TS/CV/DC CFD Team

CFD Simulation of a Fire in CERN Globe of Science and Innovation

Sara C. Eicher

THE PROBLEM

- The Globe is a spherical shape building made mainly of wood, with a crown vortex placed at its top. It consists of two floors and a basement room.
- The building is fitted with fire sprinkler, ventilation and smoke extraction systems.
- Current emergency strategies to control smoke spread and evacuation are incomplete due to need to comply with established fire safety regulations.
- In the event of a fire in the first floor, the smoke extractor in place is believed to be inadequate for removal of the hot smoke accumulated in the remaining upper volume of the Globe.

OBJECTIVES

- To evaluate the performance of current emergency smoke extraction strategies of the Globe in the event of a fire.

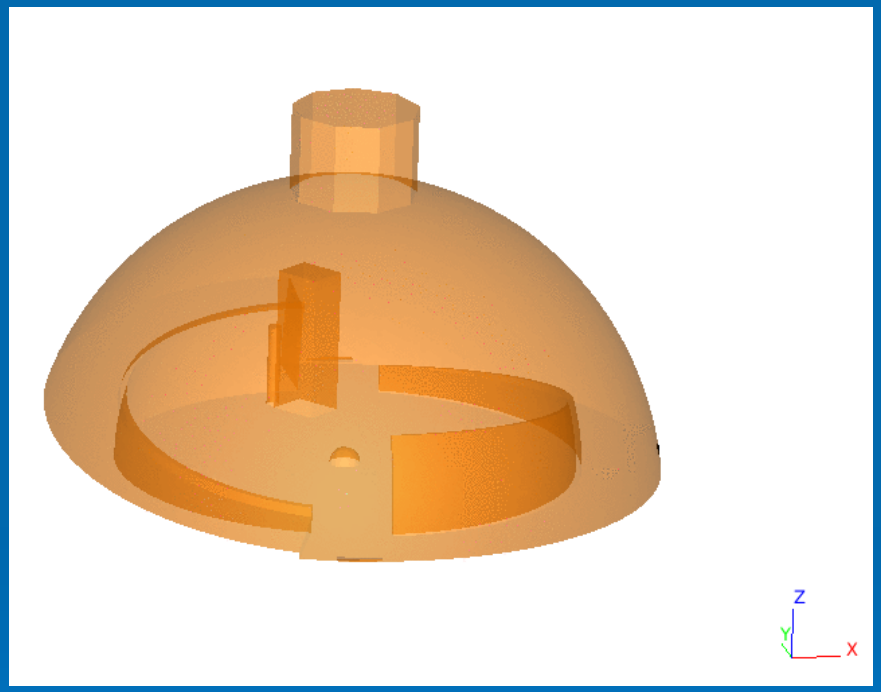
- To evaluate the effectiveness of placing hatches at the central vortex to provide natural smoke evacuation by comparison with the behaviour of the smoke system currently in place.

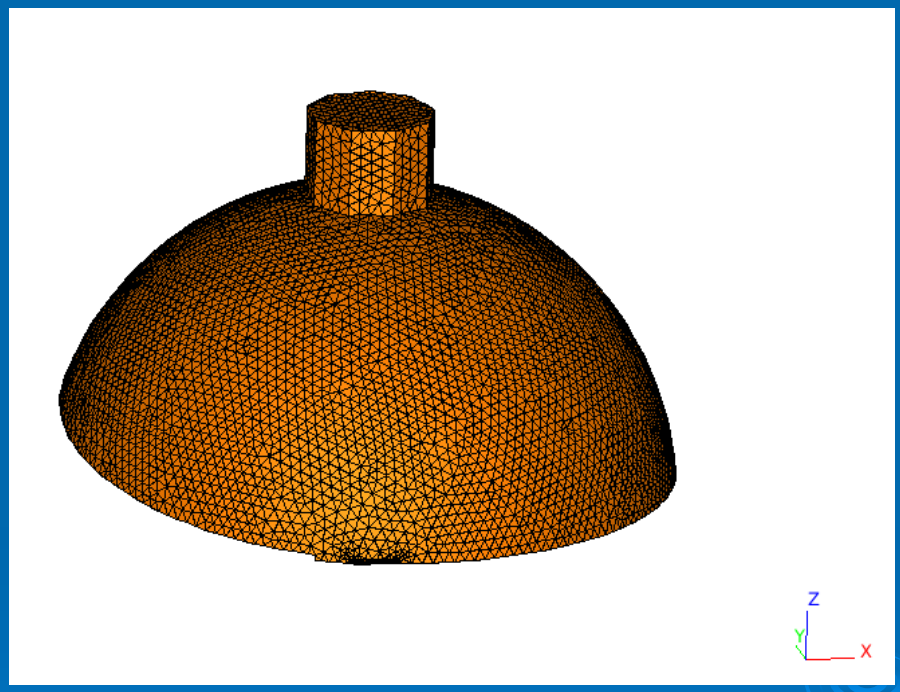
- To optimise the improved smoke evacuation system by investigating the effect of location, size and overall quantity of hatches to be placed within the constraints of the vortex geometry.

