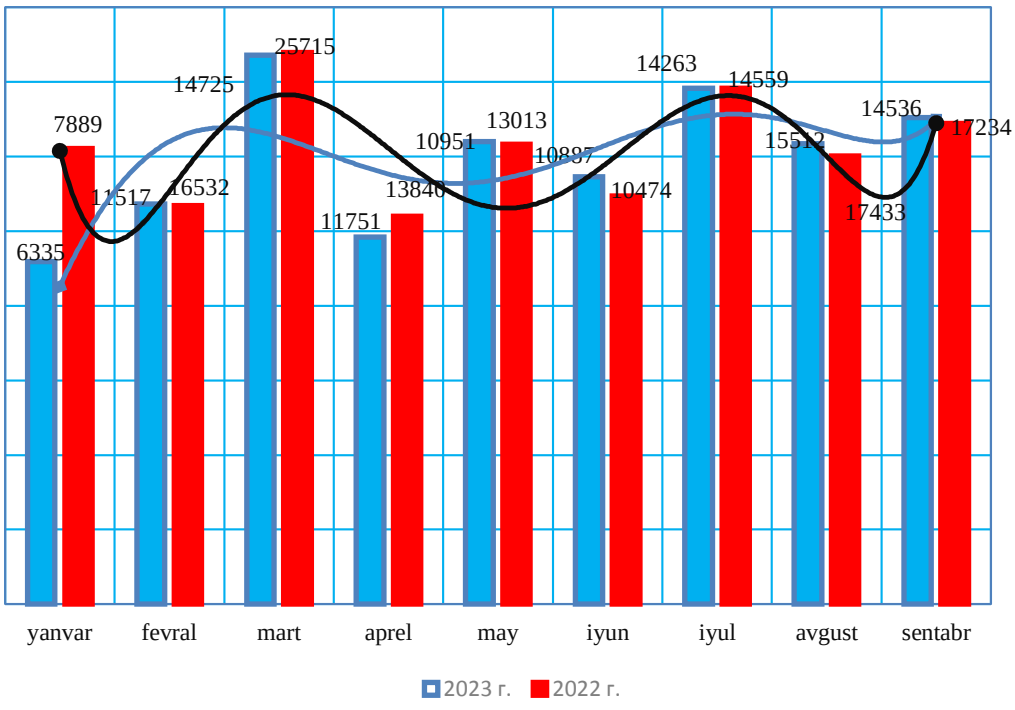

*Figure 1. Railcar loading indicators at Station "K" in the 2022-2023 lunar cross section*

Also, an analysis of the main performance of the station in the cross-section of years was carried out and its comparative table was developed (Table 5).

*Table 5*

*Comparative table of carriage loading indicators at Station "K" in the cross section of months for 2022-2023*

| | January | February | March | April | May | June | July | August | September | In 9 months |
|---|---|---|---|---|---|---|---|---|---|---|
| 2023-y report | 6335 | 11517 | 14725 | 11751 | 10951 | 10887 | 14263 | 15512 | 14536 | 110477 |
| 2022-y report | 7889 | 16532 | 25715 | 13840 | 13013 | 10474 | 14559 | 17433 | 17234 | 136689 |
| +\- | -1554 | -5015 | -10990 | -2089 | -2062 | 413 | -296 | -1722 | -2698 | -26212 |
| % | 80,3 | 69,6 | 57,2 | 84,9 | 84,1 | 103,9 | 97,9 | 88,9 | 84,3 | 80,8 |

From the results of the account, it can be seen that based on the comparative table of Station performance, the highest discrepancy was recorded in June, according to which the highest increase of 103.9% was achieved in the same month of 2023, compared to June 2022.

*Table 6*

*Analysis of income accrued at the "K" railway station for 12 months in 2023 compared to income in 12 months in 2022*

| Name | 2022 | 2023 | Difference, +/- |
|---|---|---|---|
| 1.Wagon release | 75901 | 67792 | -8109 |
| 2.Maneuver work | 75603 | 92089 | 16486 |
| 3.Wagon wash | 48335 | 54554 | 6219 |

| | | | |
|---|---|---|---|
| 4.Agreed collections | 781730 | 1021759 | 240029 |
| Fines | | | |
| Name | | | |
| 1.Fine for standing wagon void | 124234 | 244368 | 120134 |
| 2.Fine for failure to comply with the plan | 2850 | 3300 | 450 |
| 3.Fine for underloading the technical norm | 4985 | 12123 | 7138 |
| Fine for non-wagon cleaning | 8970 | 12900 | 3930 |
| Specification | | | |
| Name | 2022 | 2023 | Difference, +/- |
| Load gain (wagon) | 2499 | 2243 | -256 |
| Unloading (wagon | 5126 | 4908 | -218 |
| Definition of C/D | 4384 | 4811 | 427 |

