ABSTRACT AND REFERENCES

APPLIED MECHANICS

THE STABILITY OF THREE-LAYER NONHOMOGENEOUS RECTANGULAR PLATES IN ANISOTROPIC RESISTING MEDIUM (p. 4–7)

Billura E. Isali

The paper investigates the problem of stability of three-layer nonhomogeneous rectangular plates in an anisotropic resisting medium, the layers of which are made of various continuously nonhomogeneous materials. It is assumed that the elastic characteristics of the layer material are continuous functions of the plate thickness coordinate. Using the Kirchhoff-Love hypotheses for the entire thickness of the element, expressions for the forces and moments were obtained, and the generalized stiffness characteristics for the considered three-layer nonhomogeneous plate were determined. In general, plate deflection stability equation systems and stress functions were obtained. In the case of the hinged support of the plate edges, a solution to the problem was constructed and the formula for determining the critical load of the plate was found. During the numerical calculations, the elastic properties of the layer material were taken as linear functions of the thickness coordinates.

Analysis of the numerical calculations shows that the plate layer material nonhomogeneity can significantly affect the critical parameters of the plate.

Keywords: three-layer plate, nonhomogeneous material, elastic characteristics, stability, critical load.

References

1. Lomakin, V. A. (1978). The theory of elasticity of inhomogeneous bodies.Moscow,USSR: Moscov State University Press, 432.
2. Volmir, A. S. (1967). Stability of deformable systems. Moscow, USSR: Nauka, 984.
3. Alfutov, N. A., Zinoviev, P. A. S., Popov, B. G. (1984). Calculations of laminated plates and shells made of composite materials. Moscow, USSR: Mechanical Engineering, 264.
4. EI-Zafrany, A., Fadhil, S. (1996). A modified Kirchhoff theory for boundary element analysis of thin plates resting on two-parameter foundation. Engineering Structures, 18 (2), 102–114. doi: 10.1016/0141-0296(95)00097-6
5. Gülkan, P., Alemdar, B. N. (1999). An exact finite element for a beam on a twoparameterelastic foundation. Structural Engineering and Mechanics. 7 (3), 259–276. doi: 10.12989/sem.1999.7.3.259
6. Panda, S. K., Ramachandra, L. S. (2011). Buckling and postbuckling Behavior Cross-Ply Composite Plate Subjected to Nonuniform in-Plane loads.Journal of Engineering Mechamics, 137 (589), 1061–1070. doi: 10.1061/(asce)em.1943-7889.0000258
7. Rahman, T., Ijsselmuinden, S. T., Abdalla, M. M., Jansen, E. L. (2011). Postbucklink analysis of variable stinffnesscomposite plates using a finite element-based perturb bationmethod.International Journal of Structural Stability and Dynamics, 11 (04), 735–753. doi: 10.1142/s0219455411004324
8. Isayev, F. Q., Qaraisayev, S. N., Karimova, B. E. (2011). The stability of the three-layered non-homogeneous orthotropic elastic plates resting on the variable elastic foundation. Proceedings of the International Symposium on Advanced in Applied Mechanics and Modern Information Technology. Baku, 192–197.
9. Dao, V. D., Hoa, L. K. (2013). Nonlinear buckling and post-buckling analysis of eccentricallystiffened functionally graded circular cylindrical shells under external pressure. Thin-Walled Structures, 63, 117–124. doi: 10.1016/j.tws.2012.09.010
10. Upadhyay, A. K., Shulka, K. K. (2014). Post-buckling analysis of skew plates sujected to combined in-plane loading. Acta Mechanica, 225 (10), 2959–2968. doi: 10.1007/s00707-014-1205-2

THE RESULTS OF PERFORMANCE TESTS OF DUPLEX CASSETTE CYLINDRIC BEARINGS IN AXLEBOXES OF FREIGHT CARS (p. 8–13)

Igor Martynov, Vasiliy Ilchyshyn, Evgeniy Mogeyko, Alena Trufanova, Vadim Shovkun

One of the important stages of creating a new design of the axlebox unit is performance tests to confirm the reliability indexes of the object.

The paper presents the results of performance tests of CBU duplex cassette-type bearings in the axleboxes of freight cars. Using such bearings will allow to increase the reliability of axlebox units, turn to another maintenance system, which allows to reduce maintenance and repair costs, save considerable material and human resources, improve traffic safety. Reliability indexes of cylindrical axlebox bearings (duplex) were determined. The lower limit of the probability of survival will be 0.889 and the upper – 1. Such a high divergence of indexes is caused by lack of test objects (only 2 cars and 16 duplex bearings).

As a result of the tests, it was revealed that cylindrical duplex cassette-type bearings have higher efficiency compared to typical cylindrical bearings. At the same time, the amount of test objects is insufficient to make reasoned conclusions about the benefits of the given design. Based on these data, it is recommended to conduct a trial operation of the pilot batch of cars in an amount not less than 100 units.

Keywords: axlebox unit, duplex cylindrical bearing, failure, reliability, accelerated test, service life.

