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Satbayev University

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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
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НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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S. S. Abdullayev[1], I. S. Bondar[1], G. B. Bakyt[1],
G. K. Ashirbayev[1], A. M. Budiukin[2], Ye. Ye. Baubekov[1]

[1]Kazakh Academy of Transport and Communications named after M. Tynyshpayev, Almaty, Kazakhsta;
[2]Emperor Alexander I St. Petersburg State Transport University, Saint Petersburg, Russia.
E-mail: seidulla@mail.ru, i.bondar@kazatk.kz, gaba_b@bk.ru,
galimzhan_68@mail.ru, remont_ps21@mail.ru, baubekov3@mail.ru

INTERACTION OF FRAME STRUCTURES WITH ROLLING STOCK

Abstract. Need of use of mobile measuring computer systems when performing diagnostics of bridges is shown and also the analysis of amplitude-phase-frequency characteristics frame reinforced concrete and metal flying structures of railway bridges is provided at the movement of the train. This in turn allows to estimate conditions of span structures by width of ranges in points of half energy of spectral curve in the area of resonances. Assessment of technical condition and diagnostics of supported artificial structures is carried out according to dynamic parameters. According to this method frequency of natural oscillations is determined from peak values of averaged spectral densities of reduced power. Comparing width of the received ranges to ranges of the new (intact) flying structures it is possible to estimate degree of wear and a damage rate of elements of designs. Based on the results of the calculations, it has been confirmed that the inclusion of elements of the bridge web and the upper structure of the track in the joint work with the main bearing structures increases the accuracy of solving the problem of determining natural frequencies.

Key words: rolling stock, metal bridges, reinforced concrete bridges, railway track, locomotive, system "path - the crew", processes of oscillations, experimental oscillograms.

Introduction. On the high-level network of the railroads of Kazakhstan more than 9000 artificial constructions are operated: big bridges – 107 pieces, average bridges – 838 pieces, small bridges - 2430 pieces, water throughput pipes – 5342 pieces, including metal bridges – 219 pieces, reinforced concrete bridges – 3308 pieces Besides, are operated out-of-class big bridges through river. On the station Kapchagay and through the Urals River in Uralsk, a railway tunnel, antilandslide galleries and other constructions [1,2]. Today because of inadequate hardware of laboratory its employees conduct visual examinations of artificial constructions. In operation on the main railway directions there are constructions built more than a century ago at which construction the train loadings existing now were not considered. Due to the input of Technical regulations of the Customs Union of TR CU 003/2011 "About safety of infrastructure of railway transport", TR CU 001/2011 "About safety of the rolling stock" has arisen need of updating of the specifications and technical documentation regulating safe service conditions of the rolling stock and a railway track. Processing of the specifications and technical documentation is carried out taking into account requirements of the International union of the railroads (Union Internationale des Chemis de Fer) and the international standards [3-5].

Characteristics of perturbations acting on the rolling stock from the side of the track. The network of the railway of the republic covers a vast territory with various climatic and geological conditions, consists of separate sections with various conditions and freight traffic, along which a large and diverse fleet of rolling stock runs [6,7].

In the studies of the interaction of the track and the rolling stock, the influence of a wide variety of factors was studied:

- characteristics of the under-rail base: non-equal-elasticity, ballast type and rail-sleeper grid;
- roughness of the rail: butt roughness, unevenness of the welded seam, wave-like wear, random irregularities [8];
- condition and geometry of the path;
- properties of the rolling stock [9];
- wheel imperfections: potholes, imbalances, random irregularities [10,11];
- speed of movement [8];
- weather conditions [10,12].

The use of computers in the information and computing complex (CPI) presents a number of significant advantages:

1. As a result of increasing the speed of data processing, the efficiency of obtaining the necessary information is greatly increased, it becomes possible (in case of critical situations) to perform immediate actions;
2. The accuracy of results is significantly increased, the possibility of erroneous decisions is reduced, since the decisions taken on the basis of the CPI are based on reference data, and not on the subjective scenes of the researcher;
3. It becomes possible to obtain a characteristic of the irregularities of a given path segment;
4. Time and material expenses for data processing are significantly reduced;
5. It becomes possible to create a single data bank containing information that completely characterizes the test or controlled test site. The information of such a bank can be used both for organization of repair works, planning and carrying out dynamic-strength and running tests of new types of rolling stock, as well as for developing recommendations for the optimal use of rails of various types, etc.

