# Update On Performance-Based Fire Safety Engineering System

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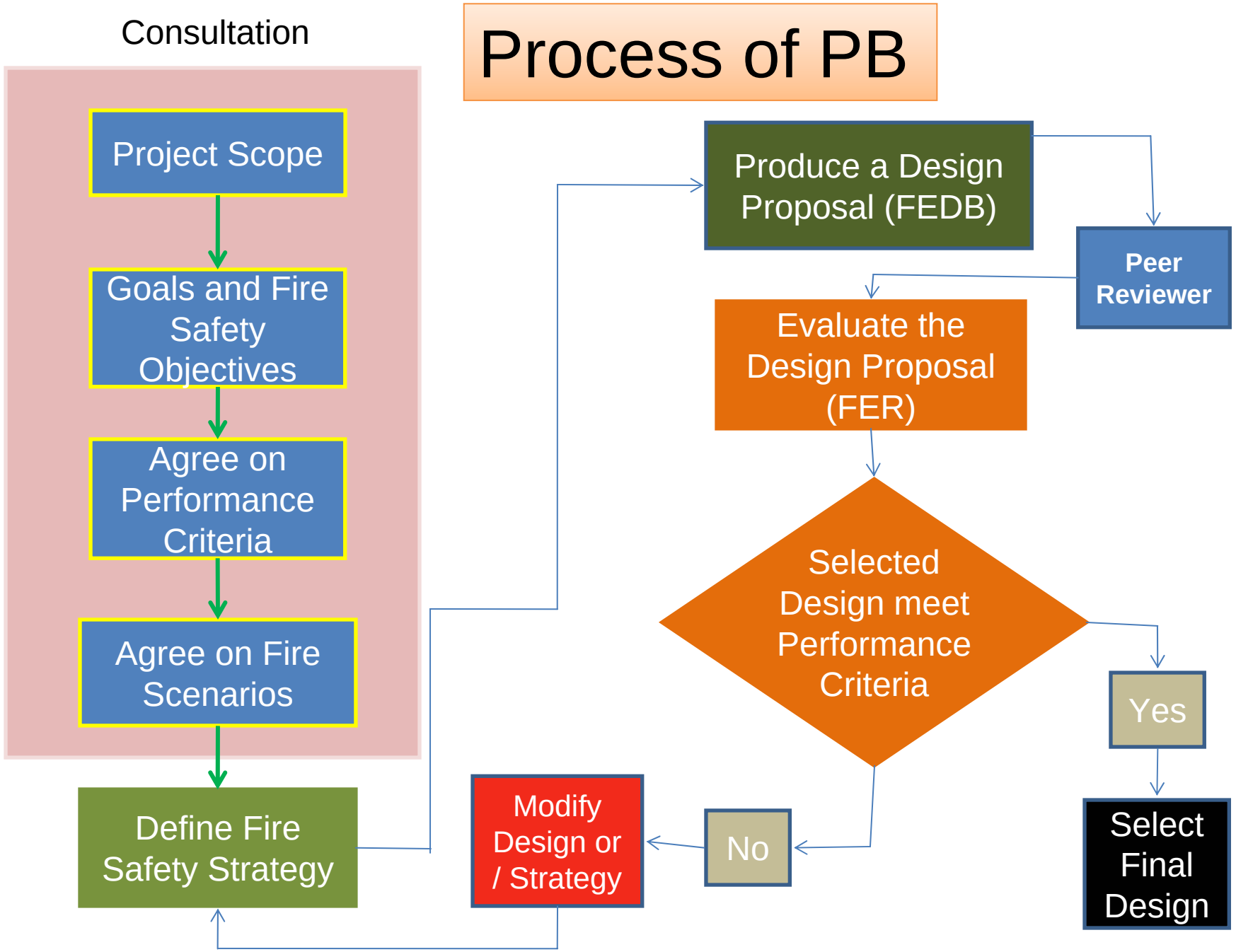
# Scope of Presentation

- Introduction
- Insight on Projects involving Performance Based Design
- Major Factors influent the adoption of PB
- Challenges in PB Design
- Conclusion