References

1. Gajdamaka, A. V. (2014). Modeli kinematiki i dinamiki cilinm dricheskih rolikopodshipnikov zheleznodorozhnogo transporі ta .Nauka ta progres transportu. Visnik Dnipropetrovs'kogo nacional'nogo universitetu zaliznichnogo transportu, 3, 51.
2. Simson, H. A. (2010). Raschet napryazhenno-deformirovannogo sostoyaniya separatora podshipnika kacheniya . Vestn. NTU «HPI», 37, 142–145.
3. Averin, N. A., Rusanov, O. A., Ivanov, S. G. (2007). Issledovaniya nagruzhennosti poliamidnyh separatorov dlya buksovyh podr shipnikov metodom konechnyh ehlementov . Vestn. VNIIZHTa, 3, 24–29.
4. Mihajlichenko, P. E. (2005). Harakter ta velichina znosu deh talej presovogo z´ednannya buksovogo vuzla vagoniv. Vestnik of Dnepropetrovsk National University of Railway Transport academician Lazarian, 6, 92–101.
5. Sakaguchi, T. (2006). Dynamic Analysis of Cage Stress in Tapered Roller Bearings. Proc. ASIATRIB. Kanazawa, 649–650.
6. Harris, T. (2006). Rolling bearing analysis. New York, 760.
7. Sanchugov, V. I., Mescheryakov, S. S. (2007). Osnovnyie problemyi sozdaniya sredstv i metodov uskorennyih ekvivalentnyih ispyitaniy podshipnikov. Nauchnyiy zhurnal «Izvestiya samarskogo nauchnogo tsentra RAN», 9 (3), 831–839.
8. Gishvarov, A. S. (2007). Modelirovanie uskorennyih ispyitaniy tehnicheskih sistem na nadezhnost i resurs. Vestnik Ufimskogo Gosudarstvennogo aviatsionnogo tehnicheskogo universiteta, 9 (1), 26–40.
9. Kuzmich, L. (1971). Uskorennyie ispyitaniya vagonnyih konstruktsiy na ustalostnuyu prochnost. Trudyi VNIIV, 14, 31–33.
10. Zaharia, S. (2012). Reliability Tests. Transylvania University Press, Braşov.
11. Derkach, B. A .(1976). O metodah opredeleniya nadezhnosti detaley hodovih chastey pri proektirovanii. Trudyi VNIIV, 30, 41–43.
12. Artamonovskiy, V. P. (1978). Otsenka nadezhnosti modernizirovannyih ram tyazhelyih elektropoezdov pri otsutstvii otkazov v opyitnoy partii. Trudyi VNIIV, 34, 51–53.
13. Martinov, I. E. (2008). Do pitannya stvorennya modeli vidmov buksovih rolikopidshipnikiv. Ukraïns'ka derzhavna akademiya zaliznichnogo transportu. Zb. nauk. prac', 96, 154–158.

14. Martinov, I. E. (2005). Planuvannya viprobuvan visokonadIynih vuzlIv vagonIv. Transportni sistemi i tehnologiyi KUETT Kiyiv, 79–83.
15. Martinov, I. E. (2005). Viznachennya pokaznikIv nadIynostI buks za rezultatami viprobuvan. HarkIv: UkrDAZT, 56, 191–198.
16. Rips, Ya. A. (1967). Informatsionnyiy aspekt statisticheskoy otsenok nadezhnosti. Avtomatika i telemehanika, 7, 140–150.
17. Fano, R. (1965). Peredacha informatsii. Statisticheskaya teoriya svyazi Izd-vo «Mir», 231.

MODELING VIBRATIONS OF MANUAL GRINDING MACHINE ИП2014П (p. 13–19)

Dmitro Stalinskiy, Yurij Sizyi, Pavlo Romanchenko

Mathematical models of the manual grinding machine (MGM) ИП2014П were given and their analysis in idling and working stroke conditions was performed. An adequacy of the presented mathematical models with the real modeling object was achieved.

The results of the analysis of existing standard requirements to unbalanced masses of abrasive wheels based on the compliance with requirements to local vibrations, affecting the operator were provided. By modeling vibrations on the left handle of the MGM in the idling conditions, it was found that the wheel imbalance is equal to 0.004 мкр on its radius, i. e., at its maximum permissible value according to GOST 23182-78 does not guarantee fulfilling sanitary standards.

An assessment of the vibration safety of the MGM in idling and working stroke conditions with abrasive wheels made using traditional shaping technology was carried out. It was found that with the existing ІПП 150x25x32 wheel shaping technology, maximum error of the wheel shape and placing it on the spindle of the MGM lead to the vibration excitation on the left handle of the MGM in the idling conditions in the range of (33÷49) mm/s, and (26÷56) mm/s in the working stroke conditions, which is on average 1.6 times higher than sanitary standards.

Keywords: manual grinding machine, vibrations, vibration speed, abrasive wheel, imbalance, mathematical model, idling, working stroke.

