ABSTRACT AND REFERENCES

APPLIED MECHANICS

MODELING FOR ESTABLISHMENT OF EVALUATION CONDITIONS OF FUNCTIONAL SAFETY OF THE RAILWAY TRACK (p. 4-10)

Iryna Bondarenko

The paper examines the modeling of the lifecycle of the railway track elements for investigating the deformation processes as the basis for the regulatory framework of the track operation to ensure the reliability of railways. To this end, the foundations of the wave propagation theory are used in describing the track and rolling stock interaction. The basic theoretical provisions and principles to describe the features of deformation operation and the calculation algorithm to determine the stress-strain state of the track are presented. Propagation of bulk and surface waves is used as exciting pulses. The requirements to the minimum length of the site under study and distance between the forces that must be considered in modeling are defined. The requirements to evaluation conditions of functional safety of the track are formed. According to the proposed model, a dynamic process, which involves the movement of the track under the effects of horizontal and vertical movements of wheels on rails for a period of time is considered.

Keywords: modeling, lifecycle, railway track deformability, wave propagation, track reliability, functional safety of track.

References

1. Suvorova, T. V., Usoshin, S. A. (2011). K raschetu volnovogo polja, vozbuzhdaemogo vstrechnymi oscillirujushhimi nagruzkami v geterogennom poluprostranstve. V sbornike trudov Vserossijskoj nauchno-technicheskoi konferentcii «Transport-2011», 37.
2. Verichev, S. N. (2008). Matematicheskie metody issle-dovanija ustojchivosti ob'ekta, dvizhushhegosja po uprugoj napravljajushhej Vestnik nizhegorodskogo universiteta im. N. I. Lobachevskogo, 4, 117–121.
3. Kornilov, S. N., Abdukamilov, Sh. Sh. (2015). Rezul'taty jeksperimental'nogo izuchenija prochnostnyh harakteristik barhannyh peskov, slagajushhih zheleznodorozhnoe zemljanoe polotno. Vestnik MGTU im. G. I. Nosova, 1, 105–110.
4. Ling, X.-Z., Chen, S.-J., Zhu, Z.-Y., Zhang, F., Wang, L.-N., Zou, Z.-Y. (2010). Field monitoring on the train-induced vibration response of track structure in the Beiluhe permafrost region along Qinghai–Tibet railway in China. Cold Regions Science and Technology, 60 (1), 75–83. doi: 10.1016/j.coldregions.2009.08.005
5. Lakušić, S., Ahac, M. (2012). Rail traffic noise and vibration mitigation measures in urban areas S. Lakušić, Technical Gazette, 19 (2), 427–435.
6. Schulte-Werning, B., Asmussen, B., Behr, W., Degen, K. G., Garburg, R. (2012). Advancements in Noise and Vibration Abatement to Support the Noise Reduction Strategy of Deutsche Bahn. Noise and Vibration Mitigation for Rail Transportation Systems, 118, 9–16. doi: 10.1007/978-4-431-53927-8_2
7. Lee, B., Chau, W., Lam, J., Yeung, M. (2012). Planning and Controlling Railway Noise in a Metropolis: Our Practical Experience. Noise and Vibration Mitigation for Rail Transportation Systems, 118, 17–23. doi: 10.1007/978-4-431-53927-8_3
8. Kasimov, B. R. (2014). Metodika prognozirovanija sostojanija putevoj bezopasnosti. transport Kazahstana, 1, 19–23.
9. Auersch, L. (2008). The Influence of the Soil on Track Dynamics and Ground-Borne Vibration. Noise and Vibration Mitigation for Rail Transportation Systems, 99, 122–128. doi: 10.1007/978-3-540-74893-9_17
10. Hussein, M. F. M., Hunt, H. E. M., Rikse, L., Gupta, S., Degrande, G., Talbot, J. P. et. al. (2008). Using the PiP Model for Fast Calculation of Vibration from a Railway Tunnel in a Multi-layered Half-Space. Noise and Vibration Mitigation for Rail Transportation Systems, 99, 136–142. doi: 10.1007/978-3-540-74893-9_19
11. Lombaert, G., Degrande, G., François, S., Thompson, D. J. (2015). Ground-Borne Vibration due to Railway Traffic: A Review of Excitation Mechanisms, Prediction Methods and Mitigation Measures. Noise and Vibration Mitigation for Rail Transportation Systems, 126, 253–287. doi: 10.1007/978-3-662-44832-8_33
12. Thompson, D. (2014). Railway noise and vibration: the use of appropriate models to solve practical problems. 21st International Congress on Sound and Vibration. Beijing, China, 1–16.
13. Avillez, J., Frost, M., Cawser, S., Skinner, C., El-Hamalawi, A., Shields, P. (2012). Procedures for Estimating Environmental Impact From Railway Induced Vibration: A Review. ASME 2012 Noise Control and Acoustics Division Conference, 381–392. doi: 10.1115/ncad2012-1083
14. Kossov, B. C., Bidulja, A. L., Krasnov, O. G., Akashev, M. G. (2013). Rezul'taty jekspluatacionnyh ispytanij geometricheski-silovogo metoda ocenki sostojanija puti. Visnyk Dnipropetrovskogo natcionalnogo unsversitetu zaliznychnogo transporty im. akad. V. Lazarjana, 5 (47), 97–104.
15. Krasnov, O. G., Akashev, M. G., Efimenko, A. V., Nekrasova, T. Ju. (2015). Rezul'taty ocenki sostojanija puti diagnosticheskim poezdom geometricheski-silovym metodom. Put' i putevoe hozjajstvo, 9, 20–24.
16. Bondarenko, I. O. (2015). Formuvannja ocinochnykh umov zhyttjevogho cyklu deformatyvnoji roboty zaliznychnoji koliji. Nauka ta proghres transportu. Visnyk Dnipropetrovskogo natcionalnogo unsversitetu zaliznychnogo transporty im. akad. V. Lazarjana, 3 (57), 107–117.
17. Al'breht, V. G., Ljashhenko, V. N., Pershin, S. P., Shul'ga, V. Ja. (1963). Besstykovoj put' i dlinnye rel'sy. Moscow: Transport, 214.
18. Verigo, M. F., Krepkogorskij, S. S. (1962). Ustanovlenie nom bokovyh dinamicheskih nagruzok podvizhnogo sostava po usloviju ustojchivosti puti poperechnom sdvigu. Moscow: Trudy CNIII MPS, 248, 210–302.

