Proposals for cooperation of “Lifting-and-transport machines and equipments” department of NTU “KhPI”

“Lifting-and-transport machines and equipments” department of NTU “KhPI”

Head of Department – Prof. Dr.-Ing. habil Dr. h. c. **Grigorov Otto Volodumurovuch**
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Specialties for bachelor's and master's degrees:

1. **Lifting-and-transport, construction, road-making, land reclamation machines and equipments**
2. **Engineering logistics systems**

Research activities of department

- Modernization of cranes and automation of their work using microprocessor control.
- Dynamics cranes.
- Crane drive (electromechanical, hydrostatic, hydrodynamic, with frequency regulation). Experimental analysis of load, such as drive, Progonny structure (bridge).
- Logistics.
- Microprocessor optimal control of a crane or a group of cranes.
- Energy savings in handling machines by applying a volume controlled drive and frequency drive.
- Expert inspection of cranes.

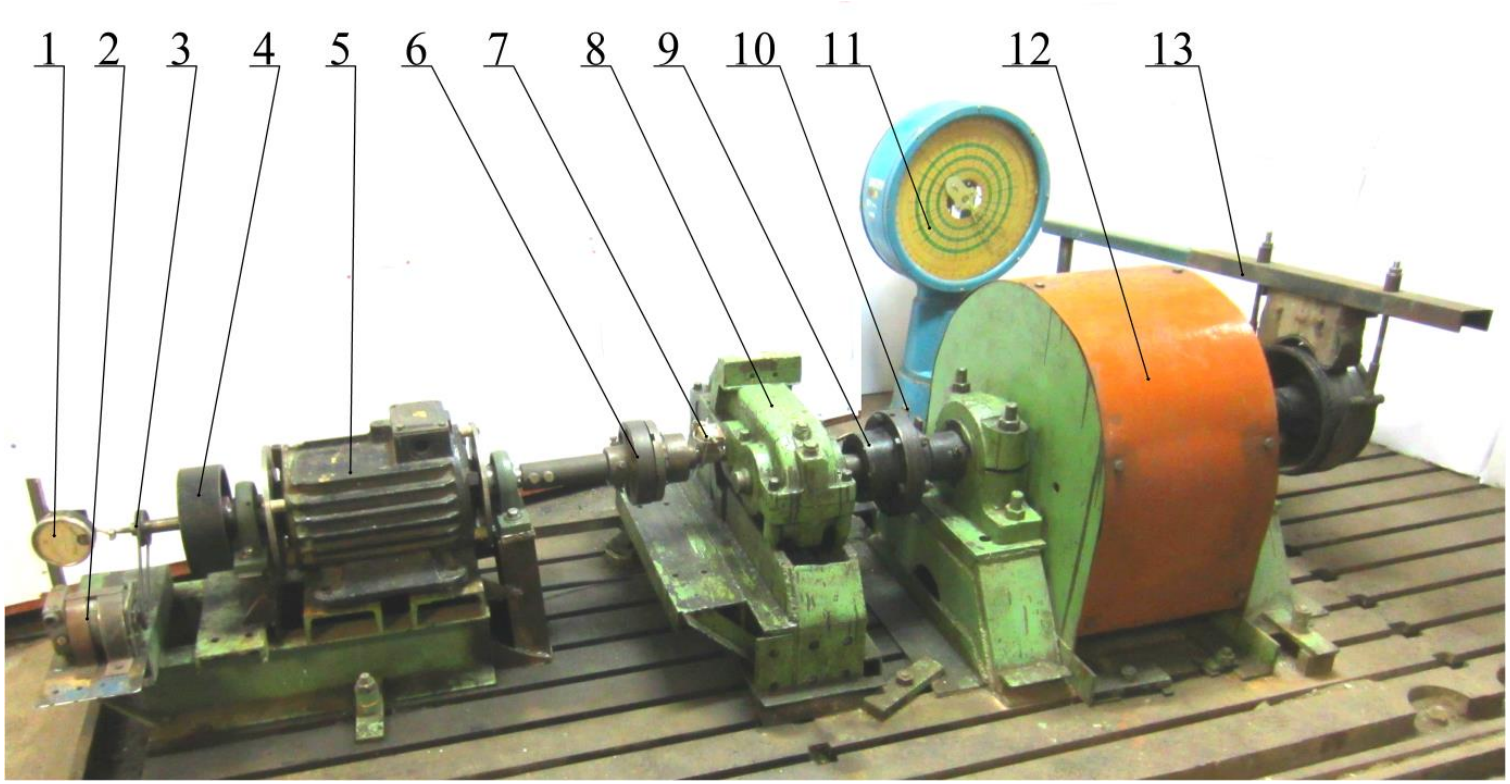
Scientific research funded by the state Ukraine:

