

# Te Papa Tongarewa Museum of New Zealand



**20 years of advances in fire modelling**  
**What are the benefits?**  
**A case study**

*Presented by Kevin Weller*

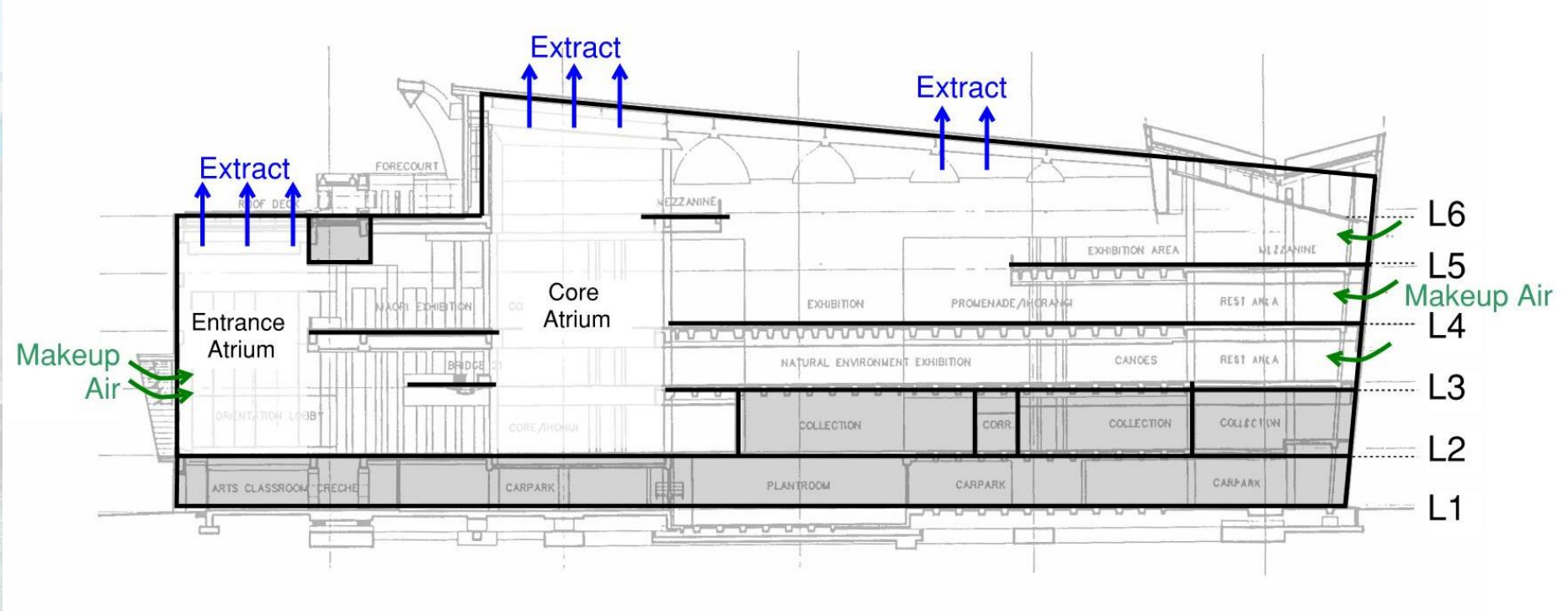


# About Te Papa

- Built 1996
- 5 hectares
- 6 floors
- Large atriums
- Single compartment



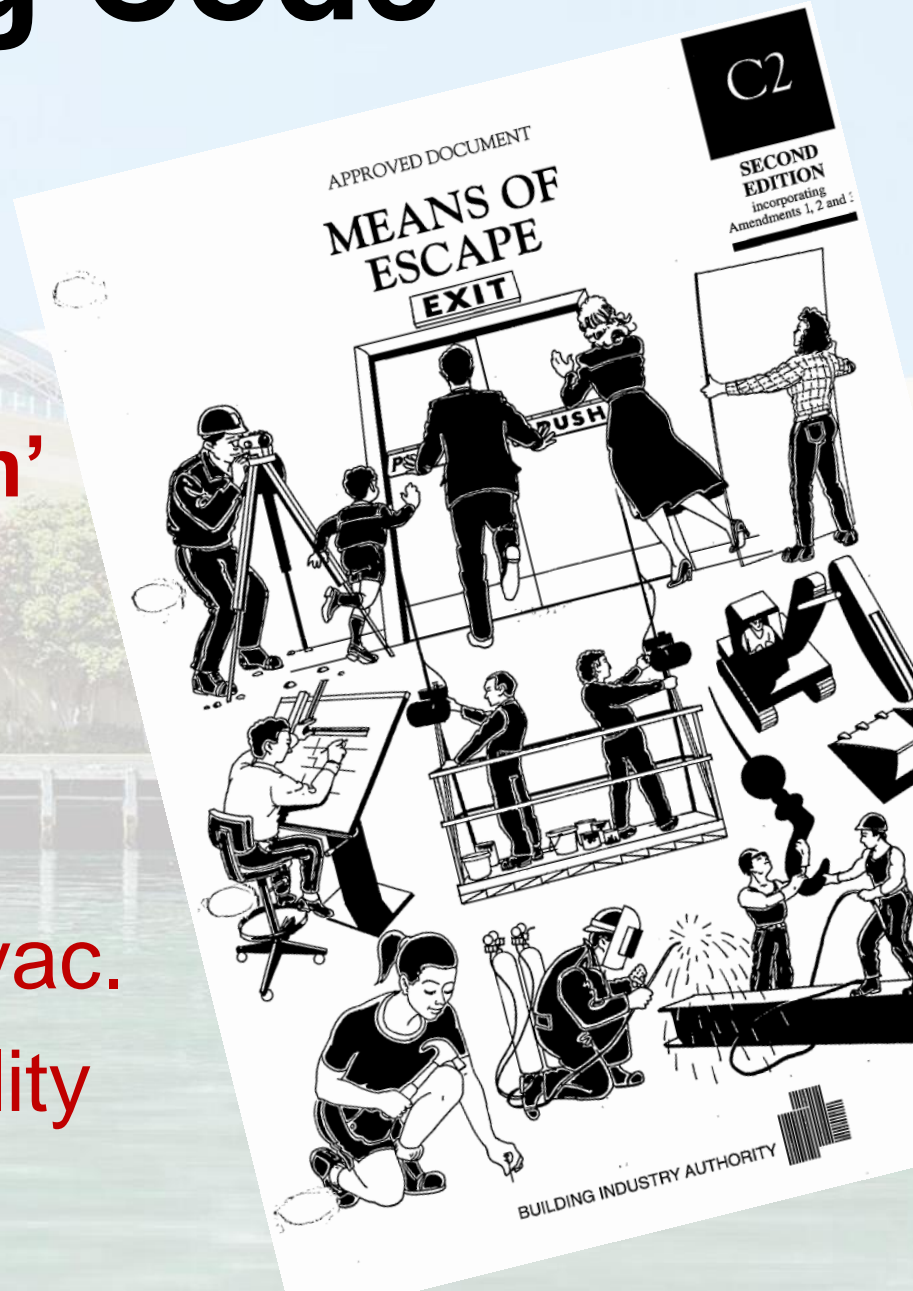
# Smoke Control System



# Building Code

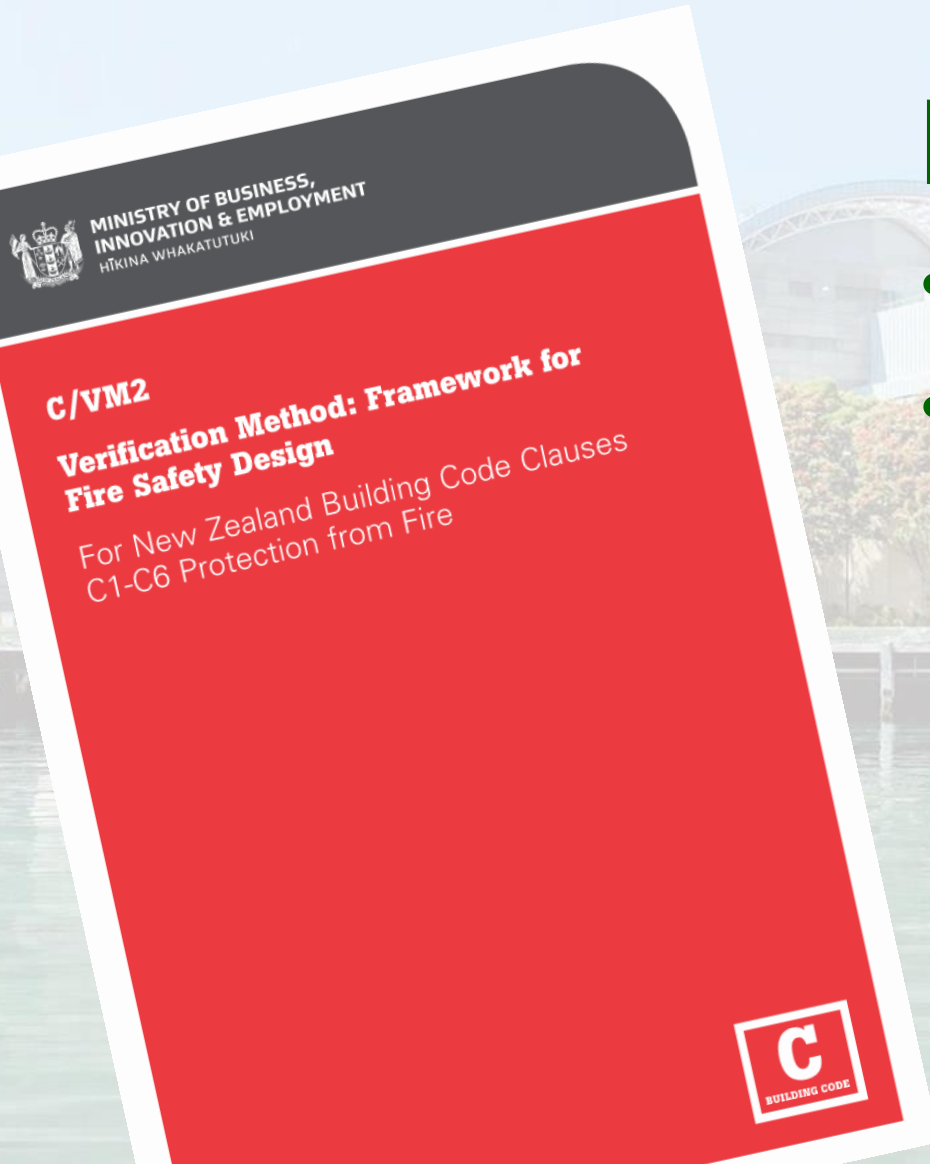
