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FDS Simulation of the Newhall Pass Tunnel Fire

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Fire Dynamics Simulator (FDS) was used to reconstruct the fire that occurred in October 2007 just north of Los Angeles, California, USA, in the Newhall Pass tunnel. The objective of the work was to determine the maximum exposure temperature in the tunnel and evaluate the conditions likely to be found in this fire. This abstract summarizes the simulations and the conclusions of the fire analysis.

On October 12, 2007, a major fire occurred in the Newhall Pass tunnel near Santa Clarita, California. The Newhall Pass tunnel is part of the Interstate 5 southbound truck lane as it passes below Interstate 5 main lanes. The tunnel is a 167-m [550-ft]-long reinforced concrete boxed girder, which was built in 1975. The tunnel fire was a result of a truck accident that led to a 31 vehicle pile-up in and around the Newhall Pass tunnel. One of the vehicles caught on fire and ignited other vehicles in the tunnel. The tunnel was fully engulfed in flames within 15 minutes.

The main objective of the work presented in this abstract was to evaluate the thermal conditions that occurred in the Newhall Pass tunnel fire. The thermal conditions were determined by two techniques. The first technique included modeling the Newhall Pass fire using the National Institute of Standards and Technology's FDS Computational Fluid Dynamics Code. The model included the tunnel geometry, vehicle geometry, weather conditions, and type of combustible materials. In addition, the model included small targets at specific location surrounding incinerated vehicles, which include material properties to predict heat transfer from the air and a subsequent temperature of these target materials during the fire. The second technique was to sample materials from vehicles involved in the tunnel fire. These samples provided information about the thermal conditions they experienced during the tunnel fire. This was determined by evaluating melting points, solid-state transformations, and thermally induced degradation. The sample analysis also provided a means to validate the fire model calculations.

A detailed numerical model was constructed based on the data and the information provided by the California Highway Patrol. In addition, environmental conditions were obtained from weather stations near the tunnel. This information was used to develop a model of the Newhall Pass tunnel fire. The full-scale numerical model accounted for these issues.

The model was run for a simulation time of one hour. The results from this simulation indicated that the peak temperatures were reached in the center and at the top of the tunnel. The maximum predicted upper layer gas temperature was 1,260 °C [2,300 °F]. This upper bound temperature was located in the center of the tunnel just below the ceiling. The maximum predicted west wall temperature was 960 °C [1,760 °F], the maximum predicted east wall temperature was 890 °C [1,634 °F], and the maximum predicted ceiling surface temperature was 970 °C [1,778 °F].

The materials analysis examined aluminum, copper, brass, and ferrous alloys. All of the nonferrous samples were analyzed for their melting points. Differential scanning calorimetry was used to measure the melting point of some of the acquired samples. All vehicles showed some signs of incipient melting of aluminum. This tended to set the lower bound temperature at around 600 °C [1,112 °F]. Other nonferrous samples included copper and brass. Only one brass sample showed incipient melting. The nonmelted brass and copper samples were used to set an upper bound temperature between 900 and 1,100 °C [1,652 and 2,012 °F]. The one brass sample that showed incipient melting had a melting point of 884 °C [1,623 °F]. The vehicle from which this sample was taken was located in the middle of the tunnel, which is where the model predicted the highest temperatures. This set a lower bound for temperatures in that region.

In addition to the vehicle located in the center of the tunnel, the materials analysis results were compared to the model at five other tunnel locations. The results of the materials analysis agree well with the modeling results. As such, the materials analysis seems to validate the model assumptions and calculations. Overall, the temperature in the tunnel varied with time and location, but it is clear from the modeling and materials analysis that the temperature in the tunnel at least exceeded 884 °C [1,623 °F].

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