SELECTED ABSTRACTS OF D.SC. AND PH.D. THESES SUBMITTED AT RUSSIAN TRANSPORT UNIVERSITIES

The texts of the abstracts originally written in Russian are published in the first part of the issue.

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Gayipov, A. B. Forecasting the need for wheel sets of freight cars and improving the technology of their repair on the railways of the Republic of Uzbekistan. Abstract of Ph.D. (Eng) thesis [*Prognozirovanie potrebnosti v kolesnykh parakh gruzovykh vagonov i sovershenstvovanie tekhnologii ikh remonta na zheleznykh dorogakh Respubliki Uzbekistan. Avtoref. dis… kand. tekh. nauk*]. St. Petersburg, PGUPS publ., 2022, 17 p.

In recent years, the supply of railway cars for current repairs (CR) within O'zbekiston temir yo'llari has been continuously increasing. Sending cars for current repair causes an increase in the cost of maintaining the car fleet and damage because of train delays due to uncoupling of faulty cars from the formed trains. The main part of the reasons for uncoupling of freight cars for repairs is caused by malfunctions of wheel sets. As a result, there is a shortage of rims and car axles from time to time.

To date, the cost of wheel sets remains at a high level. The changing demand for wheel sets and the speculative increase in prices for them indicate the need to improve long-term planning of demand, considering the life cycle and consumption of rim thickness, taking into account the volume of transportation work performed. One of the main tasks for determining the right direction to solve the shortage problem is to determine the balance of rims and axles in the long term in order to minimise the risks for all participants in the transportation process.

Thus, the issues of determining the balance of wheel sets and reducing the frequency of uncoupling of cargo cars for CR by improving the system of maintenance and repair of wheel sets of cargo cars are relevant.

The objective of the work was to develop a scientifically based methodology for calculating the need for the fleet of cargo cars in Uzbekistan in all-rolled wheels and axles, taking into account the technical condition of cars and the technology for repairing wheel sets, as well as the transportation work performed.

The tasks of the work included:

• analysis of the state of the fleet of cargo cars of JSC O'zbekiston temir yo'llari and determination of indicators of their reliability in operation;

• determination of the rate of wear and mileage of wheel sets before uncoupling in relation to innovative and conventional cars;

• development of a science-based methodology for calculating the need for wheel sets of cargo rolling stock and drawing up, on its basis, a balance of wheel sets for the predicted volumes of transportation by rail;

• selection of a system for turning the profile of the tread surface, which ensures the maximum resource of the wheel set and the minimum probability of uncoupling for current repairs.

The developed science-based methodology for calculating the need for wheel sets for a cargo car fleet takes into account the cargo turnover performed by railway transport and the presence of both conventional and innovative cars in the fleet.

In the thesis, a set of studies was carried out in order to determine the need for wheels and car axles and rational ways to improve the technologies for repairing cargo car wheel sets.

The analysis of the current state of the work of railway transport – the main quantitative and qualitative indicators of the freight car fleet of the Republic of Uzbekistan – showed that the supply of cars for unscheduled repairs due to wheel set malfunctions is increasing annually, which makes research in the field of increasing the resource of wheel sets relevant.

Based on the results of the study performed to assess reliability of wheel sets of ordinary and innovative cars, it was found that for wheels of innovative cars made of steel of increased hardness of grade «T», compared with the wheels of ordinary cars made of steel of grade «2», the degree of wear of wheels is much lower and, as a result, they have increased operational reliability.

The life of wheels is influenced not only by the material of wheels and running gear, but also by the structure of the car itself and its operating conditions.

The resource of wheels of the same type in the same bogies turned out to be significantly lower for hopper cars of model 19–9870–01.

The developed science-based method for calculating the need for all-rolled wheels and axles makes it possible to assess the need for railways in them, which differs by taking into account the likelihood of changes in the flange thickness, the occurrence of slides and shelling, in order to minimise risks for all participants in the process of manufacturing, operation and repair of cargo cars.

The developed and proposed methodology for calculating the required fleet of cargo cars for the railways of Uzbekistan for the period up to 2025 makes it possible to assess the current state and the required fleet of cargo cars, taking into account the forecast of the total volume of transportation by rail.