EXPERIMENTAL RESEARCH OF THE WAVE LOAD ON THE UPPER PART OF HYDROTECHNICAL STRUCTURES (p. 10-16)

Stanislav Rogachko, Irina Panova

The vertical component of the wave load acting on the model of the upper structure of the hydraulic structure is experimentally investigated. The results of processing of the experimental data using the least squares method are presented. A graphical interpretation of the experimental results is given. The estimated dependencies for determining the resultant of the vertical component of the wave load on the upper structure of the through-type structures in the steepness range of the wave, studied in the experiment are obtained. They show that the required load is directly proportional to the wave amplitude and the length of the model in the wave beam direction, and also depends on the clearance-to-wavelength ratio. Examples of calculation of the required load are given. Recommendations on the use of the results of the experimental investigation for inclusion in the regulations are proposed.

Keywords: through-type hydraulic structure; upper structure; vertical component of wave load.

References

1. SNyP 2.06.04-82*. Nagruzky y vozdejstvyya na gydrotexnycheskye sooruzhenyya (volnovie, ledovie y ot sudov) Aktualyzyrovannaya redakcyya (2012). Moscow.
2. Rogachko, S. Y. (2005). Opredelenye otmetky nyza verxnego stroenyya morskyx neftegazopromislovix gydrotexnycheskyx sooruzhenyj. Gydrotexnycheskoe stroytelstvo, 7, 15.
3. Svod pravyl. proektyrovanye morskyx ledostojkyx platform. Part I. Klassyfykacyya, osnovnie polozhenyya, trebovanyya k nagruzkam y vozdejstvyyam. Ostojchyvost. SP – 33 – 10100 (2001). Moscow.
4. Noskov, B. D., Pravdyvecz, Yu. P. (2004). Sooruzhenyya kontynentalnogo shelfa. Moscow: ASV, 162, 194.
5. Chacrabarti, S. K. (1994). Hydroddynamics of Offshore Structures. WIT Press (UK), 464.
6. Turgut, S. S. (2014). Wave Forcer on Offshore Structures. Cambridge University Press New York.
7. Leshhenko, S. V., Makarov, K. N. (2013). Metodyka rascheta vertykalnix gydrodynamycheskyx volnovix nagruzok na goryzontalnie elementi morskyx gydrotexnycheskyx sooruzhenyj. Gydrotexnyka, 2 (31), 20–25.
8. Rogachko, S. Y., Panova, Y. N. (2015). Eksperymentalnaya ustanovka dlya yzmerenyya vertykalnoj sostavlyayushhej volnovoj

nagruzky y volnovogo davlenyya na modely verxnego stroenyya gydrotexnycheskyx ssoruzhenyj. Patent na yzobretenye № 108448. Kyiv.
9. Panova, Y. N. (2014). Eksperymentalnie yssledovanyya volnovoj nagruzky na verxnee stroenye gydrotexnycheskyx sooruzhenyj. Visnyk Odeskoyi derzhavnoyi akademiyi budivnycztva ta arxitektury, 56, 260.
10. Pavlenko, G. K. (1956). Soprotyvlenye vodi dvyzhenyyu sudna. Morskoj transport. Moscow, 507.
11. DBN V.1.2 – Nagruzky y vozdejstvyya Mynstroj Ukrayni (2006). Kyiv.
12. SNyP 2.01.07-85* Nagruzky y vozdejstvyya (1985). Gosstroj SSSR, Moscow.
13. MNK i regressionnyj analiz Onlajn + grafiki. Available at: http://mathhelpplanet.com/static.php?p=onlayn-mnk-i-regressionniy-analiz

INVESTIGATION OF THE PROCESS OF EXCITATION OF DUAL-FREQUENCY VIBRATIONS BY BALL AUTO-BALANCER OF GIL 42 SCREEN (p. 17-23)

Gennadiy Filimonikhin, Volodymyr Yatsun

The 3D model of the upgraded light-duty unbalanced-throw screen GIL 42 with the ball auto-balancer as the exciter of dual-frequency vibrations is developed.

