Kaimai Tunnel track slab assessment

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Abstract

Kaimai Tunnel is an 8.5km long KiwiRail tunnel on one of the busiest freight rail lines in NZ North Island. The concrete base slab that supports the track slab in the drill and blast section of the tunnel was cast on a fill layer rather than country rock. The fill layer has in places been washed out over time leaving voids under the base slab resulting in local track slab failures. Previous studies by others recommended major interventions or complete replacement of the track slab for the full tunnel length. This was considered impractical by KiwiRail due to the disruption to the network.

The first phase of the Arup study concluded that the trackslab could be retained subject to manageable remedial actions. A key component of this study was the interpretation that the existing paved concrete track (PaCT) and base slabs are acting as an unreinforced concrete element spanning between the side drains. Understanding the risk associated with this unintended and unusual structural form was critical in the development of the agreed remedial works. Concrete fatigue was one of the important factors investigated.

Keywords: tunnel, rail, track slab, fatigue, unreinforced concrete

1 Introduction

Kaimai Tunnel is an 8.5km long KiwiRail tunnel passing below the Kaimai Ranges on the East Coast Main Trunk freight line between Tauranga and Hamilton, North Island, New Zealand. It is one of the busiest freight lines in New Zealand carrying 12 million tonnes of freight per year and operating with an 18Tonne (18T) axle load limit. The single track is straight and on a 0.3% constant grade for the tunnel length. The line is not electrified with up to 30 trains a day passing through the tunnel.

The tunnel was opened in 1978 after 9 years of construction. The tunnel comprises 3.5km of drill and blast tunnel (horseshoe section) and 5km of TBM tunnel with cast insitu concrete lining (circular section).

Variable ground conditions were encountered during construction, reflecting the stratified ancient volcanic block that the tunnel mainly passes through. Both sections of tunnel are drained with flow rates within the tunnel drainage system of up to 10m^3/minute. These flows have remained constant over the years. The tunnel is 600m below the top of the ranges at its deepest point. Temperatures within the tunnel are reasonably constant and elevated by the rock temperatures that are close to 40 degrees Celsius in the heart of the range.

The original track was mounted on a cork based resilient layer fixed with Pandrol clips. The lightly reinforced PaCT slab was placed by a concrete paver onto an unreinforced concrete base layer, forming the trackslab in the tunnel.

https://doi.org/10.2749/christchurch.2021.0545
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