Monitoring of reinforced concrete bridges retrofitted by external tendons

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Abstract
Present traffic loads on bridges often exceed the actions anticipated at the time of construction. In Germany several prestressed concrete bridges with deficits in their load bearing capacity had been identified. An established retrofitting method is the installation of external tendons with deviation and anchorage blocks. Since the later proved to be a critical detail, their structural behaviour was monitored for three bridges in Hessen. The anchorage blocks were fitted with extensometers, strain gauges were installed on prestressing rods and the temperature was recorded. Also alert protocols were established, to detect potentially hazardous situations. The effects of different construction stages were tracked. The influence of short- and long-term temperature changes on the readings was assessed. In summary, the monitoring provided valuable insights into the structural interaction between the existing superstructure and the elements of the retrofitting.

Keywords: bridges; extensometers; external tendons; monitoring; post-tensioning; retrofitting; strain gauges.

1 Introduction

1.1 Development of traffic loads on highway bridges

In the past decades the European highways have experienced a steady increase in daily vehicle numbers and axle weights. In Germany the total heavy freight traffic on roads has approximately doubled in the last 20 years, with authorities anticipating a further increase in the future [1]. More than half of the bridges in the German highway network however have been constructed before the 1980s. They were designed with a traffic load model that consisted of a vehicle with a total weight of 600 kN as shown in Figure 1 and a uniformly distributed load of 5 kN/m² in the main lane and 3 kN/m² in the remaining lanes according to DIN 1072:1967 [2].

Figure 1. Traffic load model for 60 t vehicle according to the DIN 1072:1967 [2]