

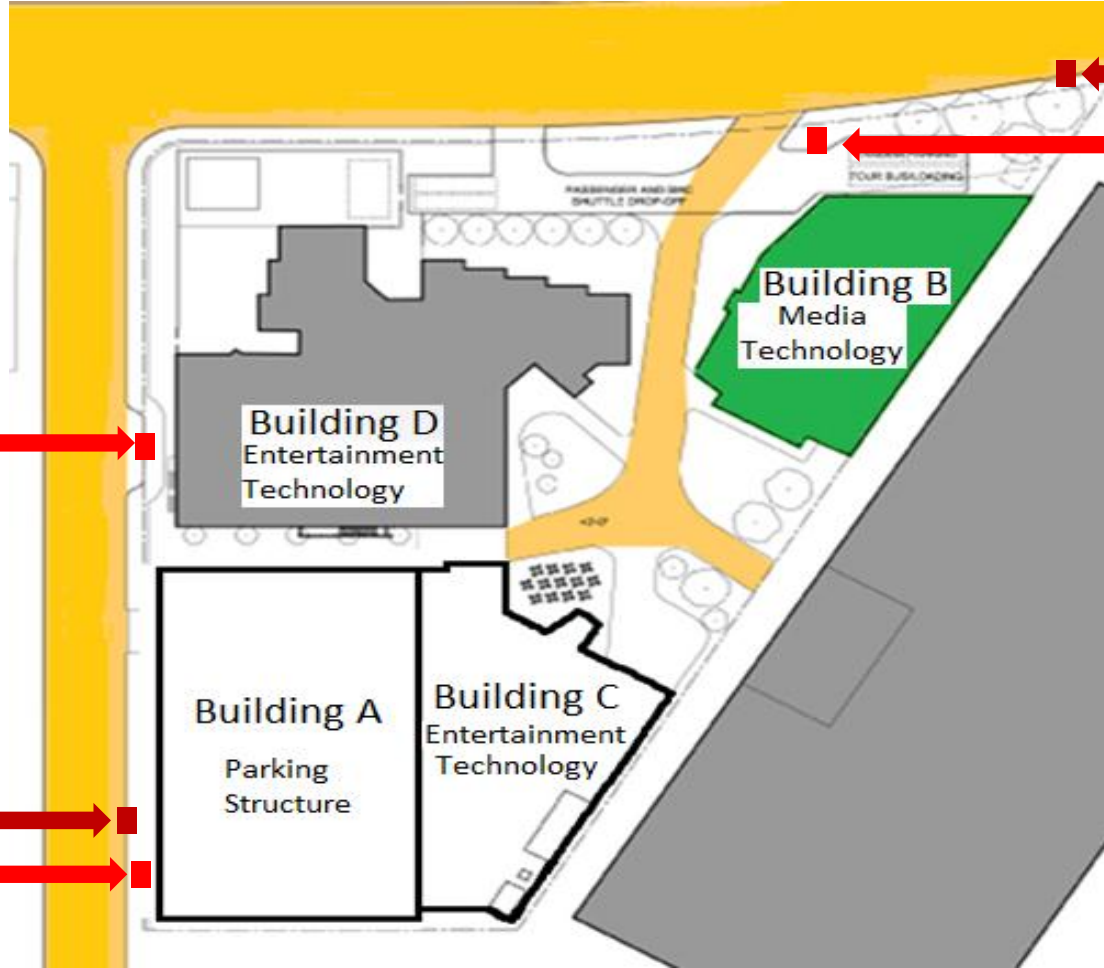
Campus Media and Technology Building

Fire Protection Engineering
Cal Poly Culminating Project
Mackenzie Hill

Presentation Outline

- Building Description
- Key Building Features
- Fire Protection Systems
 - Fire Suppression
 - Fire Alarm and Detection
 - Egress Analysis
- Performance Based Analysis
 - STEPS (Simulation of Transient Evacuation and Pedestrian movementS)
 - FDS (Fire Dynamics Simulator)

Site Plan



Fire Hydrant

FD Connection

FD Connection

Fire Hydrant

FD Connection

Building D
Entertainment
Technology

Building B
Media
Technology

Building A
Parking
Structure

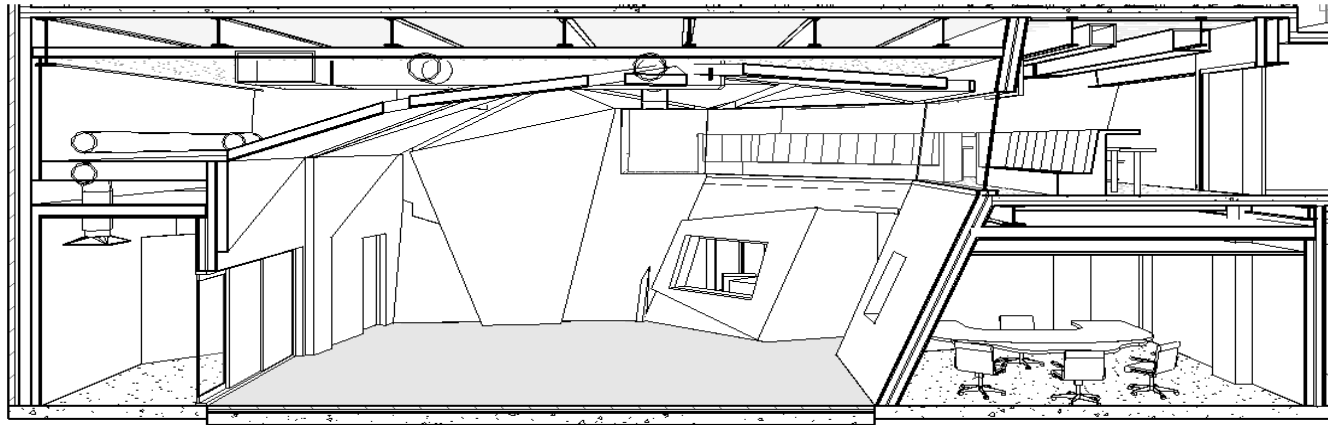
Building C
Entertainment
Technology

PASSENGER AND BAG
SHUTTLE DROP-OFF

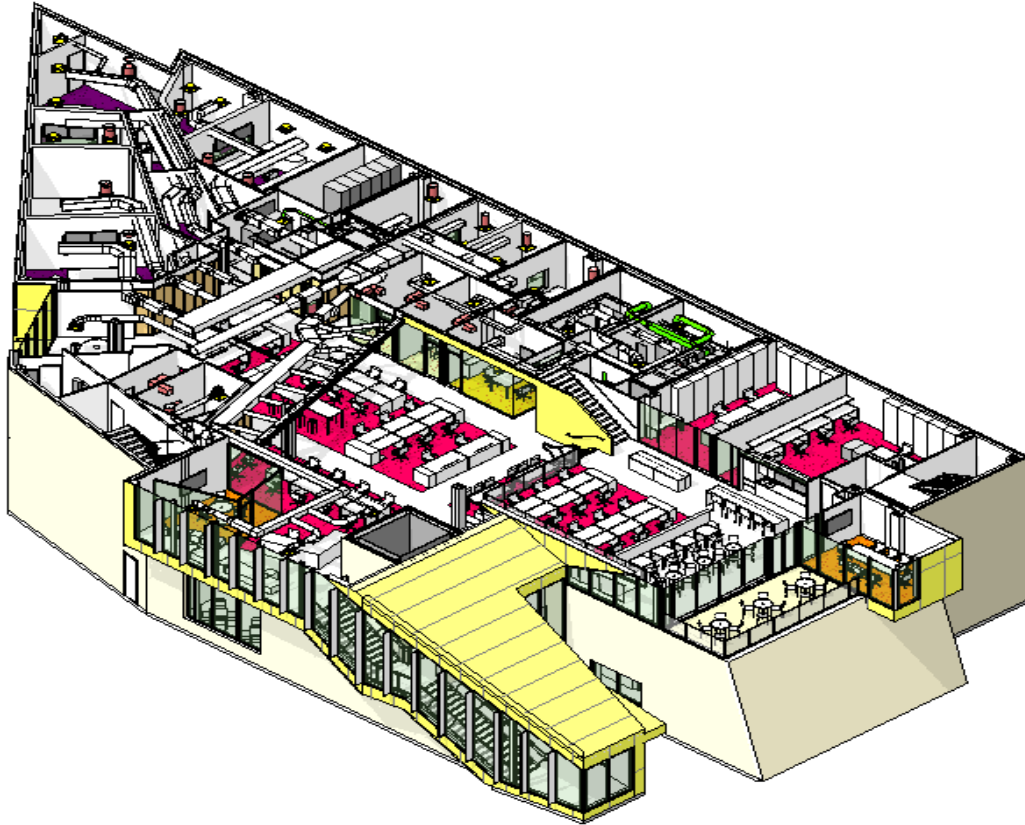
FOUR BUSLADING

Building Description

- Three stories with a performance viewing balcony
- Highest occupied level 30 feet from grade
- Largest floor area 12,500 square feet
- Total building area: 32,645 square feet
- Mixed used configuration with Group A and B
- Type IIB construction

