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Geological-engineering and geotechnical issues concerning the function of the railway bridge across the Amgun' river operated by the Far Eastern Railway

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Abstract

The operation of transport structures in the Russian Far East is characterized by specific common features. The majority of engineering structures were built predominantly in the first half of the 20th century. Their construction employed simple technologies based on manual labor which often resulted in inferior quality of work. In addition, the factors that aggravate the operational reliability of the bridges are the severe climatic and complicated geological-engineering conditions of the regions under consideration. The authors have analyzed the results of monitoring the current status of the operating unclassified bridge structure and its geological environment. The analysis has shown major destructive geological-engineering factors that cause deformations and defects in the bridge supports and spans. The authors have provided a qualitative and quantitative forecast on the bridge operation performance taking consideration of the prospective increment in live load and railway traffic intensity.

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Keywords: destructive geological processes and impacts; span and bridge support condition; bearing capacity; forecast.

Introduction

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The majority of engineering structures of the railways in the Russian Far East were built in the 1930s-1950s, i.e. their working lifespan has reached approximately 60-70 years which is close to the normative working lifespan established by the regulative documents of the OJSC "Russian Railways" [1, 2, 3]. The operation of the bridges and culverts is complicated by their location in the northern construction-climatic zone where the number of structures in faulty condition is 1.5-2.0 times higher than in regions with temperate climate. The design standards for bridges and culverts with permanent increment in the working load intensity (N7; N8; C14) have been changed and updated several times since their construction.

Such conditions caused an urgent need for reconstructing the engineering structures in order to increase their bearing capacity and to extend their working lifespan. This is only possible with monitoring of the current technical state of engineering structures as well as assessing the state of the geological environment and specific climatic conditions.

Methods

We assessed geological-engineering conditions on the basis of the field research conducted by the authors. Their field research included geological-engineering survey, shaft-sinking and drilling works. It also included selecting samples of soils, underground and surface waters. We applied laboratory methods to study physical and mechanical properties of soils. Core samples were selected in the process of coring with further laboratory assessment of their strength properties. Assessment of the condition of span structures is based on the results of the on-site investigations of the bridge.

Description of results

In order to resolve these issues we have performed a whole complex of research procedures applied to the big bridge across the Amgun' river on the railway line Komsomolsk-on-the-Amur – Novy Urgal belonging to the Far Eastern Railway (the former section of the Baikal Amur Mainline). The bridge was put into operation in 1949. It has seven steel spans performed as trusses with parallel chords with a design span of 55.0 m. The complete length of the bridge is 403.41m. Supports and deep foundations are built of site concrete (Fig. 1)

Fig. 1. General view of the bridge across the Amgun' River. The riverbed part of the bridge crossing is set up of quaternary alluvial deposits. Steel trusses with parallel chords; deep foundations and supports are built of site concrete.