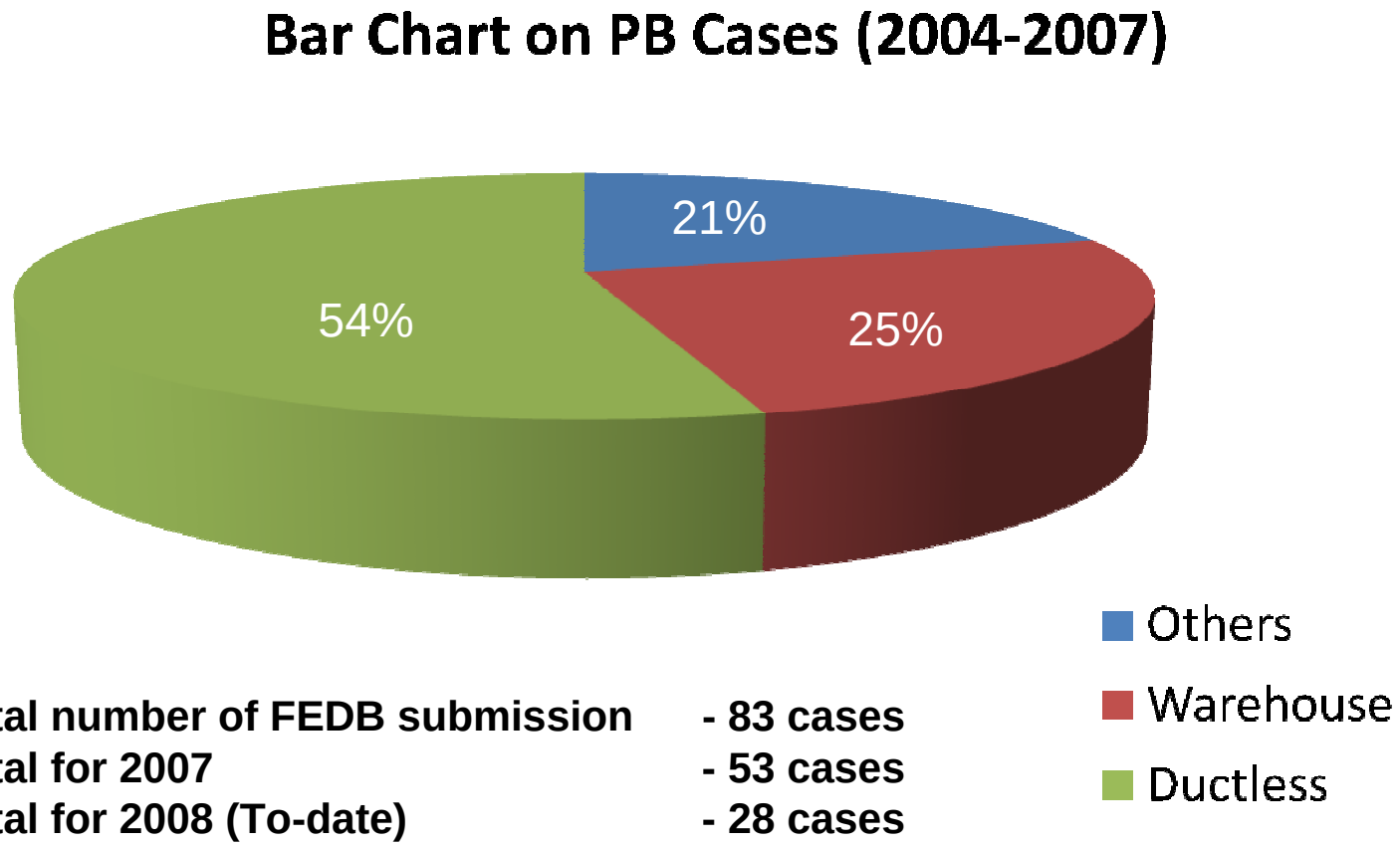
# Introduction

- Performance-based fire safety design was implemented on 1 July 2004
- Till date total of 63 Fire Safety Engineers

# Process of PB



# Statistics of PB Cases Sorted by Project Type




**Total number of FEDB submission - 83 cases**
**Total for 2007 - 53 cases**
**Total for 2008 (To-date) - 28 cases**

# Scopes of PB Design

- Warehouse – Smoke Control >5000m2
- Car Park Purging – Use of ductless fan system
- Means of Escape – Discharge of Staircases
- Element of Structure – use of unprotected steel structures
- Smoke Control – Smoke reservoir size

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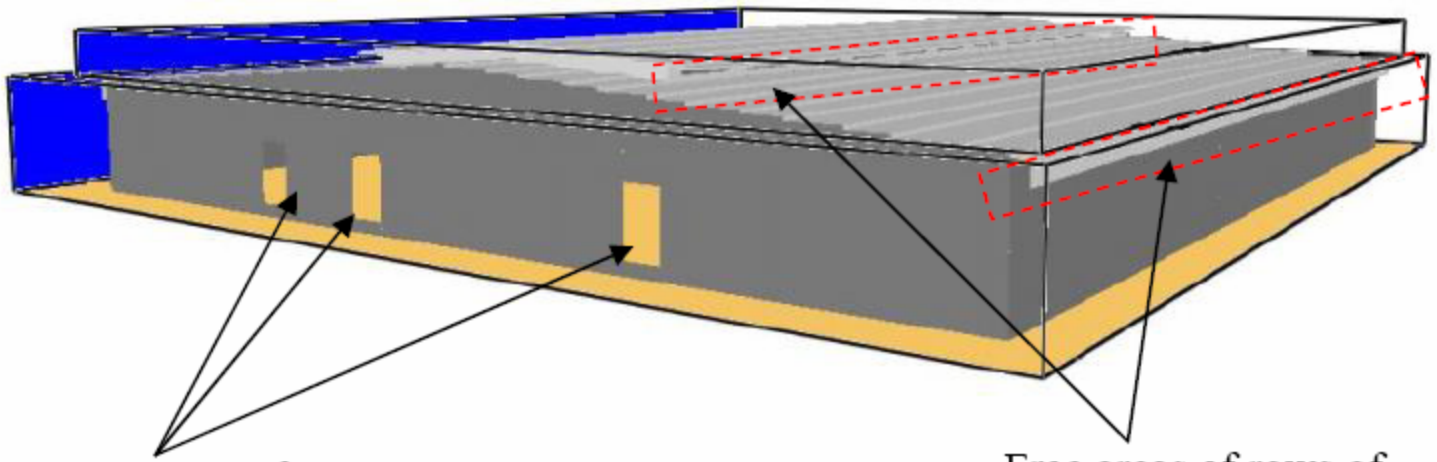
Smokeview 4.0.7 - Mar 12 2006

# Typical Warehouse with Smoke Control via Smoke Vents



Free areas of 3 shutters modelled

Free areas of rows of vents facing elevation 2 and 4 modelled

mesh: 1

# Scopes of PB Design

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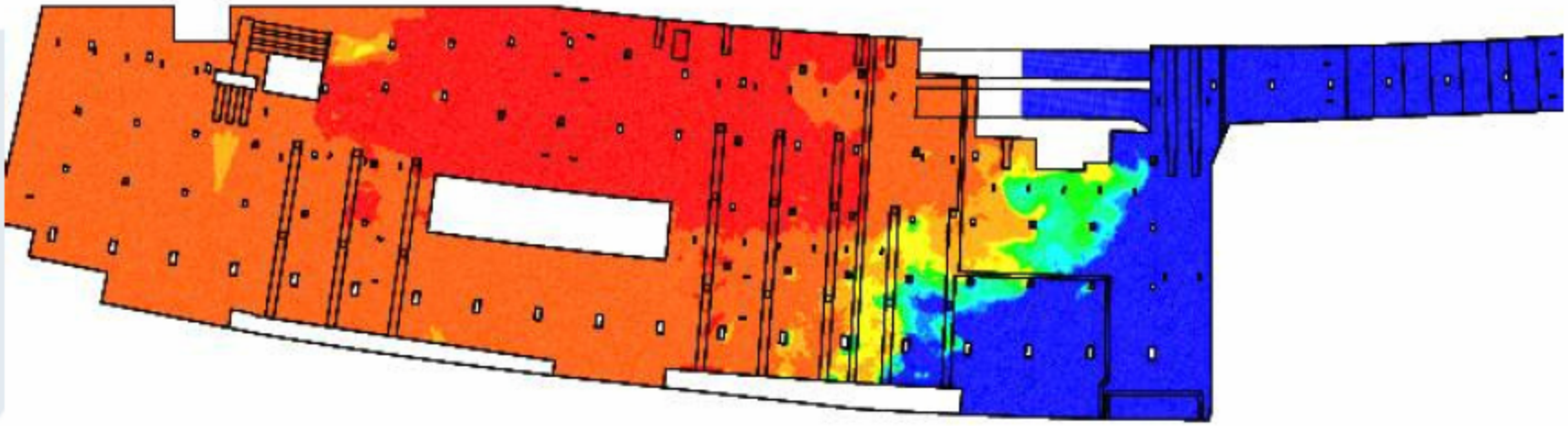