To obtain characteristics informative for solving the problem of classification of vertical irregularities by their spectral characteristics, the methods of factor and variance analysis were used in the studies [13,14].

One of the methods of lowering the dimension of the original indicative space is the method of principal components, which provides a transition to a new system of attributes $Y=\{y_1...y_2\}$ each of the components y_i has the following properties:

1. y_i is a linear combination of the initial characteristics:

$$y_i \sum_{i=1}^{N} a_{ij} x_i \qquad j=\overline{1,N} \tag{1}$$

2. All γ_i are statistically independent of each other, i.e:

$$cov(y_l, y_k) = 0 \qquad l \neq k \tag{2}$$

3. All γ_i are ordered by their variance in the sample under study, with the first component γ_i having the greatest variance:

$$D(y_1) \geq D(y_2) \geq ... \geq D(y_N) \tag{3}$$

The transition to the system of principal components is a rotation of the coordinate system in such a way that the projection of the sampled sample on the first axis, γ_i, possesses the greatest possible variance for this sample. The second axis perpendicular to the first is directed in such a way that it is uncorrelated with the first and that the projection of the sample under study has the greatest variance on it. Similarly, the remaining axes of the main components are constructed. All of them are uncorrelated with each other and are arranged in descending order of variances.

Lowering the dimension of a characteristic space by the method of principal components is usually the rejection of those principal components to which the minimum variance of the original sample falls. However, the features with the greatest dispersion are not always the most informative for solving classification problems [15].

Figure 1 shows the images of two classes, described by two signs – x_1 and x_2. In the transition to the main components, the axis $\acute{O}_1$, will have the greatest dispersion, however, the second component is the most informative component for solving the classification problem. The above example shows the need to analyze the informativeness of components that do not have a large variance.

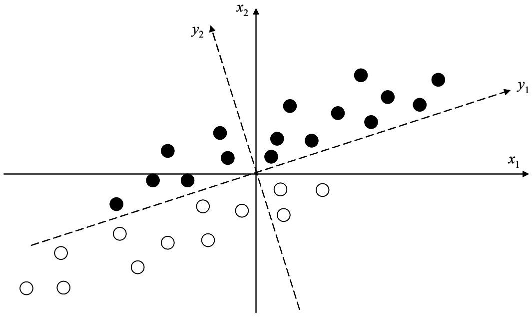

Figure 1 – Transformation of the original feature space inti the space of the main components

Using the spectral characteristics of the drawdown of the path stored in a bank of spectra, an estimate of the covariance matrix of the harmonic components C_x (table 2).

Table 2 – The matrix of component weights

Points	Frequency range (I/M)									
	I/60M-I/30M	I/30M-I/15	I/15M-I/10M	I/10M-I/7.5M	I/7.5M--I/6M	I/6M-I/5M	I/5M-I/4.5M	I/4.5M-I/3.7M	I/3.7M-I/3.3	I/3.3M-I/3M
y_1	0.783	-0.47	0.28	-0.28	-0.07	-0.03	-0.04	0.028	-0.016	-0.002
y_2	0.35	0.55	0.51	0.5	0.21	0.106	0.04	0.025	0.008	0.003
y_3	-0.31	-0.68	0.3	0.5	0.28	0.15	0.044	0.04	0.01	0.006
y_4	0.407	-0.08	-0.75	0.45	0.17	0.16	0.06	0.04	0.02	0.007
y_5	-0.03	0.076	-0.02	-0.464	0.783	0.35	0.16	0.14	0.016	0.015

The conducted studies showed that the first five components accounted for 99.7% of the variance of the initial characteristics - 76%, 13.2%, 5.4%, 3.5%, 1.6%, respectively. Figure 2 shows a graphical representation of the component weights that determine each of the five first components in the region of harmony of the spectra studied.

Thus, the space of the main components that are informative for solving the problem of classifying the state of the path in terms of the indicator of the probable initial conditions (the structure of the track, the type of rolling stock, the speed of 60 km / h) is constructed.