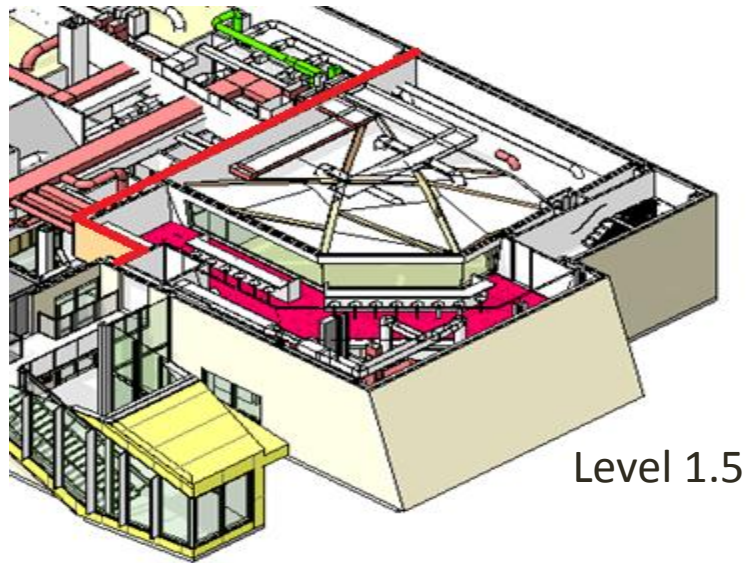


Building Description



- Principal operations for the Campus Radio Station
 - Performance Studio
 - Telecommunication studios
 - Multiple control rooms
 - Computer labs
 - Offices

Building Features



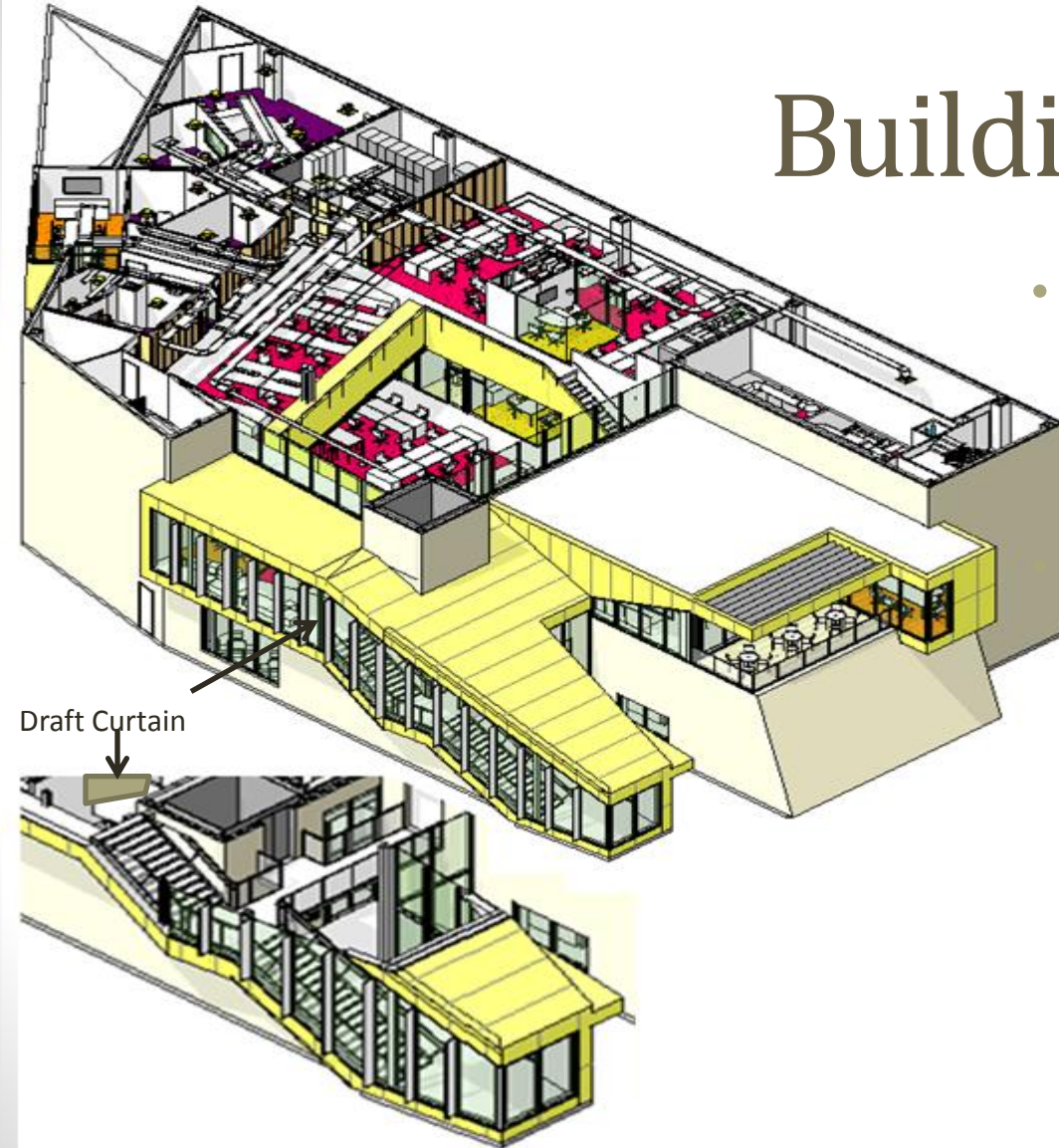
- Rated Separation will divide Group A and Group B occupancies
 - CBC Table 508.4
- Viewing balcony is enclosed and not prescriptively compliant but was DSA approved

Building Features

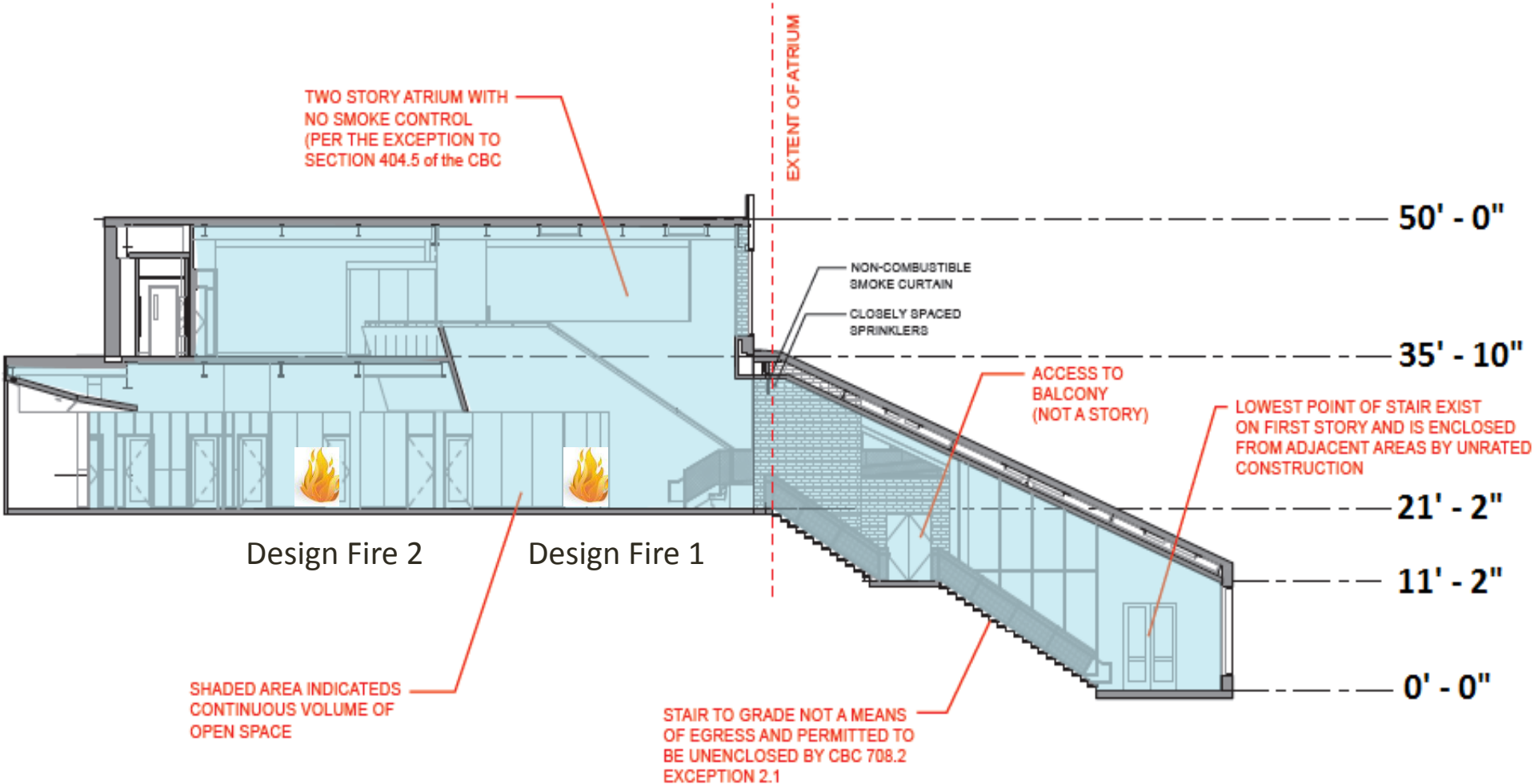
- Atrium
 - Two level connection does not require a smoke control system
 - Section 404.5 Exception