Typical Basement Smoke Purging System

Visibility @ 1.7m height

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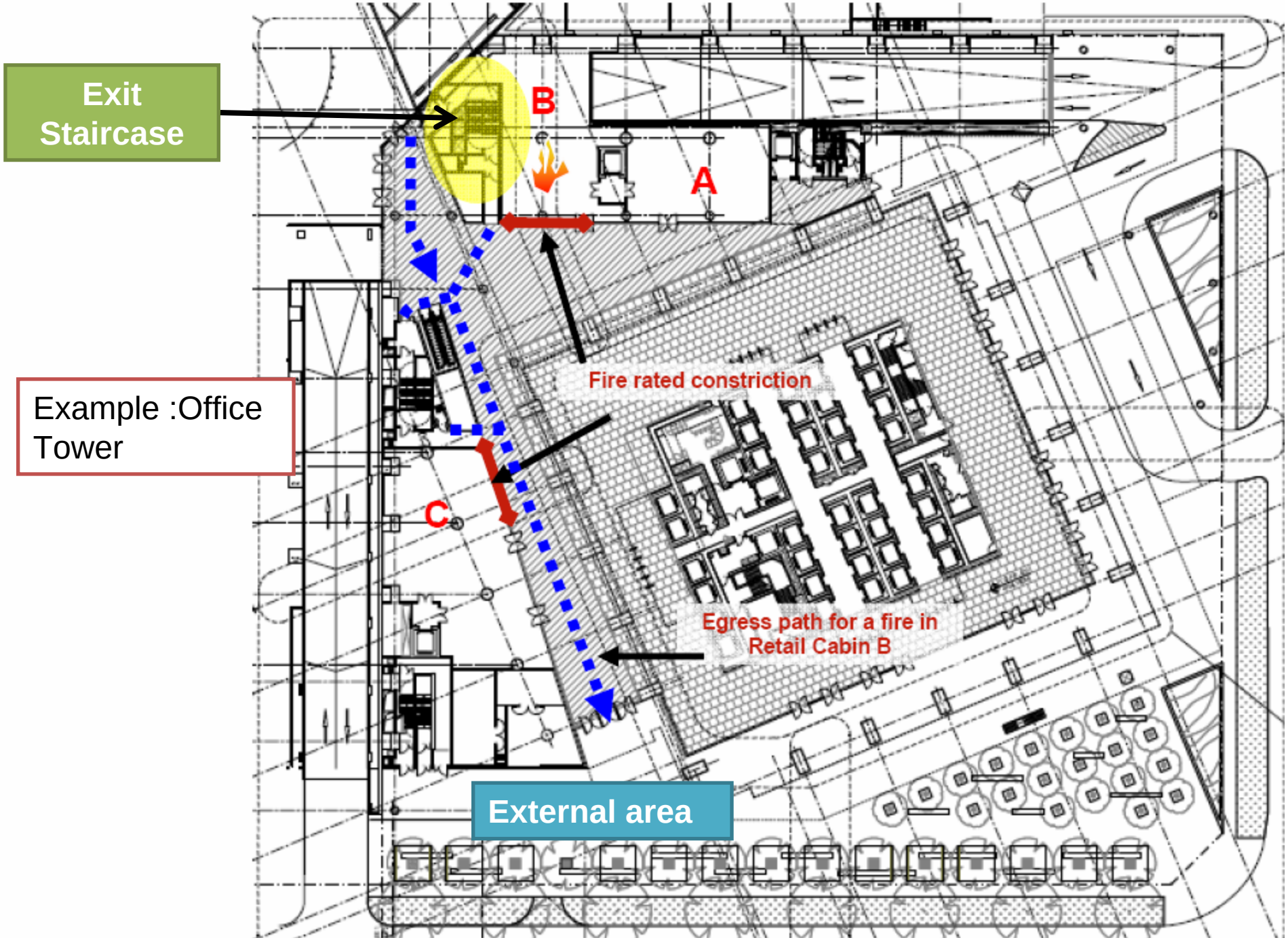
Exit Staircase
Example :Office Tower
B
A
C
Fire rated constriction
Egress path for a fire in Retail Cabin B
External area

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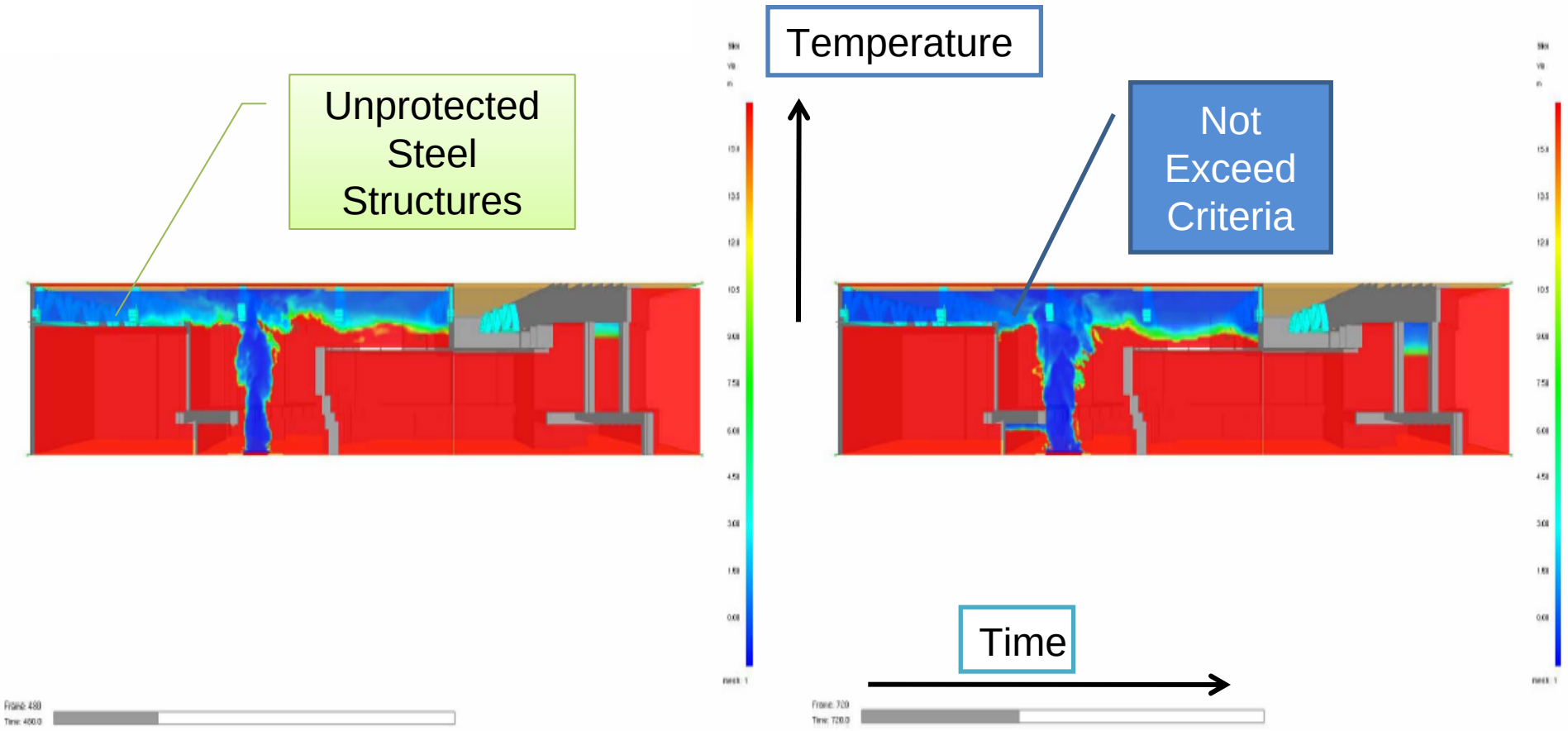