The use of wheel repair profiles with a flange thickness of 27 mm is not rational, as this leads to a decrease in the wheel life in terms of mileage (by 1,5 times) and increases the cost of wheel turning in operation (costs are added for 2 turning when using a ridge thickness of 27 mm).

It has been established that the introduction of amendments to the regulatory documents regarding the requirements for the flange thickness of 27 mm instead of 26 mm after current repair (for cars with the remaining resource before the scheduled repair for a mileage of 60 thousand km or a period of less than 9 months) will reduce the number of uncouplings thanks to reduced need for CR-2 current repair because of thin flanges.

Replenishment of the fleet of cargo cars of JSC O'zbekiston temir yo'llari with new modern innovative cars with increased carrying capacity makes it possible to gradually reduce the need for wheels due to the large resource of new wheels.

For the railways of Uzbekistan, it is recommended to accept a minimum thickness of the flange of 24 mm and introduce the following turning system: 33–24–30 (turning factor 1,97) or 33–24–33 (turning factor 1,83).

Changing the allowable flange thickness to 24 mm can have a positive effect and reduce the number of uncouplings in unscheduled repairs. In this regard, this proposal is recommended for use.

It is advisable to keep the ridge thickness of 26 mm when delivering for loading. This will reduce the cost of current repairs of CR-2 loaded cars by reducing the work on uncoupling cars from trains.

05.22.07 – Railway rolling stock, train traction and electrification.

The work was performed and defended at Emperor Alexander I St. Petersburg State Transport University.

Kopylova, E. V. Optimisation of suburban passenger transportation based on organisation of a passenger flow. Abstract of D.Sc. (Eng) thesis [*Optimizatsiya prigorodnykh passazhirskikh perevozok na osnove organizatsii passazhiropotoka. Avtoref. dis… doc.tekh. nauk*]. Moscow, RUT (MIIT) publ., 2022, 48 p.

The basis for development of any state is holistic, integrated development of its individual regions, the socio-economic framework of which is formed by urban agglomerations and megacities, which are the most important places for concentration of labour, industrial, cultural and other types of resources. In the Russian Federation, there are 16 megacities (cities with a population of over 1 million people) and 22 agglomerations with overall population over 1 million people each, a number of which are formed by cities with a population of less than 1 million people. The main advantage of the agglomeration is that, by forming a common settlement system, several cities make it possible to create a single market that is equal to or greater in terms of resources than a large metropolis. The formation of urban agglomerations and the rational use of their resources to solve a number of economic, social, and environmental problems inherent in a modern urbanized society is impossible without high-quality provision of transport links. It is suburban transportation that ensures labour mobility, contributes to development of the labour market, and has a positive multiplier effect on development of the economy of individual regions and the country as a whole.

Transportation by rail is characterised by a high degree of reliability, regularity and environmental friendliness. This type of transport has the highest carrying capacity, so it can become the basis for establishing strong transport links in urban agglomerations and megacities. The measures provided for by the Concept for development of suburban passenger transportation by rail are aimed at meeting the needs of the population in high-quality transport services and creating conditions for sustainable development of suburban railway transportation. It is possible to guarantee the necessary level of accessibility of suburban transportation for the population of the country with the given parameters of quality and safety only if long-term schemes of transport services for the population are developed, taking into account the capabilities of all modes of transport.

The formation of effective schemes of transport services for the population requires the solution of a number of complex technical, technological, regulatory, economic and managerial tasks and in modern conditions is of paramount importance both for the state and its individual regions, and for railway transport as the owner of the transport infrastructure.

To solve the problems facing the railway transport, a developed information and digital environment has been created. At the same time, numerous automated systems are mainly informational. The choice of rational solutions in various areas of railway transport is up to the individual. At the same time, a person is not always able to cope with the multivariance of possible solutions. Any big data processing systems should be built using optimisation decision-making models. Such a task is also set in the Transport Strategy of the Russian Federation: «…research and development of analytical systems and mathematical models that provide support for decision-making to regulate functioning and management of development of the transport complex».

The objective of the thesis was to increase the efficiency and customer focus of suburban passenger transportation in urban agglomerations based on organisation of a suburban passenger flow.