Open Stair

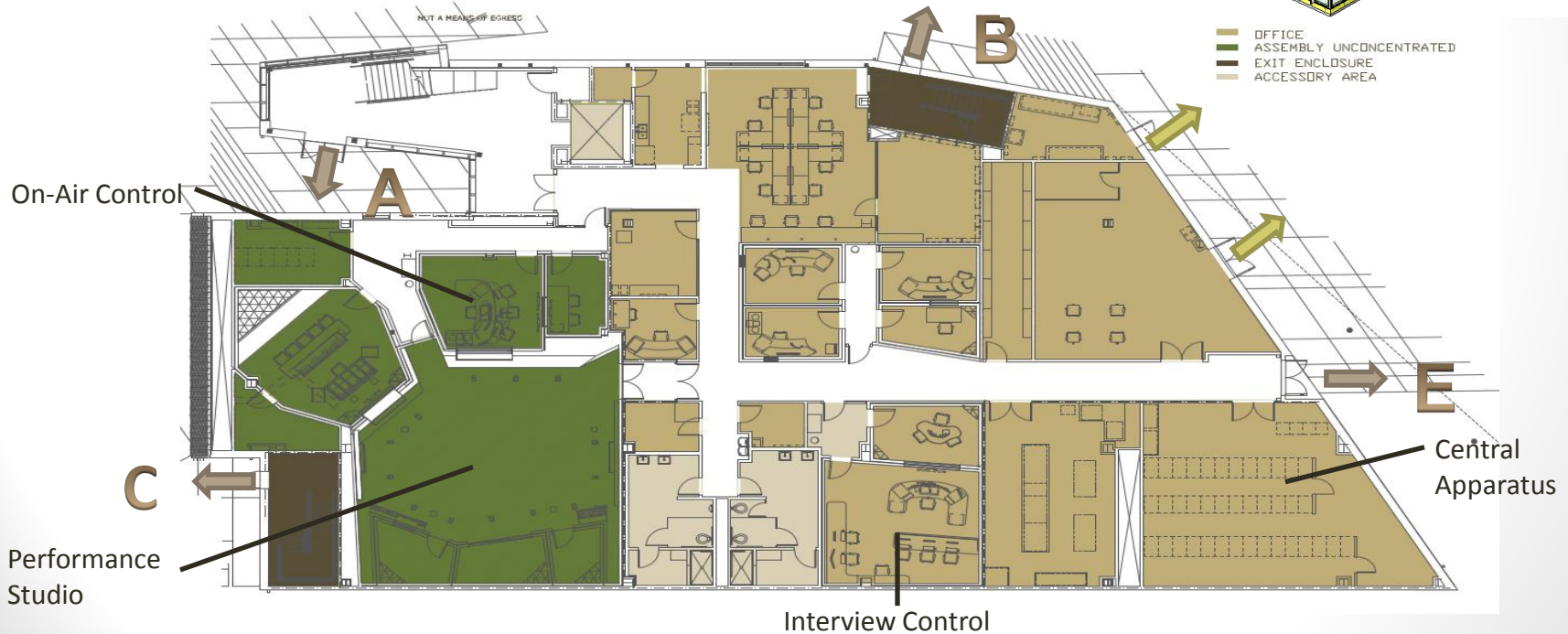
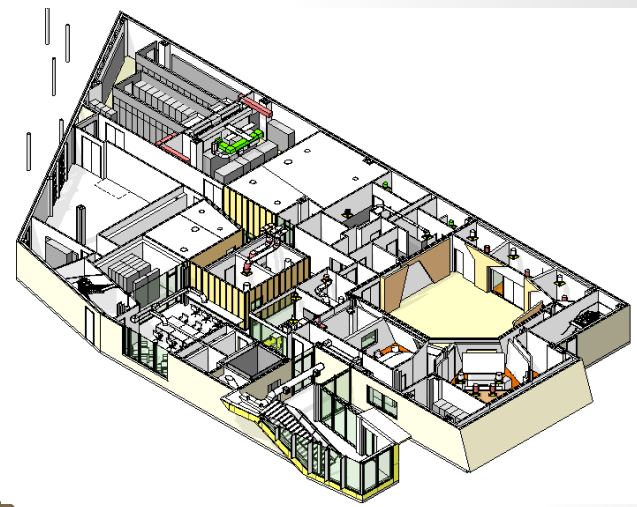
- Considered non-egress stair
- Connects three levels by openings
 - Opening is protected by a draft curtain and closely spaced sprinklers meet the required separation of 1 hour.
 - CBC 708.2 Exception 2.1



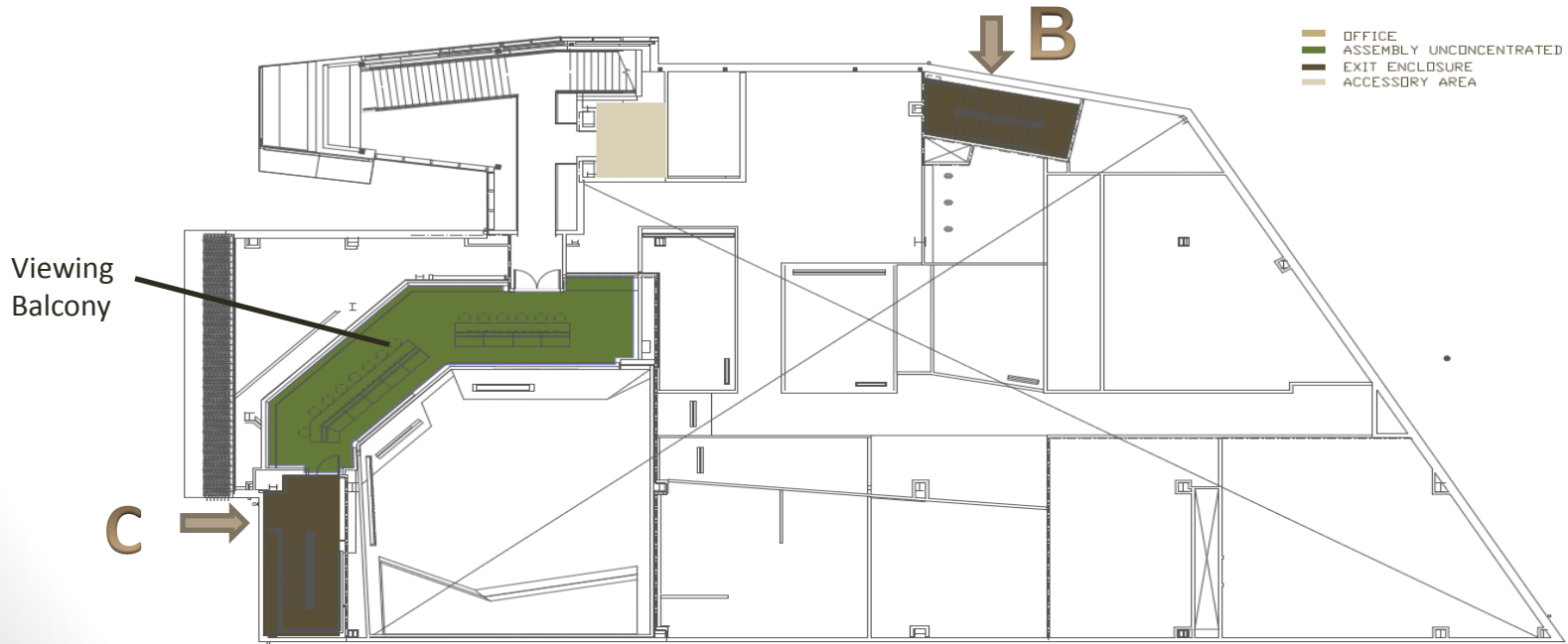
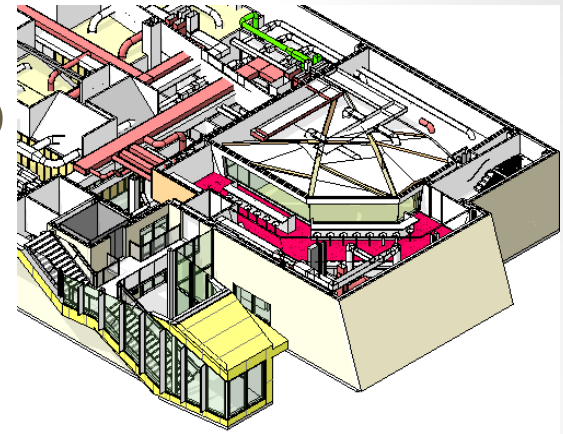
Section View



