Cracking and Fatigue of Heavy Loaded Prestressed Concrete Bridge in Sweden

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Abstract

A prestressed concrete bridge was built in 1963 with BBRV cables. It has three spans and a total length of 134.8 m. Due to mining activities the bridge was loaded with trucks with a total weight of 90 ton during 2012-2014 and from 2019. Crack development has been monitored manually and from 2020 with strain gauges and LVDTs. Cracks normally vary between 0.1 to 0.3 mm in width and grow in length with time. In November 2020 some of the strain gauges on the concrete showed alarming growth and the bridge was closed for traffic. Additional strain gauges were installed on vertical reinforcement bars and an assessment was carried out of the fatigue capacity of the bridge. It was found that the new strain gauges did not indicate any growth in strain and that the fatigue capacity was sufficient. The bridge could be opened again for traffic after being closed for five weeks. Monitoring drift in the strain gauges and fatigue are discussed.

Keywords: Prestressed concrete bridge, cracking, fatigue**,** monitoring, assessment, heavy loading,

1 Introduction

Many prestressed concrete bridges in the world have an age of more than 50 years and questions are being raised about their condition and load-carrying capacity [1]-[3]. In this paper a case study is presented of a bridge built in 1963 over Torne River at Autio in northern Sweden, not far from the border to Finland, see Figure 1, [4].

2 Design and Construction

The bridge has a total length 138.8 m and has three spans: 36.4 + 62.0 + 36.4 m. The width is 7.48 m. The prestressing was applied with BBRV cables of 32 ϕ 6 mm wire. The bridge was built in the following order with formwork supported by trusses:

(1) Abutments and intermediate supports.
(2) Main beams for side spans + consoles for main span (16 m) + cross beams.
(3) Prestress stage I (side spans).
(4) Concrete deck for side spans and consoles.
(5) Prestress stage II (side spans).
(6) Remaining mid span (30 m).
(7) Prestress stage III (mid span);
(8) Bitumen and railings.

The concrete for the beams and deck were originally set to K400 and K300 respectively. However, the quality in the beams had to be raised to K450 with a nominal compression strength of 45 MPa. The allowable stress for K400 for shear **or**