1. Reducing energy consumption and reduce dynamic loads handling facilities using hydraulic, pneumatic and frequency controlled drives (2017-2018)
2. Creation of scientific bases and advanced energy-saving structures and process of lifting and transportation systems and machine-tractor units (2012-2013)
3. Development of methods for energy efficiency and resource handling facilities, machine-tractor units and hybrid vehicles (2013-2014)

Research activities

Research activity is devoted to questions of decrease of dynamic loadings, economy of energy, systems of automatic control and data collection. The technique of an assessment of increase in service life of elements of cranes at reduction of dynamic loadings was elaborated.

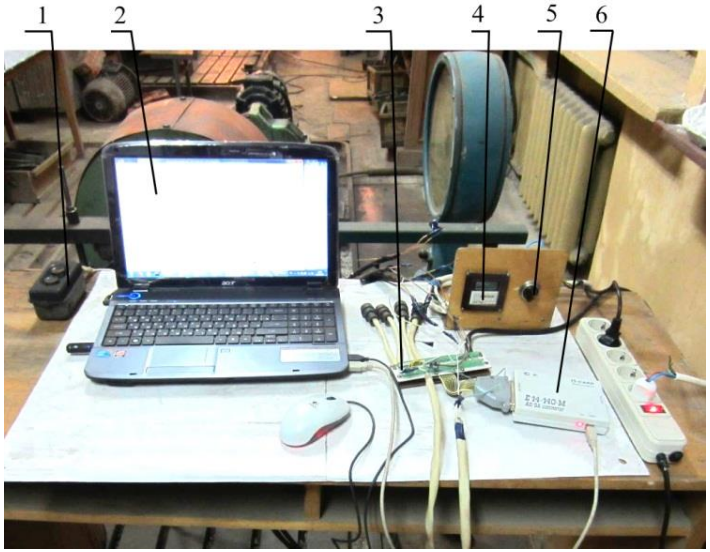
The test bench of laboratory “Lifting and shifting machinery and equipment” department is shown below with which experiments were made.



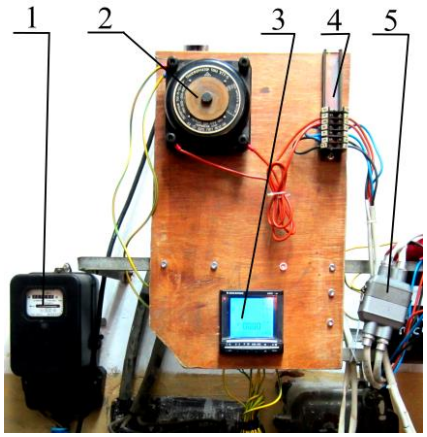
Test bench of trolley movement mechanism of bridge crane with a variable frequency drive

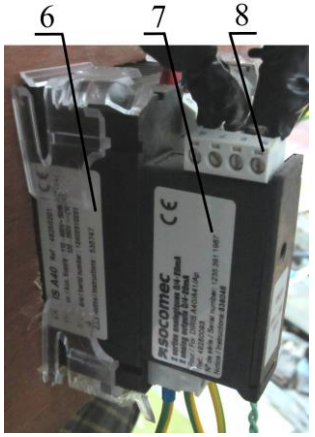
Dynamic performance and power consumption modes were investigated at this test bench when using the trolley movement mechanism of the bridge crane with a variable frequency drive at all stages of the operating cycle.