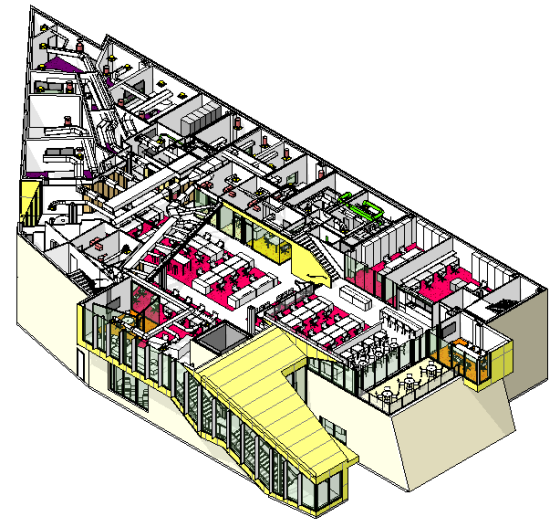
Occupancy - Level 1



Occupancy – Level 1.5



Occupancy - Level 2



- OFFICE
- ASSEMBLY UNCONCENTRATED
- EXIT ENCLOSURE
- ACCESSORY AREA

B

Open Office

Terrace

Open Office

On-Air Control

C

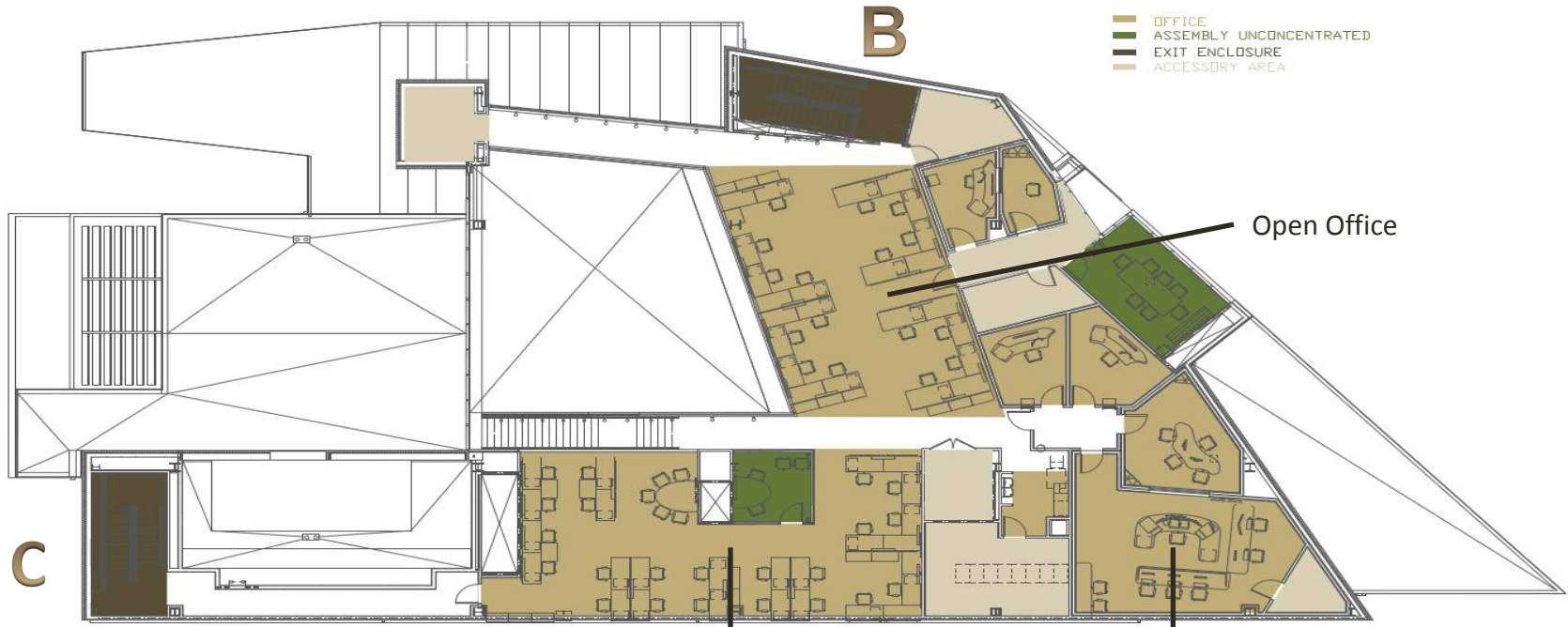
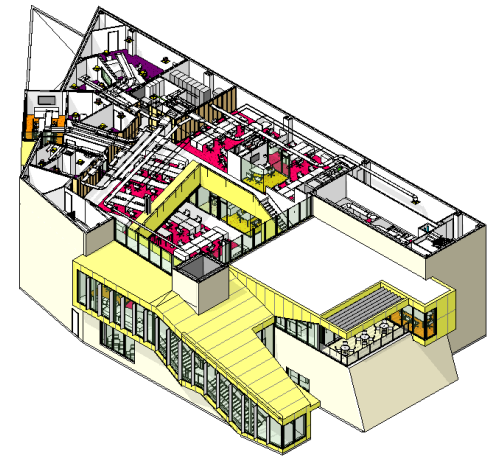
Computer Department

News Edit

Interview Control



Occupancy – Level 3



- OFFICE
- ASSEMBLY UNCONCENTRATED
- EXIT ENCLOSURE
- ACCESSORY AREA

Open Office

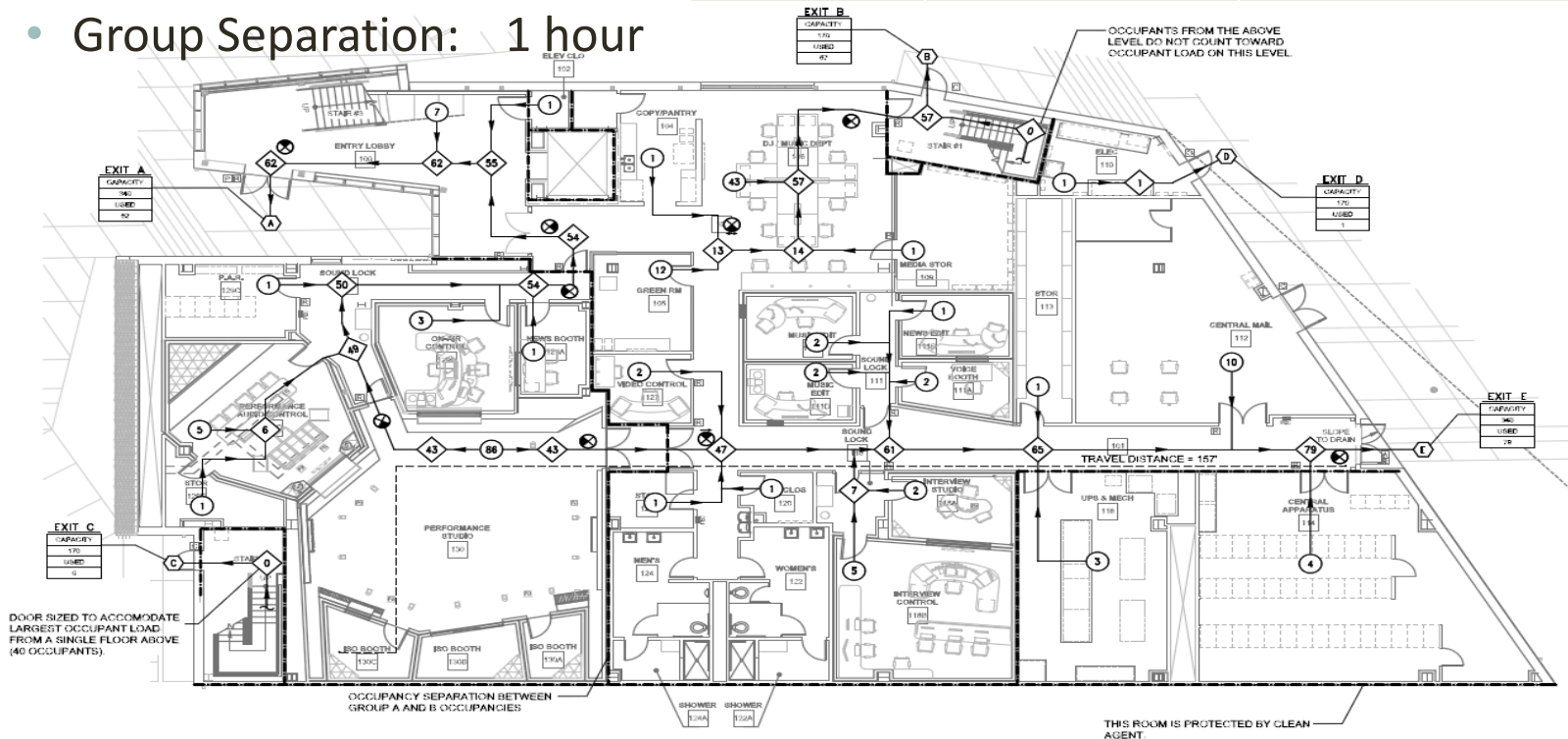
Open Office

Interview Control

Separation Strategy

- Exit Enclosures: 1 hour
- Shaft Enclosures: 1 hour
- Data Center: 1 hour
- Group Separation: 1 hour