References

1. Mikulinskij, A. M., Starikov, G. A., Shejman, L. S. (1976). Zashhita ot vibracij pri rabote s pnevmaticheskimi shlifoval'nymi mashinami. Moscow: Mashinostroenie, 84.
2. Stramcov, V. Ju., Gotlib, Ja. G. (1969). O vlijanii abrazivnyh krugov na vibraciju ruchnyh shlifoval'nyh mashin. Mehanizirovannyj instrument i otdelochnye mashiny. Moscow, Vol. 2.
3. Stalinskij, D. V., Sizyj, Ju. A., Jarovaja, L. G., Romanchenko, P. V. (2002). Vlijanie neuravnoveshennosti mass abrazivnyh krugov na vibracionnuju harakteristiku raboty ruchnyh shlifoval'nyh mashin. Ekologija ta virobnictvo, 3, 53–56.
4. Stalinskij, D. V., Jarovaja, L. G., Romanchenko, P. V. (2003). UkrGNTC «Jenergostal'», g. Har'kov, Ukraina Vlijanie tochnosti izgotovlenija i jekspluatacionnyh svojstv abrazivnogo instrumenta na uslovija raboty operatorov ruchnyh shlifoval'nyh mashin. Jekologija i zdorov'e cheloveka. Ohrana vodnogo i vozdushnogo bassejnov. Utilizacija othodov, 1, 89–97.
5. Stalinskij, D. V., Romanchenko, P. V., Sizyj, Ju. A. (2011). Vibracii ruchnoj shlifoval'noj mashiny pri rabochem i holostom hode. Vestnik NTU «KhPI», 40, 3–8.
6. Stalinskij, D. V., Sizyj, Ju. A., Romanchenko, P. V., Ljubimyj, Ju. N. (2014). Jeksperimental'nye issledovanija vibracionnoj harakteristiki ruchnyh shlifoval'nyh mashin. Fizicheskie i komp'juternye tehnologii. Kharkiv: GP HMZ «FED», 21–29.
7. Issledovanie javlenija obledenenija ruchnyh pnevmaticheskih instrumentov (1969). Mehanizirovannyj instrument i otdelochnye mashiny, 2, 24–43.
8. Vasil'ev, Ju. M., Borisov, A. G. (1968). O mehanicheskom impedanse sognutoj ruki cheloveka. Nauchnye raboty institutov ohrany truda VUSPS. Moscow: Profizdat, Vol. 52.
9. GOST 17770-86. Mashiny ruchnye. Trebovanija k vibracionnym harakteristikam. Vzamen GOST 17770-72, 10.
10. GOST 23182-78. (ST SJeV 559-77) Krugi shlifoval'nye dlja ruchnyh mashin. Tehnicheskie uslovija. Terminy i opredelenija – po GOST 21445-75, 6.
11. Stalinskij, D. V., Sizyj, Ju. A. (2000). Optimal'noe proektirovanie dinamicheskih sistem obdirochno-shlifoval'nyh stankov. Kharkiv: HGPU, 113.

METHOD OF STRENGTH CALCULATIONS AND DETERMINATION OF MAXIMUM EQUIVALENT STRESS IN CROWNBLOCK SHEAVES (p. 20–26)

Konstantin Dihtyarenko, Andrew Pupyshev, Vladimir Chervinskiy, Natali Tovstuha

In order to reduce the specific load in the branches of tackle system of drilling rig, it is necessary to increase the number of sheaves in the crown block and the tackle block, in the crown block there is always by one sheave more than in the tackle block. The drilling rig takes various loads, which are transmitted to the sheaves, where the load distribution occurs. The first sheave undergoes the greatest load, which is trying to "break down" the side wall of the sheave. This is caused by the fact that there is an angle between the sheave and winch, which is located away from the well center. This affects the metal production in the sheave groove. These features impact the enormous wear. Until the repair with the use of lining, repair was made through metal welding and boring for the nominal dimensions of the sheave groove. To solve this problem, in the drilling industry, it was decided to make such repairs as in the mining industry, where repair is performed with the use of lining. To determine the material for sheave lining, it was necessary to identify forces, stress and loads, arising in the tackle system at a given load. The results obtained indicate that the given sheaves are subjected to lining without geometric deformation and fracture of metal.

Keywords: tackle system, reeving, stress, string, groove, block, lining.

References

1. Dihtjarenko, K. V., Chervinskij, V. P., Pupyshev, A. I. (2012). On the question of increasing the lifetime kronblochnyh pulley rigs. Eastern-European Journal of Enterprise Technologies, 1/7(55), 20–22. Available at: http://journals.uran.ua/eejet/article/view/3409/3209
2. Stepanova, E. M. (2010). The effective use of modern liners for pulleys winders mines of Ukraine. Gljukaus, 2, 70–71.
3 Bagramov, R. A. (1988). Drilling machines and systems. Moscow: Nedra, 501.
4. Lee, H.-H. (2005). Motion planning for three-dimensional overhead cranes with high-speed load hoisting. International Journal of Control, 78 (12), 875–886. doi:10.1080/00207170500197571
5. Aleksandrov, M. P., Kolobov, L. N., Lobov, N. A. (1986). Lifting machines: a textbook for high schools in "Handling machinery and equipment". Moscow: Mechanical Engineering, 400.
6. Vajnson, A. A. (1989). Handling machinery. Moscow: Mechanical Engineering, 536.
7. Pisarenko, G. S., Jakovlev, A. P., Matveev, V. V. (1988). Handbook of resistance materialov. Kiev: Nauk. Dumka, 736.
8. Sorokin, V. G. (1989). Database of steels and alloys. Moscow: Mechanical Engineering, 640.
9. Il'skij, A. L., Kas'janov, V. M., Poroshin, V. G. (1967). Drilling machines, mechanisms and structures. Moscow, Nedra, 469.
10. Uniform safety standards for the development of the main types of oil and gas equipment (1982). RD 39-22-617-81, MNP.