Modern methods for diagnosing bridges. One of the important tasks for the qualitative inspection and diagnostics of the existing state of span structures, supports, approach embankments, the upper structure of the track and other elements of artificial structures (ISSO) is the acquisition and use of modern devices of the latest generation. One of them is the latest generation Photometer PM-600/630 device from the Swiss company Proceq. The operation of the Photometer PM-600/630 is based on the principle of electromagnetic induction in determining the rods of the armature. The sensor coils induce a magnetic field, due to which eddy currents are formed on the surface of the electrically conductive material (rod of the armature). Eddy currents are formed on the surface of any electrically conductive material in magnetic fields. They induce a magnetic field in the opposite direction. The difference between the induced and received magnetic field is used by the device to obtain the results [15].

For example, the bridge monitoring system developed in Switzerland (Bridge Monitoring System "BRIMOS") [16] is based on the fact that the state of any design is reflected in the characteristics of its dynamic behavior. The so-called "dynamic autograph" (response) of the structure contains all the information that is necessary for a detailed assessment of its state. The technique used to assess the technical state of structures uses the method of estimation of random effects (Ambient Vibration Monitoring), which can be defined as a method of identification of bridge structures by dynamic response to a random effect, which can be considered wind, micro seismic activity or bridge-moving transport.

In Japan, the use of complex monitoring systems is quite common, for which special hardware and software systems have been developed and are constantly being improved. However, there are very few publications on the improvement of dynamic identification systems. Identification of a system is understood as the definition of the dynamic characteristics of a bridge or other engineering structure from information obtained by recording its oscillations.

Very simple and at the same time very effective is the method of selecting peak values of the parameters of oscillations of a bridge structure, based on the analysis of only output signals, connected with the determination of peak values. In accordance with this method, the natural oscillation frequency is determined from the peak values of the averaged reduced power spectral densities (SPM). These values are obtained by recalculating the measured values of vibration displacement, vibration velocities and vibration acceleration using a discrete Fourier transform. The coherence function, calculated for two simultaneously registered output signals, is close in magnitude to that for the natural frequencies. This pattern, in addition, helps to detect precisely those frequencies that can be considered as own frequencies. It is assumed that the dynamic response at resonance refers only to its own tone. The method of selecting peak values does not require the use of complex algorithms for its implementation. Within the framework of this method, various modifications of the fast Fourier transform are used to construct the graphical representation of the spectral density function, which are described in detail in the special literature [17-19]. The described method has been successfully tested in Austria and Switzerland on a large number of structures.

Experiment. The objects of the research described in the present work were beamed metal (built in 1952) and ferroconcrete (1972 built) span structures of the bridge across the Irtysh-Karaganda channel of the Erejmentau-Ekibastuz railway line in the Republic of Kazakhstan (km 257 PK 7 + 0) l = 27 m and 16 m.

Figure 3 show the schemes of a metal and reinforced concrete span structure with the arrangement of vibration sensors on structural elements.

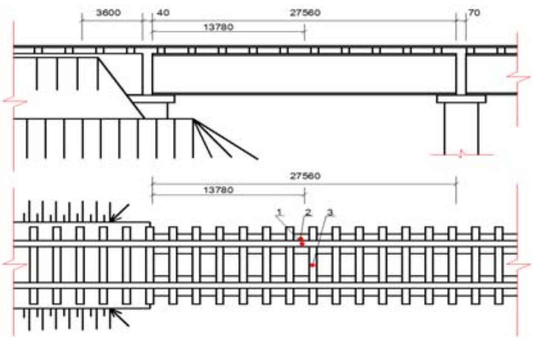

Figure 3 – Scheme of a metal span structure with the arrangement of vibration sensors on structural elements:
1 - middle of the beam span structure; 2- the sole of the rail; 3- middle of the wooden beam.

Of particular interest in the studies were frequency spectra of forced vertical oscillations of span structures, since they can be used to judge the causes that cause vibration of a bridge [14, 20]. To this end, a spectral analysis of the oscillograms of vertical vibro-displacement metal (figure 4, a) and reinforced concrete (figure 4, *b*) beams was performed during the movement of the rolling stock with velocities v = 41 to 98 km / h.