Key parameters that affect the stability of dual-frequency vibrations are identified.

It is found that the fields of dual-frequency vibrations are relatively large, which allows changing the characteristics of dual-frequency vibrations by changing these parameters.

The box mass increase reduces the lower vibration frequency. Herewith, the corrector weights automatically adjust to the box mass change.

The mass increase of corrector weights directly increases the amplitude of slow vibrations of the box. The mass increase of the unbalance on the auto-balancer housing directly increases the amplitude of fast vibrations of the box. The rotor speed increase directly increases the speed of fast vibrations of the box. A number of parameters that affect the value of the amplitude of slow vibrations are identified.

Since dual-frequency vibrations have two components, arising from the unbalance on the auto-balancer housing and corrector weights respectively, it was decided to examine each component separately. As a result, it is found that the auto-balancer operates as two independent vibration exciters:

– the first is formed by corrector weights, and it excites slow vibrations of the box with the natural resonant frequency;

– the second is formed by the unbalanced mass on the auto-balancer housing, and it excites fast vibrations of the box with the rotor speed.

Keywords: vibration exciter, dual-frequency vibrations, 3D modeling, unbalance, resonance vibrator, auto-balance, screen.

References

1. Blagov, I. S., Kotkin, A. M., Zarubin, L. S. (1984). Directory of enrichment of coals. Moscow: Nedra, 614.
2. Lanets, O. S. (2008). Highly resonant vibration machine with electromagnetic actuator (Theoretical bases and practice of creation). Lviv: Publishing Nat. Univ "Lviv Polytechnic", 324.
3. Hurskyi, V. M., Kuzo, I. V., Lanets, O. S. (2010). Providing dual-frequency resonant modes of vibration table compaction concrete mixes. Proceedings of the National University "Lviv Polytechnic". Serie "Dynamics, durability and design of machines and devices", 678, 44–51.
4. Bukin, S. L., Maslov, S. G., Ljutyj, A. P., Reznichenko, G. L. (2009). Intensification of technological processes through the implementation of vibrators biharmonic modes. Enrichment of minerals: Scientific and technical journal, 36–37 (77-78), 81–89.
5. Artyunin, A. I. (1993). Research of motion of the rotor with autobalance. Proceedings of the higher educational institutions. Mechanical Engineering, 1, 15–19.
6. Sommerfeld, A. (1904). Beitrage zum dinamischen Ausbay der Festigkeislehre. Zeitschriff des Vereins Deutsher Jngeniere, 48 (18), 631–636.
7. Filimonikhin, G. B. (2001). Universal stand for studying the dynamics of passive autobalancing and testing ball autobalancer. Scientific works KDTU, № 9, 101–107.
8. Filimonikhin, G. B. (2004). Balancing and protection from vibrations of rotors by autobalancers with rigid corrective weights. Kirovograd: KNTU, 352.
9. Lu, C.-J., Tien, M.-H. (2012). Pure-rotary periodic motions of a planar two-ball auto-balancer system. Mechanical Systems and Signal Processing, 32, 251–268. doi: 10.1016/j.ymssp.2012.06.001
10. Artyunin, A. I., Alhunsaev, G. G., Serebrennikov, K. V., Sushkeev, J. B. (2003). Some special conditions of unsteady motion of a pendulum rotors autobalancing. Proceedings of the Second International Conference "Problems of modern machines", Ulan-Ude, 4, 4–12.
11. Serebrennikov, K. V. (2004). Features of dynamics of rotor systems with pendulum autobalancers. Ulan-Ude, 18.
12. Artyunin, A. I., Alhunsaev, G. G. (2005). About special regime of movement rigid rotor with elastic supports and pendulum autobalancing. Proceedings of the higher educational institutions. Mechanical Engineering, 10, 8–14.
13. Artyunin, A. I. (2013). The effect of "jam" and features a pendulum motion of the rotor autobalancing. Education & Science: Scientific publications MSTU. NE Bauman, 8, 443–454.
14. Artyunin, A. I., Eliseev, S. V. (2014). The possibility of generalizing the problem of dynamic interactions in the balance spinning solids. Reshetnev reading, Part 1, 18, 269–271.
15. Artyunin, A. I., Khomenko, A. P., Eliseev, S. V., Ermoshenko, Y. V. (2015). The generalized model of vibration mechanics and nonlinear effect of "jam" of the pendulum at the resonant frequencies of the mechanical system. Mechanical Industry and Engineering Education, 1 (42), 61–67.
16. Artyunin, A. I., Ermoshenko, Y. V., Popov, S. I. (2015). Experimental study of the effect of "jam" of the pendulum at the resonant frequencies of the mechanical system. Modern technologies. System analysis. Modeling, 2 (46), 20–25.
17. Filimonikhin, G. B., Yatsun, V. V. (2014). The use of passive autobalancer as dual-frequency circularly vibration exciter. Patent of Ukraine 92337, G01M 1/32, F04D 29/66. Filed 18.03.2014. Bul. № 15, 4.
18. Filimonikhin, G. B., Yatsun, V. V. (2015). Method of excitation of dual frequency vibrations by passive autobalancers. Eastern-European Journal of Enterprise Technologies, 4/7(76), 9–14. doi: 10.15587/1729-4061.2014.23317
19. Filimonikhin, G. B., Yatsun, V. V. (2014). 3D modeling of the excitation autobalancer two-frequency oscillations platform screen by using Solidworks and Cosmos motion. Mathematical and simulation modeling systems, 218–221.
20. Filimonikhin, G. B., Yatsun, V. V. (2015). Experimental research of dual-frequency vertical vibrations platform excited ball autobalancing. Vibrations in engineering and technologies, 4 (80), 90–95.

