CFD MODELING AND EXPERIMENTAL ACTIVITY ON REAL SCALE TUNNEL FIRES

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OBJECTIVE

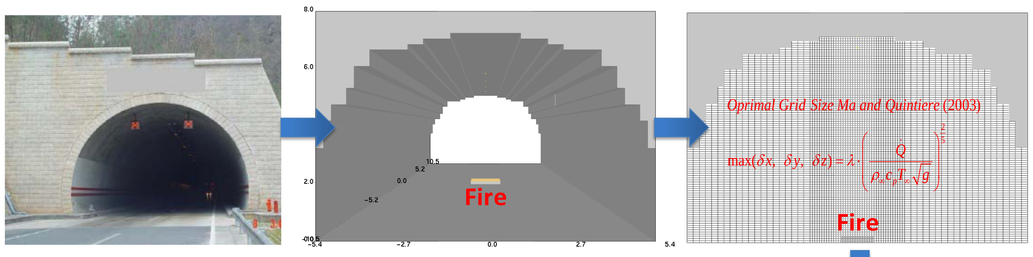
Aim of this work is to validate the Fire dynamic Simulator, a CFD code for fires developed at NIST, using literature experimental data obtained in tunnel fires experiments. Moreover, a cooperation with the *Corpo Valdostano Vigili del Fuoco* allowed to perform experimental campaign inside the San Bernardo tunnel.

Fire Dynamics Simulator (FDS) [1]

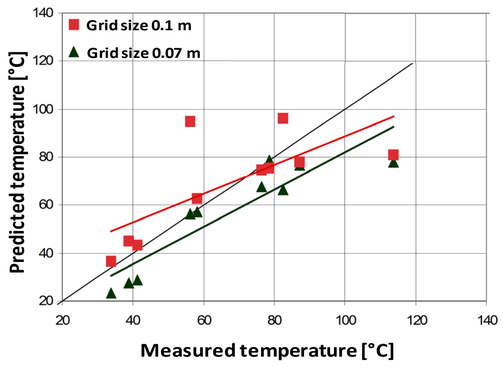
- ❖is a CFD model of fire thermally-driven fluid flow.
- ❖Includes simple combustion model, radiation, and sprinklers
- ❖ appropriate for the low-speed, thermally-driven flow
- ❖Emphasis on the smoke and heat transport from fires.
- ❖Turbulence modeled by Large Eddy Simulation (LES).
- ❖Structured grid only

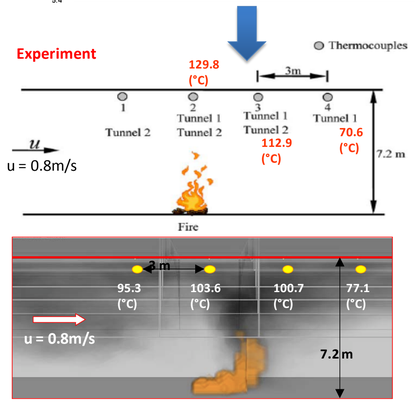
- ➢Obtain deeper understanding of FDS code.
- ➢Develop a model to predict the total heat Release and the flux of danger to citizens and rescue team
- ➢Analysis of the experiments in order homogenize the methods and to provide experimentation guidelines
- ➢Extrapolation of the "small scale" tests to large fires are possible, with Computational Flow Dynamic (CFD)
- ➢Application to tunnels of the Italian Alps

Fire Scenario #1 (Road tunnel Tests [2])