The main objectives of the study to achieve this goal were:

• formulation of the problem of organising passenger flow based on the analysis of scientific research in the field of transport support for the population of urban agglomerations and organisation of suburban passenger transportation by rail;

• substantiation of the choice of the dynamic coordination method for optimising suburban passenger transportation based on organisation of passenger flow;

• choice of agglomeration for testing and approbation of the methodologies proposed in the thesis;

• creation of a methodology for organising suburban passenger flow based on the dynamic matching method;

• creation of a methodology for organising a multi-jet passenger flow based on a multi-product method of dynamic coordination;

• development of a technology for checking the results of calculations on optimisation models on a simulation model;

• development of a method for effective provision of suburban traffic and respect of the timetable with trains with creation of an optimisation model based on a dynamic transport problem.

The object of the study was suburban passenger transportation carried out by rail in urban agglomerations.

The subject of the study is improvement of the work of railway transport in the field of transport support for the population of urban agglomerations.

The scientific novelty of the study lies in the methodology developed for the first time for optimising suburban passenger transportation in dynamics based on organisation of the passenger flow itself, namely:

• the problem of organising passenger flow to find a consensus between the needs of passengers and the possibilities of transport is formulated;

• an optimisation model and a technology for its application for organising a homogeneous passenger flow based on the dynamic matching method is developed;

• an optimisation model and a technology for its application for organising a multistream passenger flow based on a multi-product dynamic matching method are developed;

• a method is developed to provide the threads of the suburban train schedule with trains using an optimisation model based on a dynamic transport problem.

The practical significance of the work lies in:

• application of the proposed methodologies for organisation of passenger flow in development of long-term schemes of transport services for the population in the regions;

• the possibility of forming a balanced transport system in each urban agglomeration and determining a rational intertransport balance based on optimisation models;

• ensuring the possibility of reducing the static reserves of suburban traffic (both infrastructural and rolling stock) due to organisation of passenger flow in dynamics;

• ensuring the efficient use of suburban trains when using a dynamic transport problem for optimal provision of suburban trains with rolling stock;

• the possibility of generating reasonable proposals for development of transport infrastructure based on the use of developed optimisation models and the technology of their joint use with a simulation model;

• using the developed optimisation models based on organisation of passenger flow as a tool for the examination of the proposed design solutions to increase the capacity of suburban lines and develop the infrastructure of stations and stopping points, comprising passenger facilities, including using simulation modelling;

• creating prerequisites for effective development of urban agglomerations based on ensuring sustainable transport links between satellite cities and core cities, and, as a result, improving the quality of life of the population of the regions and the country as a whole.

Approbation of the developed methodologies for organisation of passenger flow and the method of ensuring the threads of the schedule of movement of suburban trains was carried out in Nizhny Novgorod agglomeration. This agglomeration with a population of over two million people is one of the largest in the Russian Federation, formed around Nizhny Novgorod and is monocentric. The largest settlements forming the agglomeration are Dzerzhinsk, Bor and Kstovo. In Nizhny Novgorod agglomeration, about 40 percent of enterprises and organisations are leading in the areas of development and production of aircraft, shipbuilding, and instrument making. Suburban transportation in Nizhny Novgorod agglomeration is carried out mainly by rail and road transport.

The verification of the results of calculations on optimisation models of organisation of passenger flow was carried out on a simulation model in IMETRA environment.

To solve the tasks set in the thesis, the methods of system analysis, the method of dynamic coordination, the dynamic transport problem, and simulation modeling were used.

The thesis developed the theoretical foundations for organisation of passenger flow and methodological solutions for optimising suburban passenger transportation in dynamics.

The analysis of studies in the field of suburban passenger transportation was carried out, which showed that earlier works had been carried out to optimise the transportation of a spontaneously developing passenger flow. This led to creation of not

always justified reserves of infrastructure and rolling stock. Optimisation methods were, as a rule, static, that is, they had limited capabilities when displaying the dynamics of suburban passenger transportation processes. The thesis for the first time formulated the problem of organising suburban passenger flow, that is, conscious transformation of spontaneous passenger flow into an organised one, in which the rhythms of departure of passengers from all stations in all directions are coordinated with the rhythms of arrival at the destination station, depending on certain criteria.

