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DYNAMIC LOADS ARISING IN TOWER CRANES DURING THEIR OPERATION

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Abstract. *In order to simplify calculations of structures under dynamic loads in operation, a diagram is given according to which the rest of all elements of the mechanism are brought to its first element (engine). This allows you to greatly simplify the equation for solving and determine the values of the elasticity or stiffness factors of the elements. The method of determining the elasticity and stiffness factors of dynamic load elements given in the work makes it possible to significantly simplify the solution of complex equations and determine their values with sufficient accuracy.*

Keywords: crane, mechanism, indicator, element, load, moment.

Loading and unloading works are an integral part of the technological process of construction. Cranes of different types are mainly used to perform these works [1].

Cranes as lifting machines are widely used in construction for the movement of goods and installation of structures.

The scientific and technological progress taking place in all countries of the world strongly requires an increase in productivity, load lifting and an increase in the working speeds of lifting machines, which leads to a reduction in transients, that is, to a decrease in the time of acceleration and braking of machines.

All this leads to an increase in the intensity of the load-lifting machine, causes additional forces on all elements of the machine, received in the technique the name – external dynamic loads [2].

On the other hand, any machine has structural features of its kinematics, deviations in the size of individual parts within the established tolerance, clearance in gear gears and couplings, deformability of the system – all this causes vibrational processes in the machine transmission and refers to phenomena – internal dynamics of the machine

For safe operation of cranes, it is important to take into account the value of all types of dynamic loads operating when calculating their structures and selecting component elements [3, 4].

Therefore, at present, the actual problem is the development of a technique for determining dynamic loads in the mechanism of lifting the cargo of cranes in case of lack of movement in order to simplify complex calculations.

Therefore, to ensure trouble-free operation and improve the reliability of cranes when calculating the structures and components of their working equipment, it is important to take into account dynamic loads that are several times higher than static ones.

Elements of dynamic loads of the crane load lifting mechanism are its elastic components – ropes and shafts, which are deformed under the influence of loads. The value of this deformation of the elements is taken into account by the coefficients of elasticity or compliance with linear and steep or their inverse value – stiffness coefficients. These coefficients depend respectively on linear or angular strains.

Due to the fact that the lifting mechanism consists of a large number of elastic elements, the assembly and solution of equations for determining these coefficients is difficult. In order to simplify the equations and these calculations, the given calculation scheme according to which the remaining elements of the mechanism are brought to its first element (engine) is recommended. This allows you to greatly simplify the equation for solving and determine the values of the elasticity factors or stiffness of the elements of the dynamic loads of the crane lifting mechanism.

Therefore, it is necessary to develop a methodology for determining dynamic loads in the mechanism of lifting the crane load in case of non-stop movement with the use of the given design schemes in order to simplify complex calculations.

Any mechanism or any machine has elements or assemblies of massive or rigid bodies, which in the course of the transition process move as a whole. Such elements can be considered absolutely rigid

bodies, and their entire mass can be concentrated at a point coinciding with the center of weight of this element or node.

Thus, the mechanism or machine consists of "point masses" which include: transported cargo, rotating parts of the engine, brake pulley, drum, gear wheels, etc. [5].

The elastic elements of the machine under its load are appropriately deformed. The amount of this deformation of the element is taken into account by the coefficient of elasticity or compliance.

The coefficient of elasticity or compliance is defined as the ratio of the value of linear deformation or the angle of twist of this element to the value of the force or torque acting on it.

In practice, more often use the value of the inverse coefficient of elasticity, which is called the stiffness coefficient.

Thus, the design scheme can be represented by a number of "point masses" connected by weightless absolutely elastic bonds.

To illustrate the dynamic action of individual masses, depending on the task, they are led to some one elastic link located on one elastic link. Due to the fact that each mechanism has both rotating and progressively moving masses, two design drive schemes are possible.

If the drive is made to some shaft of the mechanism, then the given scheme of rotational motion is applied.

For such a scheme, external loads (torques), inertial forces (moments of inertia or flywheels), elasticity of kinematic elements (coefficients of torsion stiffness), backlash or clearances are specified.

If brought to the translational moving elastic element - rope, chain, rod, then the given scheme of translational stroke is applied.

It follows from the analysis of data of calculation schemes that if we take into account all the elements of the machine in the design scheme, then the scheme is very difficult, and the definition of dynamic loads is an intractable task. Therefore, in order to study dynamic processes in a mechanism or machine, it is advisable to use the so-called given calculation schemes that reflect the actual operation of the mechanism or machine and allow non-difficult decisions to obtain and analyze dynamic loads.

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ДИНАМІЧНІ НАВАНТАЖЕННЯ, ЯКІ ВИНИКАЮТЬ У БАШТОВИХ КРАНАХ ПРИ ЇХ ЕКСПЛУАТАЦІЇ

Анотація. *З метою спрощення розрахунків конструкцій баштових кранів при динамічних навантаженнях в роботі наводиться схема, згідно з якою решта всіх елементів механізму доводяться до його першого елемента (двигуна). Це дозволяє значно спростити рівняння для вирішення і визначити значення коефіцієнтів пружності або жорсткості елементів. Наведений у роботі метод визначення коефіцієнтів пружності і жорсткості елементів динамічного навантаження дозволяє значно спростити розв'язання комплексних рівнянь і з достатньою точністю визначити їх значення.*

Ключові слова: кран, механізм, індикатор, елемент, навантаження, момент.

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