Fire design for the refurbishment of a railway tunnel

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Abstract

The North-to-South tunnel connection under Brussels, is the most important railway connection of Belgium. Due to the increasing safety demands and the extremely heavy use during the past sixty years, a refurbishment project is planned fort he near future. One of the most important issues for this refurbishment project will be the fire safety design. To study this in detail, a three-dimensional finite element model has been developed to study the influence of a design fire on the existing construction, as well as on all possible additional measures. This design models the thermal radiation caused by the fire in detail, as well as the mutual radiation between the elements, the conductivity in the materials of the tunnel cross-section and convective airflow within the tunnel. All material properties are based on Eurocodes 1991-1-2 and 1992-1-2. The design fires are in principle defined by Eureka and RABT.

Keywords: tunnels, refurbishment, fire design, finite element modelling, three-dimensional, Eurocodes.

1 Introduction

The North-to-South tunnel connection under Brussels, is the most important railway connection of Belgium. Built in 1952, it now allows about 1200 trains to pass over its six railway tracks. The tunnel cross-section, is quite specific because it consists out of three tunnel tubes, each containing two tracks, separated by concrete columns. Due to the increasing safety demands and the extremely heavy use during the past sixty years, a refurbishment project is planned fort he near future.

One of the most important issues for this refurbishment project will be the fire safety design. To study this in detail, a three-dimensional finite element model has been developed to study the influence of a design fire on the existing construction, as well as on all possible additional measures. A two-dimensional approach would lead to much more conservative results. In addition, this three-dimensional approach allows for studying the actual location of the initiation of the fire, which will be much more localised than just assuming a uniform temperature increase for all of the elements in the finite element model, which would be the strategy in 2-D. This design models the thermal radiation caused by the fire in detail, as well as the mutual radiation between the elements, the conductivity in the materials of the tunnel cross-section and convective airflow within the tunnel. All material properties are based on Eurocodes 1991-1-2 and 1992-1-2. The design fires are in principle defined by Eureka and RABT.

https://doi.org/10.2749/stockholm.2016.2510
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