Research and calculation of load-lifting cranes (easels)

Bayan Tokushevna Sazambayeva[1], Murat Chusainovich Sarguzhin[1], Ainash Sergazovna Beisenova[2], Marat Kenjalievich Shurenov[2]

[1]The Kazakh National and Technical University of K. Satpayev , Satpayev str., 22, Almaty, 050013, Kazakhstan
[2]Kazakh Engineering, Finance and Banking Academy, Zhibek zholy str., 184/15-17, Almaty, 050000, Kazakhstan

Abstract. Currently, the design and calculation of overhead cranes, there are different approaches to selecting prospective design, the definition of loads, calculating the stress state of metal crane. Include data collection and analysis of information on cranes, on their basis the morphological classification allows to determine the prospects for the development of bridge cranes. Developed software automated design system of overhead cranes, including interactive analysis complex design decisions metal elements, the basic mechanisms and assemblies cranes. The calculation of the beam with the definition of bending moments and reactions in supports for their more effective application designed loading, when moving truck with a load equivalent stress map obtained structural model, which allows to determine the most loaded parts of the frame.
[Sazambayeva B.T., Sarguzhin M.C., Beisenova A.S., Shurenov M.K. **Research and calculation of load-lifting cranes (easels).** *Life Sci J* 2014;11(10s):483-486] (ISSN:1097-8135). http://www.lifesciencesite.com. 92

Keywords. Performance gantry cranes, coefficient of the gantry crane, gantry crane exploitation.

Introduction

In the modern conditions of line and automated production value of lift-and-carry machines is great. They were beyond the original assignment – ancillary equipment for mechanization of labor-intensive processes of production – and are links in the technological circuit, providing production continuity, the main regulator of the line production, defining a rhythm and productivity of the capital equipment of the enterprise. Lift-and-carry devices are a basis of complex mechanization and automation of productions. Highly productive operation of all enterprise depends on a right choice of the most rational machines [1].

Construction of lift-and-carry machines is continuously enhanced, in communication with what there are new tasks by calculation, design, research and a choice of optimum parameters of the machines providing high technical and economic rates and quality of machines.

One of varieties lifting – transport machines is easels of bridge type. Bridge easels depending on assignment and nature of performed operation supply with different load gripping adaptations: hooks, grabs, special captures, etc. The bridge easel is very convenient for use as thanks to relocation on the crane ways located in the upper part of shop, it doesn't occupy the useful space [2].

The modern design approach of bridge easels is considered within an implementation tendency in industrial production of the projections assuming creation of a common information space throughout all life cycle of a product. For successful implementation of projection and new technologies in production are widely used integrated into a CAD (CAD/CAM/CAE) the projections intended for design of products of mechanical engineering of any complexity. However, full composition of the components necessary for the solution of all tasks of design automation of easels, any of existing systems doesn't possess. Some of these systems have specialized modules for design of bridge easels. However for bridge easels similar development are absent. This circumstance also causes reviewing in this article of the problems connected to projection and design automation of bridge easels [3].

Main part.

For achievement of a goal the following interconnected tasks shall be solved:

1. To carry out the analysis of information known now on constructing and design of load-lifting easels, to adapt them in relation to the task of design of bridge easels of general purpose.
2. To carry out projection of parameters and constructions of the load-lifting machines, including a complex of mathematical models of the expected analysis of parameters and constructive solutions of main engines and nodes of easels.
3. To develop morphological classification of the load-lifting machines, including databases from perspective constructions of details and nodes.
4. To develop the software of automated system of design of the bridge easels, including an interactive complex of the analysis of designer solutions of elements of a metal construction, main engines and nodes of easels.

5. To create the general method of calculation of load-lifting machines of bridge type of general purpose on the basis of which to create basis of constructive solutions of the easels, oriented on switching on in the integrated CAD of bridge easels, to create the mathematical model setting correlation between parameters, to set the criteria defining them optimum indexes and to execute approbation of functioning of bridge easels applicable for specific technological productions with obtaining necessary designer documentation.

In the field of lifting mechanical engineering of RK there is a task of lowering of metal consumption of construction of load-lifting machines. Facilitation of created crane constructions can be carried in the following directions:

• By optimization of constructive decisions;

• Application constructional stale more quality;

• Assignment of reasonable estimated criteria of bearing capacity of crane metalwork and their differentiation.

Further enhancement of constructions of load-lifting machines can be reached due to enhancement of estimated methods on bearing capacity, longevity, and reliability taking into account dynamic influence of loadings [4].

By reviewing estimated techniques and constructions of bridge easels it must be kept in mind that the industry of construction of easel of RK, unlike European, was and remains to the ready construction oriented on acquisition and preferentially on satisfaction of internal needs of intensively operating industry. Therefore the priority direction in development and manufacture of bridge easels is the maximum support of their operational reliability and longevity. It causes calculation of a metal construction of easels.

