

Quantitative characteristics of construction and reconstruction of railway sections in Uzbekistan

K. S. Lesov, Z. Z. Ergashev, M. K. Kenjaliyev*, and Sh. A. Tadjibaev

Tashkent State Transport University, Tashkent, Uzbekistan

Abstract. In this article the results of construction and reconstruction of railway sections to ensure the spatial connectivity of the regions of the country and integration into the global transport space are considered. The use of a systematic approach for selecting the most rational methods of quantitative and qualitative analysis of construction and reconstruction of railway sections is proposed. The basic characteristics and stages of construction and reconstruction of railways in Uzbekistan are given. The indicators of new railway sections construction, construction and reconstruction of railway sections for speed and high-speed trains movement during the period of Uzbekistan's independence have been analysed. When analysing the indicators the quantitative estimation by length, total cost and cost per kilometre of large investment projects, realized during Uzbekistan's independence years have been used.

1 Introduction

In the course of capital construction, fixed assets for production and non-production purposes are created. A special place in this process is occupied by the construction of railways, as it ensures the development of the regions of the country, intensifies the production of various sectors of the national economy [1, 2].

As a result of government policy in the field of transport, Uzbekistan has carried out extensive work to organize an effective transport system that meets the needs of the economy and the population for transport services by all types of transport [3].

At the present time all conditions for fruitful integration into the world transport space in the field of passenger and freight transportation by rail, in connection with the structural reforms to provide all regions of the country with a network of railroads have been created [4].

As recognized by the international community, Uzbekistan has a high transit and transport-communication potential, capable of connecting the East with the West, the South with the North.

Effectively using this potential and opportunities, “Uzbekistan Temir Yullari” joint-stock company carries out considerable work to develop, improve and reconstruct railway transport communications and ensure the safety of freight and passenger traffic.

New railroads built in difficult mountain and desert conditions, passing through mountain ranges and sandy terrain, provided with modern infrastructure facilities, are

*Corresponding author: mkenjaliyev@mail.ru

unique structures in the Central Asian region.

Railway construction should be considered mainly in the context of a rational solution to the problem of development, strengthening and improvement of the network at a fundamentally higher, systemic level by methods of short-term and reliable solution of multivariant problems of design of organization of production, able to embody the achievements of scientific and technological progress.

Improvement of construction and reconstruction of railway sections requires a systematic approach of design solutions to select the most rational ones using quantitative and qualitative analysis of economic and mathematical methods [5-7].

2 Objects and methods of research

2.1 Methods of quantitative assessment of the characteristics of construction and reconstruction of railroads

For the quantitative assessment of the characteristics of construction and reconstruction of railway sections of Uzbekistan used statistical theory, which widely enough covers the range of methodological and methodological tools that allow quantitative measurement of the studied relations.

Quantitative analysis of statistical data is conducted on a rational scale, which shows how many times one or another indicator is more or less than another, but it contains only positive values.

The analysis of statistical data allows us to distinguish analytical and descriptive stages. The analytical stage uses the method of determining the absolute and relative statistical value. At that, the absolute value gives quantitative characteristics of the length of construction by stages of development of railroads of Uzbekistan. Relative values express the cost of constructing one kilometer of railroads.

In the descriptive stage to present the dynamics of changes in the length of the section (km), the cost of the construction section, as well as the cost per 1 km of road (in million U.S. dollars), the processed data are presented in the form of bar charts.

Quantitative assessment of the construction of new, and reconstruction of existing railway sections of Uzbekistan for high-speed train traffic by the average value of the cost per 1 km of road. The results of the analysis and evaluation of new construction and reconstruction are shown in the form of line diagrams. Line diagrams clearly reflect the characteristics of dynamics and estimates of changes in the cost of construction of one kilometer of railroads in different conditions.

3 Results and their discussion

3.1 Railroad construction infrastructure in the areas of new construction

Uzbekistan's railroads are an integral and important part of the international transit transport corridors in the East-West and North-South directions.

Using effectively the transit potential, JSC "Uzbekistan Temir Yullari" actively carries out work on designing, construction, reconstruction and reorganization of railroads, providing safety of passenger and freight traffic.

