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Determination of the dynamic overloads in the loader structure

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Abstract

The paper presents the results of the experimental study conducted for the analysis of the loads acting on the loader utilized in the underground mines. The analysis of the overloads generated on a bucket boom/arm during transportation was performed. The study encompassed the measurements of the accelerations and strains in the different areas of the vehicle. Comparison of the obtained results enabled to determine the dynamic coefficients of the overloads acting on the loader during the operation of the machine it the underground mining conditions.

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Keywords: acceleration measurements; stain meaurements; minig machine; strain gauges.

1. Introduction

The authors performed the experimental study based on measurements of the stresses of a load-bearing structure of the loader utilized in the underground mining (fig. 1). The testing was carried out in the areas comprising a front axle and an operating system of the bucket of the machine. A characteristic feature of this type of the machines is performing the haulage of an ore over the substantial distances. Driving on the uneven ground in mines may generate significant dynamic loads. In order to reduce the overloads in a lifting system of the loader bucket, two hydraulic

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accumulators with a different pressure adjustment were implemented. The accumulators decrease the overloads while transportation of the machine with full and empty bucket. It contributes to the improvement of the durability of the operational elements. The unladen mass of the loader amount to 47300 kg and the capacity of a bucket is equal 8,5m^3. The experiment was performed on a hardened ground. Measurements were taken during driving over the 250mm hump with the front axle. Both wheels needed to drive over the obstacle simultaneously. For that reason the hump was situated perpendicularly to the driving direction of the loader.

Fig. 1. General view of the loader.

2. Sensor locations

In a frontal part of the loader, 7 accelerometers measuring the accelerations in the different directions were situated [1,2]. The authors placed also the strain gauges in order to measure strains in the selected areas of the load-bearing structure of the boom (fig. 2). The sampling points were determined on the basis of the computational simulation of the underground machine [3,4]. Table 1 presents measuring points, where the sensors were mounted.

Table 1. Location of the sensors.

No.	Sensor location	Measuring direction
a9	Front axle – right side	Vertical (Z)
a10	Front axle – right side	Perpendicular to vehicle axis (Y)
a11	Front axle – left side	Vertical (Z)
a12	Front axle – left side	Perpendicular to vehicle axis (-Y)
a13	Joint	Vertical (Z)
a14	Joint	Vertical (Z)
a15	Bucket pivot pin – left side	Vertical (Z)
a16	Bucket pivot pin – right side	Vertical (Z)

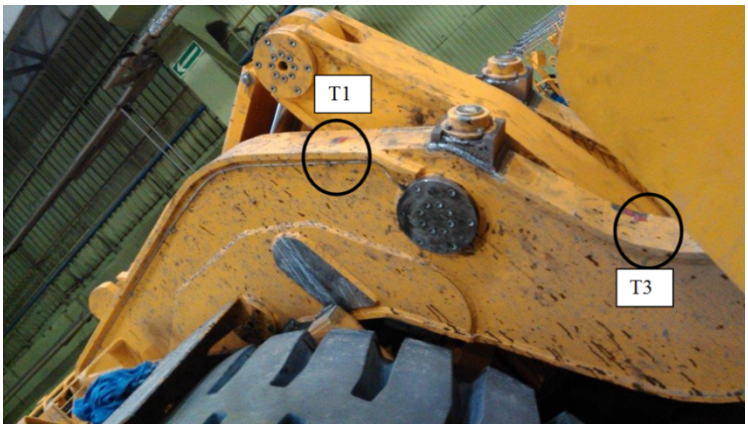

Fig. 2. Positions of the selected measurement points.