



Analysis of a heavy goods vehicle fire in wind conditions and its impact on structural performance of a cable-stayed bridge

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Abstract

With growing concern over the fire risk of bridges, an analysis of temperature fields of heavy goods vehicle (HGV) and the impacts on bridge structure was conducted, by taking a cable-stayed bridge as a research object. With the test data of HGV fire in the Runehamar tunnel in Norway, the HGV fire model was obtained with numerical simulation. Using this model, the flame temperatures of HGV fire on the bridge deck were acquired at wind velocities of 0 m/s, 2.5 m/s and 5 m/s respectively. Considering the heat transfer characteristics of fire, the temperatures of stay cables were also achieved, and then the failures of stay cables were studied. After that, the safety assessment of bridge was conducted. The results show that the wind could reduce the damage of stay cables caused by fire. And the HGV fire has limited influence on the overall safety performance of bridge, but will pose a serious threat to the reliability and durability of bridge. So it's necessary to take effective measures to reduce the loss caused by fire.

Keywords: bridge fires; cable-stayed bridge; failures of stay cables; heavy goods vehicle; wind

1 Introduction

In recent decades, due to rapid development of transportation, there has been an increase of fire related accidents in bridges, and some of these fires caused many bridges to collapse. A U.S.-wide survey on bridge failures was conducted by the New York State Department of Transportation (NYSDOT), which 18 state departments of transportation responded. And the survey showed that nearly three times more bridges have collapsed in the 1990-2005 period due to fire than due to earthquakes[1]. So bridges fires are becoming a new concern for bridge researchers.

Bridges are critical in commerce and transportation of people and goods within and among communities. A fire accident can cause bridge to be closed or sustain a very limited traffic at the time of failure and result in traffic disruptions and detours, which may lead to significant economic and public losses. On April 29, 2007, a tanker carrying nearly 3400L of gasoline overturned on the I80/880 interchange in Oakland, USA, and burst into flames. And the high temperature of the flames resulted in the elevated roadway collapsed finally. 26 days were taken for repair and then the interchange bridge reopened to traffic. The economic consequences were very severe to the San Francisco Bay Area,