Creation of perspective constructions of load-lifting easels requires, the analysis and synthesis of experience of research, constructing, manufacture and maintenance of bridge easels for the purpose of establishment of a national and international tendency in this area of mechanical engineering, deep study of information on their constructions and parameters that will help designers and developers to be guided in the developed system of design of bridge easels in world practice.

In this regard, we collected materials in parameters and constructions of cargo easels for the last five years. The collected material on constructions of easels was systematized. In a figure 1 the flowchart of calculation of the bridge easel, in a figure 2 - the diagram of a choice of the considered easel from the developed morphological classification is shown, Easels were considered in the form of the array subdividing into classes, the base of an array were constructions of load-lifting easels, assignment, the main nodes, details, a metalwork.

It is known that metal constructions are applied in all engineering constructions of the considerable flights, height and loadings [5].

Depending on the constructive form and assignment metal constructions can be separated on: crane and other mobile constructions – bridge, tower, gantry cranes, etc. From the carried-out analysis follows that metal constructions of easels possess the following advantages: reliability, ease, industrialism, impermeability, high strength and density, impermeability for gases and liquids.

The preliminary, right choice of constructive diagrams and sections of elements of metalwork, calculation with use of the modern programs in use load-lifting machines provide their stability, rigidness and durability [6].

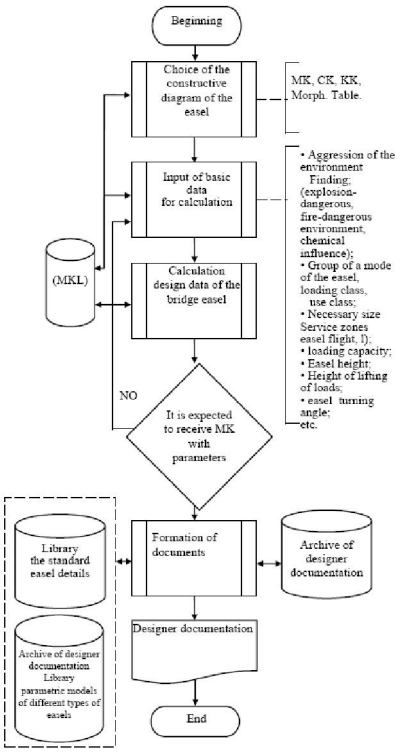

Figure 1- Block diagram of calculation of bridge easels

In this operation beam calculation with determination of the bending moments and responses is given in support. For creation of the program the object-oriented model of program components - the Delphi language and communication with an object model of AutoCAD was used. Delphi allows integrating completely development with objects of COM. Support of architecture of CORBA (Common

Object Request Broker Architecture) opens before the applications created in Delphi for the Wintel platform (Windows + Intel), the world of other operating systems (UNIX, OS/2, WMS) [7].

In case of creation of object-oriented model of program components, in Delphi it is focused on the maximum use of a code. It allowed to create applications very quickly from in advance prepared objects, and also to create own objects for the environment Delphi.

The developed program calculates bending moments and responses, also automatically removes the appropriate formula in case of button click "calculation" on the principal page, a figure 2. Determination of responses in support is shown in a figure 3.

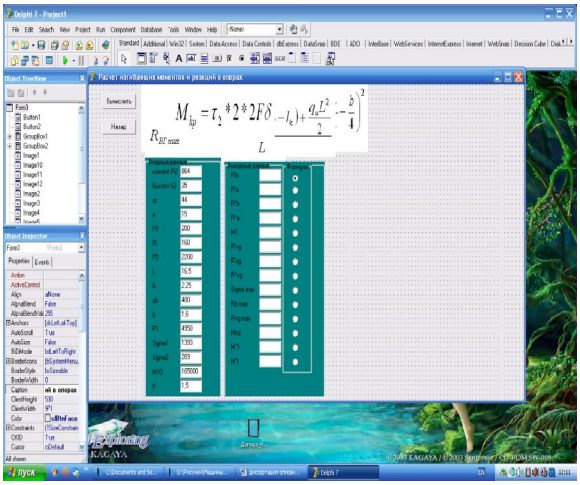

Figure 2 - Determination of the twisting and bending moment of the principal beam of the bridge easel

