FIRE NUMERICAL SIMULATION FOR SECURING ROAD INFRASTRUCTURES

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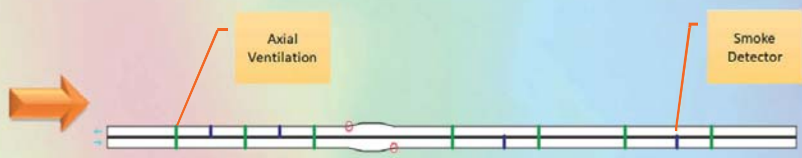
- Modelling geometry and installation of fire detection and ventilation facilities

We operated the modelling using Fire Dynamics Simulator (FDS) of the «Condò» Gallery in Lecce, Italy. To simulate the scenario all the geometry of the gallery has been considered, both the tubes, in order to evaluate the possibilty that smoke could enter back the other tube. Thus, some semplifications have been applied on geometry: curves have been approximated rectilinear since FDS doesn't allow modelling curves and longitudinal slope has been negleted. Ventilation is the typical one of emergencies so the activation of the fans happens after smoke detection.



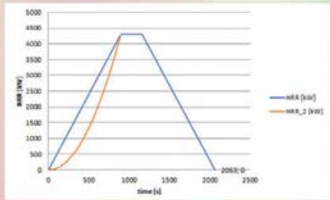
- Fire scenarios

SCENARIO	TYPOLOGY OF VEHICLE	ENERGY CONTENT (GJ)	PEAK HRR (MW)	TIME OF PEAK HRR (min)
SCENARIO_1	CitroenBX,1986	5	4.3	15
SCENARIO_2	Small car + Large car	7.9	7.5	13

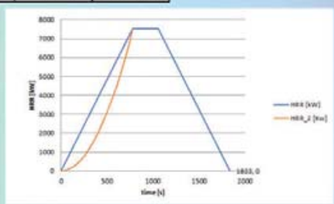
The burner has been tested in the most critical scenario, that is near the emergency exits. Two different fire dynamics have been picked out, considering different release rate value.

- Features of fire scenarios

SCENARIO	t (s)	$\dot{Q}$ (kW)	α
SCENARIO_1	900	4300	0.005309
SCENARIO_2	780	7500	0.012327



SCENARIO_1: coefficient of growth due to a slow growing fire.



SCENARIO_2: coefficient of growth due to an average growing fire.

- The runs in post-processing phase

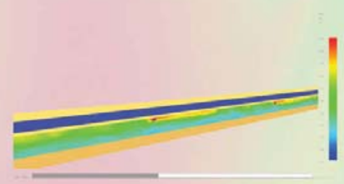
In the development of fluid-dynamic simulation the results for different meshes with different grid steps are evaluated. Such evaluations are called Sensitivity analyses, during which occur that the results obtained from simulation are not excessively influenced from the resolution of the calculation grid that has been used.
Once the runs have finished, run 8 and 10 have been chosen as object of post-processing phase, respectively corresponding to scenario 1 and 2, considered optimal in the result satisfaction / computational burden ratio.

RUN	DESCRIPTION	IJK	STEP [m]	N°CELL
RUN_8	Complete model analysis, partition in 20 meshes, 1 car.	51x10x30 (x20)	1	306000
RUN_10	Complete model analysis, partition in 20 meshes, 2 cars.	51x10x30 (x20)	1	306000

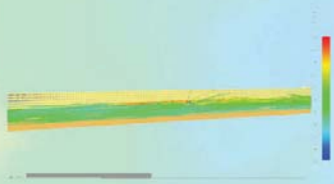
- Results of post-processing

RUN_8: Output of SOOT MASS FRACTION after 508 s of simulation.

RUN_8: Output of SOOT MASS FRACTION after 1376 s of simulation.



RUN_8: Output of SLICE OF VELOCITY after 1804 s of simulation.

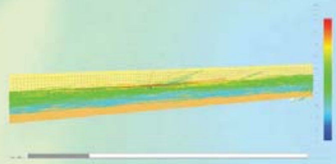


RUN_8: Output of MULTI-SLICE VECTOR OF VELOCITY after 1804 s of simulation.

RUN_10: Output of SOOT MASS FRACTION after 404 s of simulation.

RUN_10: Output of SOOT MASS FRACTION after 812 s of simulation.

RUN_10: Output of SLICE OF VELOCITY after 880 s of simulation.



RUN_10: Output of MULTI-SLICE VECTOR OF VELOCITY after 880 s of simulation.