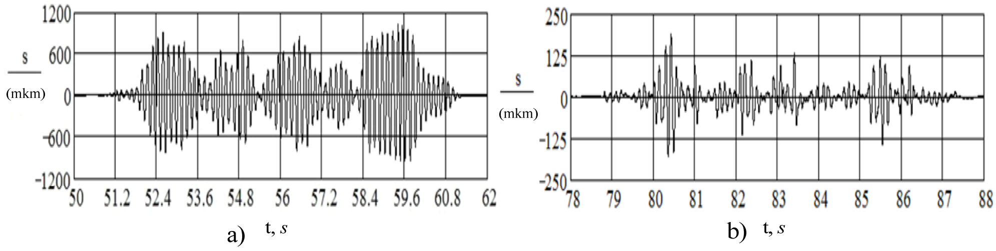

Figure 4 – Oscillograms of vertical vibro-displacement: *a - a metal beam with the passage of an electric train of 10 cars at a speed of 98 km / h, b - reinforced concrete beam at passage of an electric train from 8 cars at a speed of 62 km/h.*

The results of the spectral analysis for these processes are shown in figure 5 *a, b*.

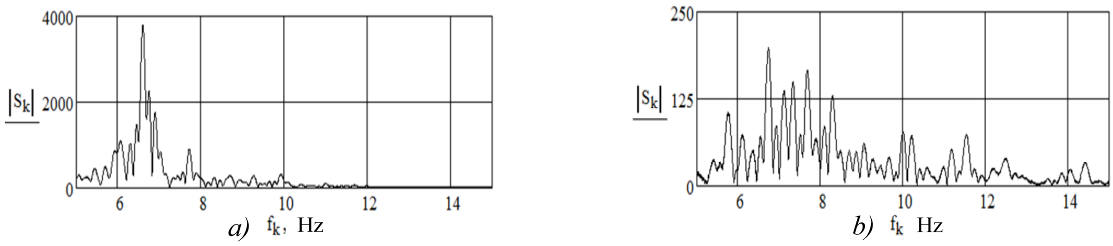

Figure 5 – Spectrum of oscillograms: *a - a metal beam; b - reinforced concrete beam*

Here, to each value of the frequency there corresponds a definite magnitude of the amplitude of the oscillations. The interaction of the metal beam span with the rolling stock occurs mainly in the case of disturbances whose frequencies are in the range $f = 5{,}34 \div 7{,}27$ *Hz*, and the reinforced concrete in the range $f = 5{,}26 \div 7{,}42$ *Hz*. These disturbances determine first of all the reaction of the span structures. The other perturbations, judging by the spectra, do not play a special role in the formation of the behavior of the span structures, since their amplitudes are very small and the energy they introduce into the system is insignificant [21].

By the "tails" of the experimental oscillograms (figure 6 a, b) and the spectra plotted from them (figure 7 a, b), the frequencies of free oscillations of the unloaded span structures were determined.

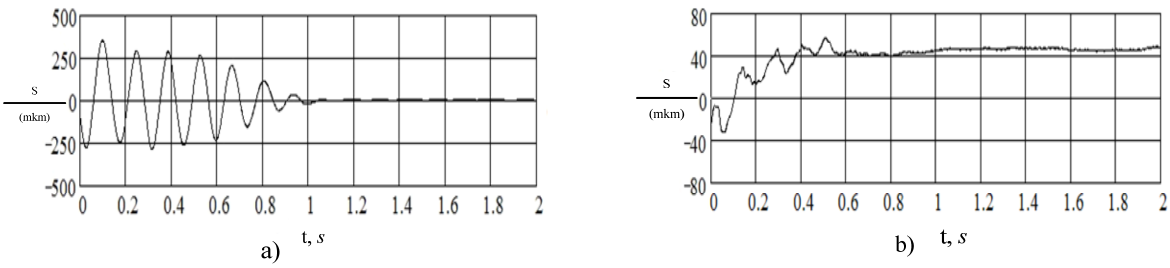

Figure 6 – Oscillograms of vibro-displacement after a load: *a - a metal beam; b - reinforced concrete beam*