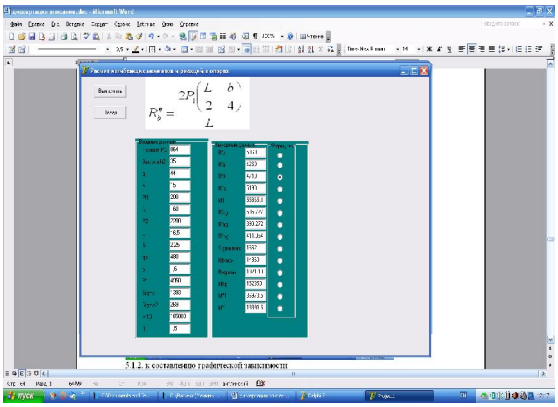

Figure 3 - Determination of responses in beam support

We will calculate congestion of a transient-time beam of the bridge easel in case of change of loading (Load factor) and cart movement [8]. We will carry out calculation when the cart is in a middle part of the bridge, in a figure 5 the deformed status of a transient-time structure of the bridge easel in case of the loading capacity of 16 t and length of flight of 16, 5 m is shown intense, to hoisting speed of 0,14 m/s, the speed of movement of the cart of 0,71 m/s. From a figure it is visible that the middle part of the bridge under the cart is the most loaded. The constructed model of the bridge of the easel is loaded in case of different the loading capacity from 3.2 t to 16 t. After the model is created and all necessary adjustments are entered in it, further actions are made: the first – is made model fixing, model partition on the terminal elements (TE), a step of splitting makes 200 mm and then is transferred in Structure 3D [9] automated workplace which means execute calculations; the second - loadings operating on it are set: cart weight with mechanisms of rise, movement, (on the diagram the cart without mechanisms is conditionally shown, but weight of these mechanisms is considered); its assessment intense the deformed status is made. The map of loadings allows analyzing distribution of different internal reactive force factors (forces and the moments arising in elements of model of construction [10]. Using settings of a dialog it is possible to view results of components and normal stresses in the plane of axes X and U of local coordinate system of construction. From a figure 4 it is visible that the middle part of the bridge under the cart is the most loaded.

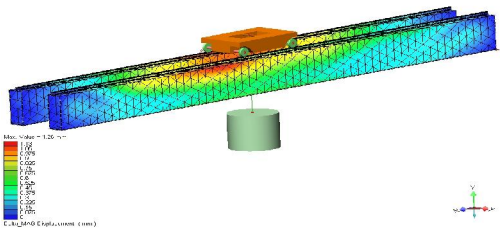

Figure 4 - Map of the equivalent tension of model of a transient-time beam of the bridge easel, when the cart in the middle of the bridge

Conclusion

- Systematization of constructions allows selecting the most perspective view of development of machines;
- The right choice of constructive diagrams and sections of elements of metalwork, calculation with use of the modern programs

allows accelerating process of calculation of easels;

• Intense the deformed status in case of difficult loading of transient-time beams of load-lifting machines (stretching compression, a bend and torsion) can be defined by the finite-element method with use of the modern programs;

• The map of the equivalent tension of model of construction allows defining the most loaded sections of construction.

Corresponding Author:
Dr. Sazambayeva, The Kazakh National and Technical University of K. Satpayev , Satpayev str., 22, Almaty, 050013, Kazakhstan.

References

1. Vishinski A.B. Technological effectiveness and bearing capacity of crane metalwork.- M.: Mechanical engineering, 1984,167 pages.
2. Alexandrov M.P., Gokhberg M. M. The reference manual on easels, volume 1,2. - L: Mechanical engineering, 1988.
3. Sazambayeva B. T. Beysenova A.S. Calculation of tensely deformed status of bridge easels. Materials of the international technical conference on September 15-17, 2009, Bishkek (Kyrgyzstan).
4. Zamry A.A. Design and n by the finite-element method of three dimensional constructions in the environment of Structure 3D automated workplace. - M.; APM, 2006. - page 286.
5. Abramovich I.I., Kotelnikov G.A. Gantry cranes for general use. Machine building. 1983 , 232 .
6. Bielli, M., Boulmakoul, A. and Rida, M. 2006."Object oriented model for container terminal distributed simulation", European Journal of Operational Research 175, pp: 1731-1751.
7. Bugaric, U. and Petrovic, D. 2007. "Increasing the capacity of terminal for bulk cargo unloading", Simulation Modelling Practice and Theory 15, pp: 1366-1381.
8. El Sheikh, A. R.; Paul, R. J., Harding, A. S. and Balmer, D. W. 1987. "A Microcomputer-Based Simulation Study of a Port", The Journal of the Operational Research Society 38, pp: 673-681.
9. Kia, M., Shayan, E. and Ghotb, F. 2002. "Investigation of port capacity under a new approach by computer simulation", Computer and Industrial Engineering 42, pp: 533-540.
10. Koh P.H., Goh J.L.K., Ng, H.S. and Ng, H.C. 1994. "Using simulation to preview plans of a container port operations", proceedings of the 1994 Winter Simulation, ed. Tew, Manivannan, Sadowski, and Seila, pp: 1109-1115.

6/12/2014