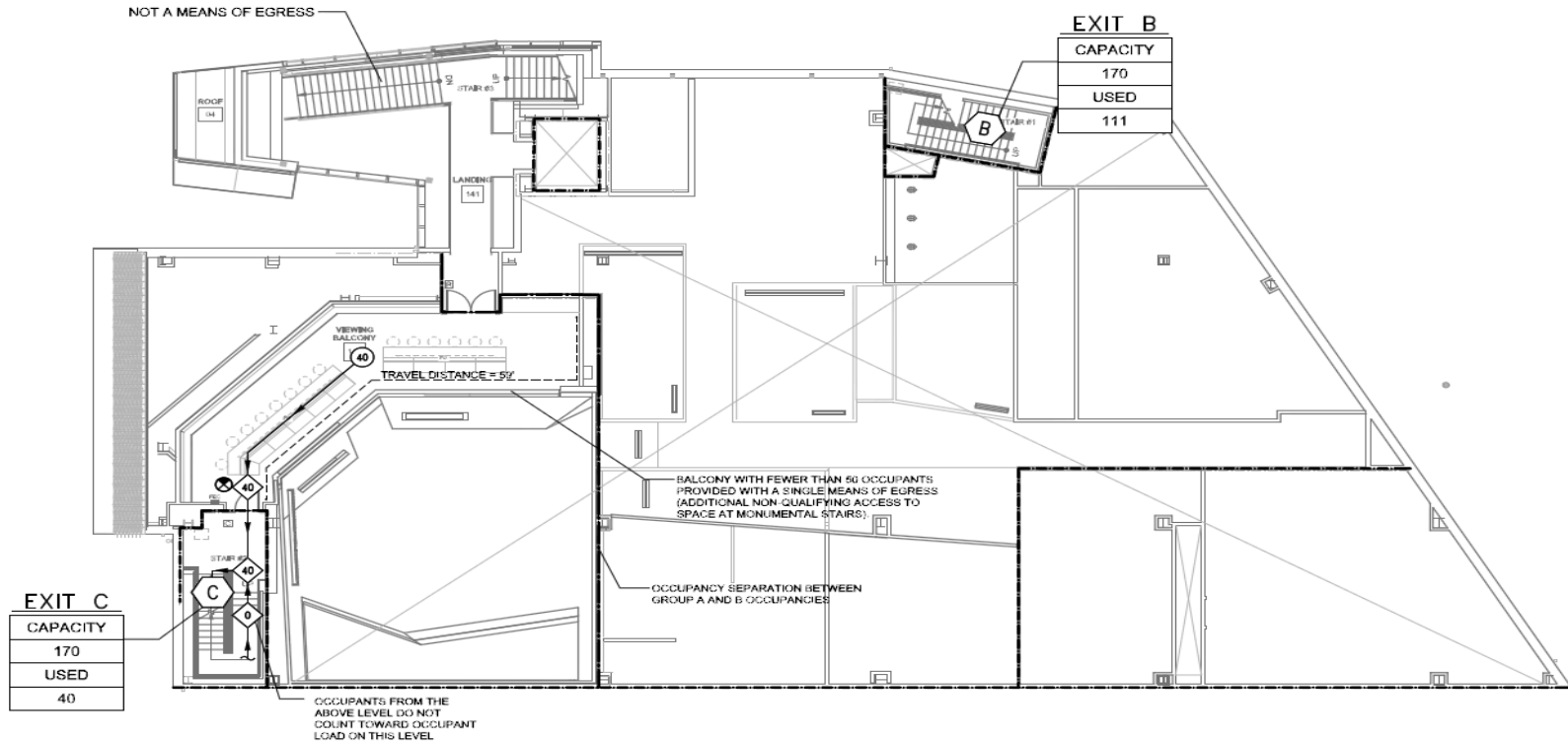
Level 1 Capacities		
ID	Limit Capacity	Actual Usage
A	340	62
B	170	57
E	340	79
TOTAL	850	199