ANALYSIS OF SOLUTIONS OF SPECIFIED DYNAMIC EQUATIONS OF BEAM BENDING ON THE EXAMPLE OF INVESTIGATION OF THE TRANSVERSE FORCES EVOLUTION (p. 27–31)

Larisa Yegarmina

The paper deals with investigating the disturbed region of the beam during a suddenly applied load on the border (the problem of suddenly applied bending moment). Structural dynamics is described by the new specified one-dimensional dynamic equations of the beam bending. These equations were derived based on a rigorous mathematical algorithm (so-called non-minimal simplification of three-dimensional dynamic equations of elasticity theory).

The resulting equations have allowed to explore the layer-thickness averaged three-dimensional picture of the disturbance propagation by constructing graphs of respective solutions for the

transverse forces. The results are in good agreement with the elasticity theory, in particular, the wave-front velocities coincide with the velocities according to elasticity theory problems. At the same time, all boundary conditions are defined in the same way as in the known problems of strength of materials.

Keywords: asymptotic-group, transverse force, bending wave, bending moment, non-stationary wave.

References

1. Timoshenko, S. P. (1967). Kolebaniya v inzhenernom. Nauka, 444.
2. Babakov, I. M. (1968). Teoriya kolebanij. Nauka, 559.
3. Vekua, I. N. (1937). K voprosu rasprostraneniya uprugih voln v beckonechnom sloe, ogranichenom dvumya paralelnimi ploskostyami. Tr. Tbilissk. Geofizich. In.-ta, 2, 23–50.
4. Kabulov, V. K. (1962). Integralnye uravnenija tipa balansa I ih primeneniye k dinamicheskomu rasschotu stergney I balok. AN UzbSSR, 185.
5. Shamrovskij, A. D. (1997). Asimptotiko-gruppovoj analiz differenk cialnyx uravnenij teorii uprugosti. ZGIA, 169.
6. Shamrovskij, O. D., Yegarmina, L. M. (2011). Rozpovsyudzhennya nestacionarnix pruzhnix xvil u tonkostinnix konstrukciyax. ZDIA, 132.
7. Shamrovskij, A. D., Yegarmina, L. N. (2009). Vyvod dinamicheskix uravnenij prodolnoj deformacii sterzhnya pri pomoshhi dvojnogo uproshheniya uravnenij teorii uprugosti. Novi materiali i texnologii v metalurgii ta mashinobuduvanni, 115–111 ,2.
8. Chernakov, P. V. (1951). Primemeniye integralov uravnenija teploт provodnosti k resheniyu zadach o kolebaniyah stergney i plastinok. Uchen. zal. Kuybyshevsk. gos. ped. i uchit. in.-ta, 11.
9. Skrypnik, I. A., Shamrovskij, A. D. (1995). Dvumernoe modelirovanie trexmernyx prodolnyx voln v ploskom sloe. Matematicheskoe modelirovanie fiziko-matematicheskix polej i intensifikaciya promyshlennogo proizvodstva, 43–50.
10. Shamrovskij, A. D., Yegarmina, L. N. (2011). Discrete models for plane static problems of theory of elasticity. Eastern-European Journal of Enterprise Technologies, 3/7 (51), 52–55. Available at: http://journals.uran.ua/eejet/article/view/1617/1514

RESEARCH OF THE DEFORMATION ZONE AT LENGTHWISE ROLLING FROM THE PERSPECTIVE OF THE RHEOLOGICAL CONCEPT (p. 31–35)

Nikolay Bereznoy, Viktoria Chubenko, Alla Hinotskaya, Sergey Matsishyn, Valera Chubenko

The analysis of complex stress-strain state of the metal during rolling was performed and many assumptions and contradictions that affect the accuracy of the theoretical calculations were identified. Such simplifications and contradictions in the modern rolling theory make the rheological concept problems urgent. To determine the metal flow when rolling - laminar or turbulent, it is necessary to define the Reynolds and Froude numbers for identifying the heat transfer type in the deformation zone using the Peclet and Prandtl numbers. This will help to choose a model for calculating stresses and strains.

The most characteristic rolling modes, which are used in both hot and cold processing were highlighted. The studies were conducted on slabbing, sheet rolling mill, cold rolling mill of the thin sheet. Draughting schedules and processing temperature were varied on this equipment. Theoretical analysis and experimental verification of the hypotheses adopted and the results obtained was used. The theoretical research was based on fundamentals of continuum mechanics, plasticity theory, methods of solving dynamic problems of elastic-plastic deformation. For determining the metal properties in the deformation zone, Reynolds, Froude, Peclet and Prandtl numbers were used.