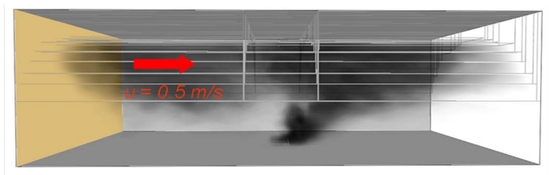


Comparison with experimental data

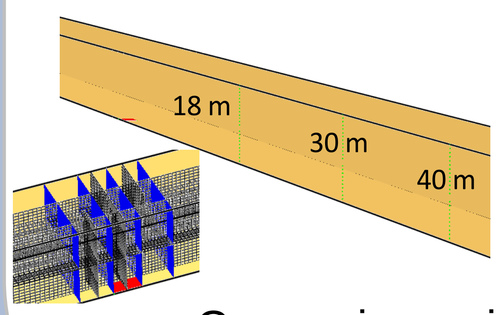


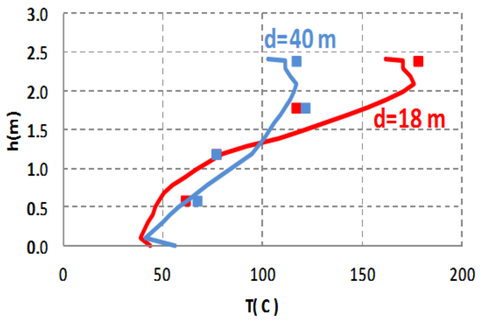


Effect of ventilation



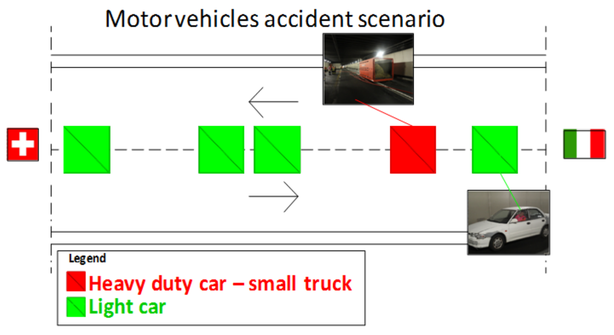
Fire Scenario #2 (Road tunnel Tests [3]: 2.4 MW)

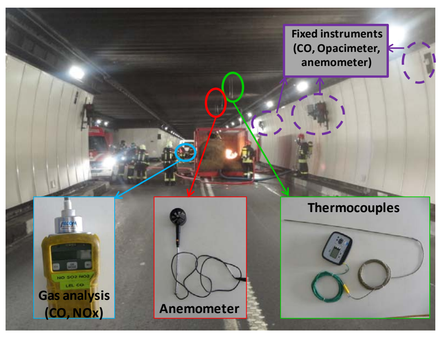




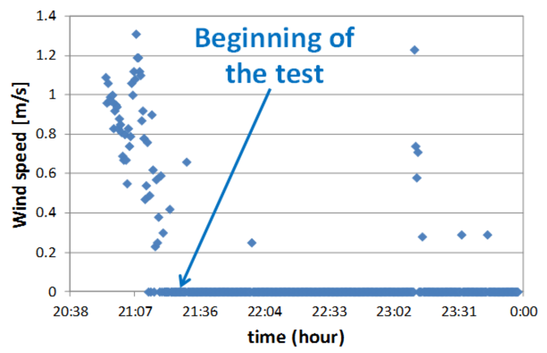
Comparison with exp results [3] is satisfactory.
Critical wind speed for backlayering correctly predicted [2.2 vs 1.9 m/s]

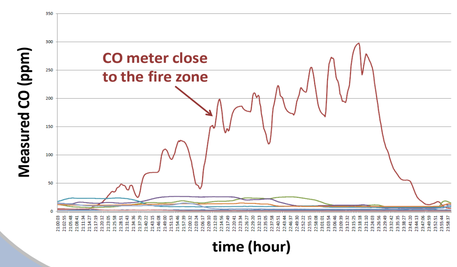
Fire Scenario #3 (San Bernardo tunnel Test)





map of the fire scenario and the position of the measuring instruments





Wind speed and CO measurements during the fire test.
Smoke for the firefighters training was obtained burning straw.

The successful comparison with the experimental results support the use of FDS code for the simulation of fire dynamics and for the evaluation of the risk associated with fires in road tunnels.
Moreover, the results of a training exercise of firefighters in the Gran San Bernardo tunnel allowed to effectively evaluate of firefighting procedures, security teams activities, and showed the ability to produce a large amount of smoke to test procedures and materials in severe conditions. New measurement of temperature and flue gases compositions were also made.

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