



## Investigation of fractures of RC twin-blocs of a fixed railway track after 40-years of service

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### Summary

A fixed railway track consisting of twin-blocs in reinforced concrete has been built in a 5km long double track railway tunnel near Zurich, Switzerland, in service since 1975. After satisfactory service behaviour over more than 35 years, cracks have been detected on several blocks. These signs of a damaging process increased in the following months and urgent measures had to be taken. Investigations showed that the main damage mechanism was due to fatigue. In particular, significant fatigue damage was produced by single overloaded axle loads and by the high number of high axle loads. In addition, inadequate detailing of the rebars in the concrete blocks was the main reason for the relatively low fatigue strength of the RC blocks. The damaged railway track was replaced by improved twin-blocs, in particular detailing of rebars in the concrete bloc was improved, and fatigue tests were conducted for validation.

**Keywords:** railway sleepers, fatigue of reinforced concrete, rebar detailing, railway action effect, extreme axle loads.

### 1. Introduction

This paper reports on the investigation of the following case of structural failure: A fixed railway track consisting of twin-blocs in reinforced concrete has been built in a 5km long double track railway tunnel near Zurich, Switzerland, in service since 1975. After satisfactory service behaviour over more than 30 years, first cracks have been detected on several concrete blocks in 2008. These observations were interpreted as signs of an ongoing damaging process which was confirmed by detection of further cracks and with increasing number in the following months. As a consequence, urgent measures had to be taken by replacing about 60 blocs yearly.

The following items were raised and had to be investigated:

- The cause of the observed damaging process should be explained and examined with particular consideration of railway traffic loading effects and the structural behaviour of the twin-blocs.
- Consequences resulting from the present case including remedial measures needed to be identified and recommended.
- The findings should be applied to other fixed railway track systems of the railway network in order to forecast their remaining service duration, including methods of monitoring and early identification of damage.

This paper reports on the first two items following a methodology including the subsequent steps:

- Analysis and evaluation of the design and construction of the twin-blocs and interpretation of observed damage (Chapter 2).