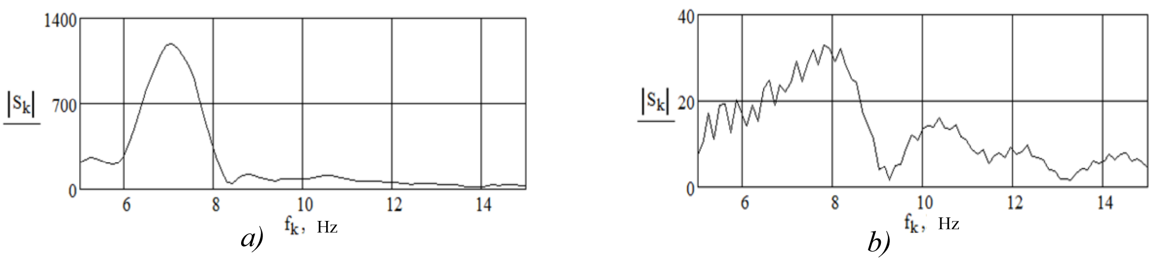

Figure 7 – Spectrum of oscillograms after the load is released: *a - a metal beam; b - reinforced concrete beam*

For metal and reinforced concrete beam girders, they are respectively equal to f_m = 7,08 Hz and $f_{r.c.}$ = 7,81 Hz.

Conclusions. From the analysis of full-scale measurements of the processes of oscillations of beam span structures, it follows that the spectrum of oscillations of the span structures when interacting with a moving train is multimodal. In this case, the frequency of the individual components depends significantly on the speed of the train, and the main part of the energy of the oscillation process is in harmonics corresponding to the frequencies of the natural oscillations of the system "span structure - railway track - rolling stock".

To estimate the state of flying structures, one can use the width of the spectra at half-energy points of the spectral curve in the resonance region. Comparing the width of the obtained spectra with the spectra of the new undamaged flying structures, it is possible to estimate the degree of wear and the degree of damage to the structural elements.

The characteristics of the oscillations of the system "span structure - path - rolling stock" obtained during the measurements described in this work can serve as initial data in the calibration of the model of the structure and in the compilation of algorithms for the problem of detecting damage.

С. С. Абдуллаев[1], И. С. Бондарь[1], Ғ. Б. Бақыт[1], Г. К. Аширбаев[1], А. М. Будюкин[2], Е. Е. Баубеков[1]

[1]М. Тынышбаев атындағы Қазақ көлік және коммуникациялар академиясы, Алматы, Қазақстан;
[2]I Александр императордың Петербург мемлекеттік теміржол көлігі университеті, Санкт-Петербург, Ресей

РАМАЛЫҚ ҚҰРЫЛЫМНЫҢ ЖЫЛЖЫМАЛЫ ҚҰРАММЕН ӨЗАРА ӘРЕКЕТІ

Аннотация. Көпір диагностикасын жүргізу кезінде ұтқыр өлшеу есептеу кешендерін пайдалану қажеттілігі көрсетілді, сондай-ақ поезд қозғалысы кезінде теміржол көпірлерінің қаңқалы темірбетон және металл аралық құрылыстарының амплитудалық-фазалық жиілік сипаттамаларына талдау жүргізілді. Бұл, өз кезегінде, резонанс аймағындағы спектрлік қисықтың жартылай энергия нүктелеріндегі диапазондардың ені бойынша аралық ғимараттардың жағдайын бағалауға мүмкіндік береді. Тірек жасанды құрылыстардың техникалық жай-күйін бағалау және диагностикалау динамикалық параметрлер бойынша жүзеге асырылады. Осы әдіске сәйкес табиғи тербелістердің жиілігі берілген қуаттың орташа спектрлік тығыздығының ең жоғары мәндерімен анықталады. Алынған спектрлердің енін жаңа зақымдалмаған жабынды құрылыс спектрлерімен салыстыра отырып, конструкция элементтерінің техникалық жай-күйін бағалауға болады. Есептеу нәтижелерінің негізінде көпір төсемі мен жолдың жоғарғы құрылысының негізгі көтергіш конструкциясының элементтерімен бірге жұмысына қосылуы меншікті жиілікті анықтау туралы міндетті шешудің дәлдігін жоғарылататындығы бекітілді.