Measurement and recording equipment of test bench of trolley movement mechanism of bridge crane

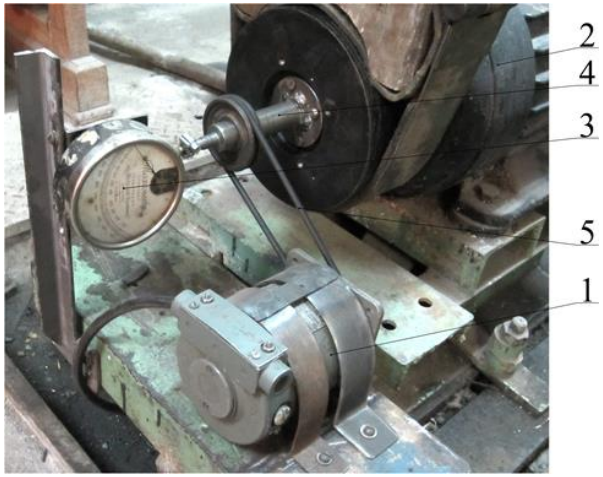


Recording equipment in the control unit of test bench





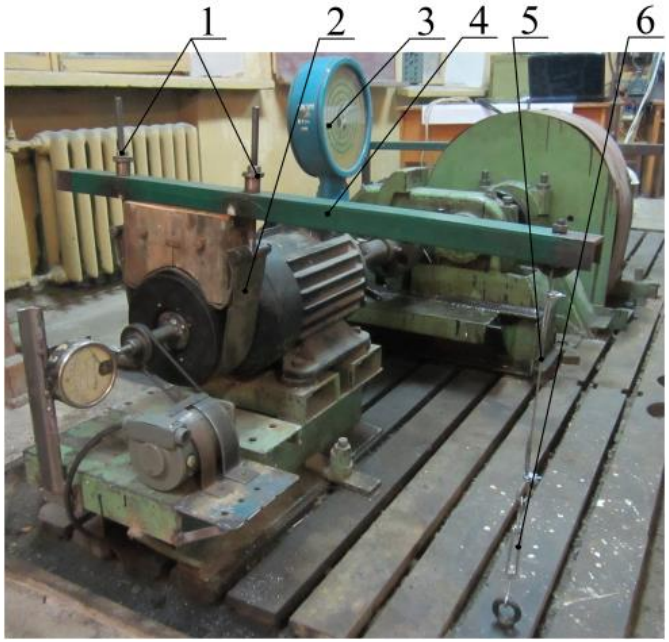
Devices for power measurement



Location of tachometer generator

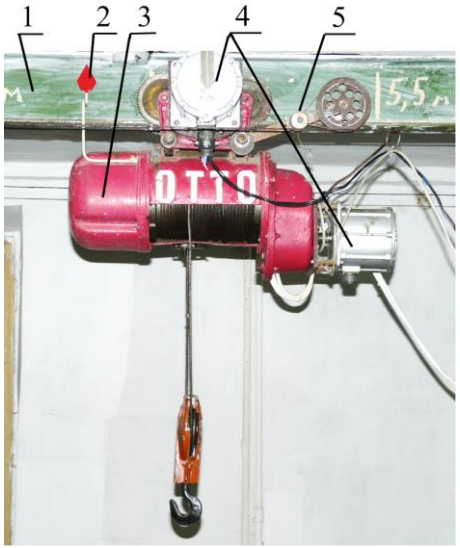
Torque sensors, power supply and amplification unit on running shaft.

Subsequently power supply and amplification unit with wireless data transmission from running shaft were developed.