Construction of the new Bukhara-Misken, Angren-Pap, Tashguzar-Baisun-Kumkurgan and Navoi-Uchkuduk-Sultanuivaystag-Nukus railway lines in complicated natural and climatic conditions is of great strategic importance for the economic development of the

Republic of Uzbekistan. New railroads with modern infrastructure facilities, are unique constructions in Uzbekistan.

The role of railway construction infrastructure is extremely high in the areas of new development. The development of new areas is a serious step in the development of the country, which should be decided upon after careful analysis of the possibility to work and provide people in these areas.

The promotion of railway construction in undeveloped regions in a market economy should be carried out through the implementation of investment programs. The fundamental point in the development of such programs is the substantiation of options for the development and location of infrastructure along the line under construction based on a comprehensive approach, taking into account the possibility of its use after construction completion. Characteristic features of the integrated approach are:

- development and placement of infrastructure;
- approach to the infrastructure as a single complex with a single management body;
- use of the principle of priority allocation of funds for infrastructure development in the allocation of multipurpose resources;
- joint consideration of options for the development of construction production and the possibility of alternatives for the phased formation of infrastructure;
- consideration of the specific nature of the formation of the needs in infrastructure services;
- consideration of the environmental factor.

3.2 The main characteristics of the transport sector of the country at the present stage

At the present stage, the country's railway industry needs to complete the planned projects and reach a higher level of operation in order to implement priority projects for rehabilitation of railway sections and construction of new ones should take into account several main criteria [8, 9]:

- strategic purpose of railway lines (formation of a unified transport network of the country);
- geopolitical purpose of railway lines (formation and development of international transport corridors);
- cargo purpose of railway lines.

Currently, the total length of the country's railways is 9,925.0 km, of which 7,400.0 km are for general use, 4,730.0 km are operational length, 1,860.0 km are electrified sections, including 980.0 km of high-speed sections.

Stages of railway construction and reconstruction in Uzbekistan.

Over the past period, the greatest historical achievement has undoubtedly been the construction of an integrated system of railway transport communications, which reliably and effectively connects the regions of our country and provides access to international transport corridors.

Today Uzbekistan's railways, which are an integral and important part of international transport systems, have reached a new level in international transport.

Stages in the construction and development of Uzbekistan's railways:

- first stage (1888-1920), tsarist Russian period – 1.049 km (21.8%);
- second stage (1920-1950), pre and post-war period – 1.225 km (25.9%);
- third stage (1950-1991) period of developed socialism – 1.261 km (26.66%);
- the fourth stage (1991-2023), the period of independence of the country – 1.213 km (25.64%).

The length of construction and development of Uzbekistan's railways by period is given in the form of bar charts in Fig. 1.

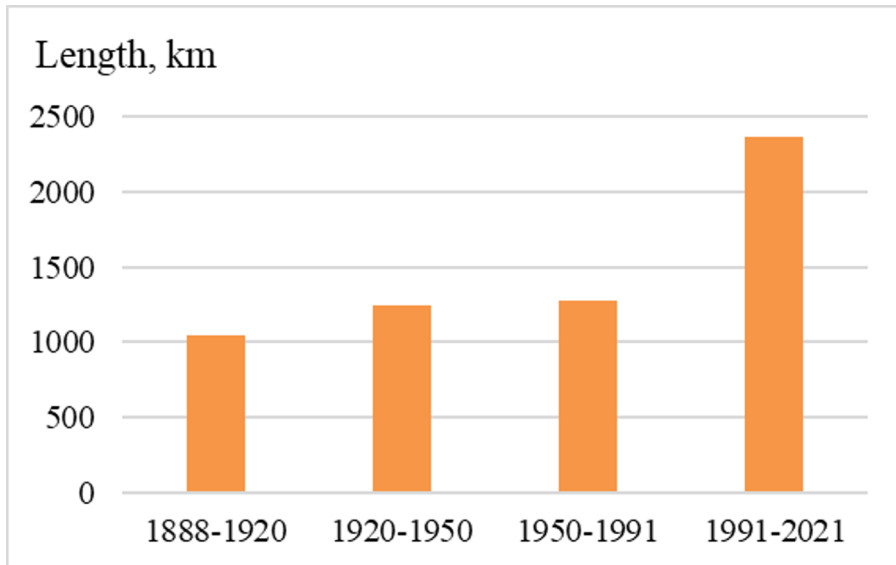


Fig. 1. Uzbekistan Railway Construction and Development Indicators.

