Performance Base Fire Engineering Study for a Large Community cum Retail Multi Storey Development with High Atrium

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

Due to non-compliances to the Code of Practice for Fire Precautions in Buildings (2007) for the development a combination of prescriptive approach and alternative solutions supported by performance-based fire engineering analysis was used. The main non-compliance for the multi-storey development is to Clause 7.6.1 for the natural engineered smoke control to the high atrium space.

Challenge

The stipulations under Clause 7.6.1 are to ensure that in the event of a fire, the egress paths are maintained at a tenable condition for at least the duration of evacuation. It is necessary to ensure that the temperature and visibility at 2.5m from any highest habited platform is maintained below 100^{o}C and above 10m respectively.

Solution

After exhaustive discussions with the stake holders, it was decided that a Performance Based Fire Engineering approach will be used to determine if the proposed natural venting and mechanical extract provisions will ensure tenability. As part of the performance based approach, a Computational Fluid Dynamics (CFD) study was conducted to simulate all the potential fire scenarios. The results of the fire simulation were then evaluated to determine the Available Safe Egress Time, ASET for the respective fire scenarios. The ASET is compared to the Required Safe Egress Time, RSET (derived from the evacuation modeling performed separately). The performance design is deemed to pass if the ASET > RSET.

Results

One of the many fire scenarios agreed upon by the stake holders involve a 10MW ultrafast fire at the base of the atrium with a 3.12m/s wind blowing from the SSE direction. The fire was simulated for a duration of 20mins and the temperature and visibility was analyzed during this simulation. At 20mins, the visibility and temperature along the egress paths of the highest habitable floor was within tenable limits. Therefore, the ASET was conservatively taken as 20mins. The RSET obtained from the evacuation model was 6.4mins; therefore the performance design was deemed to pass and adopted as the final design.