A NUMERICAL ANALYSIS OF NON–LINEAR CONTACT TASKS FOR THE SYSTEM OF PLATES WITH A BOLTED CONNECTION AND A CLEARANCE IN THE FIXTURE (p. 24-29)

Oleksandr Atroshenko, Mykola Tkachuk, Oleksandr Ustinenko, Oleksiy Bondarenko, Natalia Diomina

The article presents an analysis of geometrically nonlinear contact tasks for the system of plates. The peculiarities of the presented tasks consist in research of a pressure-deformed state of two plates connected with a bolt fixture with a clearance and loaded with a uniformly distributed transverse force along the upper edge. Both geometrical and structural non-linearities are presented in the study tasks. The geometrically nonlinear formulation determines the SSS for plates connected with a bolt fixture with a clearance. Maximum deformation of such plates is 0.028 m and the equivalent (von-Mises) stress is 1200 MPa. The bolt skewing and the plate deformation increase tensile forces in the bolt, thereby increasing the force of the bolt fixture tightening (1500 N to 4000 N). The proposed methodology can be used for solving similar tasks as it considers a wide range of operating loads. In case when the researched object is a solid plate, geometrically linear and non-linear formulations do not guarantee reliable results.

Keywords: stress-strained state (SSS), silo, finite element technique, system of plates, reaction in the supports.

References

1. Atroshenko, O. O., Tretyakov, V. B., Ivantsov, I. I., Veretelnik, O. V. (2013). A rationale for calculation models of silo items. Vestnik NTU "KhPI", 1, 139–154.
2. Design of steel structures: Silos (2007). Brussels, CEN Eurocode 3.
3. Actions on Structures. General Actions – Snow Loads (2003). Brussels, CEN Eurocode 1.
4. Actions on Structures. General Actions – Wind Actions (2005). Brussels, CEN Eurocode 1, 4.
5. Shi, Y., Wang, M., Wang, Y. (2011). Analysis on shear behavior of high-strength bolts connection. International Journal of Steel Structures, 11 (2), 203–213. doi: 10.1007/s13296-011-2008-0
6. Tang, G., Yin, L., Guo, X., Cui, J. (2015). Finite element analysis and experimental research on mechanical performance of bolt connections of corrugated steel plates. International Journal of Steel Structures, 15 (1), 193–204. doi: 10.1007/s13296-015-3014-4
7. Gallego, E., Gonz lez-Montellano, C., Ram rez, A., Ayuga, F. (2011). A simplified analytical procedure for assessing the worst patch load location on circular steel silos with corrugated walls. Engineering Structures, 33 (6), 1940–1954. doi: 10.1016/j.engstruct.2011.02.032
8. Mohammed, H., Kennedy, J. B. (2009). Fatigue Resistance of Corrugated Steel Sheets Bolted Lap Joints under Flexture. Practice Periodical on Structural Design and Construction, 14 (4), 242–245. doi: 10.1061/(asce)sc.1943-5576.0000021
9. Chung, K. F., Ip, K. H. (2001). Finite element investigation on the structural behaviour of cold-formed steel bolted connections. Engineering Structures, 23 (9), 1115–1125. doi: 10.1016/s0141-0296(01)00006-2
10. Ju, S.-H., Fan, C.-Y., Wu, G. H. (2004). Three-dimensional finite elements of steel bolted connections. Engineering Structures, 26 (3), 403–413. doi: 10.1016/j.engstruct.2003.11.001
11. Anuriev, V. I. (2006). A handbook for designers and mechanical engineers. Moscow: Mashinostroenie Publ., 928.
12. Vasidzu, K. (1987). Variation methods in the theory of elasticity and plasticity. Moscow: Mir Publ., 542.
13. Birger, I. A., Mavlyutov, R. R. (1986). Strength of materials. Moscow: Nauka Publ., 560.
14. Basov, K. A. (2005). ANSYS: user's guide. Moscow: DMK Press Publ., 640.
15. Kaplun, A. B., Morozov Ye. M., Olferyeva M. A. (2003). ANSYS in the hands of engineers. Moscow: Editorial Publ., 272.
16. Atroshenko, A. A. (2014). Experimental research on the system of plates with a bolted connection. Vestnik NTU "KhPI", 14, 105–112.
17. Atroshenko, A. A. (2014). Bending of a plate with large displacements and longitudinal forces of influence. Vestnik NTU "KhPI", 29, 3–13.