3.3 Quantifying the construction of new railway sections in Uzbekistan

As a result of the investment policy pursued in the transport sector over the years of independence, major investment, including infrastructure projects, have been implemented in the country, which have important economic and political significance. These include:

- construction of Uchkuduk - Sultanuizdag railway section, 342 km long, with reconstruction of Navoi - Uchkuduk and Sultanuizdag - Nukus sections, 399 km long;
- construction of Tashguzar-Kumkurgan railway section, 223 km long;
- construction of the 35-km double track Yangier-Dashtabad railway section;
- construction of Yangier-Farkhad railway section, 23 km long;
- construction of Angren-Pap railway section, 123 km long;
- construction of Bukhara-Misken railway section, 356 km long;
- construction of the railway section in the Islamic Republic of Afghanistan Khairaton-Mazar-e-Sharif, 75 km in length.

The result of quantifying the construction of new railway sections during Uzbekistan's independence period is shown in Fig. 2.

Analysis of the construction figures for new railway sections during the period of independence shows that the cost per kilometre ranges from 0.8 million U.S. dollars (USD) (Bukhara-Misken) [10, 11] to 11.4 million USD (Angren-Pap).

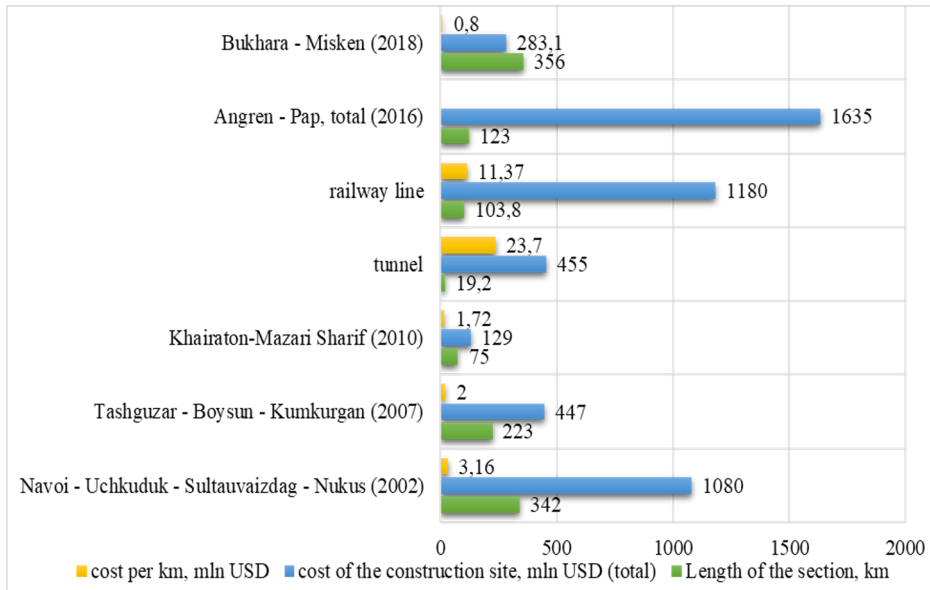


Fig. 2. Indicators of construction of new railway sections.

3.4 Quantification of the reconstruction of Uzbekistan railway sections for high-speed train traffic

All over the world and in Uzbekistan, in particular, much attention, along with new construction, is being paid to the reconstruction of existing railways for high-speed and high-speed traffic.

Uzbekistan's modern railroads are characterized by trends of innovative development of speed and high-speed passenger traffic, new speed and high-speed electrified lines are being built and existing electrified railroads are being modernized.

High-speed traffic of passenger trains is organised as a result of reconstruction on the following railway sections [12, 13]:

- reconstruction of the Marokand-Karshi railway section, 140km long;
- reconstruction of the Samarkand-Bukhara railway section, 291 km long;
- reconstruction of the Tashguzar-Kitab railway section, 92 km long;
- reconstruction of the Karshi-Termez railway section, 325 kmlong;
- reconstruction of the Pap-Kokand-Andijan railway section, 186 km long.

