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Abstract-

This paper presents the validation of a coupled hybrid (1D/3D-CFD) modelling methodology, using FDS version 6.7.5, for the first time, with full-scale fire tests. Real fire conditions of the Runehamar tests with maximum centreline velocity, backlayering lengths, and maximum temperatures at different locations both upstream and downstream from the fire source. An expression to evaluate the length of the 3D domain where the fire is located is successfully assessed. Also, a pressure boundary condition at one of the portals is suggested to predict more precisely the inner flow conditions. The temperature profiles are accurately predicted with time-averaged differences lower than 20% beyond 40 m downstream from the fire source in the three tests. Furthermore, with the coupled hybrid approach, the backlayering length is estimated accurately with the fire of 66 MW and underestimated in the 6 MW and 119 MW fires, i.e. a maximum difference lower than 4% of the total tunnel length. The validated proposed methodology allows accurate predictions of temperature for tunnel fires and reduces the computational cost between 27% and 75% with respect to a full-CFD numerical model.

Index Terms- CFD; Coupled hybrid modelling; Tunnel ventilation; Tunnel fire; FDS; Full-scale tests

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