Means of Egress - Level 1.5

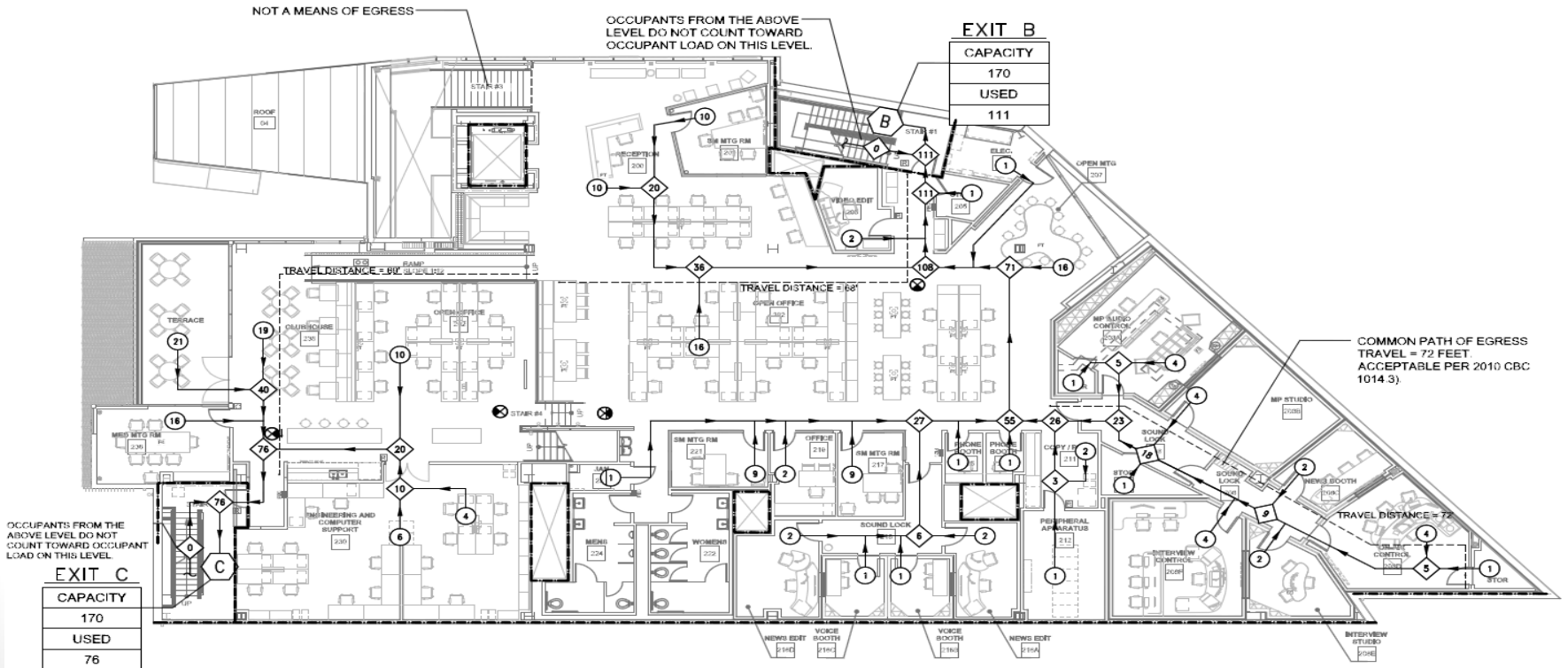
Level 1.5 Capacities

ID	Limit Capacity	Actual Usage
C	160	40
TOTAL	160	40



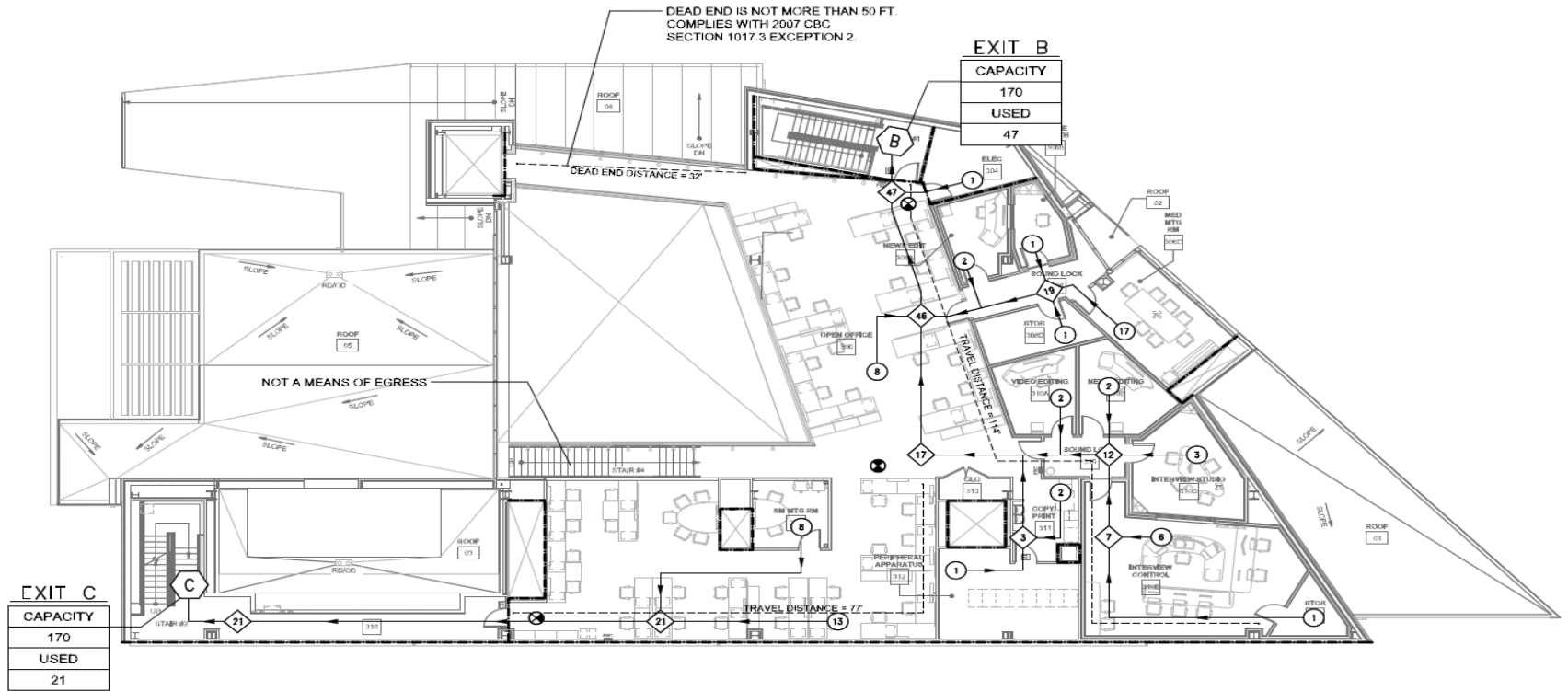
Means of Egress – Level 2

Level 2 Capacities		
ID	Limit Capacity	Actual Usage
B	160	111
C	160	76
TOTAL	320	187



Means of Egress – Level 3

Level 3 Capacities		
ID	Limit Capacity	Actual Usage
B	160	47
C	160	21
TOTAL	320	68



Water Based Suppression

- Automatic Sprinkler System required throughout per DSA and City Code.
- Light Hazard
 - Quick Response UL listed
- Combined sprinkler riser/standpipes will be provided in each stair.
 - One standpipe will extend to the roof
- Alternative suppression system
 - Novec 1230 to protect the Central Apparatus Room and Pre-Action system



Fire Alarm and Detection

- Campus requires a public address system for emergency evacuation provided in all classrooms and public areas
- Operation of any fire detector, sprinkler, or water-flow device will activate the notification appliances.
- Visual notification appliances are located in all publically and common use area and sound-proof rooms.
- Components
 - Strobes
 - Combination speaker/strobes
 - Smoke/heat detectors
 - Duct detectors
 - Flow Switches
 - Tamper Switches
 - Pull Station



STEPS Analysis

- Grid Size – Occupants travel on a plane divided into a grid of cells where only one occupant can occupy a single cell.
 - Cell Dimensions: 0.32m x 0.5m (estimated shoulder width)
- Travel Speed – Based on the type of individual and type of walking surface. Effective travel speeds are reduced due to crowding and queuing.
- Demographics effect Walking Speed
 - Age and Mobility
 - Patience Parameter – commitment to an exit

Exit C



Exit B

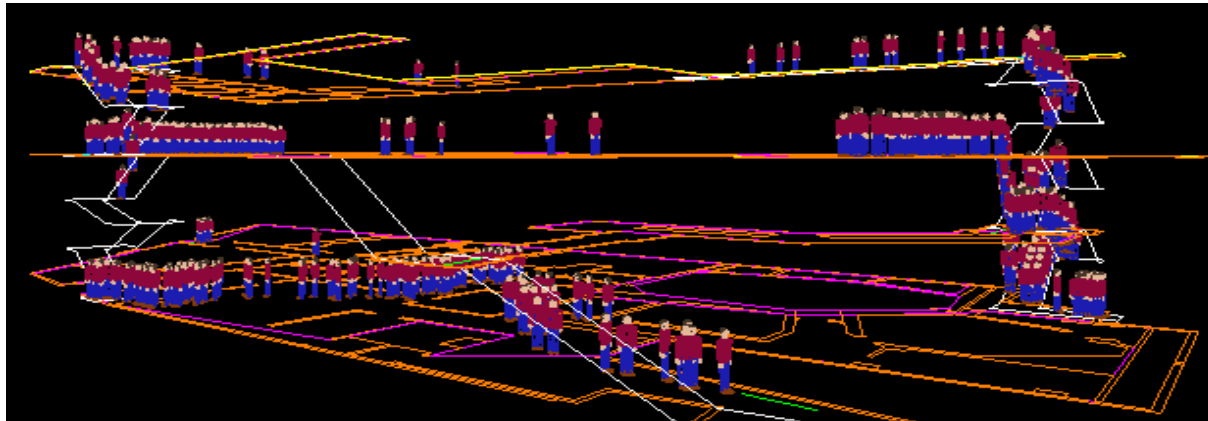
STEPs Results

- Scenario 1: Two Stair Enclosures Available
- Scenario 2: Two Stair Enclosures and the Open Stair

Scenario	Evacuation Time
1	2.22 minutes
2	1.49 minutes

Exit B

Exit C



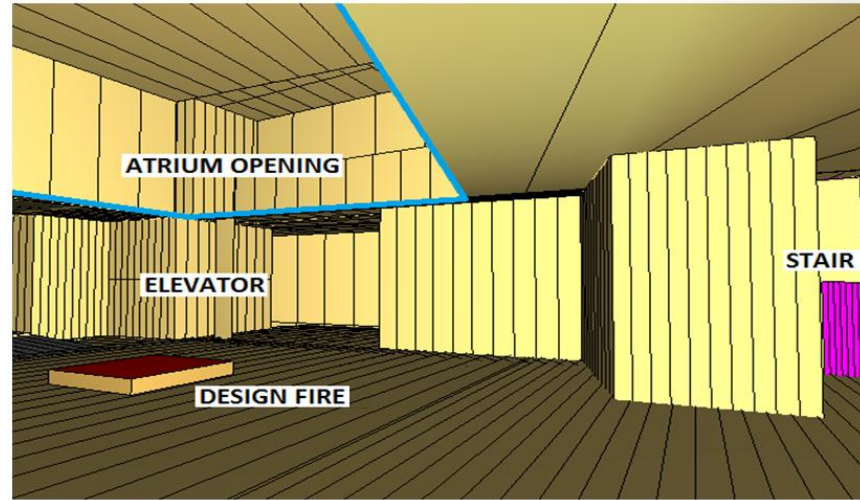
Tenability Criteria

- Goals
 - Life Safety
 - Minimize Property Loss
 - Minimize Loss of Operations

Performance Criterion	Reference	Limit
Visibility	SFPE Handbook	6 meters
CO concentration	SFPE Handbook	1400 ppm
Temperature	NFPA 130	60 °C
All measurements taken 6 feet above the egress walking surface.		