The result of quantitative assessment of reconstruction of railway sections for high-speed train traffic during the period of Uzbekistan's independence is shown in Fig. 3.

Analysis of indicators of reconstruction of railway sections for high-speed train traffic during the period of independence shows that the cost of reconstruction of one kilometre ranges from 0.54 million USD(Pap-Kokand-Andijan) [14, 15] to 2.23 million USD(Samarkand-Bukhara).

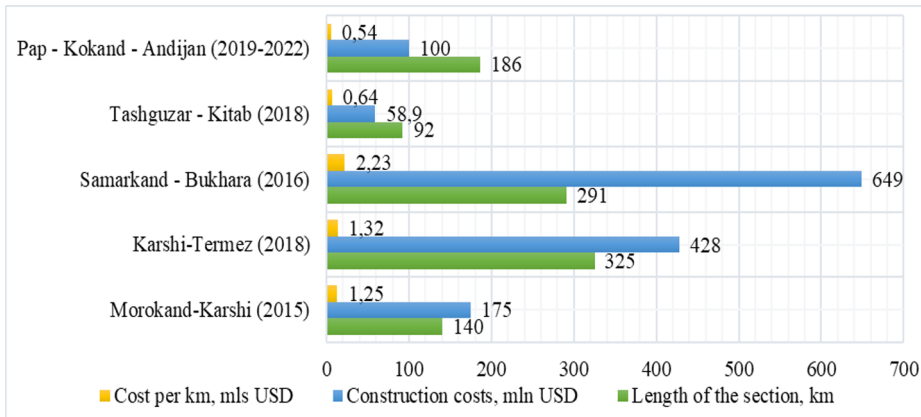


Fig. 3. Indicators of reconstruction of railway sections for high-speed train traffic.

3.5 Quantitative assessment of the construction and reconstruction of railway sections of Uzbekistan for high-speed train traffic

High-speed rail traffic in Uzbekistan was envisaged to be introduced in accordance with Decree No. 615 of 17 November 2009 of the Cabinet of Ministers of the Republic of Uzbekistan [16].

Analysis of the experience of leading countries, which have implemented projects to build high-speed railroads, indicates two approaches to solving this problem. Japan, France, Italy, Germany and other countries have taken the first way on the basis of their own achievements and scientific developments. The second way was followed by the USA, Spain, Korea and China, which used the experience and technical solutions of foreign scientists and specialists.

JSC “Uzbekistan Temir Yullari” after repeated consultations with foreign experts in the scientific and technical field has chosen the second way of introduction of high-speed movement of passenger trains to 250 km/h on the basis of model of the Russian railroads. First of all, institutes of “Boshtransloiha” and “Toshtemirulloiha” have proposed the adaptation in Uzbekistan of Russian regulatory documents on the organization of high-speed and high-speed traffic.

The main directions of the organization of high-speed and high-speed traffic according to international practice:

- organization of mixed traffic of passenger and freight trains up to 200 km/h after reconstruction of existing railroads;
- organization of high-speed traffic of passenger trains at a speed of up to 250 km/h, by constructing new railroads.

In the conditions of Uzbekistan, these issues and problems are urgent, so the organization of high-speed train traffic was carried out on specialized passenger lines.

In international practice, there are two main directions for organizing speed and high-speed train traffic:

- reconstruction of existing railroads to organize mixed high-speed passenger and freight traffic with passenger train speeds of up to 200 km/h;
- construction of new high-speed lines to ensure passenger train service.

For the railroads of the Republic of Uzbekistan, these issues and problems are also relevant, so the issue of organizing high-speed traffic on specialized passenger lines is

appropriate.

High-speed traffic of passenger trains is organized as a result of construction and reconstruction on the following railway sections [17, 18]:

- construction and reconstruction of the double-track electrified Yangier - Dashtabad railway line for high-speed train traffic;
- construction of the second track and reconstruction of the Dashtabad - Dzhizak railway section for high-speed train traffic.

The result of quantitative assessment of construction and reconstruction of railway sections for high-speed trains during the period of independence of Uzbekistan is shown in Figure 4.

The cost of one kilometer of construction and reconstruction of the double-track electrified railway line Yangier - Dzhizak was 3.77 million USD, and the construction of the second track and reconstruction of the Dashtabad - Dzhizak railway section, 1.61 million USD [19, 20].