Then

- ‘Acceptable Solution’
- Large atriums
  - Alternate solution
  - 10 minutes to evac.
  - Indefinite tenability





# Building Code



## Now

- Compliance Document
- ASET vs RSET
  - Set performance requirements

# Engineering tools

- **FIRE SIMULATOR**
  - Zone model
- **EVACNET+**
  - Nodal model

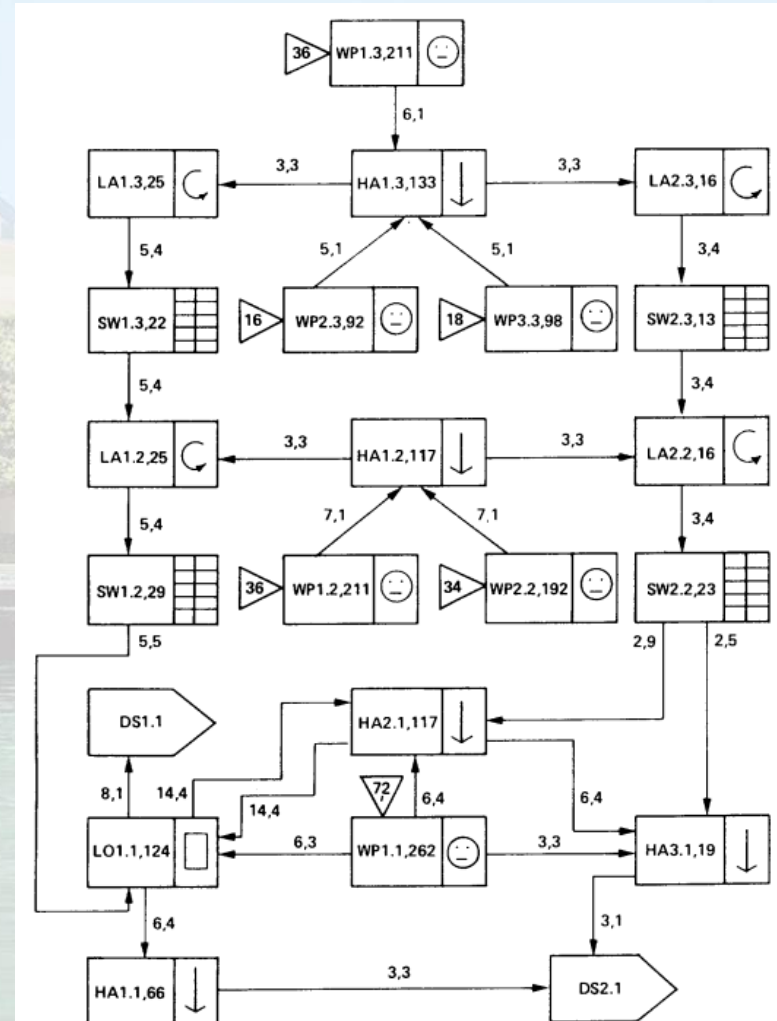


Fig. 1. EVACNET+ representation of a three story building.

