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Load-bearing steel structure diagnostics on bucket wheel excavator, for the purpose of failure prevention

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ABSTRACT

The appearance of cracks on load-bearing steel structure of compact, hydraulic bucket wheel excavator was a perennial problem. Unfavourable stress concentration, inadequate geometry and structure of materials, inadequate operational technology has led to crack appearance and reduced structural integrity. Finite elements method is defined in this paper as a diagnostic tool for the prevention of the anomalies during operation of the bucket wheel excavator. Solution for repair and reconstruction of the excavator's super structure is the result based on a detailed analysis of the load, identified cracks, the results of calculation and the identified causes of structural failure of excavator's super structure.

1. Introduction

Bucket wheel excavators are complex systems, with numerous functionally important components. Its operational life, as the most important and most complex single system within continuous mining system for open cast mining, is directly related to durability of the steel structure. There are not precise criteria related to steel structure, such as ones for replacement or revitalization of drive units, which is adding to complexity of the problem. Long-term monitoring requirement and data enabling realistic description hinder determination of firm relations between load-bearing structure and operational life. Experimental measurements and visual analysis must provide support to numerical model, based on finite elements method, which in this case is basic diagnostic tool.

Bucket wheel excavator SchRs800 (manufactured by O&K, Germany), which operates at Drmno open cast mine in Kostolac coal basin, is shown in Fig. 1. Analysis of this excavator's structure is described in this paper.

Diagnostics of condition and behaviour of steel structure and fault analysis, by finite elements method, has been subject for numerous researchers around the world. On the other hand, few researches are using these methods for mining machinery operation analysis, bucket wheel excavators in particular. Few of them published their work.

Application of finite elements method and vibrations analysis based on tensiometric measurements on the SchRs800 excavator superstructure provided basis for this paper [1]. Discrete model of superstructure, comprised of components such as beam which are not stiff is considered in details. Excessive vibrations of the entire superstructure were recorded in real situations during excavator operation. These vibrations caused platform and structural base failure. In order to avoid these vibrations in the future, examinations of dynamic and other operating conditions were performed, in the form of numerical calculations using finite elements. In this way, the diagnostics of excavator's superstructure is defined as preventive action,

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