# Use of Simulation on Unprotected Steel Structures

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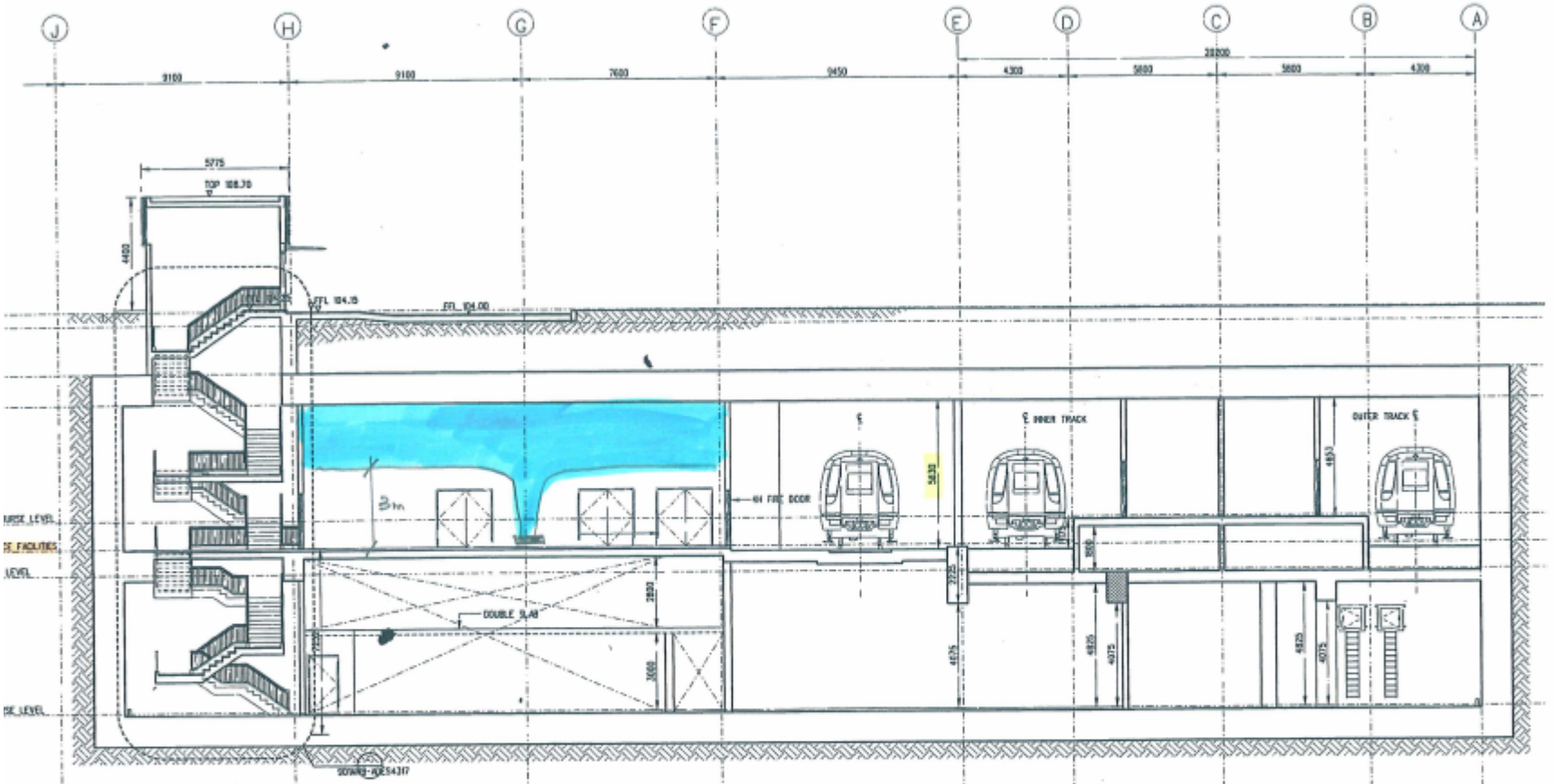



Smoke Management with Extended Smoke Reservoir Size

Figure 3

SECTION J–J

SECTION KEY PLAN

01-06

FOR ACC

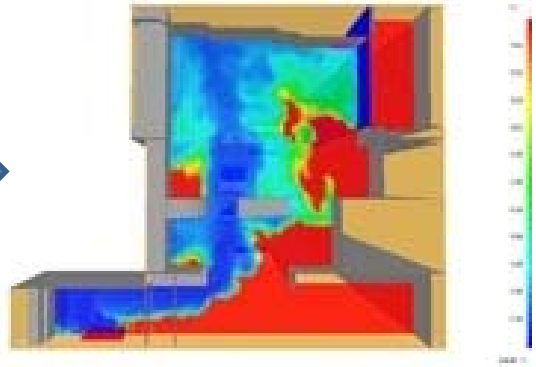
FINAL SU

Qualified Person Endorsement :