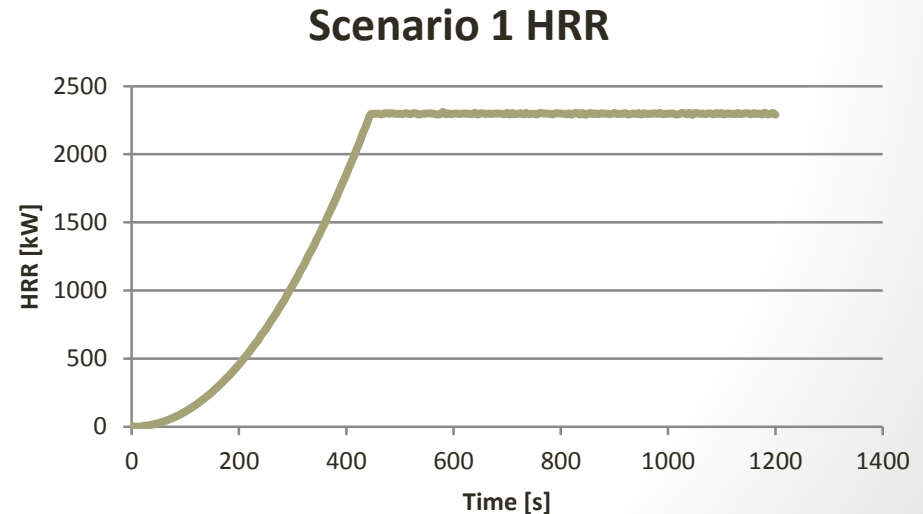
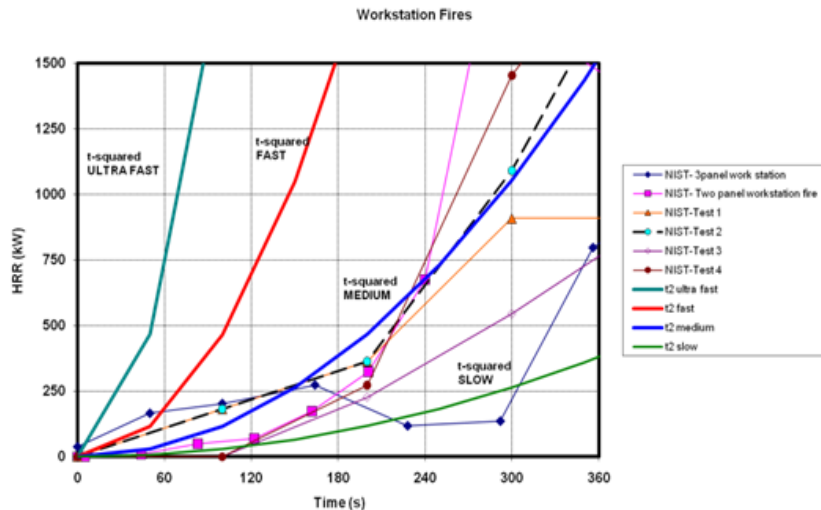
Fire Scenario

- Life Safety Code Scenario 1
- Multiple Workstation Fire
- Center of second floor under atrium opening
- Sprinkler controlled fire

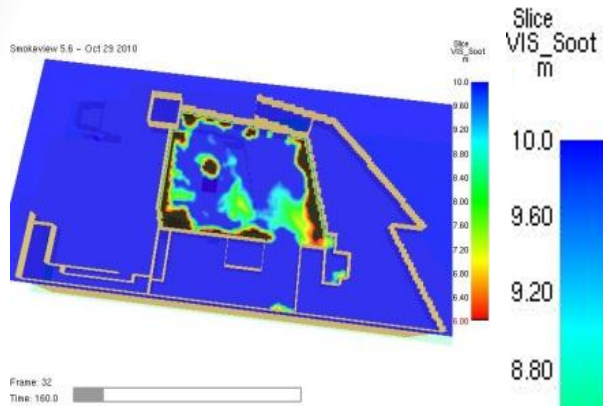


Fire Scenario: HRR

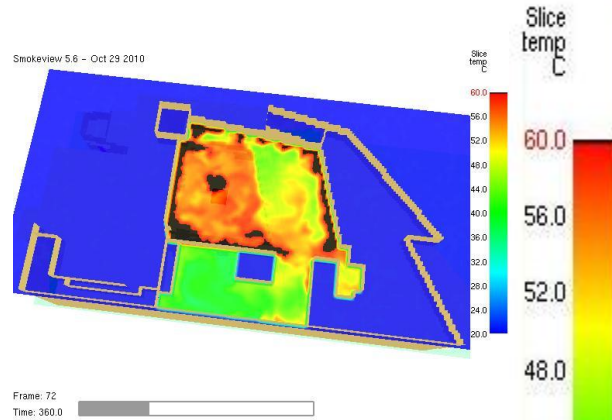
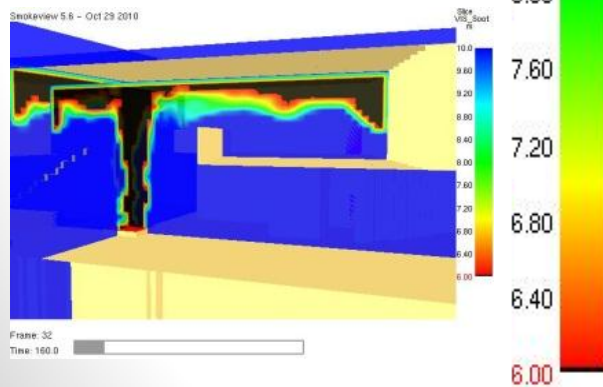
- Sprinkler Activation Calculation
 - Maximum spacing 15 feet
 - Centered between 4 sprinklers
- Medium t^2 fire
- Height: 28.9 feet
- Peak HRR of 2,716kW.
- Reaction Properties
 - Soot Yield: 0.1
 - CO Yield: 0.04
 - Heat of Combustion: 19,826 kJ/kg



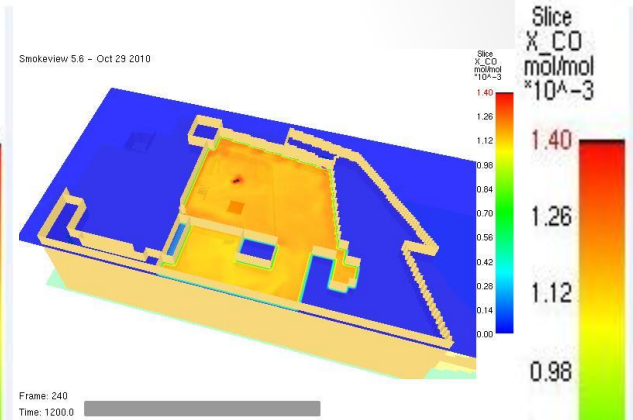
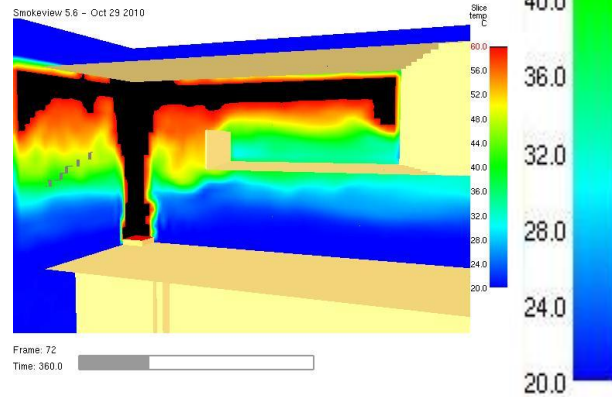
Fire Scenario 1: Level 3 Results