DEVELOPMENT AND INVESTIGATION OF FACE BUFFER IMPULSE SEAL OF CENTRIFUGAL COMPRESSOR (p. 30-39)

Andriy Zahorulko, Dmytro Lisovenko, Vasyl Martsynkovskyy

The method of simplified static calculation (one-dimensional model of laminar isothermal flow in the face gap) and the experimental results of the design of the face buffer impulse seal for the centrifugal compressor are presented. The flow characteristics of the seal depending on the sealed and buffered fluid pressure and the shaft speed are obtained. The dimensions of the seal (dimensions of the rings, the load factor, the number and dimensions of the chambers and feeders) are selected so that to working ability at the shaft speed of up to 10,000 rpm and pressure up to 5.0 MPa with leakages not exceeding 37 nl/min. The dual seal design will reduce the volume flow rate and increase the efficiency of the centrifugal compressor. The design of such a seal can also serve as a barrier or backup seal. Due to the gas-static action of the buffer groove, it can be used in rotary machines at low sliding speed.

Keywords: buffer impulse seal, static calculation, flow characteristics, centrifugal compressor.

References

1. Neuberger, S., Bock, E., Haas, W., Lang, K. (2014). Gas-lubricated mechanical face seals reduce CO2 emissions. Sealing Technology, 2014 (9), 8–12. doi: 10.1016/s1350-4789(14)70343-5
2. Tabata, H., Sano, M. (2005). Study of High Efficiency Turbocompressor. Development of High-Speed and High-Pressure Dry-Gas-Seal. IHI Engineering Review, 38 (1), 1–5.
3. USA, F 16 J 15/34. Dual Non-Contacting Mechanical Face Seal Having Concentric Seal Faces.
4. Bridon, R., Lebigre, O. (2011). Gas seal contamination. Proceedings of the Fortieth Turbomachinery Symposium, Houston. Texas, 146–152.
5. Sattler, M. (2009). A new oil barrier seal for dry gas seals. Sealing Technology, 2009 (9), 8–11. doi: 10.1016/s1350-4789(09)70495-7
6. Zhu, W.-B., Wang, H.-S., Zhou, S.-R. (2014). Research on sealing performance of hydrostatic pressure mechanical seal. Journal of Marine Science and Technology, 22 (6), 673–679. doi: 10.6119/JMST-014-0321-1
7. Zhu, W. B., Zhou, S. R., Wang, H. S. (2011). Performance of Externally Pressurized Dry Gas Seal. Advanced Materials Research, 335-336, 610–614. doi: 10.4028/www.scientific.net/amr.335-336.610
8. Wang, Y., Yang, H., Wang, J., Liu, Y., Wang, H., Feng, X. (2009). Theoretical Analyses and Field Applications of Gas-Film Lubricated Mechanical Face Seals with Herringbone Spiral Grooves. Tribology Transactions, 52 (6), 800–806. doi: 10.1080/10402000903115445
9. Gaft, J., Martsinkovskyy, V., Gromyko, B., Zahorulko, A. (2003). Design and calculation of mechanical seals with self-adjusting clearance. Proc. XVII Int. Conf. on Fluid sealing, BHR Group, York, England, 505–520.
10. Gaft, J., Zahorulko, A., Martsynkovskyy, Vl., Kundera, Cz. (2012). Theoretical and experimental investigations of buffer face impulse seals. 11th EDF/Pprime Workshop: "Behaviour of Dynamic Seals in Unexpected Operating Conditions", Futuroscope, September, 70–80.
11. Zahorulko, A. V. (2015). Theoretical and experimental investigations of face buffer impulse seals with discrete supplying. Eastern-European Journal of Enterprise Technologies, 4/7(76), 45-52.doi: 10.15587/1729-4061.2015.48298
12. Gas lubricated mechanical seals (1997). Feodor Burgmann Dichtungswerke GmbH & Co., First Edition, 75.

THE EMERGENCE OF RESONANCE WITHIN ACOUSTIC FIELDS OF THE FLOAT GYROSCOPE SUSPENSION (p. 39-44)

Viktorij Mel'nick, Volodimir Karachun

The formation nature of resonance phenomena, which give rise to the rapid growth of the gyro errors in hypersonic flight conditions in the suspension of a two-stage float gyroscope is revealed. On the example of the industrial design of the float gyroscope, computational models are built. They allowed determining the influence of the antisymmetric and symmetric impedance of the housing on the emergence of resonance conditions in the suspension. The influence of the propagation direction of acoustic radiation on the occurrence of the features, leading to the rapid growth of additional autonomous positioning errors is determined.

The resonance content at high (above the cutoff) and low (below the cutoff) frequencies is revealed. It is shown that at high frequencies the resonance is formed by only bending vibration of the housing in the sound field provided that the antisymmetric impedance is much lower than the symmetrical impedance.