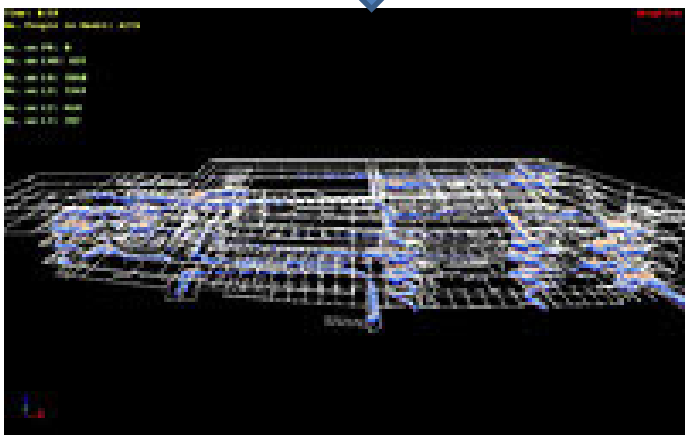
Consultants :

# NTUC Hub Project



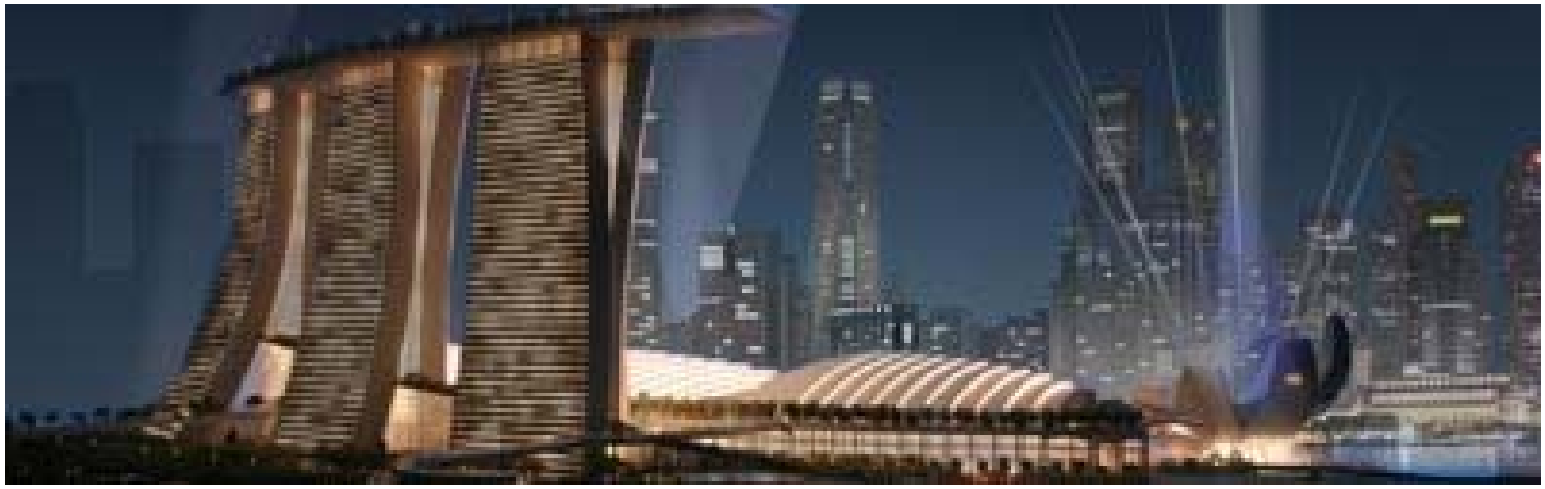


Use of Fire Simulation for Use of Unprotected Steel Structures



Use of Evacuation Simulation for Exit Capacity

# Marina Bay Integrated Resort





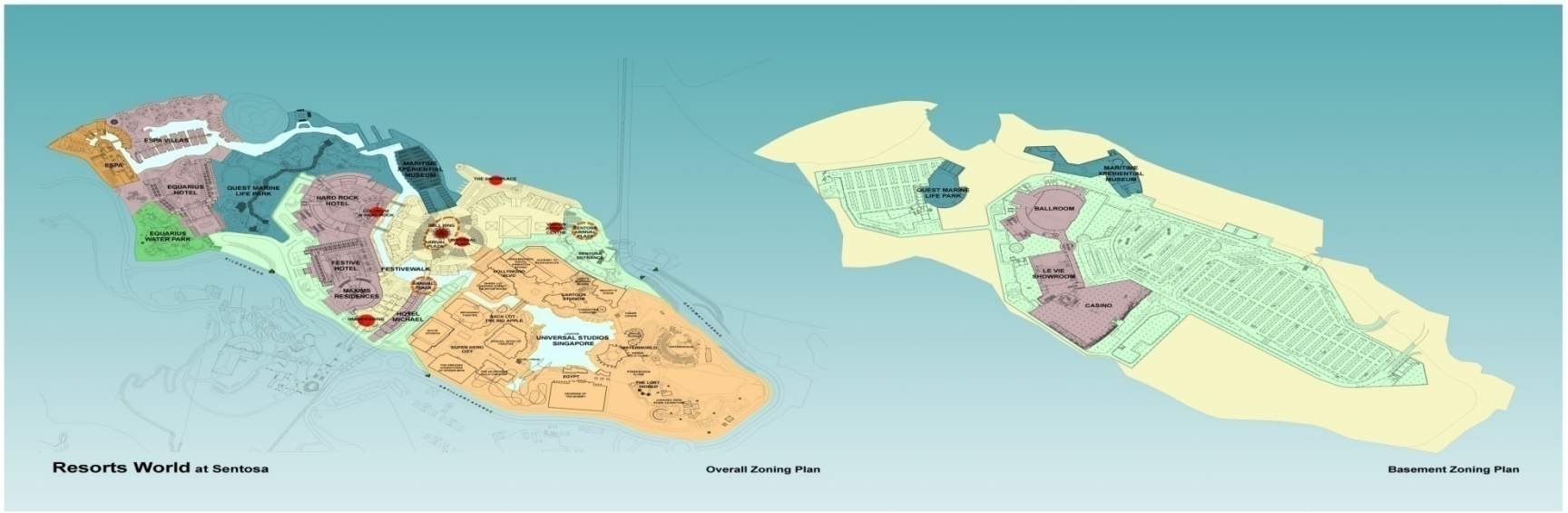
Scope of Performance based Included:

-Evacuation Modelling

-Fire Management Modelling

-Car Park Ductless Fan System

# Sentosa Integrated Resort






Universal Globe at Universal Plaza



Entrance to Universal Studios Singapore Along Hollywood Blvd



Hollywood Blvd at Universal Studios Singapore

Scope of Performance based  Included:
-Evacuation Modelling
-Fire Simulation Modelling
-Use of Combustible Roofing Materials