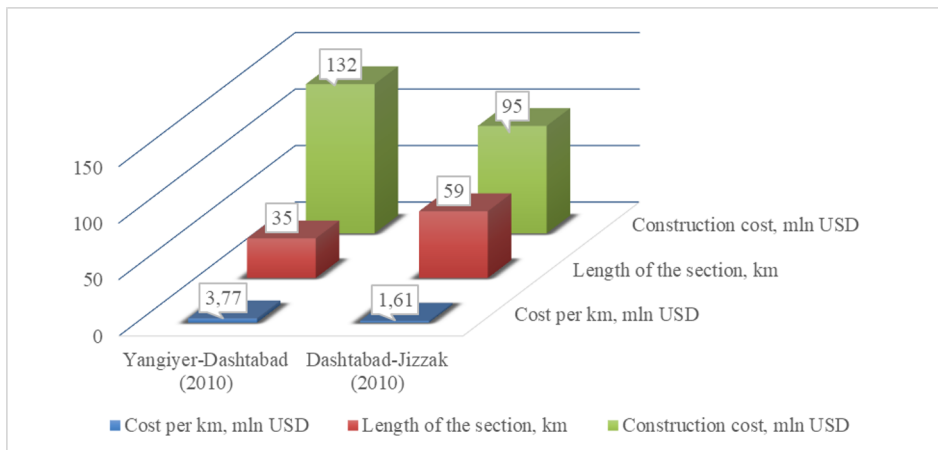


Fig. 4. Indicators of construction and reconstruction of railway sections for high-speed train traffic.

3.6 Main directions of scientific and technical development of construction production

The Development Strategy of the Transport System of the Republic of Uzbekistan for the period until 2035 shows the expansion of construction production and the dynamics of scientific and technological progress. The purpose of the Development Strategy is to improve the railway industry and increase the transport and transit potential of Uzbekistan.

Stable and sustainable development with the introduction of modern innovative technologies in the enterprises of JSC "Uzbekistan Temir Yullari" is a favorable condition for the development of the transport industry, as well as the entire economy of Uzbekistan.

At the moment, the railway industry must complete the implementation of previously planned projects, to provide for prospective, qualitative development to reach a higher level of functioning.

The gained experience in construction and operation of the railway infrastructure with the company's own funds and wide involvement of investments from both foreign and the Republic of Uzbekistan has made it possible to reach the world level during construction and operation of the new railway line Khairaton-Mazari-Sharif in the territory of the Islamic Republic of Afghanistan.

Plans for the construction, reconstruction of railroads and conversion to high-speed and high-speed train service must take into account the basic criteria for priority planned projects:

- strategic lines;
- geopolitical lines intended for the creation and development of international transport corridors;
- freight lines intended for the operation and exploitation of fields;
- passenger lines intended for passenger transportation increasing the mobility of the population.

The implementation of these projects will result in the creation of a unified transport network of railroads of the Republic of Uzbekistan, evenly develop the infrastructure of all regions of the country, create conditions for the stable growth of the state economy.

4 Conclusions

In Uzbekistan as a result of state policy in the transport sphere the large-scale work on construction and reconstruction of railway sections of development of regions of the country and effective integration into the world transport space has been carried out.

For the last period there has been formed a single coherent system of railway transport communications, including large infrastructure projects on construction of new railway sections, construction and reconstruction of railway sections for speed and high-speed trains traffic, implemented for the years of independence.

Analysis of indicators of construction and reconstruction of railway sections during the period of independence of the country. Thus, cost of one kilometer makes from 0.8 to 11.4 million USD, reconstruction - from 0.54 to 2.23 million USD, depending on region and conditions of building.

The implementation of planned projects, qualitative development to reach a higher level of functioning with the introduction of innovative technologies allows the creation of a unified transport network of railroads of the Republic of Uzbekistan.

