Effects of extreme fire scenarios on bridges

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Summary

Vandalism, human errors or accidents can result in significant fire events on and beneath bridges. Examples for such fire events in Germany include the Wiehltalbücke (26/08/2004) or a bridge at BAB A57 near Dormagen (14/02/2012). Bridges and bridge components collapsed partly due to these fire events or it became necessary to deconstruct the complete structure and rebuild it. In a research project the consequences of extreme fire events beneath and on top of bridges were systematically elaborated. Scenarios of a burning truck loaded with wood pallets were investigated. Additionally the scenario of burning liquids flowing out of a tanker at different rates was part of the analysis. The result of the CFD calculations shows that fires beneath bridges have to be differentiated from fires on top of bridges. Due to the hindered convection by the bridge superstructure and the reflecting effects of abutment and superstructure, temperatures can occur in the event of fires which are known from tunnel fires. Up to date, no specific experimental studies at an original scale for fires beneath bridges are known. Hence, in order to validate the used models, an original-scale bridge fire test stand was erected in order to carry out a truck test fire. In order to answer the question which bridge structures, if any, have to be protected in the future - besides infrastructural and economic aspects - constructional aspects should be taken into account with due consideration given to material and structure.

Keywords: Fire; bridge; vulnerability; CFD simulation; original-scale large fire test

1. Introduction

Bridges and tunnel constructions are key elements of the Federal German road network. Due to their connectivity they create the condition for individual mobility and supply of private households and business. Furthermore, they represent a significant macro-economic value. Sustainable protection of the existing structures comprising of currently 240 tunnels and 39,000 bridges in Germany is therefore a high priority with regard to the availability of the infrastructure and the welfare of our society. The objective of the joint research projects SKRIBT and SKRIBT^{Plus} (Protection of Critical Bridges and Tunnels) [1] is to look at possible hazards in terms of current and future threat situations for bridge and tunnel structures in the course of roads and to develop effective protective measures, thus reducing the vulnerability of crucial infrastructures and their users.

In this context a comprehensive study on the effects of extreme fire scenarios on the durability of road bridges [2] was conducted for the first time by the Leipzig Institute for Materials Research and Testing (MFPA) on behalf of the Federal Highway Research Institute (BASt). This was necessary because vandalism, human errors or accidents can result in significant fire events on top and beneath bridges. Examples for such fire events in Germany include the Wiehltalbücke (26/08/2004)

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