Performance Based Fire Engineering Study of a Train Depot

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

A single-storey train depot is used for general maintenance and storage of commuter trains. As the building floor area exceeds 5000m^2, the building must be installed with an engineered smoke control system (Singapore Fire Code clause 7.5.1).

Challenge

In order to conform to the prescriptive fire code, the smoke reservoir size cannot exceed 2000m^2 and each reservoir must be served by adequate smoke venting louvers. Due to operational requirements (overhead crane system), it was not possible to provide smoke barriers to limit reservoir size to less than 2000m^2. Therefore, all stakeholders agreed to use a Performance Based Design approach.

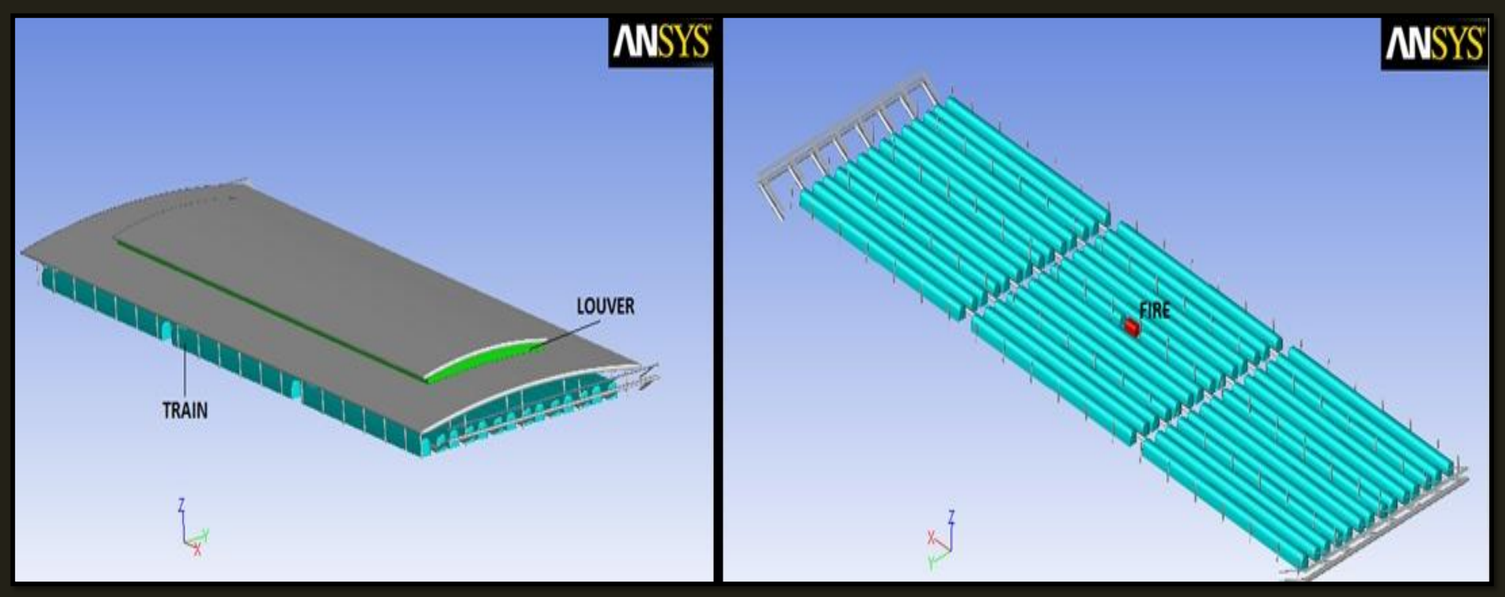

Fig 1: Computational Domain of the Train Depot

Solution

The root objective of a performance based design approach is to ensure tenable conditions for evacuation. The performance criteria is Available Safe Egress Time (ASET) > Required Safe Egress Time (RSET), i.e. visibility > 10m and temperature < 100^{o}C at 2.5m above highest occupied level during evacuation. Computational Fluid Dynamics (CFD) fire simulations and evacuation studies were used to determine ASET and RSET respectively.