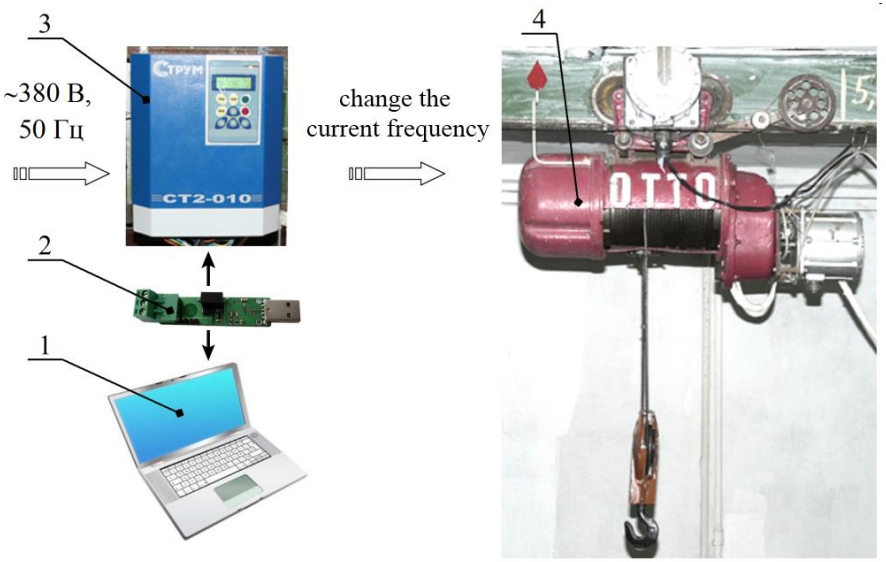


Calibration of torque sensors

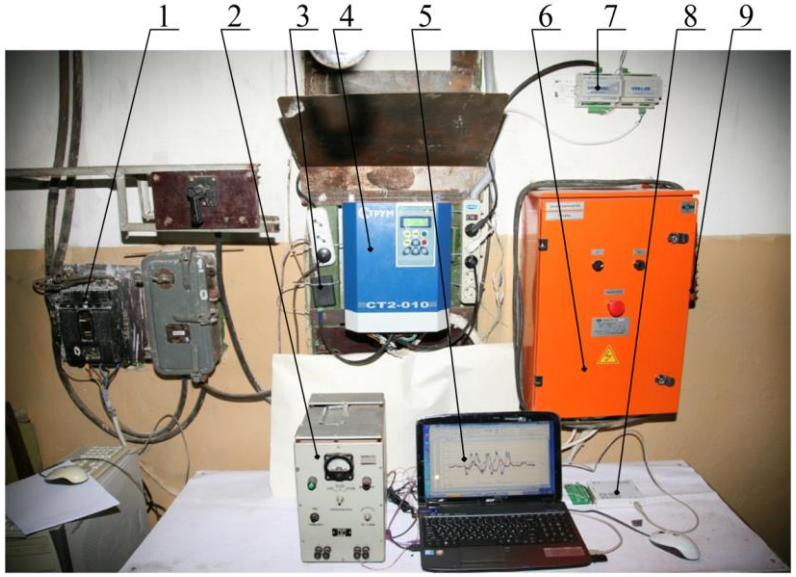
Computer control system and software, allowing to realize the optimum laws of motion of the crane trolley