When we analyze the indicator of the introduction and withdrawal of wagons, we consider that during the 12 months of 2023, 823 wagons of mineral fertilizer, fuel lubrication products, coal products were imported into and out of the county road, 938 wagons were charged at the age of 12 months of 2022, 75,901 thousand were withdrawn (Table 6). This figure decreased by 10101.0 thousand rubles compared to the previous year. This is because up to 12 months in 2022, 322 cars of wheat products were shipped from urban roads as well as 29 cars shipped by the construction organization HisorakGidro and coal and fuel products 587 cars of freight total 938 cars were unloaded and increased. During the 12-month period of 2023, 70 wagons of wheat products were loaded and unloaded from the highway. Iron concrete product 10 cars lifting and Container Houses 7 cars increased 567 cars from fuel and fuel products, coal products 266 cars lowered total increased wagons 823 cars by the same period of last year, as a result of a decrease in the number of cars by 115 cars, revenues also decreased by 8109.0 thousand rubles [1-7].

When analyzing the increase in load on the car, it became known that according to it, in the 12 months of 2023, 2,243 cars were loaded and completed to 139,019 tons, in the 12 months of 2022, 2,499 cars were loaded to 163,259 tons, compared to the previous year, when the number of cars was reduced to 256, our increased loads decreased by 24,192 tons, but in the 12 months of 2023 102% completed. If so, at the beginning of 2023, that is, in January, February, there was an anomalous cold flow and a large amount of precipitation, then the demand for increased load by customers, increasing the load from the second quarter of the year was increased. But we can see that some loads have decreased in the load increase, of which: iron concrete products have decreased by a total of 95 cars 6671 tons of wheat 474 cars 30910 tons of white stone 44 cars 3067 tons of cement 106 cars 6970 tons. Cargo-bearing enterprises Agro Trade holding LLC, Hojailim conn LLC, cement-unloading enterprises have not increased cargo at all during the 12 months of 2023. To remedy this situation, measures and meetings are being taken to increase the load on entrepreneurs from the railway [13-15].

In the case of unloading indicators, 375 cars of cement arrived for 12 months in 2022, while 13 cars of cement cargo arrived for 13 months in 2023. The main reason for the reduction of this load is due to the launch of the new cement plant “Q-K” LLC, located in the “K” district, when entrepreneurs bringing all cement products are carrying out transportation of cargo by road. From the above analyzes, it can be seen that an increase in the flow of trains in the plots where the station is located is occurring in this context, an increase in the number of trains will lead to an increase in the containers transported in them. Given this, ensuring the stagnation of empty containers transported in the regions where the station “K” is located is one of the urgent tasks. In this context, an analysis of the existing wind gust zones was carried out on the scale of the “Q” Branch, where the “K” station is located.

It is permissible to analyze the “Wind Flower” in the areas where the railway sections are located in order to determine the conditions for the overturning of empty containers from the influence of the wind when moving the rolling stock. In particular, in foreign experience, there were many cases of

violation of road safety as a result of the overthrow of empty containers on wind-dependent sections of Railways on the territory of the Russian Federation, the CIS countries and the United States. By Order of JSC "Russian Railways", when transporting empty containers on special railway platforms, a number of measures have been approved aimed at reducing the risk of traffic accidents in conditions of strong wind, heavy rain or hurricane forecasts along their route. In the event of a strong wind, heavy rain or storm in an area that depends on the wind in the direction perpendicular to the rail axis, the following are prohibited:

- allow the opposite movement of passenger trains with a container-carrying freight train in an area with a wind speed of more than 20 m / sec;

- shipping container-carrying freight trains to wind-dependent area when wind speeds exceed 25 m/sec [11-14, 19-20].