The method of dynamic matching has been chosen as an optimisation apparatus for organisation of passenger flow. This method allows displaying the processes of transportation, the approach of passengers to the stations of departure, waiting at the stations of departure and destination, waiting for a transfer to another mode of transport in dynamics. Any parameters can be changed during the calculation period.

An optimisation model based on a single-product dynamic matching method has been developed to transform a homogeneous passenger flow from the original to a more organised one. A technology has been developed for applying the model to search for a consensus between the interests of a passenger and transport, which makes it possible to choose from a set of formally optimal solutions the option that most satisfies the content of the problem of organising suburban passenger transportation in an urban agglomeration.

A directed iterative process has been built to streamline the sequence of experiments on the model in order to speed up the search for a rational option among the formally optimal ones. It was found that in order to find a rational meaningful option for organisation of passenger flow, it is most expedient to change two parameters when performing each new calculation on the model. Changing five or more parameters gives a hard-to-predict option. Exhaustive calculations were carried out on the example of Nizhny Novgorod agglomeration. By changing restrictions and costs (weight coefficients), when organising passenger flow, it is possible to give priority to individual stations, directions, routes of rail or road transport. Passenger flow with higher priority is subject to the least adjustment.

An optimisation model based on a multi-commodity dynamic matching method for organising a multistream passenger flow has been developed. The technology of its use has been formed. The model for organisation of a multistream passenger flow has also been worked out on the example of the transport complex of Nizhny Novgorod agglomeration. This model makes it possible to single out several segments of passenger flow in an already organised homogeneous passenger flow and take into account their specific travel requirements. The model allows setting overlapping or non-overlapping periods of the desired arrival at the head station of passengers of each segment. Also, by changing restrictions and costs (weight coefficients) in the calculation, it is possible to set the priority of certain segments of the passenger flow in each direction or station.

A simulation model of the considered polygon of Nizhny Novgorod agglomeration has been developed using IMETRA simulation system, which allows a wide range of experiments to be carried out for a deep assessment of the results of calculations on optimisation models. The rhythms of organised passenger flow departure obtained with the help of optimisation models were tied to the schedules of electric trains. Experiments on a simulation model have shown the correctness of using optimisation models. In particular, waiting for passengers at the stations of departure and destination with an organised passenger flow is reduced. For Nizhny Novgorod agglomeration, organisation of passenger flow will reduce the unproductive waiting time for passengers at departure stations by 1,5–4,5 times, depending on the optimal option chosen from the content point of view, and at the head station by almost 2 times.

A new method for calculating the optimal turnover of electric trains using an optimisation model based on a dynamic transport problem has been developed. The method allows not only finding the best option, but also provides materials for its critical evaluation. Three options for using the method of optimising the supply of trains for the scheduled service of suburban trains are proposed. Approbation has been made on the example of suburban rail transportation in Nizhny Novgorod agglomeration. It is shown that a slight shift in one or more lines of the suburban train schedule can significantly reduce the number of trains in circulation. For instance, when using 8 trains, 11 threads of the schedule are shifted, when using 12 trains – 1 thread, when using 14 trains, no adjustment is required. Thus, when using 12 trains, it is possible to ensure a high level of customer-oriented traffic schedule while saving money on the purchase and operation of two suburban trains.

The results of the thesis research were recommended to the Centre for Corporate Governance of the Suburban Complex of JSC Russian Railways for use by suburban passenger companies in development of comprehensive plans for transport services to the population. The methodology for organising suburban passenger flow was accepted for implementation at the site of activities of JSC Volgo-Vyatskaya Suburban Passenger Company and was used in organisation of multimodal passenger transportation in Nizhny Novgorod agglomeration.

The prospects for further development of the thesis topic are that the developed methodologies can become the basis for new scientific research in the field of improving passenger transportation, taking into account their dynamics. The developed optimisation

models for organisation of suburban passenger flow require further in-depth study to ensure the effectiveness of practical implementation.

2.9.4. Transportation process management.

The work was performed and defended at Russian University of Transport.