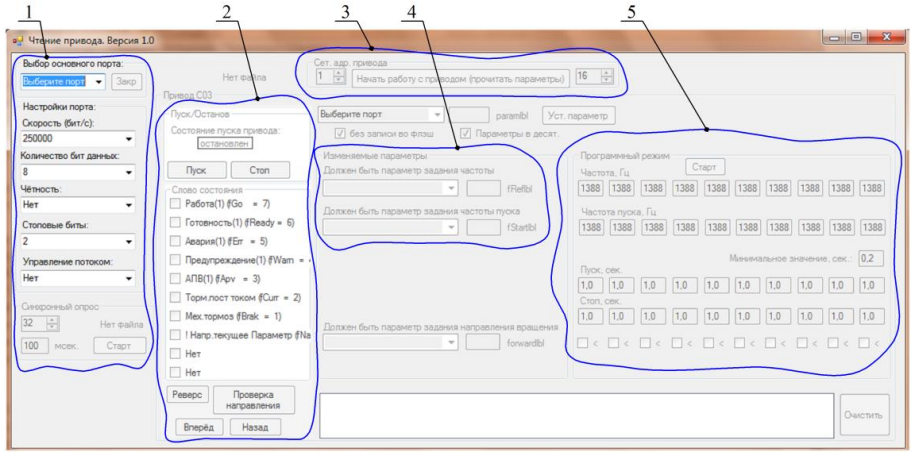
Crane trolley model



The structure of the microprocessor control system



Recording equipment in the control unit of crane trolley model



The program window for control the frequency converter

Publications

#	title	language	link	where published	co-author
1	Realization of Energy-Saving Control Modes on Cranes of Great load-Carrying Capacity	Eng	http://www.upet.ro/annals/mechanical/pdf/2010/Annals-Mechanical-Engineering-2010-a13.pdf	Annals of the University of Petrosani. – "Mechanical Engeneering" vol. 12(XXXIX), 2010. p. 111-118	Grygorov O.V. Zaytsev Y.I., Svirgun V.P.
2	Analysis of starting-braking processes in crane mechanisms with variable-frequency drives	Ukr	http://jml2012.indexcopernicus.com/abstract.php?icid=1031399&id_lang=3	Bulletin of Kharkiv National Automobile and Highway University № 57. - 2012 p. – p. 249 - 256	Grygorov O.V.
3	Remaining life definition of crane metal construction on value of coercive forces	Eng	http://www.upet.ro/annals/mechanical/pdf/2012/Anale%202012%20-%20Grigorov%20O.pdf	Annals of the university of petrosani, Mechanical engineering, 2012 Vol. 14 (XLI), Editura Universitas Petrosani, Romania	Grygorov O.V., Gubskiy S.O., Okun A.O.
4	Evaluation improved durability metals crane in applying frequency drive	Ukr		Scientific and technical and industrial magazine "Engineering", Lviv («Машинознавство»), 2013 р. – № 9-10 (195-196). – С. 20-24.	Grygorov O.V.,
5	Energy efficiency improvement of cranes by the use of variable frequency drive	Ukr	https://www.google.com/url?q=http://irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe%3FC21COM%3D2%26I21DBN%3DUJRN%26P21DBN%3DUJRN%26IMAGE_FILE_DOWNLOAD%3D1%26Image_file_name%3DPDF/Znpudazt_2014_148(1)__6.pdf&sa=U&ved=0ahUKEwicvtXwiorLAhVlSZoKHeCVCaEQFggIMAI&client=internal-uds-cse&usg=AFQjCNH0v3uH1SbLT8wt5czkOFAyWisqtA	Proceedings of the Ukrainian State Academy of Railway Transport 2014, вип. 148, ч. 1	Grygorov O.V., Ziubanova D.M.

Publications

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6	Remote control of hydrostatic drive mechanisms for hoisting machinery and logistics centers	Eng	http://icmas.eu/Volume10_Issue3_2015.htm#111-116	University POLITEHNICA of Bucharest “Proceedings in Manufacturing Systems”, volume 10, issue 3, 2015. P. 111-116.	Grygorov O.V., Ziubanova D.M.
7	Crane running wheels with elastic ring inserts	Ukr	http://base.uipv.org/searchINV/search.php?action=viewdetails&IdClaim=195583&chapter=abstractEN	Patent. 104240 UA Ukraine, (2013.01) B 60 B 9/00. № a201212255;	Grygorov O.V., Stepochkina O.V., Okun A.O., Gubskiy S.O., Chernyshenko O.V.
8	An inertial device for determining kinematic parameters of a bridge crane	Ukr	http://base.uipv.org/searchINV/search.php?action=viewdetails&IdClaim=183129&chapter=abstractEN	Patent. 77321 U, МПК (2006.01) B 66 C13/46. № u201208916;	Grygorov O.V., Okun A.O., Zaytsev Y.I., Tsebrenko M.V.
9	Cable crane	Ukr	http://base.uipv.org/searchINV/search.php?action=viewdetails&IdClaim=200641&chapter=abstractEN	Patent. UA105564C2 Ukraine, (2014.01) B 66 C21/00. № a201211379;	Grygorov O.V., Okun A.O., Gubskiy S.O., Los E.O.