The obtained values of the Reynolds and Froude numbers confirm the process modeling theory in the fact that at large values of these numbers, inertia plays a major role in the cold rolling processes, and at small – during hot rolling – viscosity and friction. Reynolds numbers show that the metal flow in the deformation zone is laminar, rather than turbulent. Peclet numbers have indicated the possibility of molecular thermal conductivity, but convective heat transfer prevails. Prandtl numbers prove that the viscous medium model should be used in the rolling process simulation since this value is greater than one. The research results allow to more accurately determine the internal stresses of the metal and energy transfer during rolling.

Studies of the deformation zone by the Froude and Reynolds numbers indicate that the metal flow in it is laminar, the values of the Reynolds and Froude numbers are the most affected by temperature and pressure through the value of viscosity or yield strength. Investigations have shown that the deformation zone should be considered as a continuous viscous medium that obeys the Newton's laws and formulas of viscosity. The research allows to perform more accurate calculations of stresses and strains that occur in the deformation zone during rolling and heating of the metal.

Keywords: deformation zone, rheological properties, metal flow, draughting schedules, stress.

References

1. Vasylev, Ya. D., Minaiev, O. A.(2009). Teoriia povzdovzhn'oi prokatky. Donets'k: TOV «Tekhnopark DonDTU «UNITEKh», 2009, 488.
2. Faraji, G., Jafarzadeh, H. (2012). Accumulative Torsion Back (ATB) Processing as a New Plastic Deformation Technique. Materials and Manufacturing Processes, 27 (5), 507–511. doi: 10.1080/10426914.2011.593235
3. Kodjaspirov, G. E., Rudskoy, A. I. (2009). Advanced Severe Plastic Deformation Techniques for Processing Bulk Nanostructured Metal Production. NANONECH' 2009, Italy, Rome, 125–128.
4. Kodjaspirov, G. E., Rudkoy, A. I., Rybin, V. V. (2010). Effect of thermomechanical processing on structure and corrosion-mechanical properties of AISI 321 steel. Advanced Materials Research, 89–91, 769–772. doi: 10.4028/www.scientific.net/amr.89-91.769
5. Berezhnyj, M. M., Chubenko, V. A., Khinots'ka, A. A. (2011). Enerhetychnyj balans ta reolohichni vlastyvosti oseredku deformatsii pry prokatuvanni shtaby hladkymy valkamy. Kryvyj Rih: Dionis, 120.
6. Shlomchak, G. G., Mamuzc, I., Voclopivec, F. (1994). Deformation Anomalies of Higher Order during the Plastic Extention of Rheologically Complex Materials / Kovine, Zlitine, technologije, letnik 28, Ljubljana, 4, 583–587.
7. Shlomchak, H. H. (2011). Razvytye predstavlenyj o vysokom ochahe deformatsyy. Metallurhycheskaia y hornorudnaia promyshlennost', 7, 38–42.
8. Tsaplyn, A. Y. (2008). Teplofyzyka v metallurhyy. Perm': Yzd-vo Perm. hos. tekh. un-ta, 230.
9. Berezhnyj, M. M., Khinots'ka, A. A., Chubenko, V. A. (2013). Reolohichni vlastyvosti potoku metalu v oseredku deformatsii pry pozdovzhn'omu prokatuvanni. Resursozberihaiuchi tekhnolohii vyrobnytstva ta obrobky tyskom materialiv u mashynobuduvanni, 1 (14), 62–68.
10. Berezhnyj, M. M., Khinots'ka, A. A., Chubenko, V. A. (2014). Nabuttia stalliu reolohichnykh vlastyvostej v oseredku deformatsii pry prokatuvanni. Kryvyj Rih: Dionis, 155.

ERROR ANALYSIS OF THE MEASURING TOOL OF THE MISSILE ELEMENT SPEED IN THE BARREL OF SMALL ARMS (p. 36–41)

Alexander Kriukov, Oleg Shabalin, Vadim Mudrik

Error analysis of the measuring tool of the missile element speed in the barrel of small arms was carried out in the paper. The main error sources include the following factors:

– deviation of the parameters of the optical scheme elements;

– imperfection of the algorithm, which was implemented in the computing component;

– presence of rotational motion of the missile element in the barrel.

The deviation of the laser radiation frequency and laser sensing angles from their nominal values significantly affect the error. A mathematical model of the measuring tool error, linking deviations of parameters from the nominal values and permissible relative error was developed.

The computing component error is mainly caused by the imperfection of the fast Fourier transform algorithm used. To estimate this component of the error, a method that allows to determine the difference between the value of the Doppler frequency shift, obtained by computing component data and its reference value was developed.

Error, due to the rotational motion of the missile element, is caused by the deviation of the sensing point of its surface from the

sensing plane. Based on the analysis of the spatial arrangement of the components of the velocity vector of the missile element point, a mathematical model of this component of the error was developed.

A generalized mathematical model of the measuring tool error, containing the result of combining the components taking into account possible correlations between them was proposed. Quantitative estimation of the maximum permissible error was performed.

Keywords: measuring tool, missile element, small arms, mathematical model, relative error.