Prokhor, D. I. Diagnostics and forecasting of the residual life of insulation systems of traction electrical machines based on monitoring the parameters of the current state of insulation. Abstract of Ph.D. (Eng) thesis [*Diagnostika i prognozirovanie ostatochnogo resursa sistem izolyatsii tyagovykh elektricheskikh mashin na osnove kontrolya parametrov tekushchego sostoyaniya izolyatsii. Avtoref. dis… kand. tekh. nauk*]. St. Petersburg, PGUPS publ., 2022, 16 p.

Failures of traction electric motors (TEM) of locomotives, especially when hauling the trains, cause significant material damage to operating organisations, the largest of which is JSC Russian Railways. As a rule, more than 75 % of TEM installed on locomotives during construction or overhaul have to be changed due to malfunctions before the next overhaul. The main causes of TEM damage are low insulation resistance of the armature winding, overshoot and all-round fire, insulation breakdown on the body. The data of the statistical survey indicate the need to improve the design of the TEM insulation and the system for monitoring its current state in operation, which confirms the relevance of the topic of the thesis.

The objective of the thesis was improving reliability and durability of locomotive traction motors by improving insulation structures and the insulation condition monitoring system.

The scientific novelty of the thesis included:

• development of bases for monitoring the current state and evaluating the residual life of the insulation of TEM locomotives according to additional parameters that are not currently standardised;

• development of a technique for determining the normalising and threshold values of additional insulation parameters at the beginning of its life cycle;

• establishment of empirical dependences of changes in additional insulation parameters on the performed ton-kilometer operation of the locomotive.

The tasks were solved using the methods of planning the experiment, methods of collecting and mathematical processing of the results of the experiment, which was performed using the software packages MathCAD and Excel. Experimental studies were carried out on full-scale test benches and mainline locomotives under operating conditions.

As a result of the conducted research, new scientifically based technical solutions and developments were obtained, aimed at improving the insulation structures and the system for monitoring the state of insulation of traction electric motors of locomotives. Their application will reduce the number of failures and unscheduled repairs of traction motors and improve the efficiency of mainline locomotives by increasing reliability and predicting the residual life of traction motors.

An analysis of statistical data on failures of locomotive TEM for 2019 and 2020 showed that 35–40 % of all failures are caused by malfunctions that occur in the design of anchors, and more than 2/3 of this number were failures caused by low resistance and breakdown of winding insulation. The given data show that the problem of increasing reliability of the insulating structure of TEM ED-118 and improving the system for monitoring the state of insulation of traction motors is relevant.

An insulation design was developed, a set of design documentation was developed and two prototypes of ED-118 motors with insulation of an increased heat resistance class H were manufactured, which passed bench tests at increased current loads and a standard cooling air flow rate. The tests confirmed the technological suitability of the developed class H insulation system for its use in the overhaul of ED-118 engines. Replacing class F insulation with class H insulation at TED ED-118 with the same fan performance will increase the allowable overheating of the windings, increase the long-term traction force of the locomotive by 10 % due to the increase in current and ensure the insulation service life of at least 20 years during normal operation.

For a more complete and reliable characterisation of the current state of TEM insulation and the likely nature of the change in its properties during further operation, it is proposed to control a set of additional parameters during its life cycle: absorption coefficient, return voltage, dielectric loss tangent, insulation capacitance. Based on the results of a survey of 158 TEMs after a major overhaul, standard values for additional parameters of the new insulation and critical threshold values to refuse an engine during acceptance tests were established.

A methodology, a program and a test stand for accelerated thermal aging of insulation have been developed. In accordance with the methodology, tests of a full-scale sample of ED-118 engine with insulation of an increased heat resistance class under load were carried out. The duration of the tests and the thermal load of the insulating structure were equivalent to the normal operation of the engine for 20 years. Based on the test results, the presence of a residual resource of the developed insulation system was confirmed, and the values of additional insulation parameters after thermal loads equivalent to the specified service life were determined.

For performance tests, two diesel locomotive sets TEM ED-118 were manufactured: one with insulation

of the standard heat resistance class F, the other with insulation of an increased class H. Based on the results of operational tests, empirical dependences of the averaged values of additional insulation parameters of classes F and H on the performed ton-kilometer operation of the locomotive were obtained, which will allow predicting the residual life of the insulation of a TEM of a specific manufacturer under operating conditions.

