CFD Modelling Study of Mechanical Ventilation System in Basement Car Park under Emergency Mode

C2D Solutions Pte Ltd

Concepts To Design Solutions

Overview of C2D

C2D Solutions Pte Ltd is a holistic knowledge-based engineering solutions provider with a wealth of experience. We are committed to deliver the most optimal solution based on sound engineering principles..

Problem Statement

The main purpose of a ductless mechanical ventilation systems for a car park in a fire situation is to achieve acceptable level of fire safety requirements within the enclosure.

Challenge

It is assumed that a car catches fire in the car park and the fire size grows to a size of 4MW and continues to burn for 20mins. During this time the ductless MV system must ensure that the smoke temperature and visibility at a height of 1.7m from the floor level are ≤ 250°C and ≥ 5m respectively. A sensitivity study also needs to be considered to show the impact of one group of jet fan failure nearest to the fire.

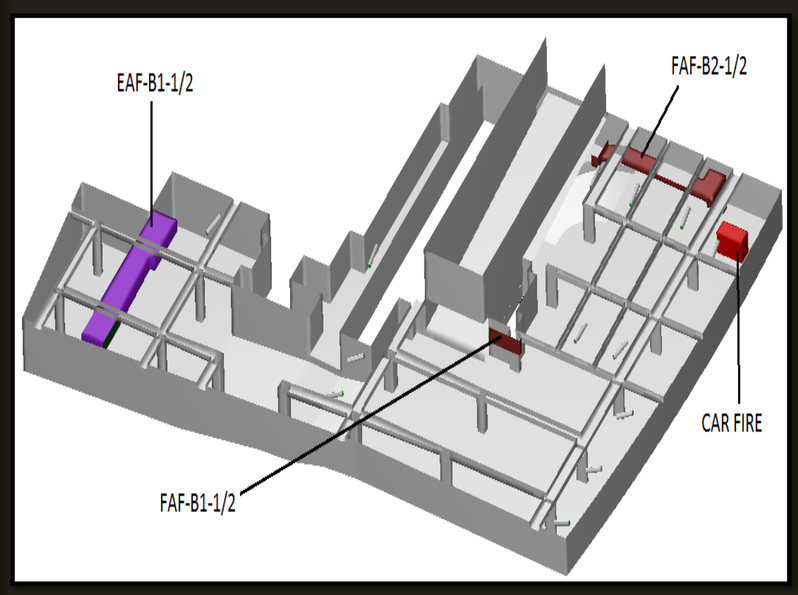

Fig 1: Computational Domain of Basement 1 Car Park

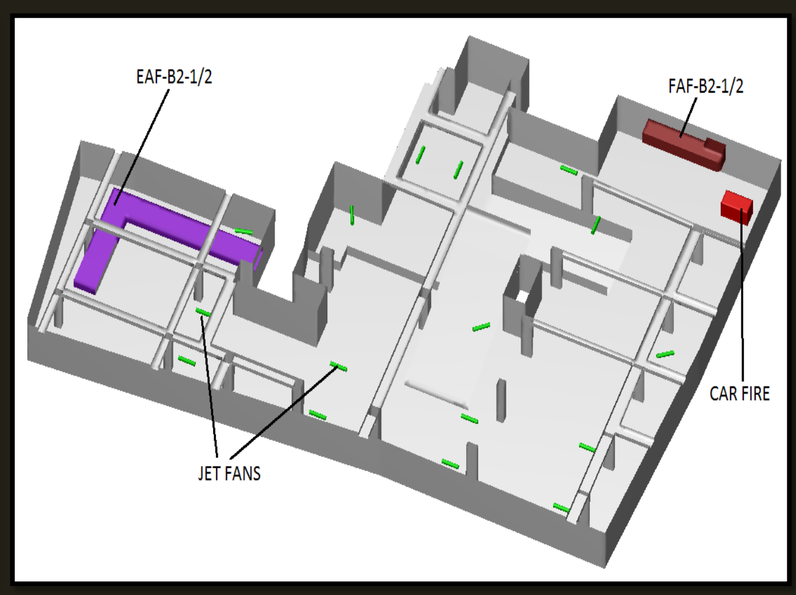

Fig 2: Computational Domain of Basement 2 Car Park

Solution

Computational Fluid Dynamics (CFD) fire simulation was used to model a 4MW car fire in the car park for 20mins. The CFD results will be used to predict the flow field, visibility and temperature at average human head level of height 1.7m. This is to establish how effectively the ventilation system can manage the smoke in the event of a fire.