# Engineering tools



- **FDS**
  - Revit
  - PyroSim
  - Smokeview
- **Pathfinder**
  - Revit



# **Then** vs **Now**

**a greater understanding**

**or**

**additional complexity?**

**What are the benefits?**



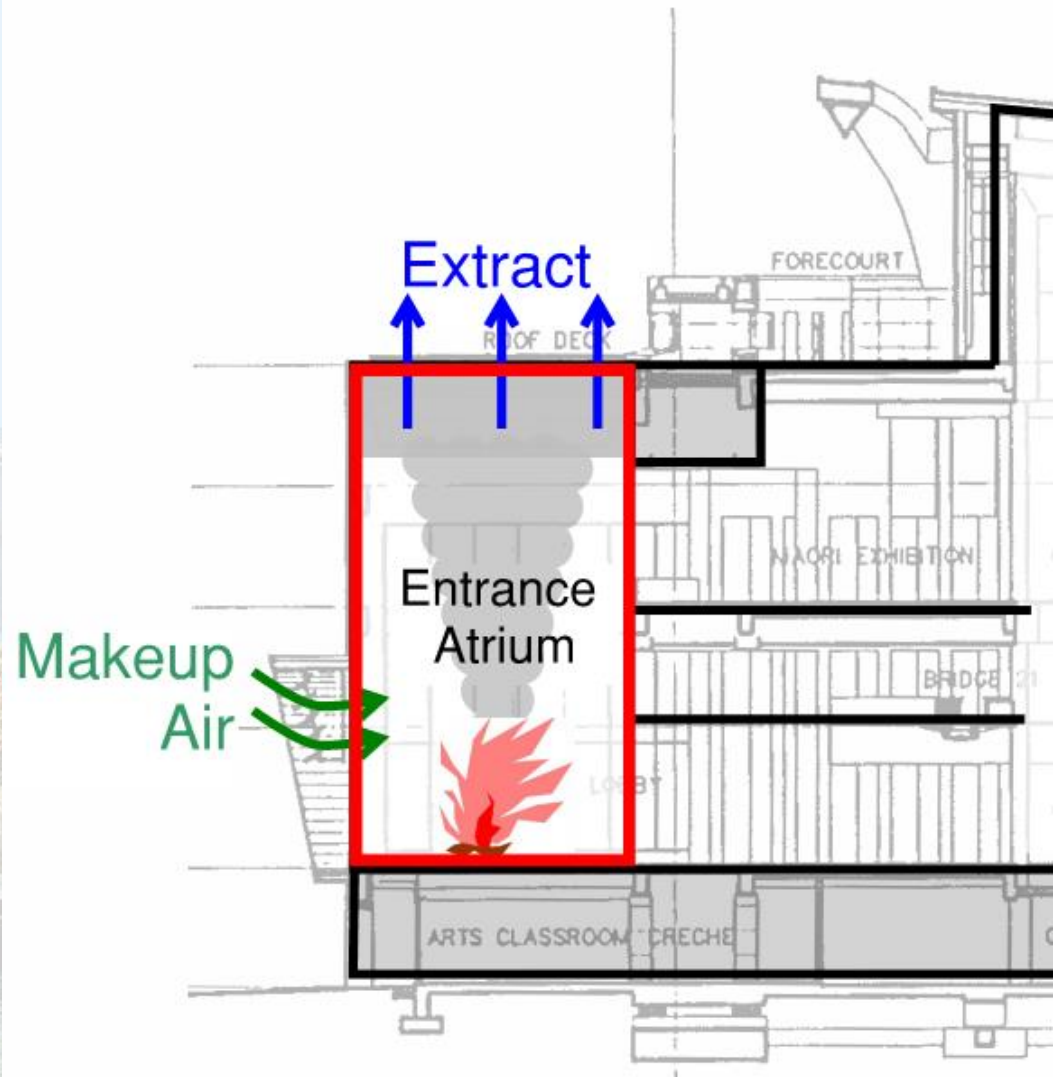
# Entrance Atrium Fire

- 22m ceiling
- Four levels
- Protected by
  - Smoke extract
  - Deluge + Flame detection