# Sports Hub Project



Scope of Performance based
Included:
-Evacuation Modelling
-Fire Simulation Modelling
-Use of Combustible Roofing Materials

# Major Factors Influent the adoption of PB

- Use of PB to save costs by developer

- Can be used to enable innovative design that the prescriptive code does not cater for

# Cost Saving for Ductless Fan System

| S/no | Range of Car Park Area (m2) | Percentage Saving Over Total Project Costs (percentage) | Estimated Total Costs of Project ($) |
|---|---|---|---|
| 1 | Up to 5,000 | 0% | 200-250K |
| 2 | Above 5000 to 10,000 | 5-10% | 350-400 |
| 3 | Above 10,000 to 20,000 | 10-15% | 700-800 |
| 4 | Above 20,000 | >20% | >1000 |

# Innovations in Design

- **Ductless System**

  -Project costs – equipment (as shown in chart)

  -Shorter installation time compared with ducted system

  -Running costs of system

Note: Running costs does not include maintenance & replacement costs

# Challenges in PB Design

- Simulation tools –how reliable?
- Computation Limitations (CFD)
- Reduce processing time of PB case

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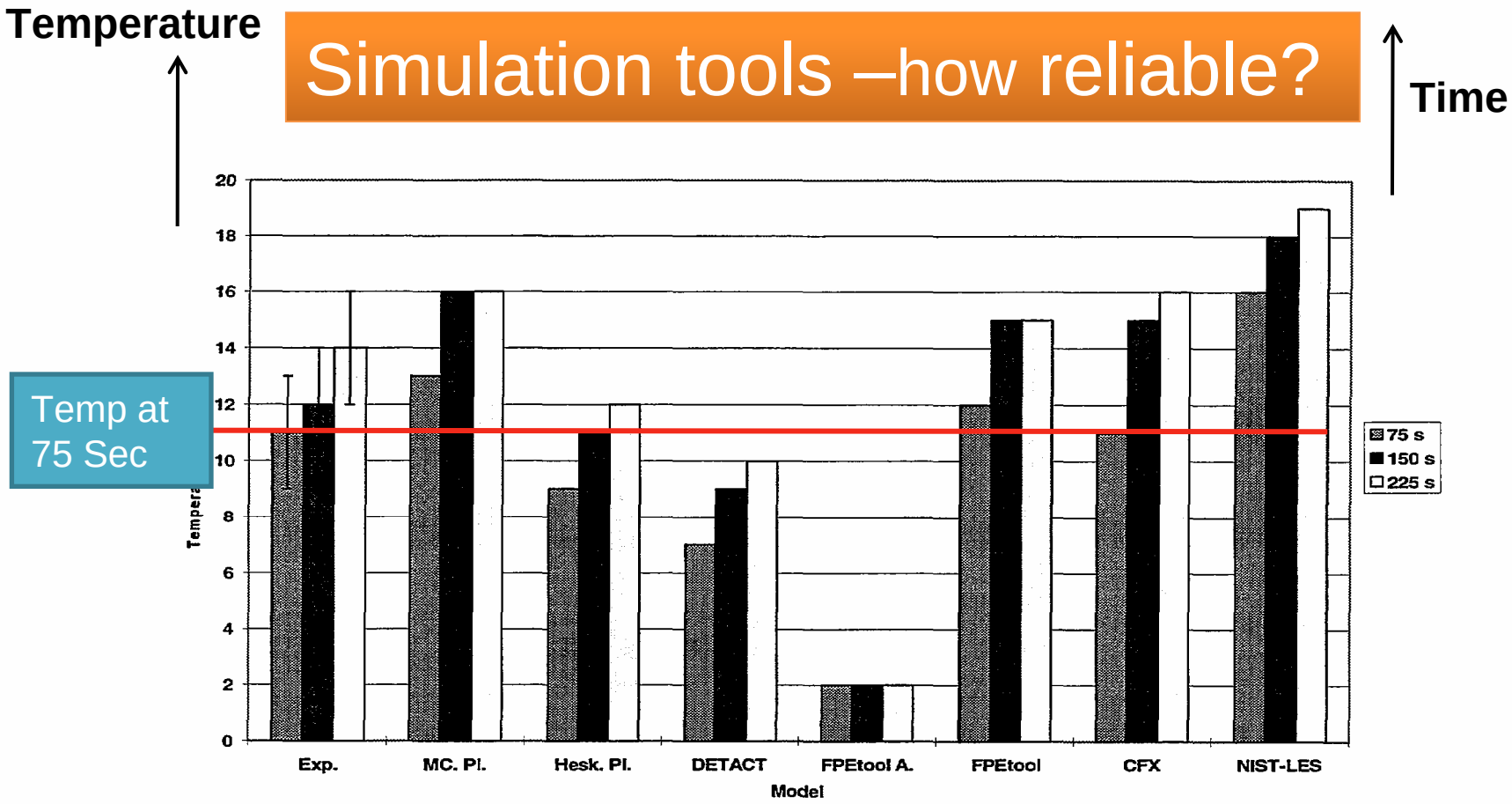
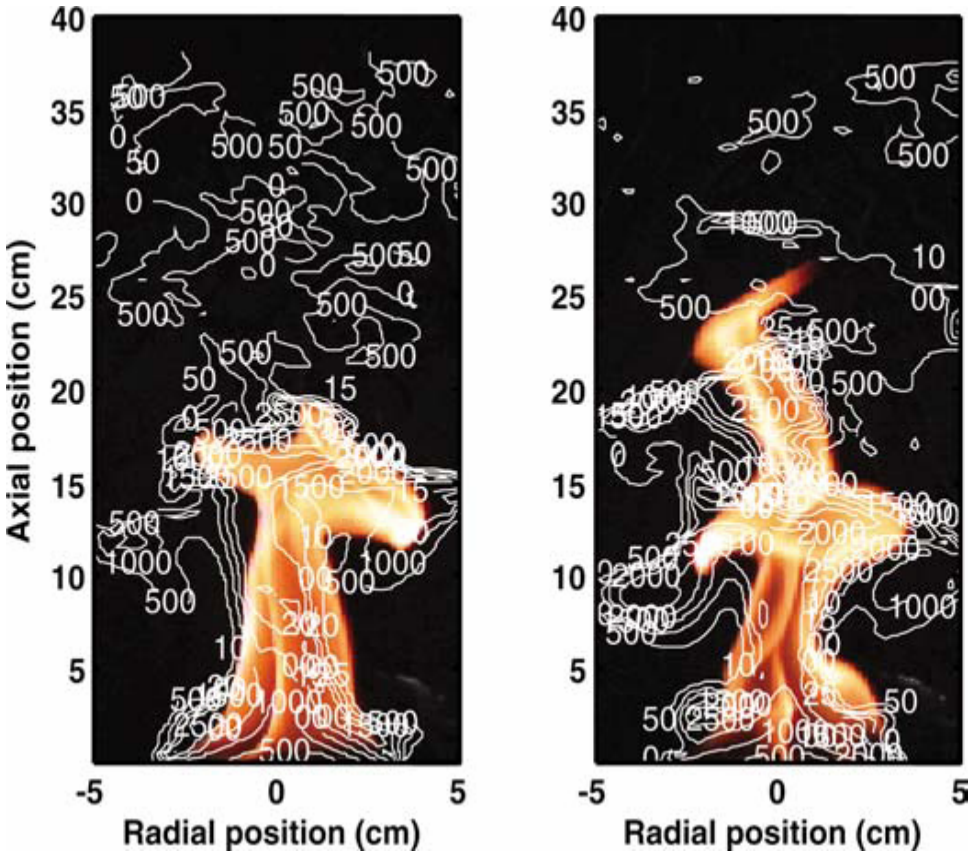
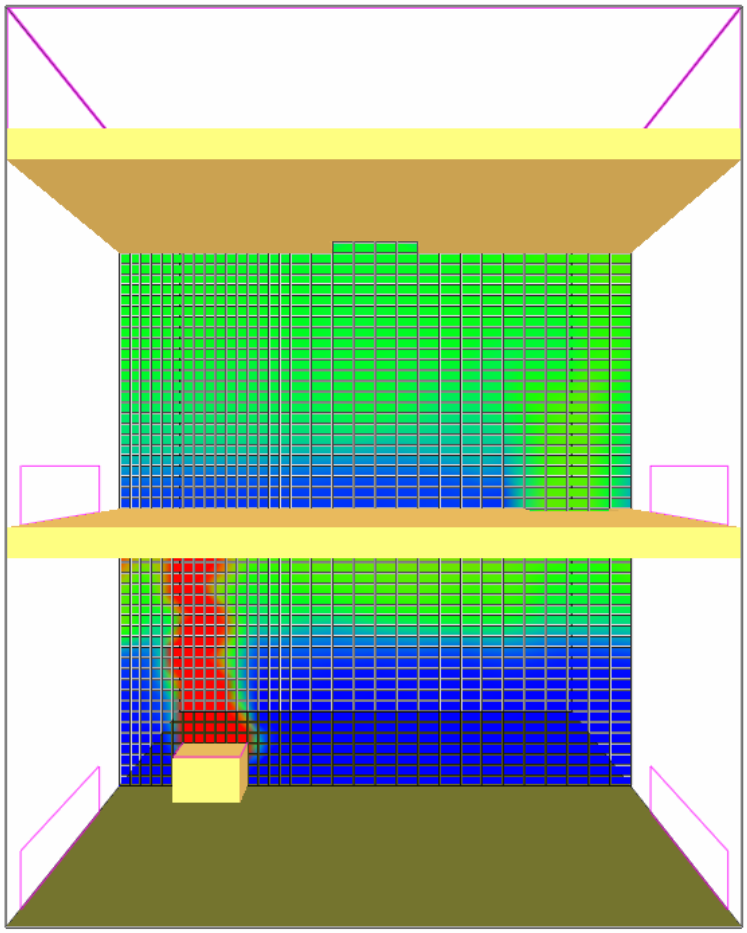