It is found that the low-frequency resonance can be formed only by the circumferential vibration of the housing depending on the sound wave incidence angles. It appears in the form of the wave coincidence of the trace of the incident and circumferential waves, or coincidence of the circumference of the frame and the circumferential wave on the plane of the incident wavefront.

The resonance methods of dealing with the influence of the sound fields as the only effective ones in the resonance conditions of hypersonic flight are analyzed.

Keywords: hypersonic technology, float gyroscope, wave coincidence, coincidence resonance, antisymmetric impedance.

References

1. Mel'nick, V. N., Ladogubets, N. V. (2016). Wave problems in acoustic environments. Kyiv: Korniychuk, 4325.
2. Mel'nick, V. N., Karachun, V. V. (2012). The sound barrier and influence of the powerful N-wave on elastic constructions of "Air to Air" class. Space Science and Technology, 18 (5), 12–23.
3. Mel'nick, V. M., Karachun, V. V. (2015). Float gyroscope. Ukrainian Patent No. 110171.
4. Proekt razvedyvatel'no-udarnogo giperzvukovogo BPLA HTV-3X "Blackswift" (SShA). Available at: http://raigap.livejournal.com/261144.html

5. Letatel'nyj apparat Boeing X-51A WaveRider stavit rekord po dlitel'nosti poleta na giperzvukovoj skorosti. Available at: http://www.dailytechinfo.org/space/4774-letatelnyy-apparat-boeing-x-51a-waverider-stavit-rekord-po-dlitelnosti-poleta-na-giperzvukovoy-skorosti.html
6. «Nadezhnaja radiosvjaz' na giperzvukovyh skorostjah vozmozhna». Available at: http://zoom.cnews.ru/rnd/article/item/nadezhnaya_radiosvyaz_na_giperzvukovyh_skorostyah_vozmozhna/print
7. Winter, F. H., Van der Binder, F. R. (2003). 100 years of flight: a chronicle of aerospace history, 1903–2003. Reston, Virginia: American Institute of Aeronautics and Astronautics, 524.
8. Barbour, N. M. (2010). Inertial Navigation Sensors. Cambridge, 10.
9. Nwe, T. T. (2008). Application of an Inertial Navigation System to the Quad-rotor UAV using MEMS Sensors. Engineering and Technology, 42, 578–582.
10. Woodman, O. J. (2007). An introduction to inertial navigation. Cambridge, 37.
11. Le Manh Hung, V. (2009). Indoor Navigation System for Handheld Devices. Worcester, 198.
12. Kulyk, M. S., Mel'nick, V. N., Karachun, V. V. (2015). Suborbital and Atmospheric Hypersound Technologies. Kyiv: NAU, 328.
13. Karachun, V. V., Tryvaylo, M. S., Mel'nick, V. M. (2001). Soundproofed casing. Ukrainian Patent No. 39599A.
14. Zaborov, V. I. (1962). Theory of sound insulation of walls. Moscow: Stroyizdat, 116.
15. Heng, M., Erkorkmaz, K. (2010). Design of a NURBS Interpolator with minimal feed fluctuations and continuous feed modulation capability. International Journal of Machine Tools and Manufacture, 50 (3), 281–293. doi: 10.1016/j.ijmachtools.2009.11.005

THE USE OF CONTROLLED CRACKING TO IMPROVE THE EFFICIENCY OF WATERJET CUTTING (p. 45-56)

Vadim Orel, Victor Shchetinin, Alexander Salenko, Nikolai Yatsyna

The study focuses on the possibilities of increasing the production efficiency of waterjet cutting with the aid of mechatronic systems. We have proved the effect of different types of loads and the form of the cut on the cracks in sheet workpieces. A computer simulation of a workpiece load facilitated identifying stress zones along the cutting contours. It is proved that controlling a non-stationary stress state allows limiting the crack growth rate. Increased energy efficiency and performance parameters in a complex-contour cutting of workpieces with an abrasive fluid jet is an important task for operating hydroabrasive technological complexes manufactured in a wide range by foreign and domestic firms. It is found that the most effective cutting is that with preloading of sheet blanks with a tensile strength up to 90 MPa. If the sheet thickness exceeds 5-6 mm the effect decreases, whereas materials thicker than 15 mm are processed with additional energy consumption. Thus, it can be assumed that when preloading devices control the stress-strain state (SSS) of the cutting area in quasi-elastic sheet workpieces the processing performance increases and the quality of the cut improves.

Keywords: hydro-abrasive treatment, processing along a curvilinear contour, controlled cracking, stress state, mechatronic devices.