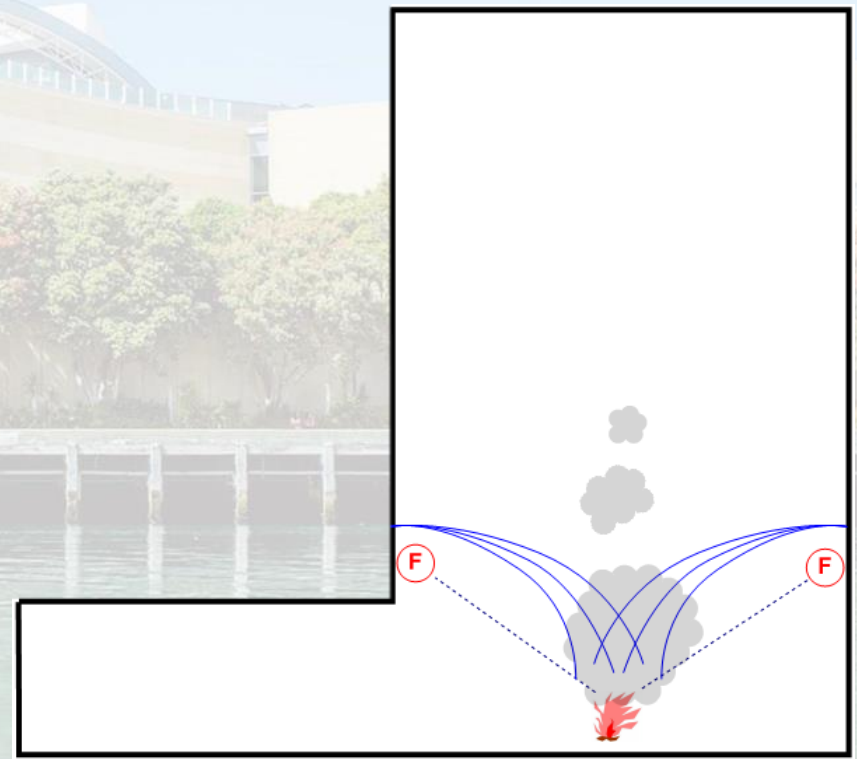
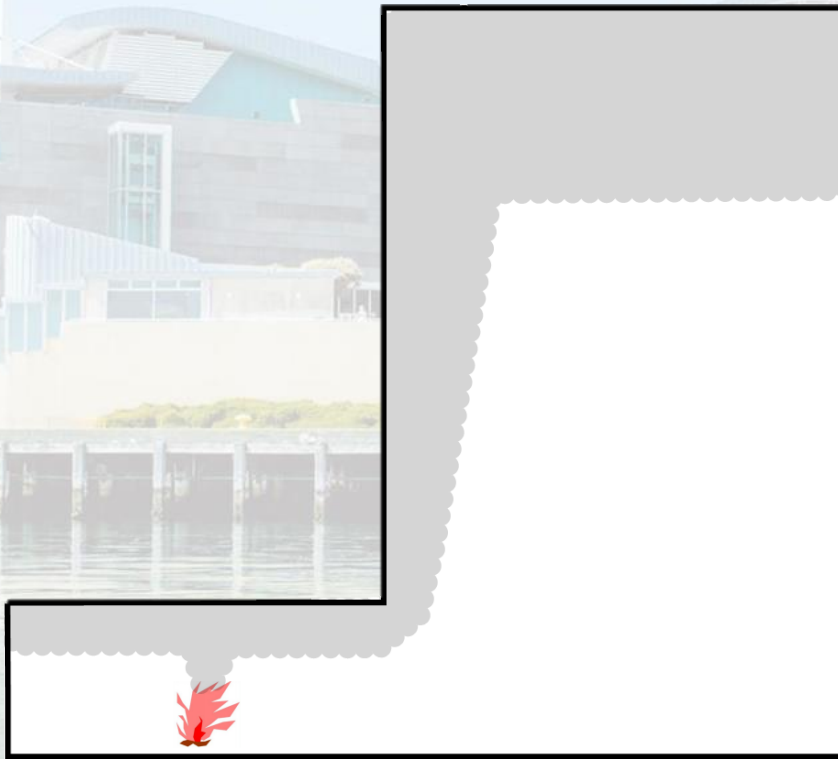
# Entrance Atrium Fire