References

1. Serebryakov, M. E. (1949). Vnutrennya balistica. Moscow: Oboronizdat GIOP, 469.
2. Golombovskiy, A. K. (1973). Teoria i raschet avtomaticheskogo orugiya. Penza: PVAEU, 492.
3. Kriukov, O. M., Mudrik, V. G. (2013). Perspektuvu eksperimentalnogo vuznachennya balistuchnuh elementiv postrilu. Akad. Of Int. Forses Ukraine, 1, 21–24
4. Kriukov, O. M., Dolya, G. N., Mudrik, V. G. (2014). Patent 88172 Ukraine, WPK G 01 S 17/02 (2006.01) Lazernuy dopplerivskuy vumiruvach shvudkosti ruhu metalnogo elementu v kanali stvola. Stated. 10.06.2013; Publish 11.03.2014, 8.
5. Kriukov, O. M., Dolya, G. N., Mudrik, V. G. (2013). Differenzialnaya lazernaya doplerovskaya anemometriya ob'ektov so svetovozvrashauschej poverhnostju. HNU of RE: science-techn. Joural. Kharkiv: Prikladnaya radioelectronica, 12 (3), 436–441.
6. Kriukov, O. M., Dolya, G. N., Mudrik, V. G., Nadj, O. A., Koval, O. A. (2014). Lazerniy doplerovskiy zasib vumiruvanya shvudkosti ruhu metalnogo elementa v kanali stvola: budova ta obroblennya vumiruvalnoi informacii. HNU of RE: scienc. Journal. Kharkiv: Metrologiya ta pruladu, 1 (45), 151–154.
7. Mihajlov, K. V. (1976). Eksperimentalnaya balistica. Priboru I metodu ballisticheskih izmerenij. Sophiya: VTS, 388.
8. Smith, J. N., Oak, R., Tenn (1954). Patent 2691761 USA, WPK G 01 S 13/58. Microwave measuring of projectile speed. № 6088; Stated. 03.02.1948; Publish. 12.10.1954, NKI 342/105; 73/167, 6.
9. Toulios, P. P., Hartman, K. (1984). Patent 4457206 USA, WPK G 01 S 13/58; F 42 C 17/04. Microwave – type projectile communication apparatus for guns. № 06/269,489; Stated. 02.06.1981; Publish. 03.07.1984, NKI 89/14.5, 37.
10. Reinhard, B., Bernhard, Z. (1993). Patent 0415906 DE, WPK G 01 S 13/58; G 01 P 3/66. Method and device for the determination of parameters of motion. № 19900809; Stated. 09.08.1990; Publish. 10.02.1993, NKI G 01 S 13/58 F; G 01 P 3/66 B, 8.
11. Kriukov, O. M., Alexandrov, O. O. (2009). Problemu vumiruvalnogo kontroliu parametriv vnutrishnjobalistuchnuh procesiv. Chestj i zakon, 2, 79–89
12. Vugodskiy, M. Ya. (2006). Spravochnik po vushej matematike. Moscow: AST: Astrel, 991.
13. Vusokotochnuj shirokodiapazonnuj izmeritel dlinu volnu. Available at: http://solarlaser.com/ru/products/high-resolution-wavelength-meters/high-resolution-wide-range-wavelength-meter-model-shr-/
14. Goniometr-spektrometr. Available at: http://www.rostest.ru/Goniometer%20spectrometer%20GS-2.php

ACENTRIFUGAL VIBRATION STRENGTHENING METHOD DEVISED TO IMPROVE TECHNOLOGICAL RELIABILITY OF MACHINE PARTS (p. 41–51)

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Considering reliability as a primary criterion in engineering machines and mechanical parts, we have analyzed why cylinder sleeves of drilling pumps fail in operation. Finishing and strengthening procedures in the technological process have proved to have essential influence on reliability indices. We have found that vibration technologies used in finishing and strengthening manufactured products can improve the operational qualities of machine parts. We have devised a method of centrifugal vibration strengthening to enhance reliability of the sleeves. The vibration machine for surround processing is adapted for centrifugal vibration strengthening of the shell. We have suggested a schematic diagram of equipment for centrifugal vibration strengthening as well as described the structure and operation principles of the equipment. The suggested industrial equipment is meant for centrifugal vibration strengthening of cylinder sleeves of drilling pumps.

We have studied and analyzed profile charts of surfaces strengthened by vibration. The analysis of the research findings has revealed that the height and stepping parameters of the processed surface (Ra, Rz, Rp, Rmax, and S) have decreased 1.5–5.8 times, which proves that vibration strengthening has cut or deformed the protrusion tips on the surface relief. The act on the results of our field tests shows that after the centrifugal vibration strengthening of the cylinder sleeves of drilling pumps the average MTBF Tahas increased 1.79 times in comparison with original ground and heat treated sleeves. Besides, the economic effect is achieved through using steel of type 20 instead of type 70.

We have specified research perspectives on optimizing the processing modes and developing practical recommendations on using centrifugal vibration strengtheners with a debalance drive aimed at improving the operational characteristics of sleeves as machine parts.

Keywords: technology, reliability, infallibility, cylinder sleeve/liner, surface layer, centrifugal vibration strengthening.

