

## Computer modelling of fire consequences on road critical infrastructure – tunnels

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**Abstract.** The proper functioning of critical points on transport infrastructure is decisive for the entire network. Tunnels and bridges certainly belong to the critical points of the surface transport network, both road and rail. Risk management should be a holistic and dynamic process throughout the entire life cycle. However, the level of risk is usually determined only during the design stage mainly due to the fact that it is a time-consuming and costly process. This paper presents a simplified quantitative risk analysis method that can be used any time during the decades of a tunnel's lifetime and can estimate the changing risks on a continuous basis and thus uncover hidden safety threats. The presented method is a decision support system for tunnel managers designed to preserve or even increase tunnel safety. The CAPITA method is a deterministic scenario-oriented risk analysis approach for assessment of mortality risks in road tunnels in case of the most dangerous situation – a fire. It is implemented through an advanced risk analysis CAPITA SW. Both, the method as well as the resulting software were developed by the authors' team. Unlike existing analyzes requiring specialized microsimulation tools for traffic flow, smoke propagation and evacuation modeling, the CAPITA contains comprehensive database with the results of thousands of simulations performed in advance for various combinations of variables. This approach significantly simplifies the overall complexity and thus enhances the usability of the resulting risk analysis. Additionally, it provides the decision makers with holistic view by providing not only on the expected risk but also on the risk's sensitivity to different variables. This allows the tunnel manager or another decision maker to estimate the primary change of risk whenever traffic conditions in the tunnel change and to see the dependencies to particular input variables.

**Keywords:** road tunnel; risk analysis; deterministic approach; scenario oriented method, fire; software tool; CAPITA

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### 1. Introduction

#### 1.1 Risk analysis in road tunnels

When designing a tunnel technology, the decision makers face an important question: “Is the proposed safety technology sufficient and suitable for this particular realisation?” Unfortunately, this question does not have a universal answer, since it is always significantly affected by

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