Түйін сөздер: жылжымалы құрам, металл көпірлер, темірбетон көпірлер, теміржол табаны, локомотив, «экипаж-жол» жүйесі, тербеліс үдерістері, эксперименттік осцилограммалар.

С. С. Абдуллаев[1], И. С. Бондарь[1], Г. Б. Бакыт[1], Г. К. Аширбаев[1], А. М. Будюкин[2], Е. Е. Баубеков[1]

[1]Казахская академия транспорта и коммуникаций им. М. Тынышпаева, Алматы, Казахстан;
[2]Петербургский Государственный университет путей сообщения императора Александра I, Санкт-Петербург, Россия

ВЗАИМОДЕЙСТВИЕ РАМНЫХ КОНСТРУКЦИЙ С ПОДВИЖНЫМ СОСТАВОМ

Аннотация. Показана необходимость использования мобильных измерительных вычислительных комплексов при проведении диагностики мостов, а также проведен анализ амплитудно-фазочастотных характеристик каркасных железобетонных и металлических пролетных строений железнодорожных мостов при движении поезда. Это, в свою очередь, позволяет оценить состояние пролетных строений по ширине диапазонов в точках полуэнергии спектральной кривой в области резонансов. Оценка технического состояния и диагностика опорных искусственных сооружений осуществляется по динамическим параметрам. Согласно этому методу частота собственных колебаний определяется по пиковым значениям усредненных спектральных плотностей приведенной мощности. Сравнивая ширину полученных диапазонов с диапазонами новых (неповрежденных) летательных аппаратов, можно оценить степень износа и степень повреждения элементов конструкций. По результатам проведенных расчетов подтверждено, что включение элементов полотна моста и верхнего строения пути в совместную работу с основными несущими конструк-циями повышает точность решения задачи определения собственных частот.

Ключевые слова: подвижной состав, металлические мосты, железобетонные мосты, железнодорожный путь, локомотив, система «экипаж-путь», процессы колебаний, экспериментальные осциллограммы.

Information about authors:

Abdullayev Seidulla Seidemetovich, Doctor of Technical sciences, Professor, Kazakh Academy of Transport and Communications named after M. Tynyshpayev, Almaty, Kazakhstan; seidulla@mail.ru; https://orcid.org/0000-0001-5028-8143

Bondar Ivan Sergeyevich, Candidate of Technical Sciences, Kazakh Academy of Transport and Communications named after M. Tynyshpayev, Almaty, Kazakhstan; i.bondar@kazatk.kz; https://orcid.org/0000-0002-0008-4043

Bakyt Gabit Bakytuly, Doctor of Philosophy (PhD), Kazakh Academy of Transport and Communications named after M. Tynyshpayev, gaba_b@bk.ru; https://orcid.org/0000-0001-5558-9316

Ashirbayev Galymzhan Kozhakhatovich, Candidate of Technical sciences, Associate Professor, Kazakh Academy of Transport and Communications named after M. Tynyshpayev, Almaty, Kazakhstan; galimzhan_68@mail.ru; https://orcid.org/0000-0002-7044-9968

Budiukin Alexey Mitrofanovich, Candidate of Technical Sciences, Associate Professor, Emperor Alexander I St. Petersburg State Transport University, Saint Petersburg, Russia; remont_ps21@mail.ru, https://orcid.org/0000-0003-3991-8372

Baubekov Yermek Yeltayevich, Doctor of Technical sciences, Professor, Kazakh Academy of Transport and Communications named after M. Tynyshpayev, Almaty, Kazakhstan; baubekov3@mail.ru, https://orcid.org/0000-0002-1134-5122

REFERENCES

[1] Khasenov S.S. Sovremennye metody diagnostiki mostov // Vestnik KazATK imeni M. Tynyshpaeva. 2014. Vol. 5. P. 10-14.

[2] Jiang H., Bian X., Cheng C. Simulating train moving loads in physical model testing of railway infrastructure and its numerical calibration // Acta Geotechnica. 2016. Vol. 11, N 2. P. 231-242.