The adopted rule involves only the organizational correction of the transportation process, but does not solve the problem of overturning empty containers. An example of this is the severe meteorological conditions of the Kerch Strait, where rail traffic is now carried out on the Crimean Bridge. Gale-force conditions with high wind speeds are a standard phenomenon for the Kerch Strait. The estimated wind speed in the section of the line between the arc can reach 40 M/s in exceptional cases. The most severe weather conditions during construction was October 2016, when the number of hurricane watches reached 447 hours (more than 18 days, including 13 consecutive days of hurricane warning). In November 2015, the maximum wind speed recorded was 30 minutes per second, with the wind direction dominating the northeast side.

The above analyzes were definitely studied on a foreign scale, for this purpose, the analysis of wind gusts in the cross-section of the regions of the railway sections "UTY" was determined using the drawing of the "Wind Flower" (Figure 2) [1-10, 15-18].

| Wind direction | Frequency of occurrence, % | |
|---|---|---|

| | |
|---|---|
| North | 19,5 |
| Northeast | 5,3 |
| East | 4,3 |
| Southeast | 3,3 |
| South | 9,7 |
| Southwest | 13,9 |
| West | 20,3 |
| Northwestern | 23,6 |

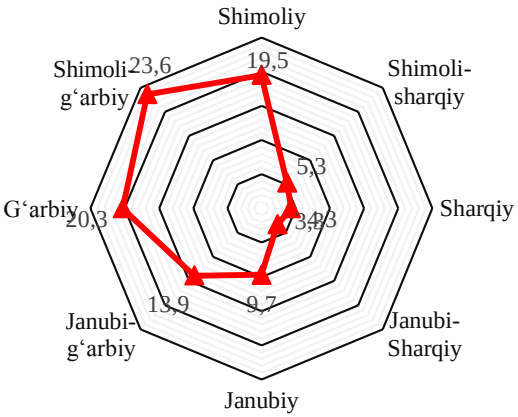


*Figure 2. Analysis of "wind gusts" and wind gusts in the area cross section (on the scale of the branch "Q") of the railway sections "UTY" JSC*

It should be noted that the wind is more negatively affected by their stagnation as a result of the side effects of the train running along bridges and lots. From the picture above, it can be seen that the analysis of wind gusts in the cross section of the "Q" Branch area by years is most affected by 23.6% in the "northwest" direction. In this regard, the need arises to develop a methodology for assessing the characteristics of strong winds, which leads to the overturning of empty containers on freight trains.

## *References*

1. Bozorov R. Sh. Aerodynamic impact of the high-speed electric train «Afrosiyob» on opposite trains. Journal of Transsib Railway Studies, 2022, no. 2 (50), pp. 96-107 (In Russian).

2. Bozorov R.S., Rasulov M.X., Masharipov M.N. Investigation of mutual aerodynamic influence of high-speed passenger and freight trains moving on adjacent tracks. Journal Innotrans Scientific-and-nonfiction edition, 2022, no. 2(44), pp. 42-48. DOI:10.20291/2311-164X-2022-2-42-48

3. “EN 14067 Railway applications – Aerodynamics – Part 2: Aerodynamics on open track”, ed: CEN/TC 256, 2010.

4. “EN 14067 Railway applications – Aerodynamics – Part 4: Requirements and test procedures for aerodynamics on open track”, ed: CEN/TC 256, 2010.

5. Lazarenko Y.M., Kapuskin A.N. Aerodynamic impact of the «Sapsan» high-speed electric train on passengers on platforms and on oncoming trains when crossing. Bulletin of the Research Institute of Railway Transport, 2012, no. 4, pp.11-14 (In Russian).

6. Raghu S. Raghunathan, H. D. Kim, T. Setoguchi. Aerodynamics of high-speed railway train / Progress in Aerospace Sciences 38 (2002) 469-514.

7. Baker C., Quinn A., Sima M., Hoefener L., and Licciardello R. Full-scale measurement and analysisof train slipstreams and wakes. Part 1: Ensemble averages. Proceedings of the Institute of mechanical Engineers, Part F: Journal of Rail and Rapid Transit, 2013. p. 453-467.

8. Baker C., Quinn A., Sima M., Hoefener L., and Licciardello R. Full scale measurement and analysis of train slipstreams and wakes: Part 2 Gust analysis. Proceedings of the Institute of mechanical Engineers, Part F: Journal of Rail and Rapid Transit, 2013. p. 468-480.