The criteria for rejection of TEM with new insulation during acceptance tests, as well as TEM that are in operation, according to additional insulation parameters, have been determined.

Proposals have been developed for organising control of the state of insulation of traction motors by additional parameters by means of mobile diagnostics in the conditions of service and operational depots, which will make it possible to strengthen input control when receiving traction motors from the manufacturer or repair organisation, to carry out operational control of the current state of insulation when performing technical maintenance and current repairs and predict the remaining life of the insulation of traction motors in operation.

As recommendations and prospects for further development of the topic of the thesis, it is proposed to develop algorithmic and hardware support for an on-board automated diagnostic complex that collects, stores and analyses information about the current state and residual resource of TEM insulation.

05.22.07 – Railway rolling stock, train traction and electrification.

The work was performed and defended at Emperor Alexander I St. Petersburg State Transport University.

Tukmakova, A. V. Development and justification of constructive and technological solutions for construction of additional railway tracks. Abstract of Ph.D. (Eng) thesis [*Razrabotka i obosnovanie konstruktivno-tekhnologicheskikh reshenii dlya stroitelstva dopolnitelnykh zheleznodorozhnykh putei. Avtoref. dis… kand. tekh. nauk*]. Khabarovsk, FESTU publ., 2022, 20 p.

Severe natural conditions lead to the rapid appearance and development of deformations in roadbed infrastructure structures, which requires an individual approach to the choice of measures to stabilise the roadbed and their theoretical justification. Typical existing solutions used to stabilise the roadbed of double-track lines in sections with different topographic conditions are not always effective during the operation period, which manifests itself in violation of integrity of earthworks, permanent deformations, and a threat to safety and uninterrupted train traffic.

The object of the study was the roadbed of additional railway lines under construction and subject to modernisation in the northern regions, including on permafrost soils.

The objective of the study was to develop and to theoretically substantiate technical solutions that ensure stability and durability of additional tracks, their safety when operating in difficult permafrost and ground conditions, as well as the integrity of the double-track structure.

Research objectives included:

• analysis of existing structural and technological solutions for construction of additional railway tracks and anti-deformation structures to ensure stability of a double-track and deformable roadbed;

• analysis of existing methods for substantiating stability of additional tracks and applied design and technological solutions in conditions of different topography of cold regions;

• critical analysis of completeness and sufficiency of initial data in the methods of computational and theoretical substantiation of existing and new design and technological solutions in design of additional tracks;

• experimental modelling of soil processes arising and developing during building a roadbed of the second track on soft soils;

• development of new structural and engineering solutions;

• selection of necessary and sufficient initial data for the developed methods for substantiating reliability of design and technological solutions in difficult conditions.

The work developed design and technological solutions aimed at ensuring stability of an additional roadbed under construction and modernisation in cold regions, as well as methods for calculating the strength and integrity of an existing roadbed reinforced with geosynthetic materials for laying an additional railway track. The technique can be used in design of additional tracks with the use of reinforcing layers in conditions of prolonged negative ambient temperatures and excess moisture in the soils of the construction zone.

Experimental studies, which were carried out in laboratory conditions on the basis of the Research Laboratory «Foundations and bases» of Far Eastern State Transport University, made it possible to prove reliability of results obtained by the developed calculation methods by modelling soil processes.

The analysis of existing methods for substantiating stability of additional tracks and the applied structural and technological solutions in difficult engineering and geological conditions showed a uniform approach to development of design solutions and construction of additional railway tracks.

A review and analysis of existing options for construction of additional railway tracks in cold regions, as well as anti-deformation structures to ensure durability and reliability of the roadbed showed that the most promising and resource-saving way to

ensure stability of the roadbed is the use of reinforcing layers while simultaneously draining surface and ground water from the roadbed. At the same time, a wide range of geosynthetic materials and the proven effectiveness of their reinforcing properties have not yet found mass recognition, and construction of additional railway tracks is carried out by a typical method through cutting ledges on the slopes of embankments of existing tracks.