References

1. Ostrejkovskyj, V. A. (2003). Theory of reliability: textbook for institutions. Moscow, 463.
2. Pronikov, A. S. (1978). Machines reliability. Moscow, 592.
3. Aftanaziv, I. S. (1998). Reliability technological providing of machines details. Mechanical engineering technology. Lviv, 132.
4. Trukhanov, V. M. (2003). The technical systems reliability of movable options type on the stage of planning and test of pre-production models. Moscow, 320.
5. Reshetov, D. N. Ivanov, A. S., Fadeev, V. Z. (1983). Machines reliability. Moscow, 237.
6. Polovko, A. M., Gurov, S. V. (2006). Reliability theory bases. Saint Petersburg, 704.
7. Alexsandrovskaja, L. N., Afanasjev, A. P., Lisov, A. A. (2001). The modern methods of faultlessness providing of the difficult technical systems. Moscow, 208.
8. Suslov, A. G. (2000). The superficial layer's quality of machines detail. Moscow, 320.
9. Schneider, Y. G. (1982). Operating properties of details with regular microrelief. Leningrad, 248.
10. Ushakov, I. A. (1985). Reliability of the technical systems. Moscow, 606.
11. Jashcheritcyn, P. I., Minakov, A. P. (1986). The non-rigid details strengthening's treatment in the engineer. Minsk, 215.
12. Shyrokov, V. V., Kusyj, Y. M., Aftanaziv, I. S., Borovatc V. M., Kuk A. M. (2010). Development of the technological rigging for the improvement of operating descriptions of details of oil-gas equipment. Efficiency of realization scientific, resource and industrial potential of in modern terms. X – Industrial conference with international participation, Slavske, Carpathians, 243–246.
13. Kusyj, Y. M. (2002). Technological security of physics-mechanical parameters of metal long-sized cylindrical detail's surface layers by means of vibrational – centrifugal strengthening. Technology of machine building. Lviv, 260.
14. Bykov, I. Y., Tchadaja, N. D. (2004). Operating reliability and capacity of boring machines. Ukhta, 196.
15. Jashcheritcyn, P. I., Ryzhov, E. V, Averchenko V. I. (1977). Technological heredity in the engineer. Minsk, 256.
16. Kusyj, Y. M., Topilnytskyj, V. G. (2013). The quality surface's research of the vibrofortified machines details. Announcer of National univarsity "Lvivska політехніка" "Optimization of productive processes and technical control in an engineer and instrument-making", 772, 196–201.
17. Aftanaziv, I., Kusyj, J., Kuritnyk, I. P. (2000) Using vibrations for strengthening of long-sized cylindrical details. Acta Mechanica Slovaca, Košice, 3, 43–46.
18. Kusyj, J., Topilnitskiyy, V. (2009). Calculations of vibratory-centrifugal strengthening treatment's dynamics by means of application software. Book of abstracts XVII Polish-Ukrainian Conference on "CAD in Machinery Design – Implememtation and Educational Problems", 25–26.
19. Stotsko, Z., Kusyj, J., Topilnytskyj, V. (2012). Research of vibratory-centrifugal strain hardening on surface quality of cylindric long-sized machine parts. Journal of Manufacturing and Industrial Engineering, 11 (1), 15–17.

20. Shyrokov, V. V., Arendar, L. A., Kovalchyk, Y. I., Vasyliv, H. B., Vasyliv, O. M. (2005). The friction surfaces profilogram computer's treatment. Physical and chemical mechanics of materials, 1, 93–96.

NEED TO CONSIDER DAMAGING ASEISMIC GEODEFORMATIONS WHEN DEVELOPING CONSTRUCTION TECHNOLOGIES (p. 52–57)

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As a result of the research, an attempt to justify the need to consider the risk of destruction of engineering structures by aseismic geodeformations depending on the type of building was made. An increase in the amplitude of the daily amplitudes of earth tidal deformations in the dates when syzygy coincides with zero declination of the Moon and the perihelion of the Moon was chosen as a criterion for selecting the activation period of global-scale geodeformations. The selected criterion corresponds to more than two-fold increase in the amplitude of geodeformations on these dates. As a result, anomalous dynamic and kinematic characteristics of the global geodeformation process in April-May 2013, accompanied by a strong earthquake in the Sea of Okhotsk 05/25/2013 were investigated.

Using heterogeneous time series of improbable "resonance" emergencies, composed for the time period of April-May 2013 and including the cases of gas burst, sinkhole collapse, collapse of buildings, underground mines, ditches, rupture of oil and gas pipelines, emergencies, related to bridges and railway accidents, as well as statistical methods, it was shown that the global geodeformation process is statistically associated with different types of emergencies. It was shown that the time series of emergencies does not obey a normal distribution of random variables since it has a statistically significant periodic component. It was found that the frequency features of emergencies in the period under review are consistent with similar frequency features of dynamic factor of geodeformations. In a first approximation, it can be noted that emergencies, associated with sinkhole collapses and lithospheric gas bursts occur most frequently in the geodynamic activity period, deformation processes appear less often directly under the buildings and pipelines. Geodeformations for bridges and railways are the least dangerous.

Keywords: seismic hazard, Earth surface deformation, destruction of engineering structures, geodeformation monitoring.