References

1. Miller, R. (1991). Waterjet Cutting: Technology and Industrial Applications. Fairmont Press, 154.
2. Brenner, V. A., Zhabin, A. B., Pushkarev, A. E., Schegolevskiy, M. M. (2003). Gidrostruynyie tehnologii v promyishlennosti. Gidro-abrazivnoe rezanie gornyih porod. Moscow: Izdatelstvo Moskovskogo gosudarstvennogo gornogo universiteta, 279.
3. Ryikunov, A. N., Yablunovskiy, Ya. Yu. (2009). Povyishenie effektivnosti gidroabrazivnoy obrabotki na osnove modelirovaniya protsessov mikrorazrusheniya materialov. Spravochnik. Inzhenernyiy zhurnal, 4, 14–17.
4. Orel, V. N., Shchetinin, V. T., Fomovska, O. V., Salenko, A. F. (2015). Using of mechanotronics devices for working movements workpieces during waterjet cutting. Journal of the Technical University of Gabrovo, 52, 35–42.
5. Matvienko, Yu. G. (2006). Modeli i kriterii mehaniki razrusheniya. Moskva: fizmalit, 328.
6. Lebedev, A. A., Muzyika, N. R. (2001). Nesuschaya sposobnost plastinyi s treschinoy pri dvuhosnom rastyazhenii. Problemyi prochnosti, 2, 20–27.
7. Petko, I. V., Belyaev, S. V., Kedrovskiy, B. G., Klaptsov, Yu. V. (1988). Razrabotka i issledovanie ustanovki dlya raskroya materialov gidrostruey vyisokogo davleniya. UkrNIKTIbyit, 161.
8. Stepanov, Yu. S., Barsukov, G. V., Alyushin, E. G. (2012). Sovremennyie tehnologii gidro- i gidroabrazivnoy obrabotki zagotovok. Naukoemkie tehnologii v mashinostroenii, 6, 15–20.
9. Antonenko, O. V. (2007). Strukturno-parametrichniy sintez gidroriznogo verstata iz sistemoyu kontrolyu zoni struminnoyi eroziyi. Progressivnyie tehnologii i sistemyi mashinostroeniya, 47, 144–156.
10. Agus, M., Bortolussi, A. (1995). Abrasive perfomance in rock cutting with AWJ and ASJ. Proc. 8-th American Water Jet Conference. St. Louis, 31–48.
11. Lamm, T. V., Isachenkov, E. I. (1998). Povyishenie tochnosti detaley iz lista pri gibke-formovke elastichnoy sredoy Tehnicheskie problemyi proizvodstva LA i dvigateley. Kazan, 20–29.
12. David, A., Summers, D. (1995). Waterjetting. Technology. Printed in Great Britain by the Alden Press. Oxford, 882.
13. Salenko, O., Schetynin, V., Khorolska, M. (2014). Improving accuracy of profile hydro-abrasive cutting of plates of hardmetals and superhard materials. Journal of Superhard Materials, 3 (36), 73–84. doi: 10.3103/s1063457614030083
14. Salenko, A. F., Fomovskaya, A. V. (2009). Kachestvo obrabotki materialov gidroabrazivnoy struey. Oborudovanie i instrument, 1, 16–19.
15. Tihomirov, R. A., Guenko, V. S. (1984). Gidrorezanie nemetallicheskih materialov. Kyiv: Tehnika, 150.
16. Svirskiy, Yu. O. (1976). Metode rascheta skorosti rasprostraneniya treschinyi pri nestatsionarnom povrezhdenii. Uchenyie zapiski TsAGI, VII (4), 81–96.

DETERMINATION OF THE DEGREE OF INFLUENCE OF REPAIR PROCESSES ON SERVICEABILITY OF UNITS OF THE TRACTION ROLLING STOCK (p. 56-61)

Yurii Datsun

The sequence and interaction of individual processes in the repair of units of the traction rolling stock are analyzed. It allowed presenting the breakdown in the repair process of units as basic events in the "fault tree" model. The resulting event of the tree is represented as the failure of the unit in operation after repair. In the absence of statistical data on the probabilities of basic events, the influence of the component on the resulting event is determined by its weight based on the logical model, which corresponds to the indicator of the structural importance of the component. Formalization of the developed "fault tree" allowed obtaining the function of the system health, which was reduced initially to the disjunctive-normal form, then to its perfect form. Therefore, it was determined that repair processes have different weights, and thus vary in degree of influence on the serviceability of the unit after repair. The processes that run in the final stages of repair have the greatest influence (weight): "Running and testing" – 0.68; "Completing and assembly " – 0.32; "Quality control of the repair (restoration) of the unit" – 0.18. The processes, implementation of which is checked in the final stages are of less weight: "Repair (restoration)" – 0.07; "Fault detection" – 0,055. Preparatory processes that are performed in the initial stages of repair (disassembly, pre-repair evaluation and cleaning of the unit) have minimum weight – 0,008.

Keywords: process, repair, unit, traction rolling stock, influence, component, failure, system, serviceability, evaluation.

