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SUMMARY ON THE CURRENT STATE OF REGULATIONS IN RAILWAYS UKRAINE

Sykal S.
Kyiv National University of Building and Constructions

Keywords: normative documents, infrastructure, high-speed movement, geometrical parameters of the railway track, geodetic support.

Formulation of the problem

The development of innovative geodetic measurement technologies and the emergence of new methods for obtaining and processing geospatial information causes progress in the design, construction and modernization of railway infrastructure.

Accumulated geospatial data is used at all stages of the lifecycle of railway infrastructure objects - from exploration and design to construction and current maintenance. The unity and relevance of geospatial data at all stages ensure the quality of the work performed, precise control of the installation or straightening of the track and the installation of infrastructure objects in the project position, create the information basis for infrastructure management. The deployment of technology based on the application of data from global navigation satellite systems (GNSS), for example, GLONASS / GPS, with the possibility of high-precision differential correction of coordinate measurement results from terrestrial satellite station, allows you to receive real-time track coordinates and ' objects of highway accuracy. Thus, the prospect of the transition to new innovative technologies for the implementation of modernization and repairs on the railways of Ukraine opens, which should be reflected in the relevant modern regulatory documents.

Analysis of recent research and publications related to this problem

Railway users are still not as often as needed to address the issue of improving the methods for determining the geometric parameters of railways. For a long time during the performance of work dominated traditional geodetic methods and tools, which were based on the use of measuring tapes, roulette and optical instruments [5, 7] or purely mechanical measuring instruments such as levels, rulers, etc. [8, 9].

The emergence of new modern geodetic measuring technologies forced geodesists to review existing approaches to engineering surveys, topographical and cadastral removal, construction, geometric parameters of the track, etc. However, the technical staff of the railway did not touch this process [5 - 9].

Innovative technologies include the technology of determining the spatial coordinates using GNSS equipment, obtaining spatial data with the help of measuring systems of aerial aerial photography and ground laser scanning and scanning in motion [11,12].

In [10, 11] the world experience of introduction of high-speed railroad traffic in different countries of the world and prospects of its development in Ukraine are considered. In the paper [13] proposed the application of new standards for the width of the railroad in the straight and curved areas. Yes, unfortunately in the instructions these questions are not highlighted. And in works carried out on the railways - new methods are not used. Hence it turns out that today in the instructions describes the implementation of work on outdated technologies, and new methods are described only in scientific works.

The purpose of the work: to analyze the current state of normative and methodical documents used on the railways of Ukraine, taking into account the state of modern geodetic equipment and advanced technologies, for use in determining geometrical parameters of the railway track.

The main content of the work

During the period of functioning of the USSR and until the mid-nineties, a significant regulatory, methodological and legal framework was established that regulates the organization of the railway industry activity as a single mechanism. At the same time in the Soviet period, the main network, rolling stock and infrastructure of rail transport were part of a single system, the activity of the railway itself was regulated by acts of the Ministry of Communications of the USSR. In the process of phased restructuring of the railway industry, there were changes in regulatory documents. Consider what has succeeded and what is not enough to overcome the high-speed barrier at 120 km / h. on the railways of Ukraine.

Solving the tasks of meeting the requirements specified in documents [2] and [3], as well as described in [10] and [11], regarding the development of railways in Europe and Ukraine, the organization of safe traffic on them, is impossible without the establishment of the coordinate-time system work of the Ukrzaliznytsia [1] (hereinafter referred to as the "Systems").

For example, one of the main tasks of creating a System [1] is to determine the coordinates of the track and its geometric parameters in a single coordinate system. Only by having such a System it is possible to achieve efficient control of high-speed freight and passenger traffic of railways, since only then it is possible to determine the location of each locomotive or carriage (equipped with GNSS receivers) on the road within the country in motion in real time with a marginal error not worse than one meter.

Described in the Directive [2] tasks, found concrete language in [3] and classified as priorities of state policy in the near future with a view to forming a single information space of the state.

After working out normative-methodical documents of the Ukrzaliznytsia (instructions, technical instructions, regulations, rules and technologies) [5-9], we can conclude that they do not describe the latest technologies with the use of modern geodetic instruments and GNSS and need to be reworked.

Normative-methodical documents are documents defining the order and rules for the execution of works, functions and operations in work processes, as well as the order and rules for the interaction of functionally conjugated roles in them (rules, regulations, regulations, procedure, methodology, working instructions)

Here are some of the outdated provisions of these documents.

"The curvature of a curve that has a small deviation of II and more degree is performed on the" eye "or using a track-breaking rifle (PRP)." [7, p. 50].