- FIRE SIMULATOR
- Single Room
- 4MW fire



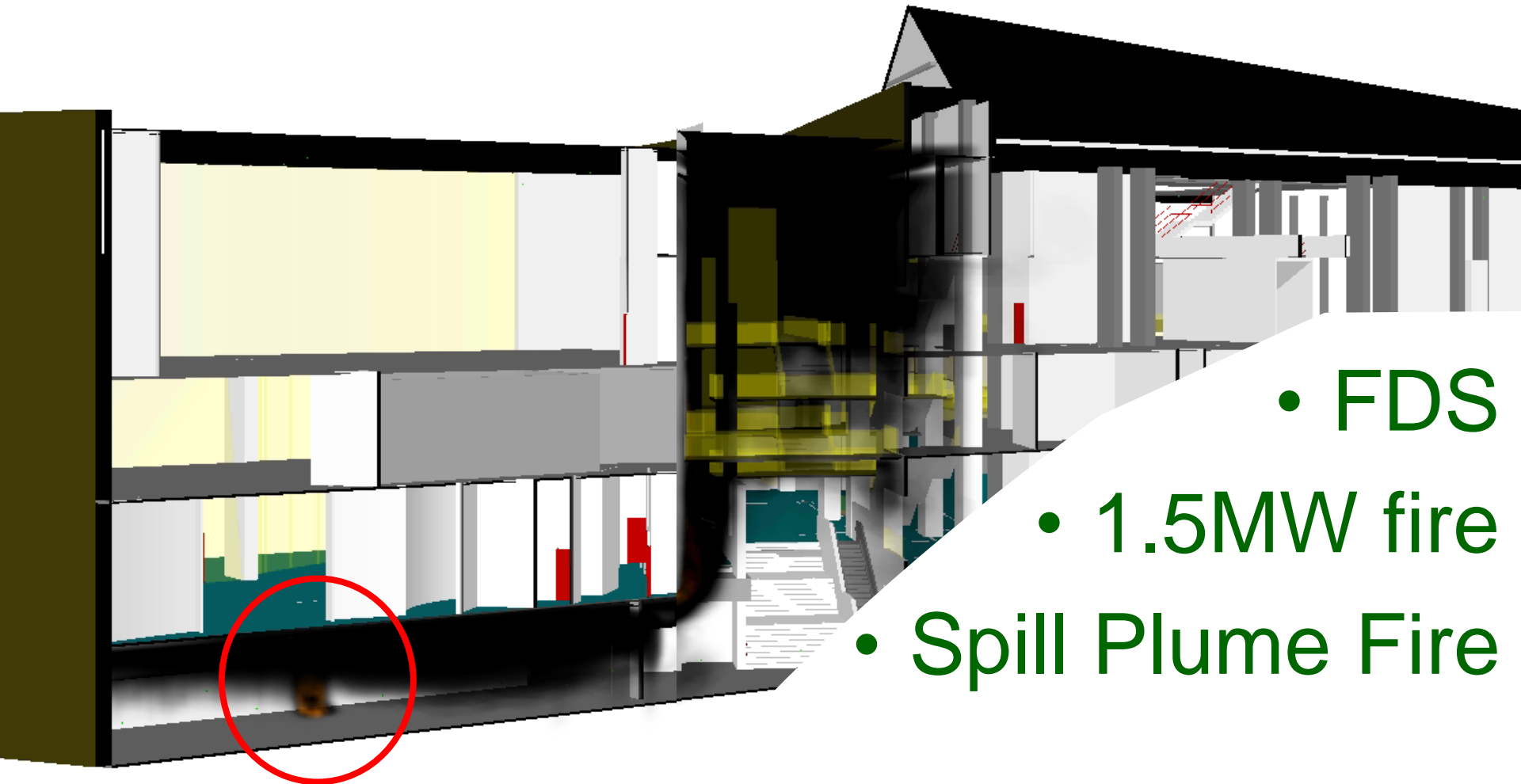
- Design layer height + Safety Factor

# Spill Plume vs. Atrium Fire



