Bridges tested to failure in Sweden

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Abstract

Five bridges of different types have been tested to failure and the results have been compared to analyses of the load-carrying capacity using standard code models and advanced numerical methods. The results may help to make accurate assessments of similar existing bridges. There it is necessary to know the real behaviour, weak points, and to be able to model the load-carrying capacity in a correct way.

The five bridges were: (1) a strengthened one span concrete road bridge - Stora Höga ; (2) a one span concrete rail trough bridge loaded in fatigue – Lautajokk; (3) a two span strengthened concrete trough railway bridge - Övik; (4) a one span railway steel truss bridge -Åby; and (5) a five span prestressed concrete road bridge - Kiruna. The unique results in the paper are the experiences of the real failure types, the robustness/weakness of the bridges, and the accuracy and shortcomings/potentials of different codes and models for safety assessment of existing structures

Keywords: Test to failure, bridges of concrete and steel, Assessment, Strengthening, Monitoring, Bending, Shar, Torsion, Bond, Fatigue, Carbon Fibre Reinforced Polymers (CFRP)

1 Introduction

Load testing is one of the oldest ways to check the quality of a bridge, Bolle *et al.* [1]. The deformations of a bridge during loading summarize its general condition and stiffness. Thus, the deformation can be identified as a key performance indicator as studied in e.g. COST 1406 [2], [3].

In this paper some examples and experiences are given from load tests to failure in Sweden; how quality control and management of bridges can be improved and how numerical models may be calibrated.

2 Service and ultimate load levels

Load testing can be performed at (a*) service-load levels* and (b) loads to check the *ultimate capacity (failure)* of a structure.

Testing for service-load levels (a) are often divided into two groups (Lantsoght *et al*. [4]-[6]):

I. Diagnostic tests to update the analytical model of a bridge so that the allowable load can be better defined. Here often the stiffness of a bridge is determined in the linear elastic stage.

II. Proof loading tests to demonstrate that a bridge can carry the loads it is intended for, Casas, Gomez [7]. Higher loads are usually used than in

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