References

1. Datsun, Y. N. (2015). Vybor strategii tekhnicheskogo obsluzhivaniya i remonta lokomotivov na osnove metodov nechetkoy logiki. Visnik Skhidnoukrainskogo natsionalnogo universitetu imeni Volodimira Dalya, 1, 77–80.
2. Hadley, G. (2012). The DuPont Analysis: Making Benchmarking Easier and More Meaningful. Available at: http://articles.extension.org/pages/11805/the-dupont-analysis:-making-benchmarking-easier-and-more-meaningful/
3. Pearce, J. M. (2015). Return on investment for open source scientific hardware development. Science and Public Policy. doi: 10.1093/scipol/scv034

4. Muralidharan, R. (2004). A framework for designing strategy content controls. International Journal of Productivity and Performance Management, 53 (7), 590–601. doi: 10.1108/17410400410561213
5. Mulcaster, W. (2008). Three strategic frameworks. Business Strategy Series, 10 (1), 68–75. doi: 10.1108/17515630910937814
6. Ishikawa, K. (1985). What is Total Quality Control? The Japanese Way. London: Prentice Hall, 240.
7. Gontareva, I. V. (2009) Determination of factors of enterprise system efficiency. Nauka i studia, 8 (20), 5–11.
8. Koverga, S. V. Peredereeva, O. S., Kuzmenko, S. P. (2010) Efektivnist diagnostiki tehniko-tehnologichnogo potentsialu mashinobudivnogo pidpriemstva. Marketing i menedzhment innovatsiy, 4 (2), 205–209.
9. Evdokimov, F. I., Lisyakov, V. F. (2005). Otsinka tehniko-tehnologichnogo potentsialu visokotehnologichnogo pidpriemstva. Naukovi vidannya DonNTU. Ekonomichna seriya, 97, 25–30.
10. Rachinska, G. V., Lisovska, L. S. (2011) Otsinyuvannya rivnya tehnologichnogo rozvitku pidpriemstv. VIsn. Nats. un-tu "Lviv. poi-Itehnika", 698, 277–281
11. Ponomarenko, V. S., Gontareva, I. V. (2011) Strukturizatsiya pokaznikiv sistemnoyi efektivnosti rozvitku pidpriemstv. Ekonomika rozvitku, 2 (58), 71–75.
12. Zhang, H. (2014). Research on the Measurement of Enterprise Technological Innovation Capability Model based on Information Axiom. International Journal of Multimedia and Ubiquitous Engineering, 9 (7), 319–332. doi: 10.14257/ijmue.2014.9.7.27
13. Heng, T. (2011). The Empirical Analysis of enterprise Scientific and Technological Innovation Capability. Energy Procedia, 5, 1258–1263. doi: 10.1016/j.egypro.2011.03.219
14. Polozhennya z atestatsii pidpriemstv z obslugovuvannya ta remontu tyagovogo ruhomogo skladu (2007). Kyiv: Ukrzaliznyitsya, 244.
15. Tartakovskiy, E. D., Puzyir, V. G., Datsun, Y. N. (2014). Formalizatsiya ekspertnyih otsenok pri attestatsii lokomotivoremontnyih proizvodstv. Materialyi pervoy mezhdunarodnoy nauchno-prakticheskoy konferentsii. Moscow, 280–284.
16. Morozova, N. M. (2011). Organizatsionnyie printsipy vyipolneniya rabot po sezonnomu tehnicheskomu obsluzhivaniyu i hraneniyu zernouborochnyih kombaynov. Izvestiya TulGU, 5 (3), 299–303.
17. Shemyakin, A. V., Astahova, E. M., Bohulenkov, S. A. (2005) Determinalnaya model hraneniya selskohozyaystvennoy tehniki. Sbornik nauchnyih trudov molodyih uchenyih Ryazanskoy GSHA, 137–139.
18. Novikov, V. A., Grishin, A. I. (2012). FMEA-analiz kritichnosti protsessa «Tehnicheskoe obsluzhivanie tehnologicheskogo oborudovaniya». Menedzhment, 6 (97), 37–41.
19. Galiev, I. G., Novikov, V. A., Grishin, A. I. (2012). Opredelenie vesomosti tehnologicheskih operatsiy i urovnya rashoda resursa agregatov i sistem traktora. Vestnik Kazanskogo GAU, 3 (25), 73–77.
20. Keda, D. P., Isakov, S. L. (2009). Sistemnyiy podhod v opredelenii slozhnosti tehnologicheskih operatsiy. Problemyi upravleniya riskami v tehnosfere, 1-2, 71–76.
21. Ryabinin, I. A. (2000) Nadezhnost i bezopasnost strukturno-slozhnyih sistem. SPb.: Politehnika, 248.
22. Serebrovskiy, A. N. (2012). Metodicheskie i vyichislitelnyie aspektyi znachimosti riska komponentov slozhnyih sistem. Matematichni mashini i sistemi, 2, 145–154.
23. Ryabinin, I. A., Cherkesov, G. N. (1981). Logiko-veroyatnostnyie metodyi issledovaniya nadezhnosti strukturno-slozhnyih sistem. Moscow: Radio i svyaz, 264.
24. Henley, E. J., Kumamoto, H. (1981). Reliability Engineering and Risk Assessment. Englewood Cliffs, NJ.: Prentice-Hall, 568.
25. O'Connor, P., Newton, D., Bromley, R. (2002). Practical Reliability Engineering. John Wiley & Sons, 513.
26. Tartakovskiy, E., Puzyir, V., Datsun, Y. (2014). Primenenie ekspertnyih metodov dlya otsenki organizatsionno-tehnicheskogo urovnya lokomotivoremontnyih predpriyatiy. Transport problems, 4 (1), 87–91.