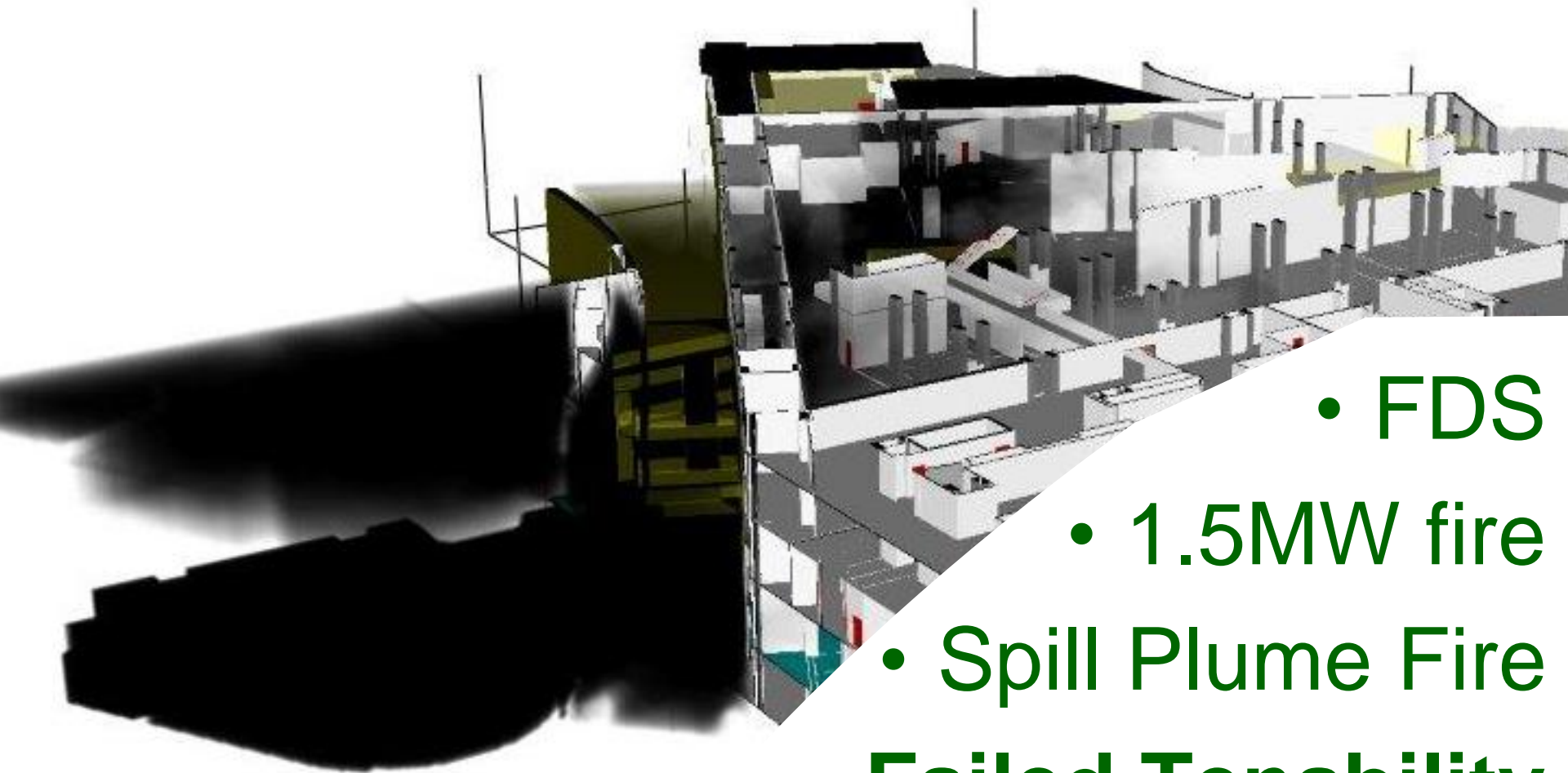


# Entrance Atrium Fire



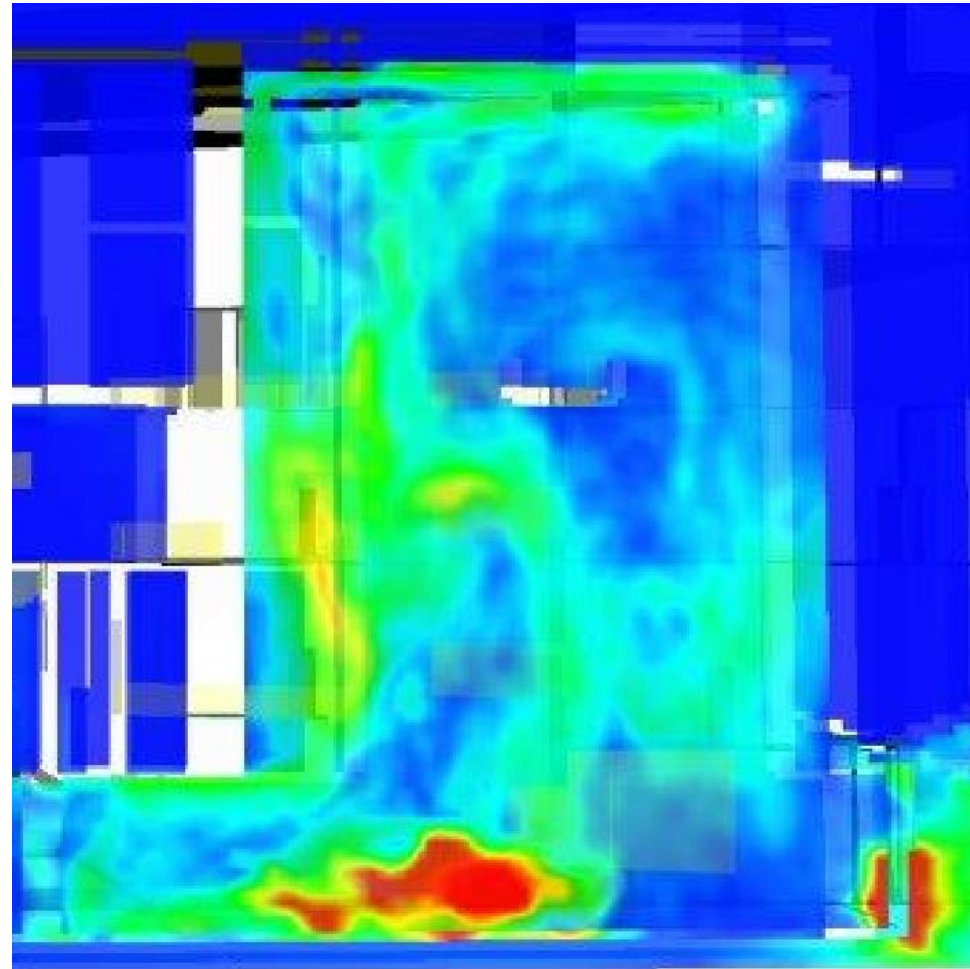
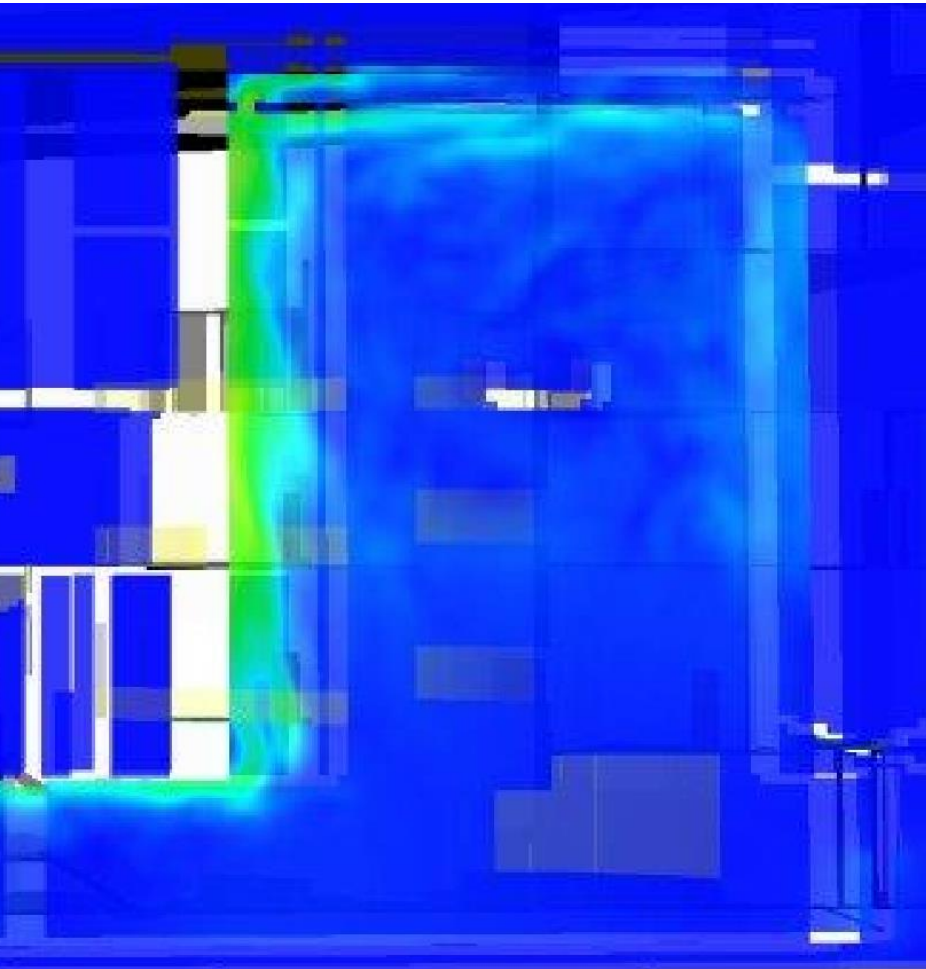
- FDS
- 1.5MW fire
- Spill Plume Fire