[3] Markov D.P. Increase of hardness of rolling stock wheels (prerequisites and perspectives) // Scientific Research Institute of Railway Transport bulletin 1995. Vol. 3. P. 10-17.

[4] Solonenko V.G., Makhmetova N.M., Musayev J.S., Bekzhanova S.E., Kvashnin M.Ya. (2019) The method of limiting speed when passing turnouts of railway vehicles with bogies of model ZK1 // News of the National Academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences. Vol. 1, N 433 (2019). P. 151-162. https://doi.org/10.32014/2019.2518-170X.19 ISSN 2518-170X (Online), ISSN 2224-5278 (Print).

[5] Abdullayev, S., Tokmurzina, N., Bakyt, G. The determination of admissible speed of locomotives on the railway tracks of the republic of Kazakhstan // Transport Problems International Scientific Journal. 2016. Volume 11 Issue 1. PP.61-68.

[6] Sergienko A.B. Obrabotka tsifrovogo signala // St. Petersburg, Peter. 2011. 758 p.

[7] Fitzwilliam D. Track structure interactions for the Taiwan High Speed Rail project // In Track-Bridge Interaction on High-Speed Railways. 2008. CRC Press. P. 65-72.

[8] Saussine G., Allain E., Paradot N., Gaillot V. Ballast Flying Risk Assessment Method for High Speed Line // 9th World Congress on Railway Research. 2011. Paris, France. P. 37-43.

[9] Kvashnin M.Ya. Issledovanie mexanicheskih kolebanii zheleznodorozhnogo puti // Diss. ... cand. tekhnicheskih nauk. 2010. Almaty, 144 p.

[10] Daniel R. Effect of malfunctioning of the braking system on thermo-mechanical properties of freight train wheels // Dissertation – AAU. 2015. 89 p.

[11] Dyachenko1 L.K., Benin A.V. An assessment of the dynamic interaction of the rolling stock and the long-span bridges on high-speed railways // MATEC Web of Conferences. 2017. Vol. 107, N 14. P. 1-7.

[12] Zhang D., Hu H., Liu Yu., Dai L. Railway train wheel maintenance model and its application // Transportation Research Record: Journal of the Transportation Research Board. 2014. P. 28-36.

[13] Tarumi H. Activities Related to Testing and Research, Japan // Railway Technical Research Institute, Annual Report. 2010. P. 7-12.

[14] Chore1 H.S., Ingle R.K., Sawant V.A. Building frame - pile foundation - soil interaction analysis: a parametric study // Interaction and Multiscale Mechanics. 2010. Vol. 3, N 1. P. 55-79.

[15] Bondar N.G., Kozmin Yu.G., Roitburd Z.G., Tarasenko V.P., Yakovlev G.N. Vzaimodeistvie zheleznodorozhnyh mostov s podvizhnym sostavom // Moscow: Transport. 2009. 272 p.

[16] Ruge P., Birk C. Longitudinal forces in continuously welded rails on bridgedecks due to nonlinear track–bridge interaction // Computers and structures. 2007. Vol. 85, N 7-8. P. 458-475.

[17] Steffens D.M. Identification and Development of a Model of Railway Track Dynamic Behaviour // Queensland University of Technology. 2005. 317 p.

[18] Michal G., Nasir A., Yun S., Zong N., Lee W., Dhanasekar M. Crash Energy Management Systems for Australian rolling stock. Australia, 2013. 70 p.

[19] Xin L., Markine V.L., Shevtsov I.Y. Numerical analysis of the dynamic interaction between wheel set and turnout crossing using the explicit finite element method // Vehicle System Dynamics. 2016. Vol. 54, N 3. P. 301-327.

[20] Lyu Y., Zhu Y., Olofsson U. Wear between wheel and rail: A pin-on-disc study of environmental conditions and iron oxides // 2015. Wear 328. P. 277-285.

[21] Solonenko V.G., Makhmetova N.M., Musayev J.S., Bekzhanova S.E., Kvashnin M.Ya. (2019) Stresses in elements of metal railway bridges under the action of the crew // News of the National academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences. Vol. 2, N 434 (2019). P. 159-165. https://doi.org/10.32014/2019.2518-170X.50 ISSN 2518-170X (Online), ISSN 2224-5278 (Print).

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