PROPSALS FOR THE COOPERATION

Decrease in Energy Consumption and Dynamic Stresses in Crane Elements through Modern Drives Application

Problem setting. Owing to application of modern computer systems and component stock with applying generator deceleration of modern drives it is possible to improve technical and operating characteristics of lift-and-carry machines, in particular to prolong the service life of lift-and-carry machines and logistic complexes by 20 to 70 per cent, and to decrease energy consumption by 30 to 40 per cent. This calls for development of a new scientific approach to determining optimum resource-saving constructions and methods of power efficiency improvement.

Aims and tasks. A scientific designing is a complex phenomenon. On the basis of new approaches' development and improvement of mathematic models and methods of analysis of machine elements' deflected mode there will be determined rationally grounded production and engineering parameters of their metal constructions and their drives' modes of operation. A scientific project supposes experimental verifying of the accepted models' adequacy, creating modern design decision and control systems ready for commercial use.

Economic attractiveness of the solutions proposed will be evaluated through scientifically substantiated methods.

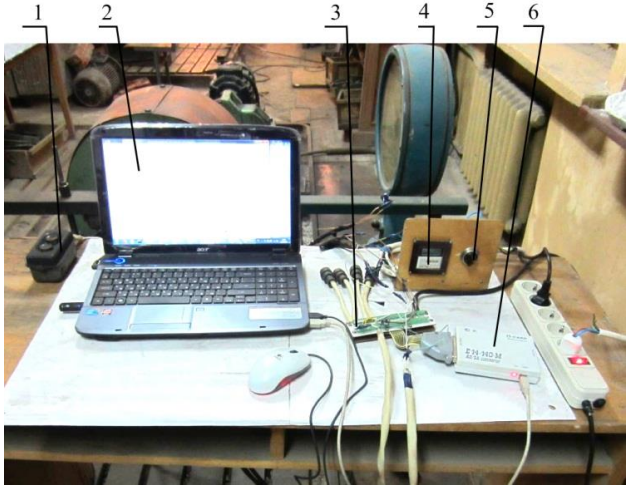
Methodology. Wider application of energy- and resource-saving technologies, as well as taking into consideration ecology data and control of their correspondence to current demands will enable obtaining ecologically safe effective lift-and-carry machines with potentially achievable energy and engineering-and-economical performance.

When solving the problem of control of machines' movement, in particular that of cranes with volumetrically regulated hydraulic drive, there will be redeveloped the idea of recuperative deceleration with electric energy return into the network. In this case the possible energy saving is several dozens per cent compared to an electric-mechanical drive.

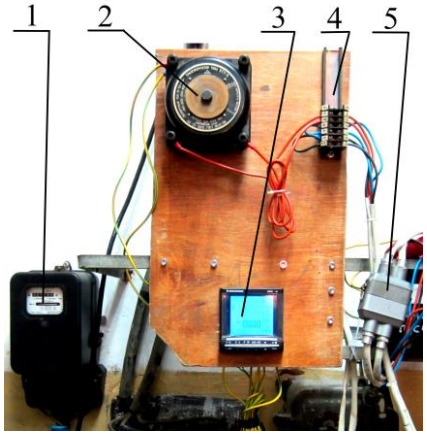
Considerable increase in operation efficiency level by the criterion of cost per unit decrease will be ensured due to development of mathematic models set of operation processes for machines' engineering-and-economical performance based on the aggregated interconnection of the main parameters of machines' technological process.