Visibility fails at 160 s

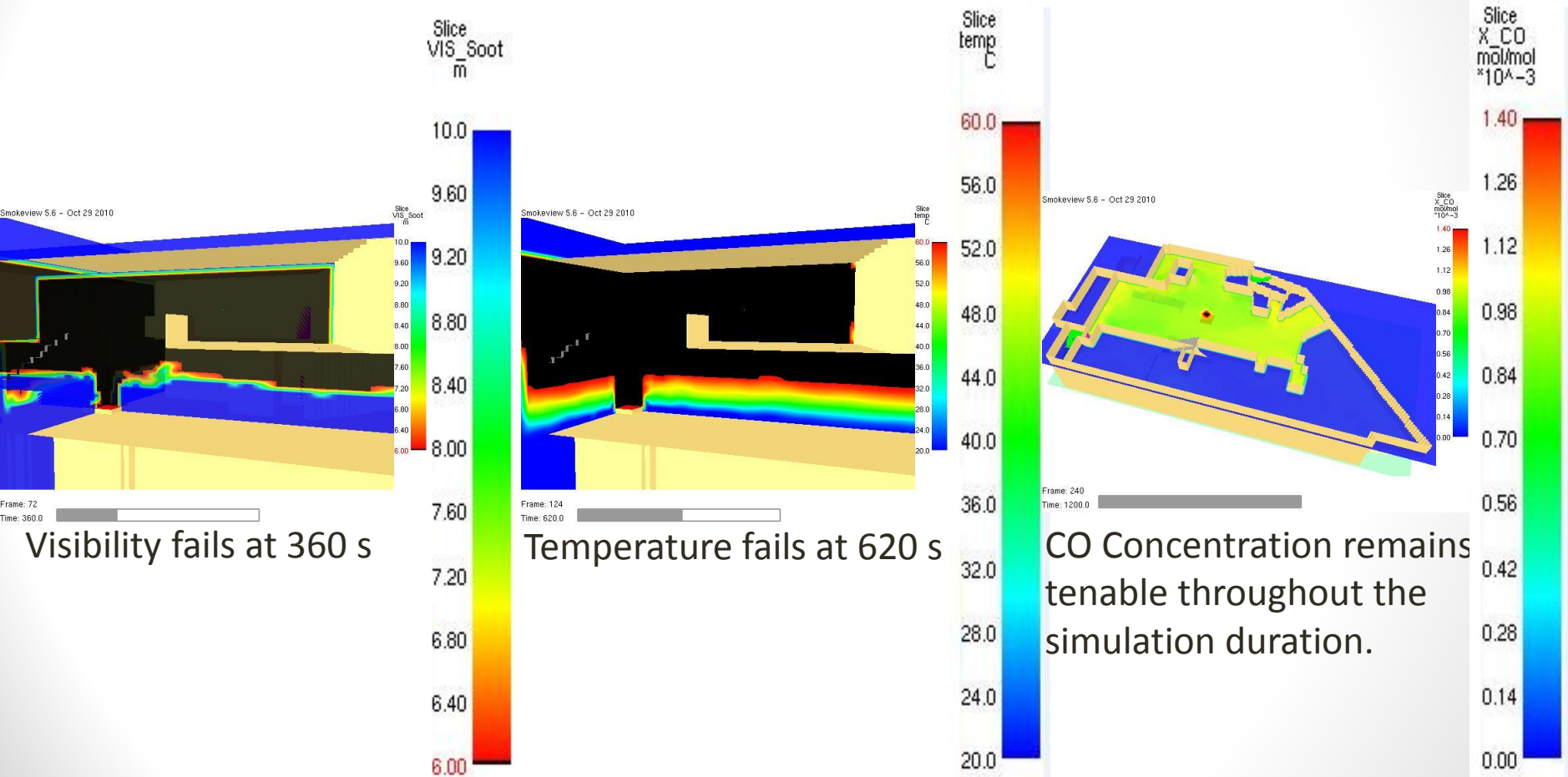


Temperature fails at 360 s

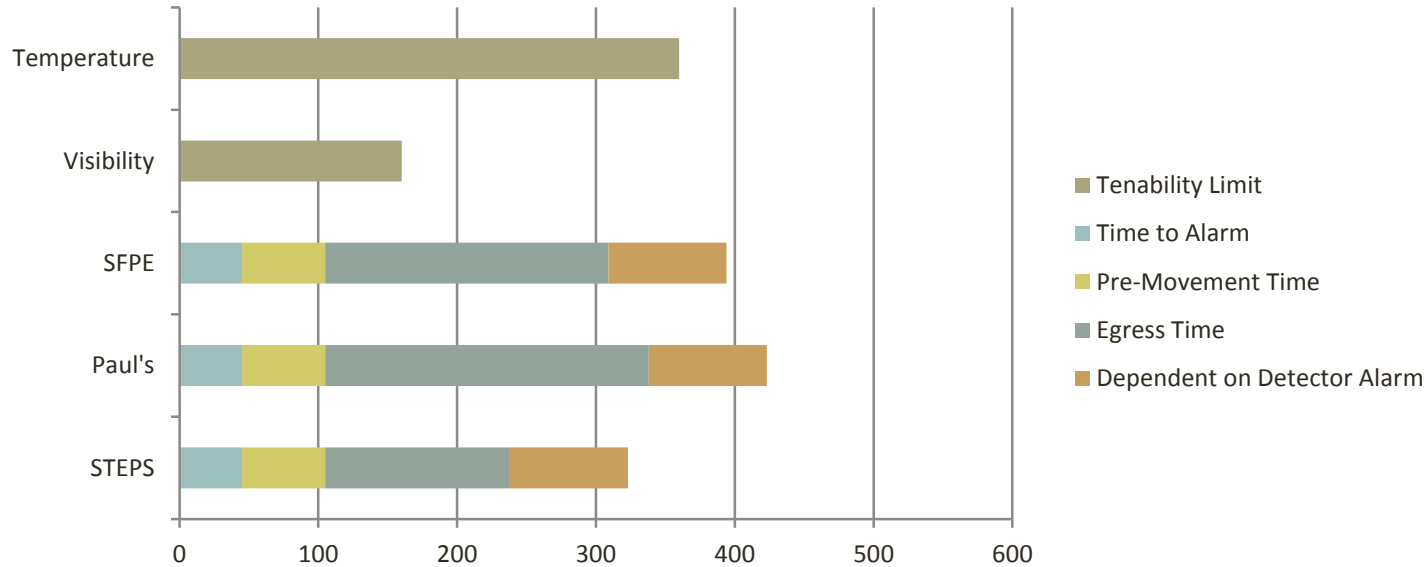


CO Concentration remains tenable throughout the simulation duration.

Fire Scenario 1: Level 2 Results



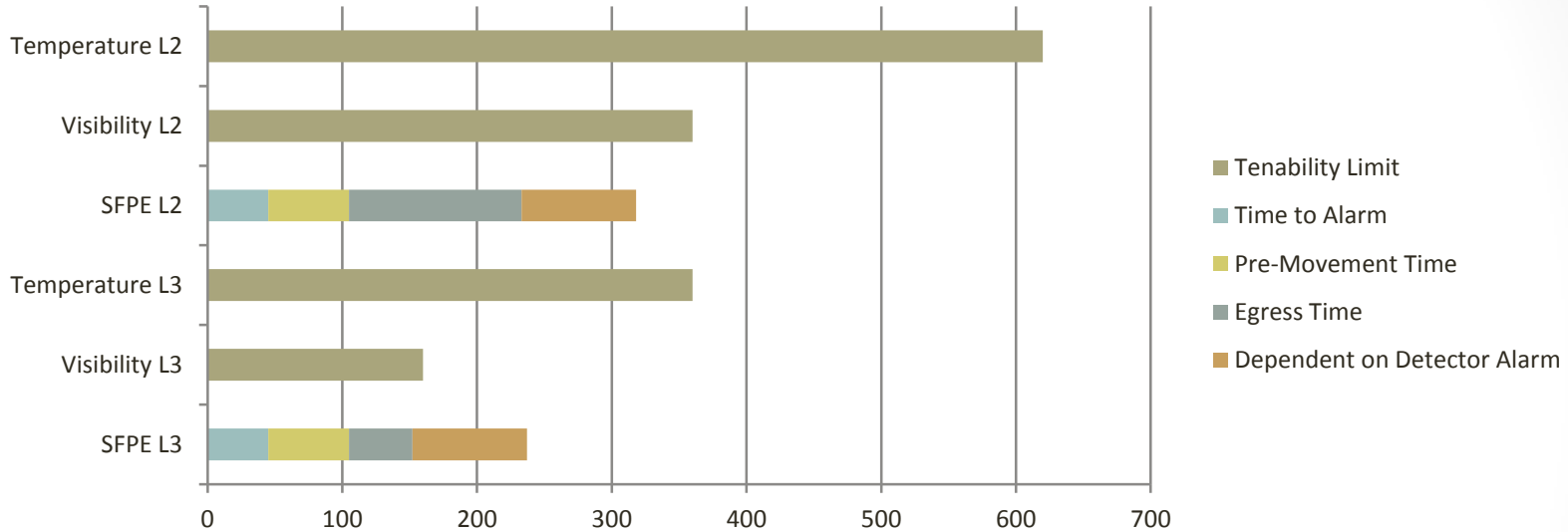
Fire Scenario: ASET vs. RSET



- Time to Alarm: 45 seconds
 - Normally occupied, occupants to sound alarm via pull station
 - Detectors would activate at 130 seconds
- Pre-movement Time : 60 seconds
 - SFPE Handbook Proulx – mid-rise office building.

Method	Egress Time
SFPE	204 s
Paul's	233 s
STEPS	133 s

Fire Scenario 1: Phased Evac



- Time to Alarm: 45 seconds
- Pre-movement Time : 60 seconds
- Level 2 Egress Time: 128 seconds
 - 187 occupants
- Level 3 Egress Time: 47 seconds
 - 68 occupants
- Tenability Limits
 - L3 Visibility: 180s
 - L3 Temperature: 360s
 - L2 Visibility: 360s
 - L2 Temperature: 620s

PD Recommendations

- Phased Evacuation
- Safety training on a regular basis (annually or bi-annual)
 - Reduce the time to alarm
- Type of furniture used and location of workstations
 - Materials with lower soot yields
 - Minimize number of workstations below atrium
- Monitor amount of combustible material
- Alternatives:
 - Enclosing the open stair
 - Install smoke control system
 - Open stair draft curtain can be removed

Summary

- Building is prescriptively compliant
 - Prescriptive based design is intended to have a “safe” building, where “safe” is not defined. (SFPE Handbook)
- Building did not meet design criteria during performance based design analyses.
 - Performance based design is intended to show how a building will perform during a fire. (SFPE Handbook)
- As a fire protection engineer it is important be aware of the difference and to notify clients and architects of the potential risks associated to these types of design decisions.

Thank You

Any Questions?