CASE STUDY

Atrium Fire Modelling

Task

A numerical simulation of the smoke and heat spreading in an atrium – to be built yet – was carried out. The atrium will be created between two existing buildings. According to the customer's request, a local fire and its smoke evolution in the atrium on the 2nd floor was modelled.

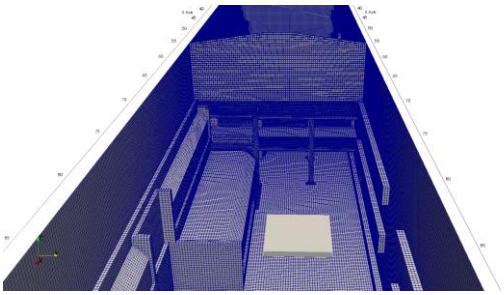


Fig.1 Computational Model

Methodology

The architect's three-dimensional model served as the basis for the creation of the model. The model consists of the perimeter walls of the buildings, ceiling and the roof. The supply of fresh air is proposed through eight rectangular channels (5.0 x 1.0) m on one side at the level of the atrium floor and on the other at a height of 3.0 m above the floor. Vents consist of 32 square openings in the roof with a total area of 81.5 m^2. The space is divided by a smoke curtain in the upper part, up to the level of the footbridge railing.

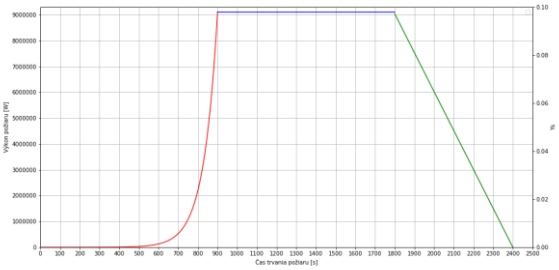
The fire was defined by a fire protection specialist by its heat release rate and smoke production in three phases of its progress according to STN EN 1991-1-2 (73 0035):

I) exponential progress phase 15 minutes,

II) plateau phase 15 minutes,

III) linear deccrease phase 10 minutes, Fig 2

IV) free venting phase 20 minutes.



Obr.2 Fire Parameters

The simulation was performed as unsteady compressible and turbulent calculation.

Results

The proposed design of a natural ventilation of the atrium space with an air intake area of 40 m^2 and an air outlet area of 81.5 m^2 is the result of several simulation runs. The smoke curtain divides the atrium space into two smoke sections DÚ 1 and DÚ 2 at the floor level of the 3rd floor. The proposed solution ensures that adequate visibility and temperature in the lower level of the atrium are maintained. Inlet air flow speeds do not exceed the maximum prescribed value of 5 m/s.

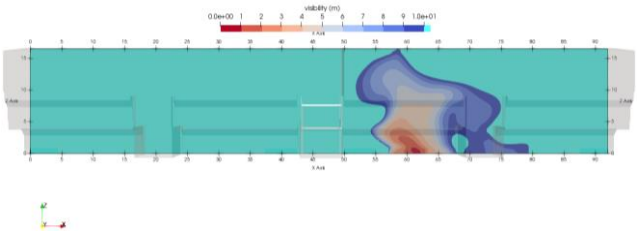


Fig.3 Visibility (m).

The effect of the natural ventilation is influenced by many factors: external weather conditions, location, progress and size of the local fire. Further, the correct operation of technical equipment, fire brigade performance, as well as the geometry and topology of the space itself.

The results are therefore valid for the selected set of initial and boundary conditions, fire development parameters and not for all possible states.

The resulting uncertainty can be reduced by the utilization of technical means: fire flaps and ventilators, thereby forcing the controlled removal of heat and combustion products of the fire.