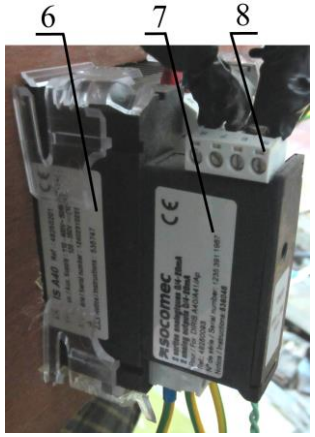
Measurement and recording equipment of test bench of trolley movement mechanism of bridge crane

Recording equipment in the control unit of test bench

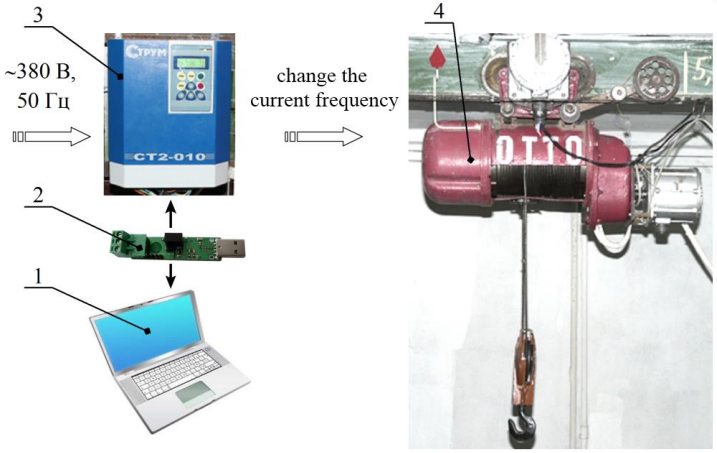


Devices for power measurement

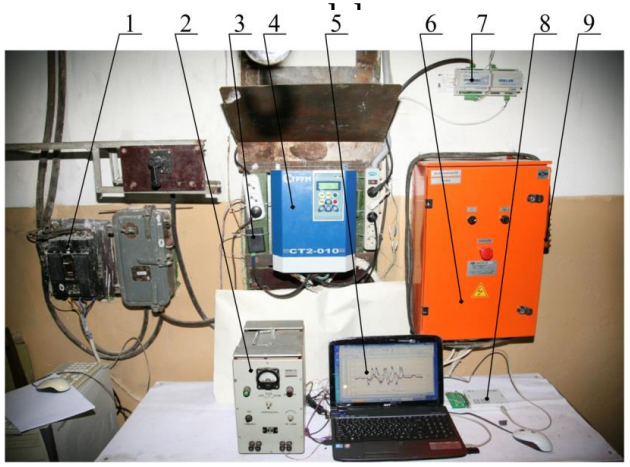




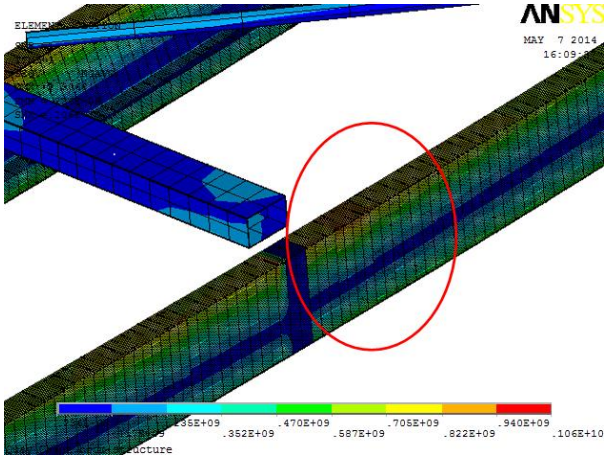
The structure of the microprocessor control system