References

1. Uchytel, I., Kapochkin, B. (2014). Changing the paradigm of modern geodynamics and seismotectonics. LAP LAMBERT Academic Publishing, 80.
2. Voytenko, S. P., Kapochkin, B. B., Uchitel, I. L., Yaroshenko, V. N. (2007). Geodynamics fundamentals of kinematic geodesy, Odessa: Astroprint Publisher, 264. [in Russian]
3. Uchitel, I. L., Dorofeev, V. S., Yaroshenko, V. N., Kapochkin, V. V. (2008). Geodynamics. Fundamentals of dynamic geodesy. Odessa: Astroprint Publisher, 311. [in Russian].
4. Uchytel, I. L., Yaroshenko, V. N., Kapochkin, B. B. (2011). Scientific priority of discovery of a natural phenomenon aseismic geodeformation and risks of this phenomenon on the territory of Ukraine. Control Systems Environmental. MHI NASU. Sevastopol, 82–84.
5. Sashurin, A. D., Kashkarov, A. A., Kopyrin, V. V. (1998). Geophysical studies of the crust in the evaluation section of the pipeline accidents Krasnoturyinsk. Mining Geophysics. International Conference. St. Petersburg, Russia. SPb .: VNIMI,. 329–333.
6. Panzhin, A. A. (1999). GPS-technology in the geodetic monitoring VAT technogenic area. Geomechanics in the mining industry: Proceedings of the / IGD UB RAS. Ekaterinburg, 68–85.
7. Panzhin, A. A., Golubko, B. P. (2000). Application of satellite systems in the mining industry. Proceedings of the Ural State Mining and Geological Academy. Ser. Mining, 11, 183–195.
8. Obara, K. (2002). Nonvolcanic Deep Tremor Associated with Subduction in Southwest Japan. Science, 296 (5573), 1679–1681. doi: 10.1126/science.1070378
9. Kawasaki, I., Asai, Y., Tamura, Y., Sagiya, T., Mikami, N., Okada, Y., Sakata, M., Kasahara, M. (1995). The 1992 Sanriku-Oki, Japan, Ultra-Slow Earthquake. Journal of Physics of the Earth, 43 (2), 105–116. doi:10.4294/jpe1952.43.105
10. Kaninth, K., Muler H., Seemuller V. (2002). Displasement of the space geodetic observatory Areqipa due to resent earthquakes. Z. Geod. Geoinf. Und landmag, 27 (4), 238–243.
11. Barkin, Yu., Shuanggen, J. (2006). Kinematics and dynamics of the Earth hemispheres. Geophysical Research Abstracts, 8, 01680.
12. Barkin, Yu., Ferrandiz, J., Garcia, M. (2006). Sources of the Earth elastic energy and its seismicity. Geophysical Research Abstracts, 8, 01685.
13. Barkin, Yu. (2006). Core polar motions and variations of the Earth figure. Geophysical Research Abstracts, 8, 02297.
14. Barkin, Yu. (2006). Core polar motion and inversion gravity variations of the Earth. Geophysical Research Abstracts, 8, 04688.
15. Haritonova, D. (2012). Solid Earth Tides in the Territory of Latvia. Geomatics, 8, 20–24.
16. Haritonova, D., Balodis, J., Janpaule, I., Normand, M. (2013). Displacements at the GNSS stations, 4th International Conference Civil engineering. Proceedings Part I Land management and geodesy, 305–309
17. Jaworski, A., Tahar, A., Reiter, P. M., Ribitsky, I. V., Vaschishak, S. P. (2012). The forecasting system geodynamic danger zone of long engineering facilities, Scientific news, Sofia, 1 (133), 281–285.
18. BREAKING: The Floor at City Hall. Available at: http://www.boston.com/news/local/massachusetts/2014/04/30/floor-boston-city-hall-buckles/dxeoNad5weJggzlGKCo5iO/story.html
19. Earthquake in the Sea of Okhots. Available at: https://ru.wikipedia.org/wiki/Землетрясение_в_Охотском_море_%282013%29
20. Earth orientation centre. Available at: http://hpiers.obspm.fr/eop-pc/
21. Kolesnik, A. V., Kapochkina, M. B., Kapochkin, B. B. (2013). Changing weather conditions during earthquakes. Hydrology, hydrochemistry and hydroekology, 4, 107–112.
22. 2013-05-24 Mw 8.3 SEA OF OKHOTSK. Available at: http://www.emsc-csem.org/Earthquake/Testimonies/comments.php?id=318696
23. Building in the center of Samara cracked because of the earthquake in the Far Eas. Available at: http://ria.ru/eco/20130524/939238354.html
24. Earthquake in Mosco. Available at: http://ru-lenta.com/proisshestviya/zemletryasenie-v-moskve-24-maya-2013-0000119658.html#__24_2013-2
25. 8 points in the Okhotsk Sea turned into a score of 1 in Moscow. Available at: http://www.vesti.ru/doc.html?id=1087670
26. Okhotsk earthquake was super-fast, proven geologists. Available at: http://www.infox.ru/science/planet/2014/07/11/Ohotskoye_zyemlyetry.phtml
27. In Odessa collapsed house. Available at: http://kp.ua/incidents/395303-v-odesse-obvalylsia-zhyloi-dom