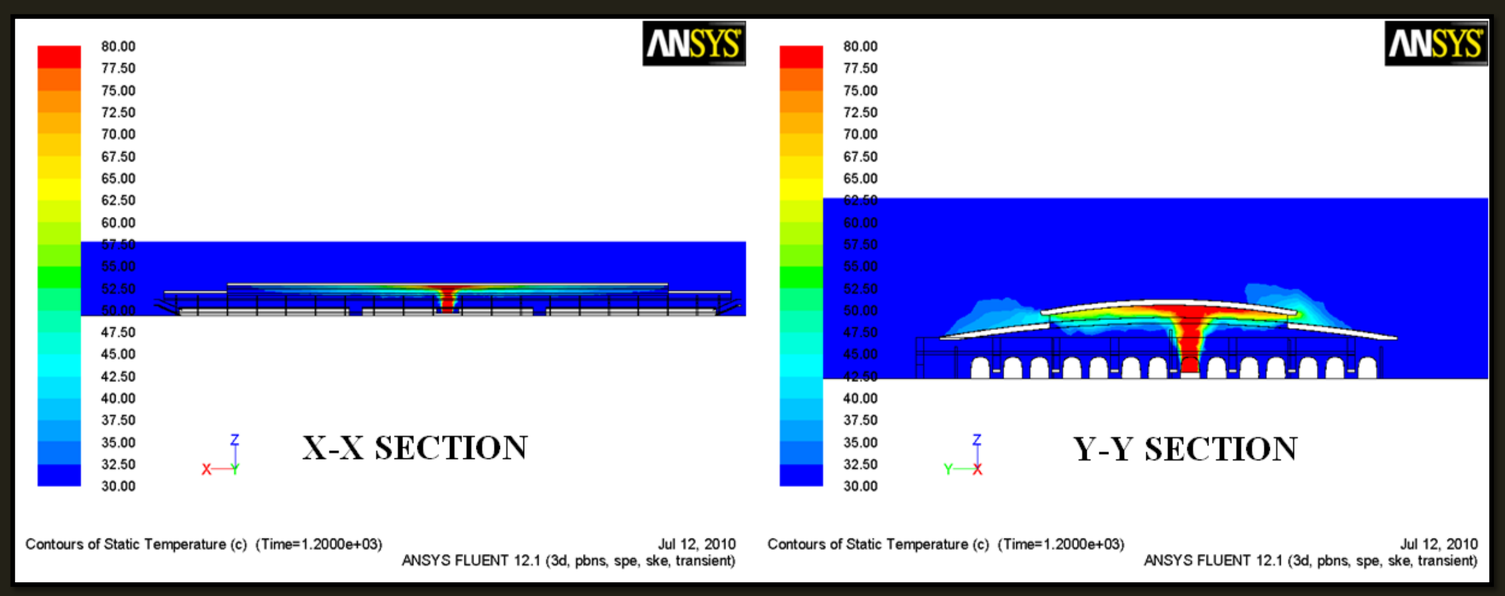

Fig. 2: Temperature Contour at sections through Fire Source

Results

CFD was used to simulate a train fire for 20mins. The results show that (at 20mins), visibility > 10m and temperature < 100^{o}C at 2.5m above highest occupied level (i.e. ASET ≥ 20mins). The predicted total evacuation timing for the depot was 8mins (i.e. RSET = 8mins). Since ASET > 2 x RSET, it is clear that the proposed Performance Based Design ensures Life Safety of the occupants.

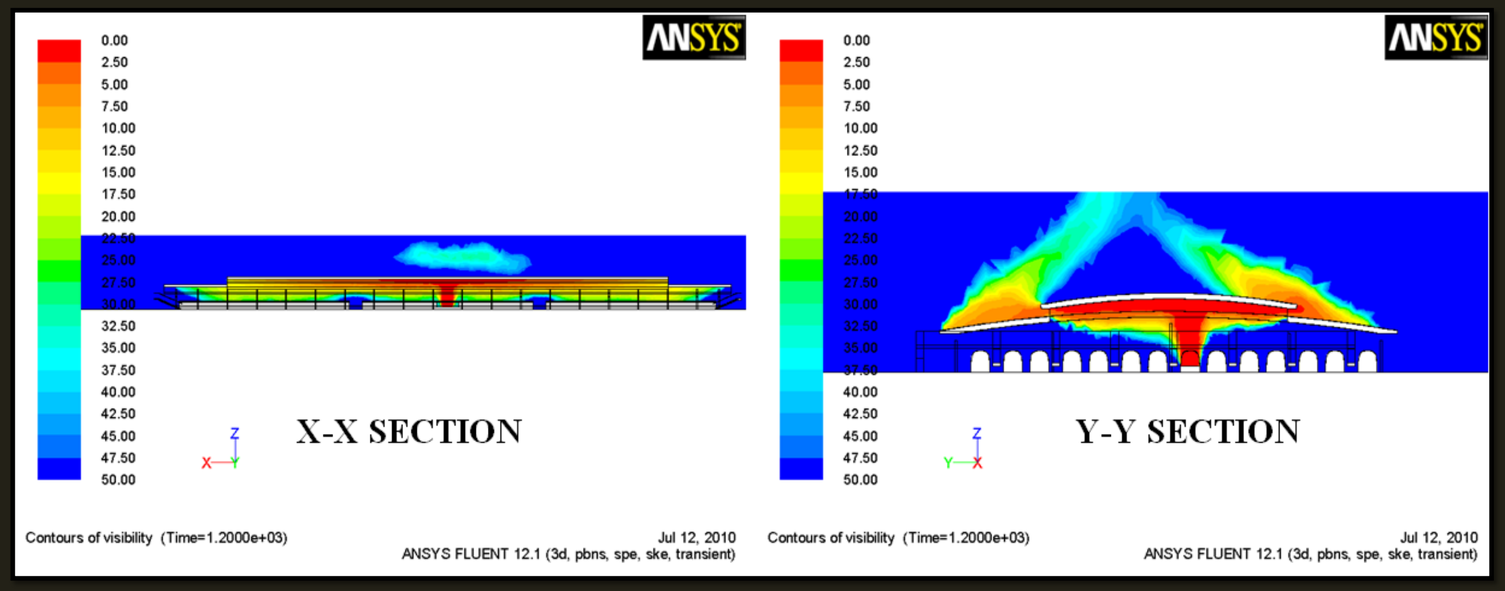

Fig. 3: Velocity Contour at sections through Fire Source