9. Katsuyuki M., Kazuaki I., Tsutomu H., Jin’ichi O., Kei H. and Atsuyushi H. Effect of train draft on platforms and in station houses. JR East Technical Review No. 16, 2010. p. 39-42.

10. Hong Wu, Zhi-jian Zhou. Study on aerodynamic characteristics and running safety of two high-speed trains passing each other under crosswinds based on computer simulation technologies. Journal of Vibroengineering, Vol. 19, Issue 8, 2017, p. 6328-6345.

11. Tian Li , Ming Li, Zheng Wang and Jiye Zhang. Effect of the inter-car gap length on the aerodynamic characteristics of a high-speed train. Journal of Rail and Rapid transit, Issue 4, September 20, 2018, p. 448-465.

12. Chris Baker, Terry Johnson, Dominic Flynn, Hassan Hemida, Andrew Quinn, David Soper, Mark Sterling. Train Aerodynamics fundamentals and applications.

Book Butterworth-Heinemann London 2019, p. 151-179. ISBN 978-0-12-813310-1, https://doi.org/10.1016/B978-0-12-813310-1.00008-3

13. Bozorov R.Sh., Rasulov M.Kh., Bekzhanova S.E., Masharipov M.N. Methods for the efficient use of the capacity of sections in the conditions of the passage of high-speed passenger trains.Journal Railway transport: Topical issues and innovations, 2021, no. 2, pp. 5-22. (In Russian).

14. Shukhrat Saidivaliev, Ramazon Bozorov, Elbek Shermatov. Kinematic characteristics of the car movement from the top to the calculation point of the marshalling hump. E3S Web of Conferences 264, 05008 (2021) https://doi.org/10.1051/e3sconf/202126405008

15. Rasulov, M., Masharipov, M., Sattorov, S., & Bozorov, R. (2023). Study of specific aspects of calculating the throughput of freight trains on two-track railway sections with mixed traffic. In E3S Web of Conferences (Vol. 458, p. 03015). EDP Sciences. https://doi.org/10.1051/e3sconf/202345803015

16. Bozorov R.Sh. About absence of theoretical base of the formula for determination of height of the first profile site of the marshalling hump / Bozorov R.Sh., Saidivaliev Sh.U., Djabbarov Sh.B. –Text : immediate // Innovation. The science. Education. 2021, №34. pp. 1467–1481. (In Russian).

17. Bozorov R. S., Rasulov M. X., Masharipov M. N. Research on the aerodynamics of high-speed trains // Universum: технические науки: электрон. научн. журн., 2022, № 6 (99).

18. Marufdjan Rasulov, Masud Masharipov, S. E. Bekzhanova and Ramazon Bozorov. Measures of effective use of the capacity of twotrack sections of JSC “Uzbekistan Railways”. E3S Web of Conferences 401, 05041 (2023) https://doi.org/10.1051/e3sconf/202340105041

19. Andrzej Zbieć. Aerodynamic Phenomena Caused by the Passage of a Train. Part 2: Pressure Influence on Passing Trains. Problemy Kolejnictwa. Issue 192, September 2021, p. 195-202. http://dx.doi.org/10.36137/1926E

20. NB JT ST 03-98. Safety standards for railway transport. Electric trains. – M.: VNIIJT, 2003. – 196 p.

21. UIC 566 Leaflet: Loadings of coach bodies and their components, 3rd edition of 1.1.90

22. Saidivaliev, Sh.U. A new method of calculating time and speed of a carriage during its movement on the section of the first brake position of a marshaling hump when exposed headwind / Sh.U. Saidivaliev, R.Sh. Bozorov, E.S. Shermatov // STUDENT eISSN: 2658-4964. 2021, №9.

23. Bozorov R.Sh., Saidivaliev Sh.U., Shermatov E.S., and Boboev D.Sh. Research to establish the optimal number of platforms in a container. Transport: science, technology, management. Scientific information collection. Issue 5, 2022, p. 24-28. https://doi.org/10.36535/0236-1914-2022-05-5 (In Russian).

24. Rasulov, M., Masharipov, M., & Ismatullaev, A. (2021). Optimization of the terminal operating mode during the formation of a container block train. In *E3S Web of Conferences* (Vol. 264, p. 05025). EDP Sciences. https://doi.org/10.1051/e3sconf/202126405025