**Chat showing the Different between Actual Plume Centerline Temperature Excess for 500 kW Fire and Modeling Tools**

# Simulation tools –how reliable?



**Good visual presentation but can you believe it..**

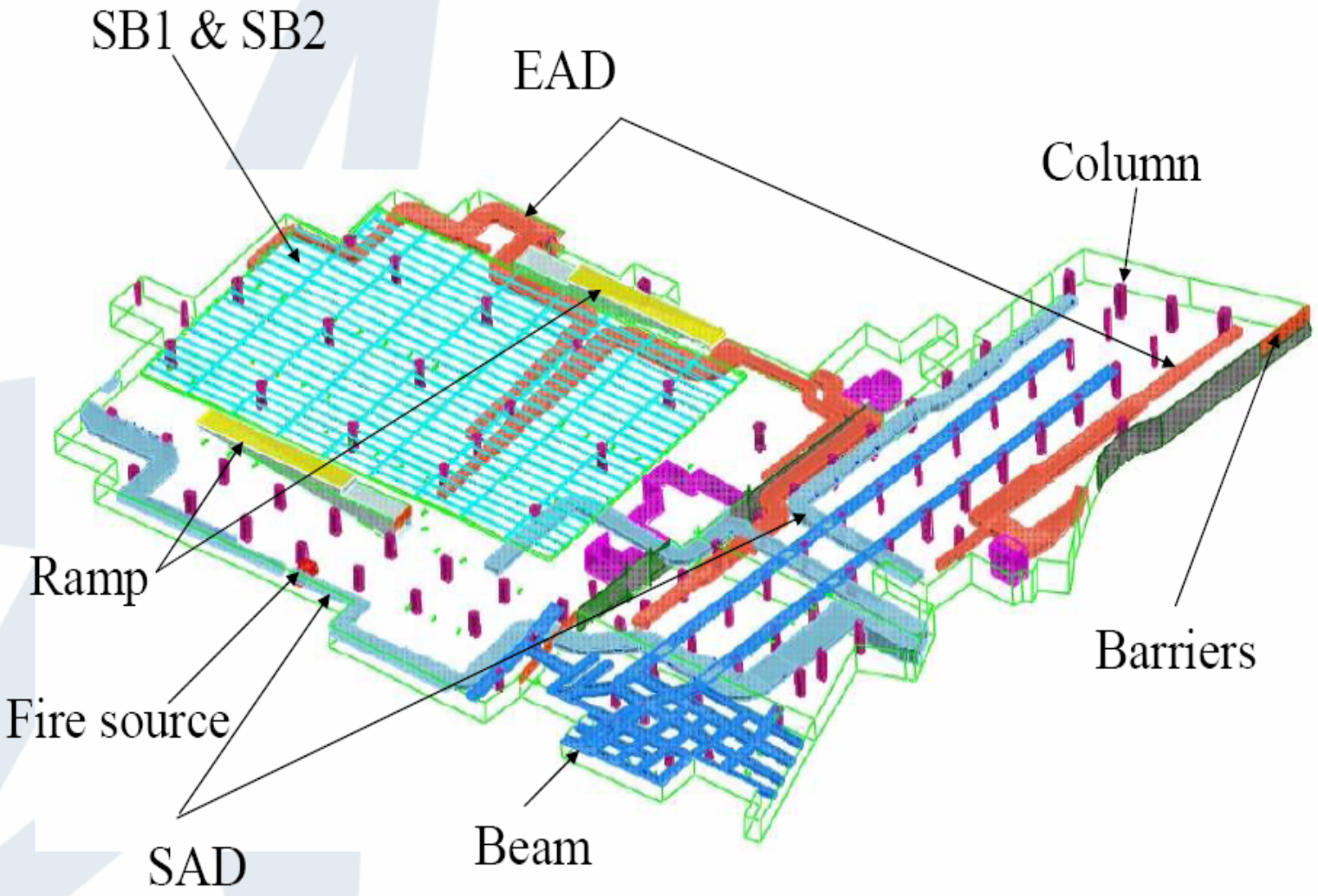
# Simulation tools –how reliable?