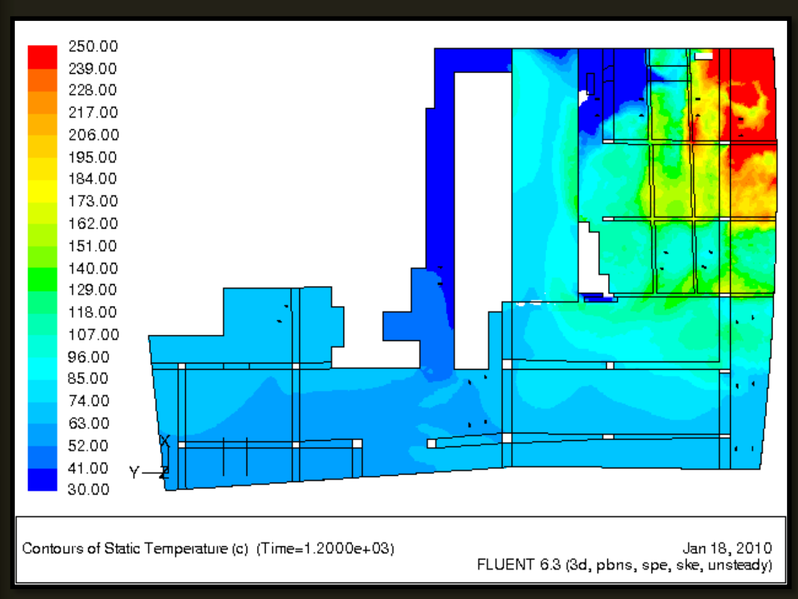

Fig. 3: Basement 1 Temperature Contour at 1.7m Height

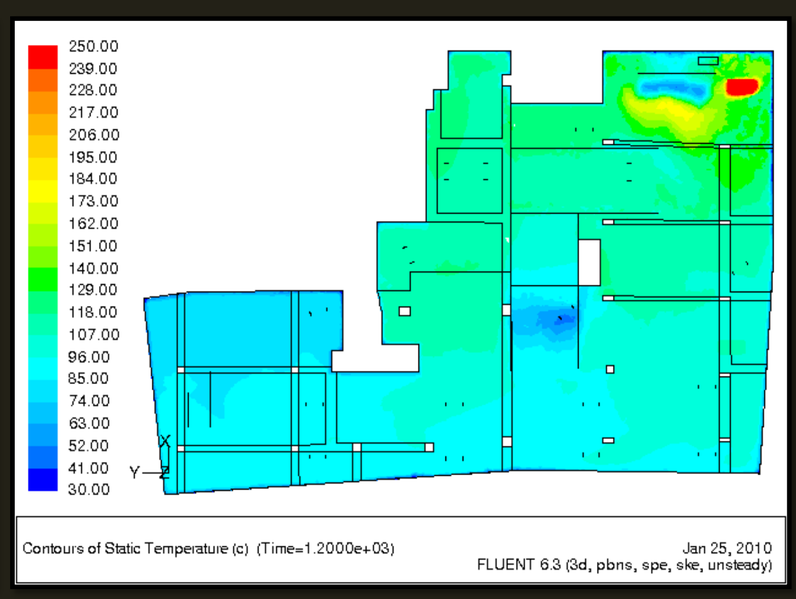

Fig. 4: Basement 2 Temperature Contour at 1.7m Height

Results

The CFD study predicts that the there are no significant stagnation zones within the car park. The visibility within the car park is at least 10m and the temperature is less than 100°C at 1.7m above the floor. The region where the temperature is more than the critical limit is only a small region around the fire, which is expected. Thus, the ventilation system for the car park seems to be adequate.

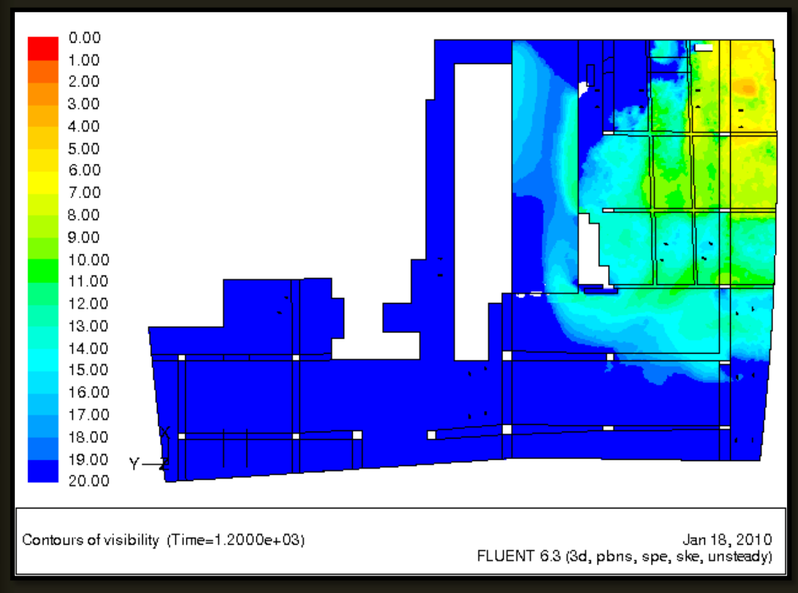

Fig. 5: Basement 1 Visibility Contour at 1.7m Height

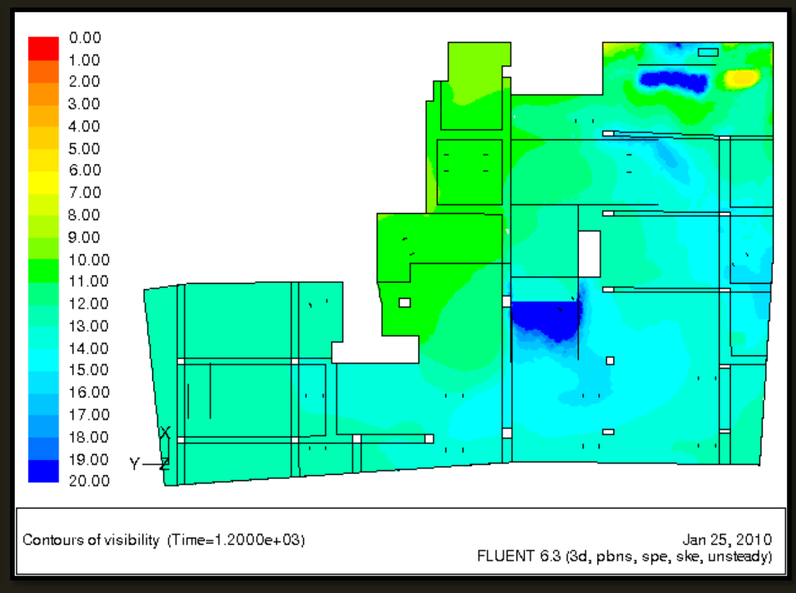

Fig. 6: Basement 2 Visibility Contour at 1.7m Height