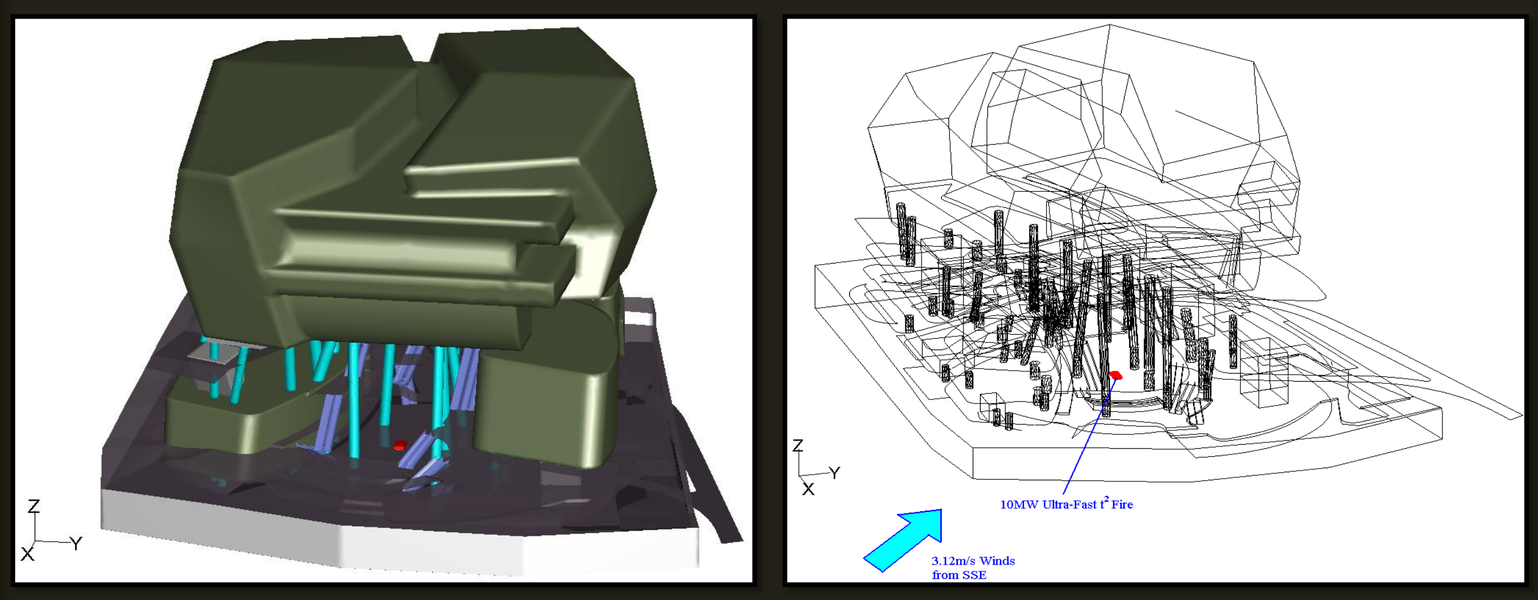

Fig 1: Computational Domain of Multi-storey with High Atrium

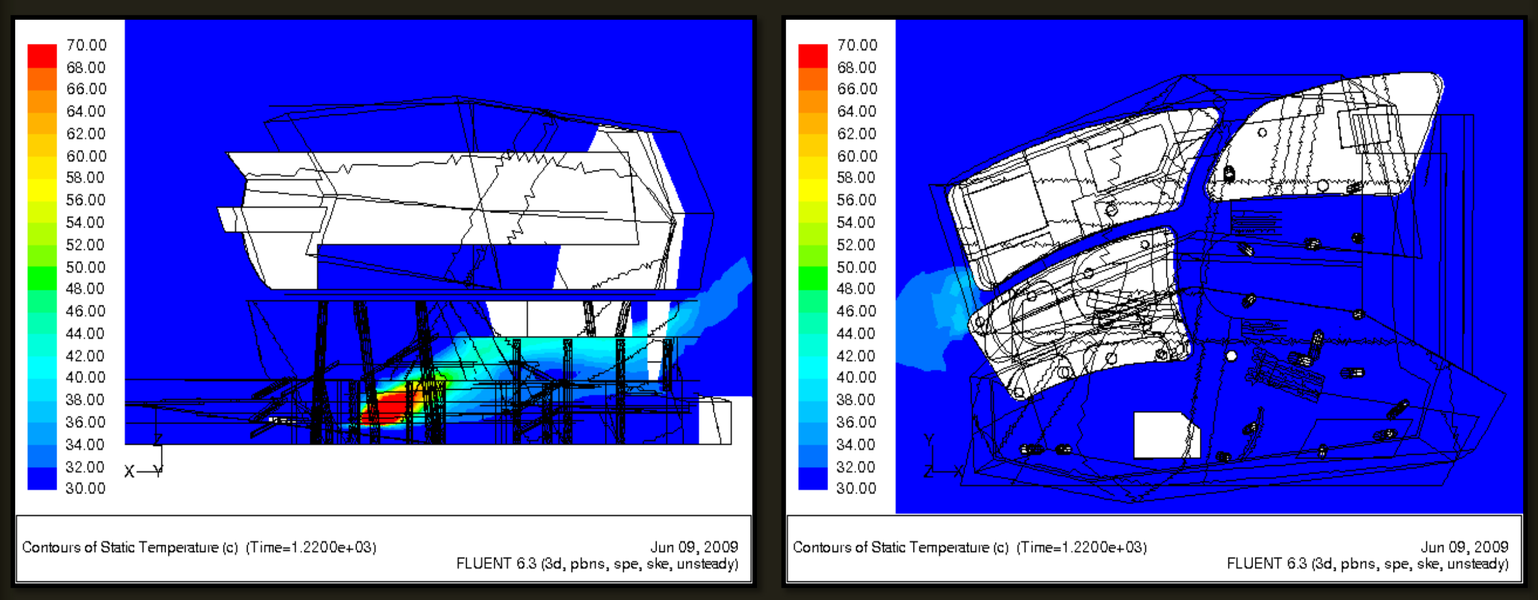

Fig. 2: Temperature Contour along Longitudinal Vertical Plane and at 2.5m above Level 4 at 20mins after start of fire

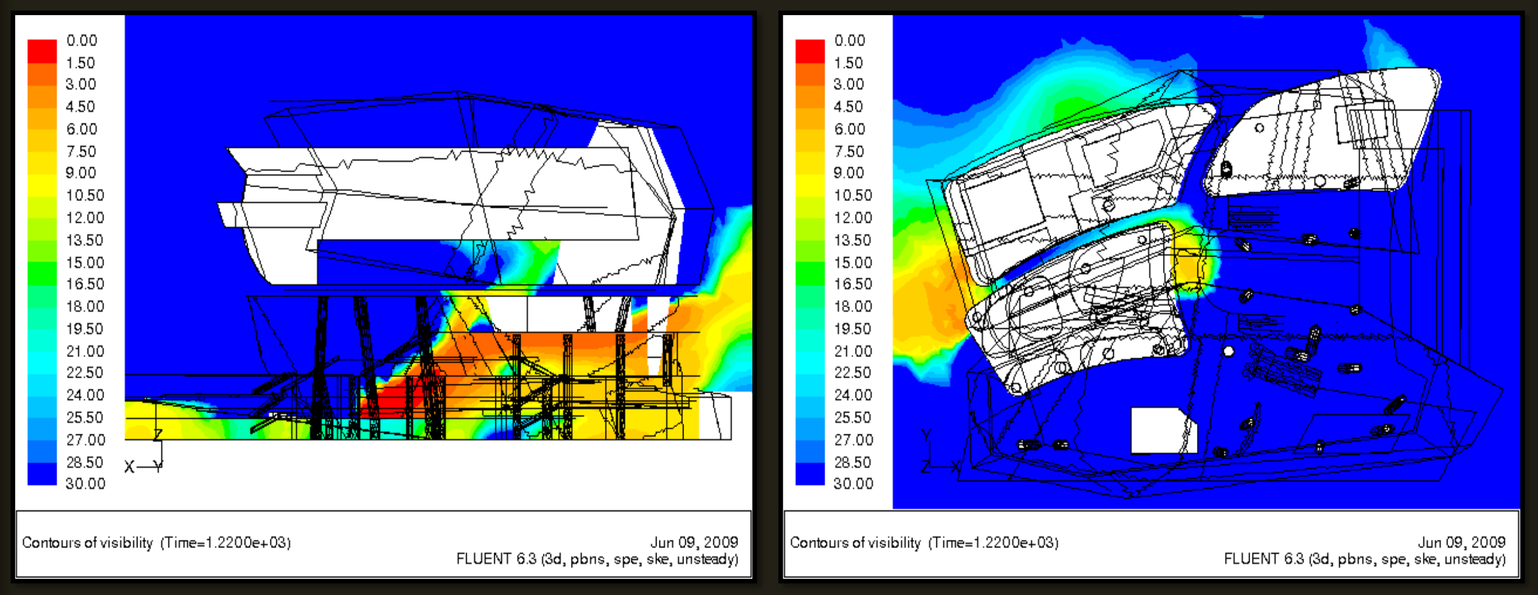

Fig. 3: Visibility Contour along Longitudinal Vertical plane and at 2.5m above Level 4 at 20mins after star of fire