Today, the PRP is not a geodetic device of high accuracy and it is impossible to control the position of the axis of the track along the whole curve (and only locally) with the accuracy sufficient to solve modern problems of increasing speed and safety of motion.

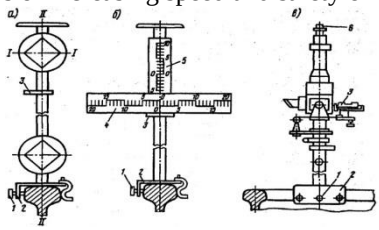

Figure 1 Cross-cut rifle gear PRP

"The state of the circular and transitive curves is determined by the results of bending arrows measurement, where the chord is used as a string of nylon threads, and the bending arm is measured by a ruler; the location of the characteristic points and the geometric parameters of the curve are determined by the graph-analytical method, the radius, the lengths of the transition curves, and the magnitudes." [7, p. 39-49].

Again, the control of the parameters of the curve is performed locally, and the accuracy of such a procedure is unsatisfactory. It is on this principle that the overwhelming majority of carriages-flaw detectors work;

Figure 2 - Diagram of measurements of bending arrows:
-1, 0, 1, 2 ... - divisions of the curve; f0, f1, f2 ... - bending arrows at the dividing points; and - the length of the chord

In the Technical Instructions [9, p. 20], it is said that "... pickets and kilometers are marked on the tape automatically in the form of serifs."

These serifs usually do not coincide with the actual locations of picket and kilometer marks due to the errors associated with the design of the car and the marking, or in the presence of pickets, the length of which does not equal 100 m. This is also not acceptable because it is not possible in the area to identify where there is a defect or indentation in the defective vehicle.

a) b)

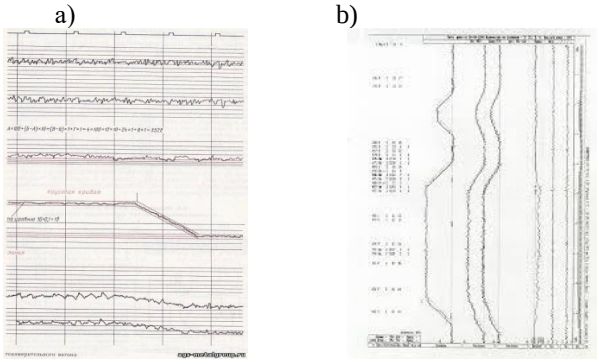

Figure 3 - A sample of the measuring tape a) without an onboard automated system (BAS), b) with an onboard automated system (BAS)

This discrepancy can be solved if the measurement results of the equipment installed in the car will be bound to the created System using the GNSS receiver, and in the hardware memory will be laid geometrical parameters of the track defined earlier also using GNSS receivers. Then, the equipment of the wagon will be able to give in real time (and not as a result of decoding) the retreat of the track from the actual position of the track laid in it.

The take-off of the picket in kind is not sufficiently precise and well-fixed: it can be depicted on the pillars of the contact network, the painting of sleepers in white color (1 piece-picket, 2 pieces - a kilometer), and when determining the estimated cost of building a new section of the railway, picking columns are not included. in the total cost of construction, indicating that they are not installed.

When creating the System [1], the physical fixing of picketing will not be necessary, but one needs to deviate from obsolete interpretations of this concept and proceed to the so-called track coordinates, which are mathematically precisely linked to other coordinate systems and can be instrumentally reproduced by geodetic instruments with an error in a few centimeters.

a) b)

Figure 4 - Picket (a) picket, b) kilometer

In the instruction CP0269 [5, p. 29] it is stated that in all the curve sections of the track the beginning of the circular curve and the end of the circular curve are marked with a white oil paint on the neck of the rail with the corresponding records of the PAC and the CCC, but with high load capacities and high intensity of trains, fixed marks (rappers) the beginning and end of the circular curve.

But the peak values and coordinates of these marks are not mathematically calculated on the basis of the instrumental measurements by the geometries and GNSS receivers. When applying modern means of measuring, calculating and storing data in the System, one must think about the need to install them in general because they are expensive in maintenance.

With regard to scientific works [10, 11], they consider the world experience of implementation of high-speed railway traffic in different countries of the world, and prospects for its development in Ukraine [10, p. 470-476], [11, p. 23-25]. They cover the following issues:

- construction of independent high-speed lines;
- reconstruction of operating railways;
- increase of speed of rolling stock, by reducing stops, etc.

But, as we see from the above, there is no hint at updating the normative documents under modern geodetic measuring instruments.