THE CFD MODEL

- Only the volume from first floor to vortex crown (included) is modelled.
- The fire is represented by a fluid region where energy and smoke sources are introduced. The combustion process will not be simulated.
- The fire source is assumed to be placed at the middle of the first floor and to increase quadratically in time to a maximum heat output of 250kW/m^3.
- Overall geometry takes into account the lift cage, inner ramp and wall partitions, 2 exit doors and the smoke extractor.
- Fire sprinkler and ventilation systems are not considered.
- Smoke extractor assumed as a mass sink.
- Adiabatic wall conditions.
- Calculation strategy: start from an isothermal steady state solution and use results as initial guess to transient calculation with accounting for the beginning of the fire.

GEOMETRY & MESH



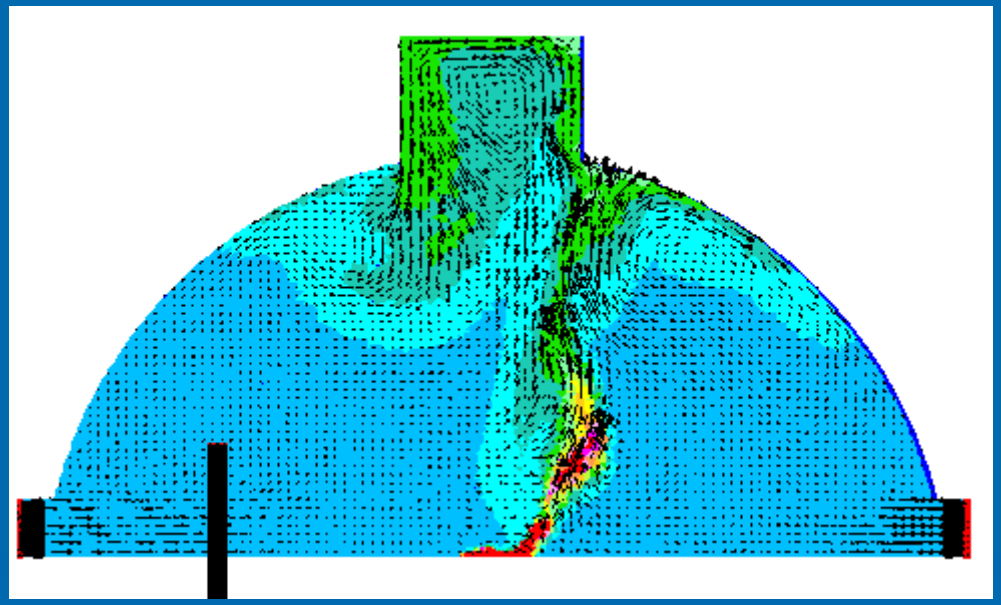


- Tetrahedral mesh containing around 1.6 million cells

EXPECTED RESULTS

- Overall behaviour of the smoke extraction system currently in place, in case of a fire sprinkler failure.
- Flow, temperature and smoke distributions within the room volume.
- Potential improvements in terms of clearing the hot smoke close to the ceiling due to the placing of hatches at the vortex crown.
- Time necessary, from beginning of fire situation, for the sprinkler system to operate.

PRELIMINARY RESULTS



Velocity magnitude field and temperature contours

sara.correia.eicher@cern.ch