# Entrance Atrium Fire



- FDS
- 1.5MW fire
- Spill Plume Fire
- Failed Tenability

# Entrance Atrium Fire

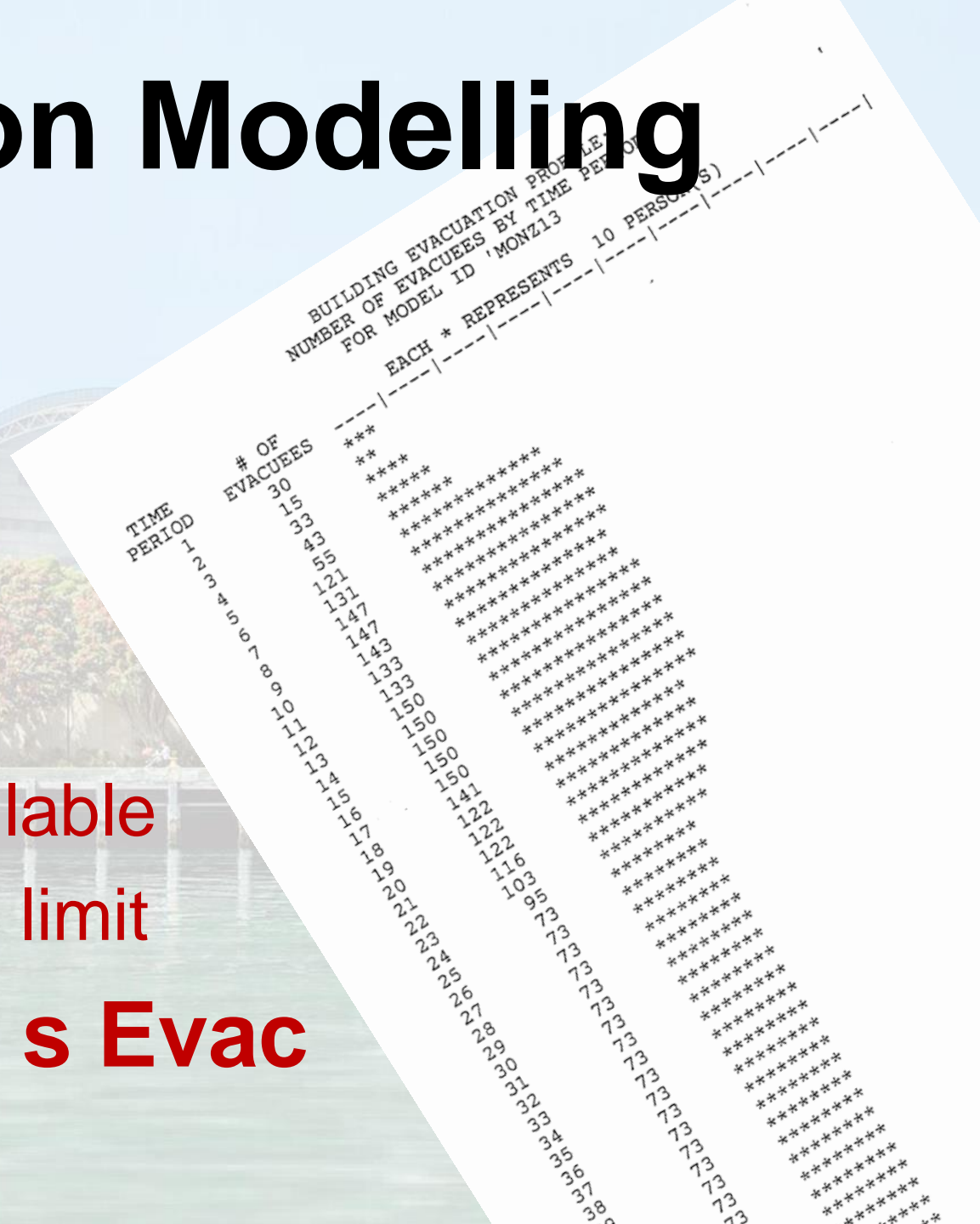




# Evacuation Modelling

## EVACNET+

- 1 model
- 4200 people
- All exits available
  - 10 minute limit
- **520 s Evac**