With regard to the present, the development of high-speed and high-speed passenger traffic is one of the most important ways of developing the market for rail passenger traffic. This is due, firstly, to the need for the withdrawal of passenger rail connections to a fundamentally new quality level that ensures the growth of mobility of the population, and secondly, the need to attract additional passenger traffic, which provides increased revenue from transportation.

At the beginning of the XXI century. high-speed trains that can develop speeds over 150-160 km / h, and after 10 years on conventional modernized lines the speed of high-speed trains will be over 200 km / h. (specialized ones - over 250-300 km / h). The speed of trains belonging to high-speed, as a rule, does not exceed 200 km / h. (repeat, and then it is not clear what it is). The definitions differ depending on the criteria that reflect the complexity of the development of the high-speed rail system. One notion of "high-speed line" is provided by the European Union in Directive 96/48 / EC [1].

European and international standards determine that high-speed traffic is a movement that provides trips between two points with speeds in intervals of 141-160 and 161-200 km / h. Ukrainian departmental standards represent the high-speed movement of passenger trains, such as the movement of passenger trains with velocities in intervals [5]:

- 141-160 km / h. - accelerated movement;
- 161-200 km / h. - high-speed movement;
- over 200 km / h. - high-speed movement.

During the period of market transformations, the railway transport of Ukraine took measures to "improve" the upper structure of the track and the earth's canvas, work was carried out on the renewal of rolling stock. But in the whole network of railways the speed of trains is low, with the exception of the directions Kiev Kharkiv, Kiev - Dnepropetrovsk, Kharkov - Simferopol, Kiev - Lviv. The limiting technical element of a complex of railway devices regarding the level of train speeds is the upper structure of the track and the earth's canvas.In the instruction CP0269 [5, p. 29] it is stated that in all the curve sections of the track the beginning of the circular curve and the end of the circular curve are marked with a white oil paint on the neck of the rail with the corresponding records of the PAC and the CCC, but with high load capacities and high intensity of trains, fixed marks (rappers) the beginning and end of the circular curve.

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On the railways of Ukraine, taking into account this circumstance, the maximum speed for passenger trains is set at 120 km / h, for trucks - 80-90 km / h. Traffic speed of passenger trains in the main directions is only 55-65 km / h. For the XXI century it is unsatisfactory, because rail transport can not compete with the automobile, let alone air transport.

Regarding the countries of Western Europe, due to the increase in the speed of trains, rail transport has an advantage over motor vehicles at distances of 250-500 kilometers and compete equally with aviation transport at distances of 500-1000 kilometers. Such speeds allow you to drive a distance of 1000 km in three hours. 1000 km is a distance that exceeds the average distance between the main capitals of European states, and as far as Ukraine is concerned, its maximum extent from the west to the east is 1316 km, and from the north to the south - 893 km, about which it is possible to draw certain conclusions.

In the situation that has developed over the past decades, the tracking of the track during design and survey works is carried out by a relative method, and the design data is prepared in relative terms, representing the output of the bracing diagram and the longitudinal profile [7].

When using the VPO, VPR, Duomatic, Unimat cartridges due to the fact that the current state of the trapped track is unknown to them, the correction is carried out only according to the prescribed bracing diagrams, that is, in the local coordinate system. As a result, this leads to the appearance of long profile drafts on the straight sections and the curvature of the curves. That is, the straight lines and the curves are well corrected on separate sites, but the sites are badly combined with each other.

Without a single coordinate binding of the project during research, construction, removal before repair, after repair, in subsequent work on current maintenance and planned preventive repairs of the track there is accumulation of "departure" from the original design position. This phenomenon is not effectively controlled by relative methods in local coordinate systems.

The prospect of further research is the development of normative and methodological documents of Ukrzaliznytsia based on the application of innovative technologies of geodetic measurements.

Conclusions:

1. Normative-methodical base of Ukrzaliznytsia, in the field of geodetic measurements, determination of geometric parameters of the track, etc., requires a substantial re-development.

2. The revision of the normative and methodological base of Ukrzaliznytsia should be carried out on the basis of the proposed concept of the coordinate-time system of the Ukrzaliznytsia [1].

3. Increase of accuracy and reliability of determination of coordinates of objects of Ukrzaliznytsia, which is especially important for geometrical parameters of a railway track.

4. Possibility of providing heavy-duty machines with reliable information (precisely tied to track coordinates (picketing)), with regard to parameters and actual disturbances of the track according to the data of railroad cars, in order to increase the productivity of machines, due to the exclusion of their measuring trips.

5. Promptly, reliably and most fully control the results of work, etc.

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Sykal S.

The article analyzes the current state of the normative documents (instructions, technical instructions, rules and technologies for carrying out works on the railway and the provisions), highlights the state of affairs, main achievements and identified unresolved issues.