References

1. Development Strategy of the Transport System of the Republic of Uzbekistan until 2035. <https://regulation.gov.uz/oz/document/3867>.
2. Unlocking the Potential of Railways: CAREC Railway Development Strategy 2017-2030. <https://www.adb.org/sites/default/files/institutional-document/231981/carec-railway-strategy-2017-2030-ru.pdf>.
3. Mirziyoyev Sh.M. Address of the President of the Republic of Uzbekistan to the Collective of "O'zbekiston Temir Yo'llari" Joint-Stock Company. <https://uza.uz/ru/posts/kollektivu-aktsionernogo-obshchestva-uzbekiston-temir-yullar-04-08-2017>.
4. Development Strategy of JSC "O'zbekiston Temir Yo'llari". https://railway.uz/ru/gazhk/strategiya_razvitiya.
5. Lesov K., Kenjaliyev M., Mavlanov A. & Tadjibaev Sh. Stability of the embankment of fine sand reinforced with geosynthetic materials. E3S Web of Conferences, 2021, no. 264, pp. 02011, <https://doi.org/10.1051/e3sconf/202126402011>.
6. Shudanov S.U. The concept of development of the railroad network of the Republic of Kazakhstan. Author's abstract of the thesis for the degree of candidate of technical sciences. Moscow, 1997, 23 p.

7. Lesov K.S. & Kenjaliyev M.K. Organizational and Technological Parameters During the Construction of the Bukhara-Misken Railway Line. AIP Conference Proceedings, 2022, no. 2432, pp. 030026. DOI: 10.1063/5.0089621.
8. Pereselenkov G.S. Transportation construction in the development of an integrated transport system of Russia. Russian journal of transport engineering, 2018, vol. 1, no.5, DOI: 10.15862/11SATS118.
9. Macheret D.A. Creation of railway network and acceleration of development of Russia. World of Transport and Transportation, 2012, no. 4, pp. 184-192.
10. Muzaffarova M. & Mirakhmedov M. Differences and commonalities impregnation of dry and wet sand. Transport Problems, 2014, vol. 9, no. 3, pp. 91-97.
11. Muzaffarova M. & Mirakhmedov M. Prospects fixation drift sands physicochemical method. Transport Problems, 2016, vol. 11, no. 3, pp. 143-152, <https://doi.org/10.20858/tp.2016.11.3.14>.
12. Abdujabarov A., Begmatov P., Eshonov F., Mekhmonov M. & Khamidov M. Influence of the train load on the stability of the subgrade at the speed of movement. E3S Web of Conferences, 2021, no. 264, pp. 02019, <https://doi.org/10.1051/e3sconf/202126402019>.
13. Abdujabarov A., Mekhmonov M. & Eshonov F. Design for reducing seismic and vibrodynamic forces on the shore support. AIP Conference Proceedings, 2022, no. 2432, pp. 030003, <https://doi.org/https://doi.org/10.1063/5.0089531>.
14. Lesov K.S., Mavlanov A.Kh. & Kenjaliyev M.K. Load-Bearing Capacity of Pile Foundations of Contact Network Supports in the Sandy Soil Subgrade. AIP Conference Proceedings, 2022, no. 2432, pp. 030027, DOI: 10.1063/5.0089622.
15. Shaumarov S., Kandakhorov S. & Umarov K. Development of the optimal composition of aerated concrete materials on the basis of industrial waste. AIP Conference Proceedings, 2022, no. 2432, pp. 030087, DOI: 10.1063/5.0089875.
16. Decree of the Cabinet of Ministers of the Republic of Uzbekistan № 615 of 17.11.2009.
17. Lesov K. Effectiveness Management of Construction Production Programs with Changes in the Facilities Saturation with Means of Mechanization. AIP Conference Proceedings, 2023, no. 2612, pp. 040022. <https://doi.org/10.1063/5.0114462>
18. Ergashev Z. Z. Methodology for determining bearing capacity of subgrade of sand dunes under vibrodynamic effects. International Journal of Scientific and Technology Research, 2019, vol. 8, no. 12, pp. 1873 - 1876.
19. Yoqubov B. B., Ibadullaev A., Yoqubova D. Q. & Teshabaeva E. U. Prospects and development of research of composite elastomer materials. Journal of Siberian Federal University. Chemistry, 2021, vol. 14, no. 4, pp. 464-476. <https://doi:10.17516/1998-2836-0255>.
20. Khalfin G.-A. & Umarov K. The work of intermediate rail fasteners on mountain sections of railways. AIP Conference Proceedings, 2023, no. 2612, pp. 040023. <https://doi.org/10.1063/5.0126396>.