Recording equipment in the control unit of crane trolley



Determination of the residual resource of cranes steel structures

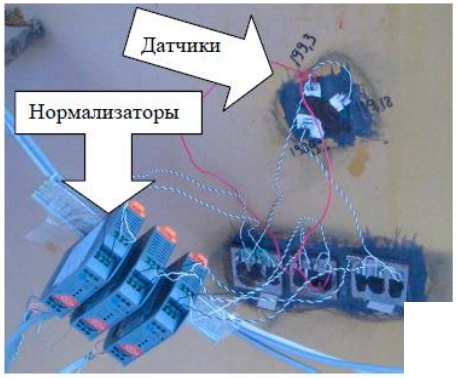


At present there is an urgent scientific and technical problem of determining deflected mode in metalwork constructions (for instance cranes, pipelines, vessels) that are past their service life and (or) need restoration.

Magnet-coercive testing of a crane's metalwork and crane wheel

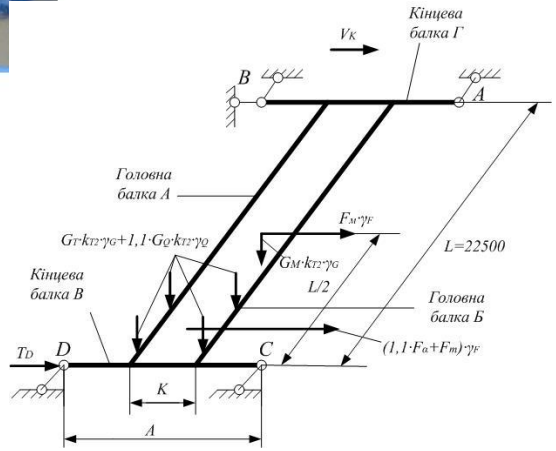
Application of magnet non-intrusive testing on the basis of coercive force will enable determining the real state of metal in the inspected cranes, crane wheels and shafts, pipelines, and vessels. The research conducted by us have made it possible to perform groundwork which takes into account the influence of temperature, tolerances in chemical composition, microstructure, metal thickness to readings of coercive force. Periodic performing of magnetic-coercive testing (monitoring) enables to forecast residual life of the controlled metalwork.

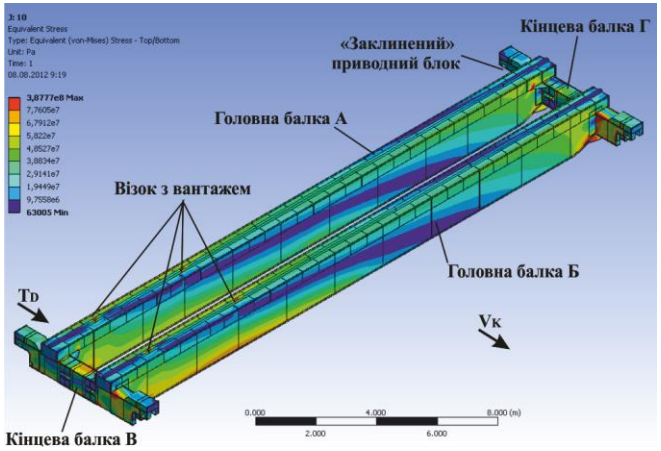
Tensiometric testing of crane construc-tion



Also, to monitor deflected mode in metalwork we propose to use tensiometric method of non-intrusive control. For this testing method equipment with at least 32 channels is to be used. The transmission of measurements results from tensiometric sensors is wireless. This enables obtaining measurements results (monitoring the state of metalwork) in any part of the world.

Crane's metalwork loading scheme and its calculation by terminal elements method





The use of results of magnet-coercive non-intrusive tensiometric control enables determining real state of deflected mode in metalwork of the inspected object. Which, in its turn, enables taking into account the real state of metal of the researched construction when conducting calculations of strength, resistance, durability, deflection mode, and even life span,. Calculations are conducted with the use of boundary states combined with the method of terminal elements. Thus, the developed complex approach will enable to determine objectively the real state of the tested metalwork (for instance of a crane, pipelines, or vessels) and forecast their service life.