753. Research of dynamics of lifting equipment

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(Received 10 September 2011; accepted 14 February 2012)

Abstract. In the recent years, girder bridge cranes are replaced by double-beam overhead cranes with beams of rectangular cross-section. In addition, new materials are used for their fabrication, characterized by different values of allowable loads and deformations. In the paper, two overhead cranes from JSC "Vilniaus kranai" are considered. A mathematical model is proposed that enables assessment of the impact of the hydraulic damper built in the cargo suspension system upon the dynamic features of the crane in the beginning of the lifting process. It was determined that in such a way the period of vibration damping is reduced. However, the impact of the damper upon the dynamics of the metal structure of the crane is limited because of high mobility of the rope as compared to the mobility of the total structure.

Keywords: overhead crane, lifting process, hydraulic damper, stiffness of the rope, time diagram.

Introduction

Overhead cranes are important equipment of a majority of industrial and energy enterprises. Reliability of their operation predetermines a success of the manufacturing process. Simultaneously, the said equipment is important with respect to the occupational safety, so an assessment of dynamic load on its operation is an urgent technical problem. Depending on the dynamic properties of the crane, the parameters of the system for protection of the driver against vibrations and knocks are chosen [1].

In terms of dynamic computations, a crane is a united dynamic system that consists of the mechanisms, the supporting metal structure, the drive and the structural unit of the part of the building where the crane operates. An assessment of the variety of all interacting elements of the crane by dynamic computation is too complicated. However, it is not required in a majority of cases because not all factors contribute to formation of the dynamic loads to the same extent. On a transfer from the real machine to dynamic computation, the physical factors that are not important for the specific case of computation are not taken into consideration.

Maximum dynamic loads in the structure of a crane are induced in the beginning of the lifting process [2], which is attributed to the transients in mechanical systems because of rapid changes of resistance and driving forces. In the case of these processes, an assessment of the interaction between the mechanism and its electric engine is of a great importance [3].

While analyzing electromechanical systems, reliable solutions for formation of Simulink model are obtained in the environment of MATLAB [4, 5]. The dynamic curve of the crane load movement impacts the loads of its metal structure as well [6].

The load to the metal structure is transferred via the rope. On cargo lifting, the stiffness of the rope is growing, so the conditions of vibration damping in the rope and the time of transfer of the load from the cargo to the lifting mechanism alter [7]. Transfer of dynamic loads from the rope to the drum of the lifting mechanism is predetermined by the rope winding conditions [8].