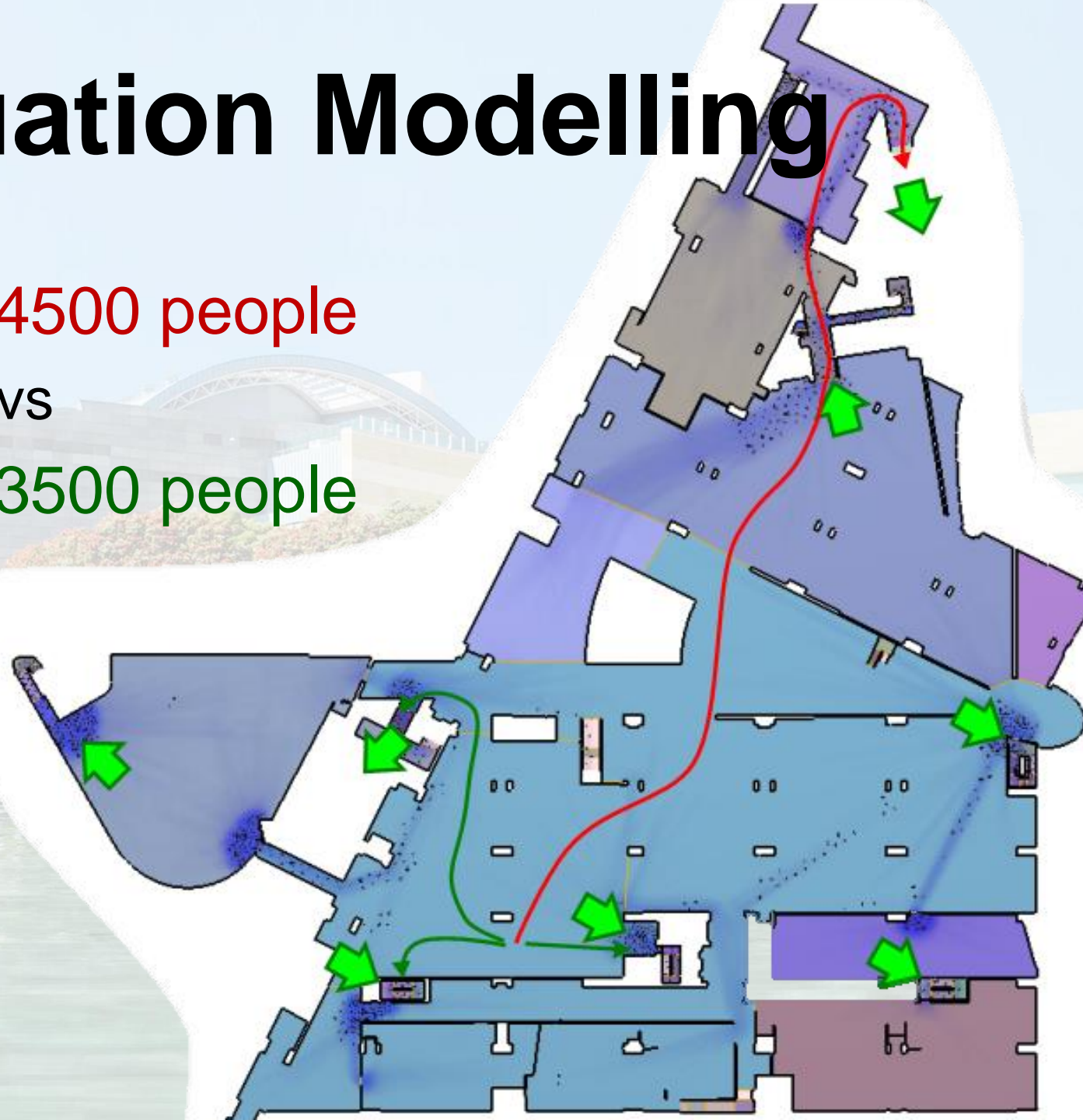
# Evacuation Modelling



- Pathfinder
- 3500 people
- 460 s to safe place
- 610s to outside

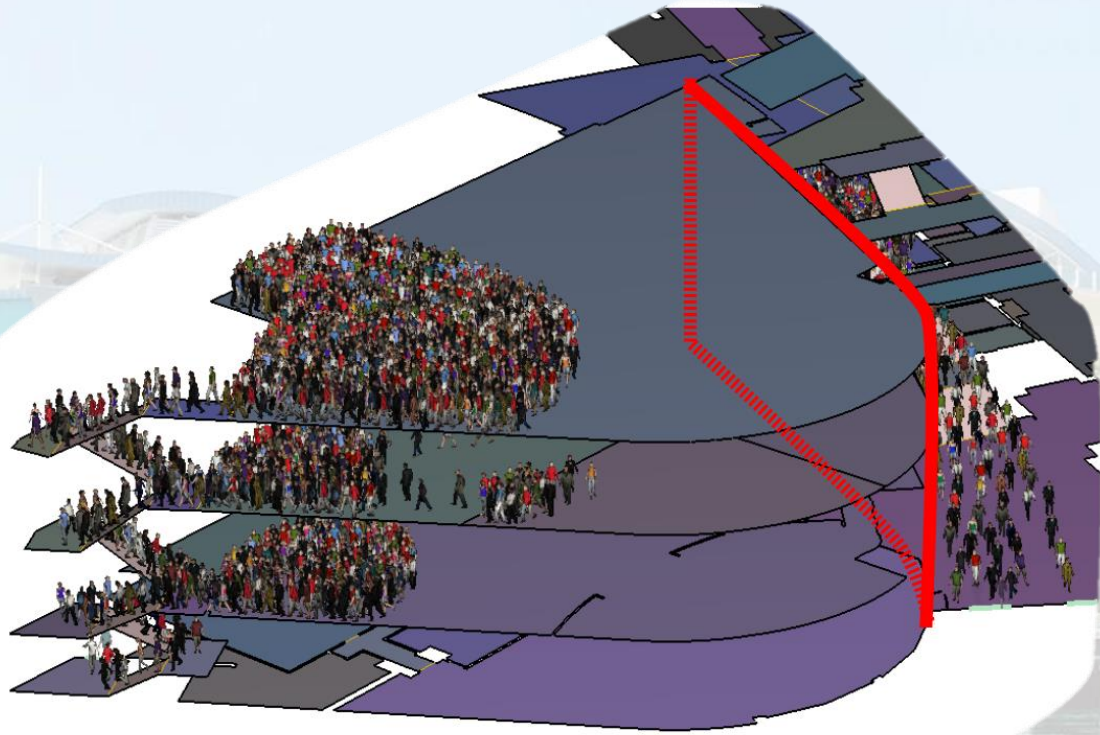
# Evacuation Modelling

- 520s for 4500 people
- vs
- 610s for 3500 people





# Evacuation Modelling



- Blocked Exit

- 1400 people

- 1200 s Evac

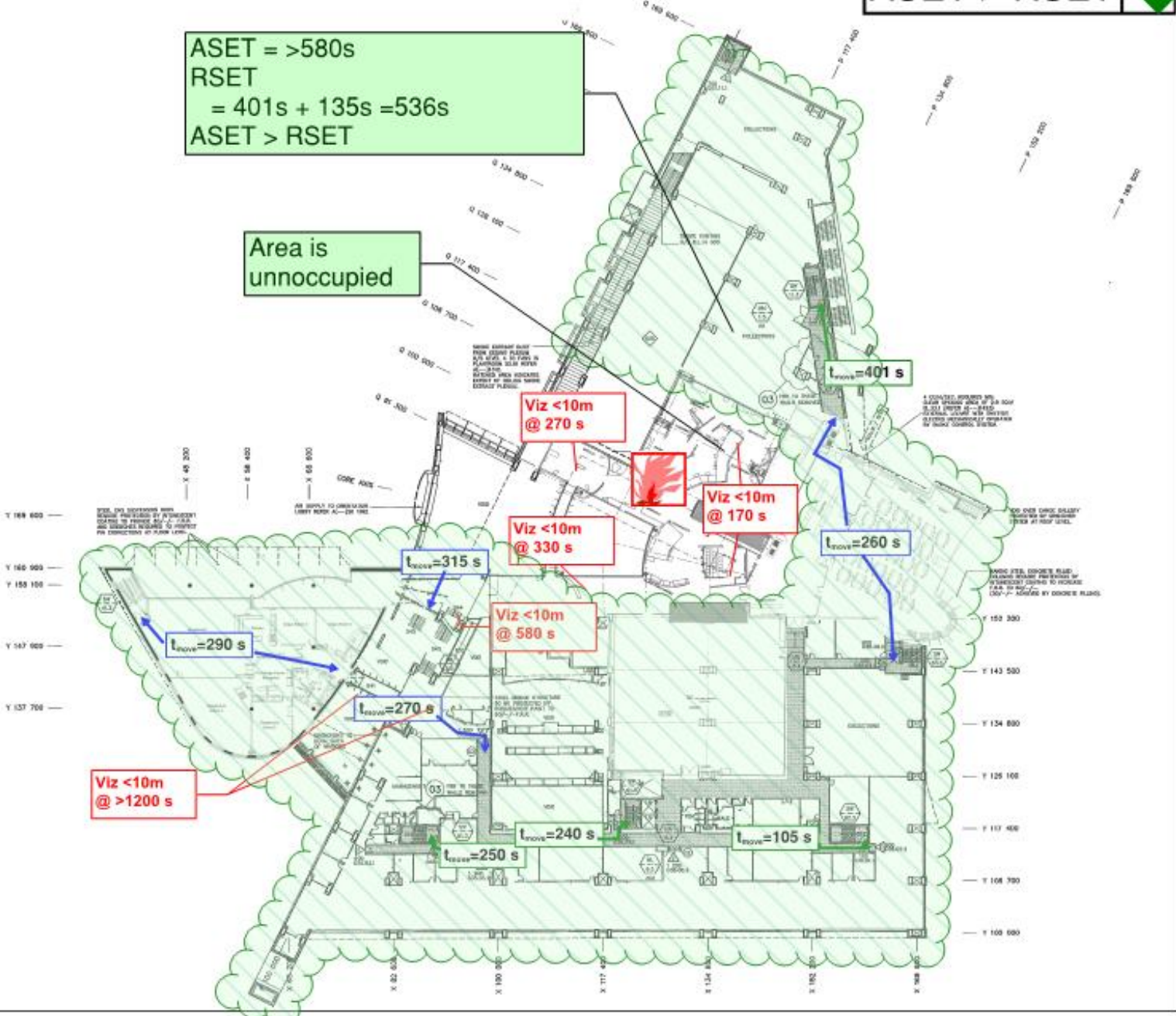
# Acceptance Criteria

- **Maintained tenability** ❌
- **Evacuation under 10 minutes** ❌
- **ASET vs RSET** ✓

**ASET > RSET** ✓

**ASET = >580s**  
**RSET**  
**= 401s + 135s = 536s**  
**ASET > RSET**

**Area is unoccupied**





# Conclusion

## Then

- **Safety factors**
- **Limited assessment**
- **Little detail**

## Now

- **More detailed**
- **More complex**
- **Better understanding**

**Benefit: a safer building**

# Questions?