The selection of initial data and methods of calculation-theoretical substantiation of new structural and technological solutions in design of additional tracks, a critical analysis of their completeness and sufficiency were carried out.

As a result of the experimental studies carried out and based on the monitoring data of the implemented solutions, graphical dependences of the distribution capacity coefficient and elastic moduli of ordinary soils and soils reinforced with geosynthetic materials were obtained. The use of reinforcing layers in soil structures can reduce the overall deformation of the structure and reduce the magnitude of vertical stresses. Dependences of the temperature-humidity regime were obtained for objects with provided (including filtration ground) drainage and for flooded places. The presence of a combined drainage system, which ensures the collection and removal of surface and ground water, increases the overall stability of the drained subgrade of the railway track and reduces its deformability from deeps and subsidence by 30 %. Theoretical calculations are confirmed by field data obtained from the results of monitoring of already built facilities.

With intensive moisture saturation of soils of the embankment (on a weak base and with water saturation), the use of reinforcing layers is not a sufficient condition to ensure a stable soil structure. To ensure stability of the roadbed under such conditions, it is necessary to provide additional solutions aimed at eliminating moisture.

To ensure stability of weak foundations of the additional track, including on permafrost soils, additional structures can be used as the first layer in contact with the foundation soils, in particular, the «flexible overpass» structures according to the utility model of Far Eastern State Transport University No. 22157, «two-stage armo-drainage system» under the patent of Far Eastern State Transport University No. 2618108.

2.9.2 – Railway track, survey and design of railways.

The work was performed and defended at Far Eastern State Transport University. ●

NEW BOOKS ON TRANSPORT AND TRANSPORTATION

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Avdeeva, G. D. Reference book on the railway ecology: Training guide [*Spravochnik po ekologii zheleznodorozhnogo transporta: Spravochnoe uchebnoe posobie*]. Moscow, Training and methodological centre of railway education, 2022, 255 p. ISBN 978-5-907479-27-2.

Hachikyan, P. P. Counteraction to terrorist threats: Monograph [*Protivodejstvie terroristicheskim ugrozam na vozdushnom transporte: Monografiya*]. Moscow, Pero publ., 2022, 409 p. ISBN 978-5-00189-978-5.

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Ksenofontova, T. Yu., Dalinger, Ya. M., Voronov, A. A., Hubieva, D. K. Marketing and strategic positioning of the civil aviation enterprises on interregional markets [*Marketingovoe i strategicheskoe pozicionirovanie predpriyatij grazhdanskoj aviacii na mezhregional'nyh rynkah: Monografiya*]. Voronezh, Nauchnaya kniga, 2022, 104 p. ISBN 978-5-907328-18-1.

Serdyuk, E. G. Social and psychological support and organisation of transport accessible environment for less mobile people: Study guide [*Social'no-psihologicheskoe soprovozhdenie i organizaciya dostupnoj sredy dlya malomobil'nyh grazhdan na transporte: Uchebnoe posobie*]. Novorossijsk, GMU, 2022, 50 p.

Shtang, A. A., Biryukov, V. V. Increasing efficiency of electric transport systems with the help of energy storage devices: Monograph [*Povyshenie effektivnosti elektrotransportnyh sistem s ispol'zovaniem nakopitelej energii: Monografiya*]. Novosibirsk, Novosibirsk state technical university publ., 2022, 258 p. ISBN 978-5-7782-4837-3.

Topical transport problems in 21st century. Works of the 1st international scientific and practical conference [April 20–21 2022] [*Aktual'nye problemy transporta v XXI veke: Trudy I mezhdunarodnoj nauchno-prakticheskoj konferencii [20–21 aprelya 2022*]. Eds. T. N. Borisova [*et al*]. Novokuznetsk, SibGIU, 2022, 258 p.

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Volod'kin, P. P., Shirokorad, O. A., Arhipov, S. A., Ryzhova, A. S. Technology to organise passenger regular transportation: Study guide [*Tekhnologiya organizacii passazhirskih marshrutnyh perevozok: Uchebnoe posobie*]. Ed. R. G. Leont'ev. Habarovsk, Pacific state university publ., 2022, 102 p. ISBN 978-5-7389-3456-8.

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