- Simulation tools is useful as a design tools
- Currently still not able to offer accurate predictions of the outcomes
- Actual fire testing is still better

# Challenges in PB Design

- Simulation tools –how reliable
- Computational limitations (CFD)
- Reduce processing time of PB case

# Fire Modeling is Complex



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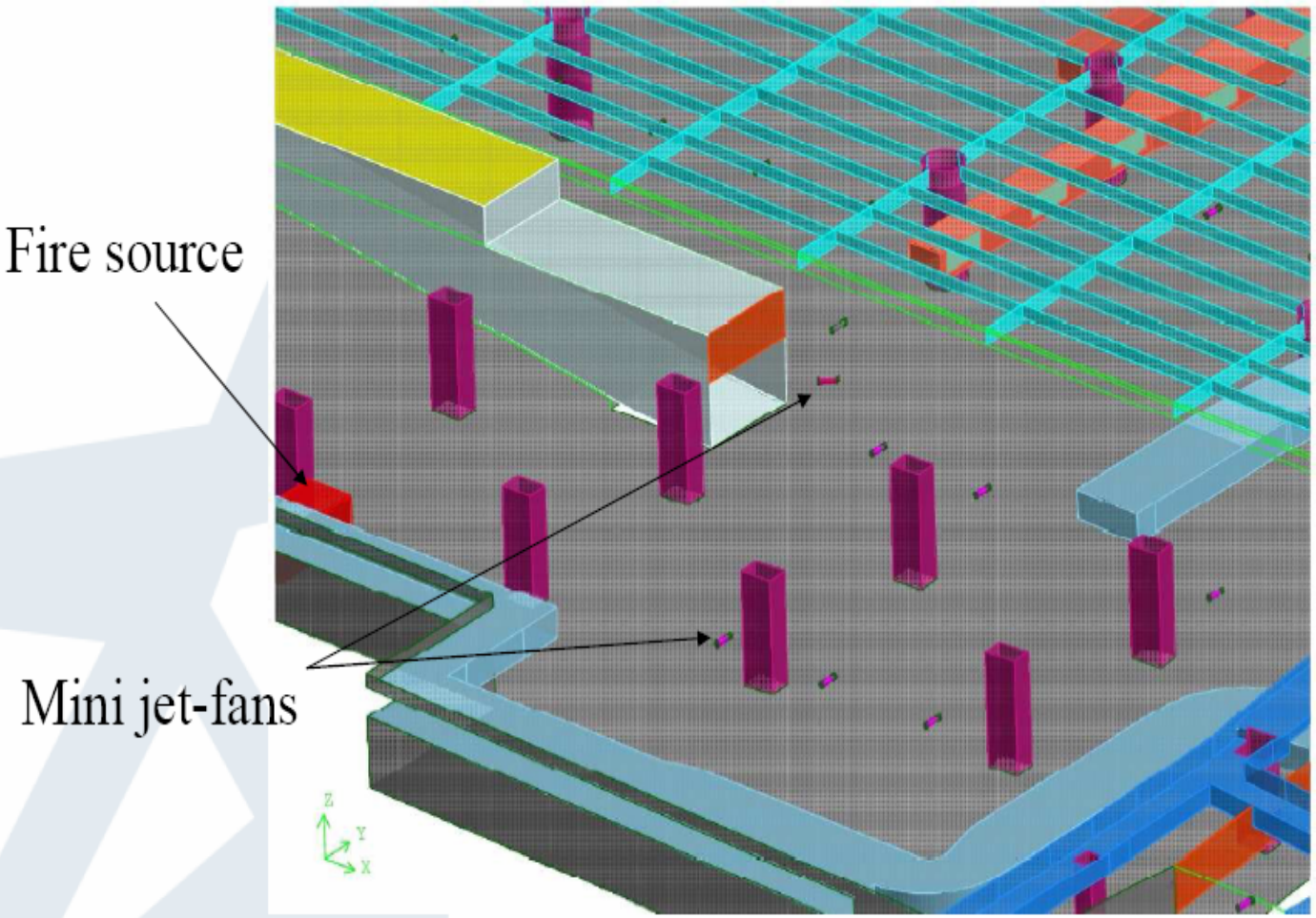


Deployment of mini jet-fans near the fire source

# Challenges in PB Design

| Floor Area (sq. M) | Mesh Size (Million) | | | |
|---|---|---|---|---|
| | 20cm | 50cm | 75cm | 100cm |
| 1000 | 4.28 | 0.45 | 0.30 | 0.28 |
| 5000 | 16.88 | 1.32 | 0.54 | 0.38 |
| 10000 | 32.63 | 2.4 | 0.83 | 0.52 |

# Challenges in PB Design

- Simulation tools –how reliable
- Computation Limitations (CFD)
- Reduce processing time of PB case

# Challenges in PB Design

-Deploy more resources to process PB case

-Developing guidelines for ductless fan system

-Further professional development for FSEs to ensure we keep abreast with latest development

-Thru dialogue with FSEs

i) Providing a list of PB cases on SCDF's website for easy reference

ii) Looking into computational limits for CFD modeling

# Conclusion

- PB approach is used source for alternative solution and not to dispense with safety provisions
- The prescriptive code should remain the basis and standards to attain
- PB should demonstrate that the design is able to achieve  the equivalent standards

The End