Mixed-Use Commercial & Residential Podium Building

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Washington State

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FPE 596

Mixed-Use Commercial/Residential Podium Building

Two residential 4-storey wood-framed buildings on top of the non-combustible podium structure

Bldg A = 90 units

Bldg B = 95 units

Bldg: Parking/Retail

- Level 1/ P1 (same elevation)
 - 6 Commercial Retail Units + Amenity
 - Visitor parking
- Level P0 Residential parking

Constructed ~ 2007/08

Common multi-family construction in the Northwest United States

Involved in the design of a sprinkler system for this project

(Design/Built project)

77 Central – Front view (Bldg A)

77 Central – Side view (Bldg B)

PRESENTATION OUTLINE

- Building construction requirements
 - Discuss separation of buildings
 - 3-hour horizontal fire barrier
 - Code mark-up drawings review
 - Fire Department Access plan (site plan)
 - Structural fire protection components
 - Travel distances to exits
 - Egress Analysis
 - Prescriptive (Code)
 - Phased evacuation concept
 - Fire Protection Systems:
 - Fire Sprinkler System (NFPA 13)
 - Fire Alarm System (NFPA 72)
 - Performance – Based Approach
 - Garage car fire in Parking P1 (Open door to Amenity space)
 - Fire in the Amenity Room
 - Kitchen fire on the top level unit (Mezzanine configuration)
 - Recommendations
-

77 Central Complex

The building type is commonly referred to as a podium building, however, this term does not appear in the IBC.

This building type separates the buildings above and below a required 3-hour horizontal assembly into 3 separate and distinct buildings specifically for the purposes of:

- determining area limitations,
- continuity of fire walls,
- limitation of number of stories, and
- type of construction only for wood-framed buildings on top of podium.

(For all other building requirements this is still one building because two residential structures are interconnected by a common parking garage. Example: Sprinkler system, fire alarm system, exterior cladding, etc)

77 Central Complex:

- Building 1 – Residential Building A
- Building 2 – Residential Building B
- Building 3 – Parking and Retail Building

Bldg Separation: Complex is subdivided into three separate buildings in accordance with IBC 2000 Section 508.2 for “Group S-2 enclosed parking garage with Groups A, B, M or R above”. This will allow for combustible construction of residential structures (Group R) above the Parking/Retail Building. 3-hr fire resistance rating is required.

Reference 508.2 typically refers to Group S-2 (parking garage) building under the 3-hr podium for separation of buildings purposes. However, a number of exceptions are permitted as below:

- Group A with less than 300 persons, and
 - Group B or Group M are permitted provided that the entire structure below the horizontal assembly having a minimum 3-hour fire-resistance rating and is protected by an approved automatic sprinkler system.
-

Building Construction:

(Residential Bldg A & B) -

■ Major Occupancies	-	Residential R2 - Apartment Building
■ IBC Requirement	-	Type III A
■ Construction Type	-	Combustible Construction Permitted (Section 508.2)
■ Floor Fire Ratings	-	1 h - Residential to Residential 3 h - Residential to Parking garage
■ Roof Fire Rating	-	1 hr
■ Building Height	-	4 Storeys permitted (from Podium. Ref. 508.2)
■ Total Building Height	-	5 Storeys from grade level
■ Building Areas:		
□ Bldg A	-	24, 870 ft ² (29,160 ft ² permitted-modified)
□ Bldg B	-	24,709 ft ² (29,536 ft ² permitted-modified)
■ Sprinkler System	-	Required (NFPA 13) – 5 Storey bldgs from grade level
■ Fire Alarm System	-	Required (NFPA 72)
■ Standpipe System	-	Required (NFPA 14)

Note: Building area (footprint) for Bldgs A and B exceed the requirements of the code.
Therefore area modification for each building will be applied as follows:
- next slide

Building Construction - Modification

GENERAL BUILDING HEIGHTS AND AREAS

TABLE 503 – 504.1

TABLE 503—continued
ALLOWABLE HEIGHT AND BUILDING AREAS
Height limitations shown as stories and feet above grade plane.
Area limitations as determined by the definition of "Area, building", per floor.

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
GROUP	HGT(H)	UL	160	65	55	65	55	65	50	40
	Hgt(S)									
M	S	UL	11	4	4	4	4	4	3	1
	A	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000
R-1	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-2 ^a	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-3 ^a	S	UL	11	4	4	4	4	4	3	3
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S	UL	11	4	4	4	4	4	3	2

- Modifications Permitted as Following:
 - Section 506.1 permits for Building Area modification based on frontage increase and for provision of an Automatic Sprinkler system
 - Bldg A (modified area) = 29,160 sq.ft permitted
 - Bldg B (modified area) = 29, 536 sq.ft permitted
 - Existing Bldg A and B are not more than 25,000 sq.ft each.

Alternative Construction Types (Discussion Only!)

GENERAL BUILDING HEIGHTS AND AREAS

TABLE 503 – 504.1

TABLE 503—continued
ALLOWABLE HEIGHT AND BUILDING AREAS
Height limitations shown as stories and feet above grade plane.
Area limitations as determined by the definition of "Area, building", per floor.

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
GROUP	HGT(H)	UL	160	65	55	65	55	65	50	40
	Hgt(S)									
M	S	UL	11	4	4	4	4	4	3	1
	A	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000
R-1	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-2 ^a	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-3 ^a	S	UL	11	4	4	4	4	4	3	3
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S	UL	11	4	4	4	4	4	3	2

Construction Types:

- Type III (B) = limited by building area of 16,000 sq.ft
- Type IV = heavy timber (not applicable)
- Type V (A) = limited by building area of 12,000 sq.ft

Building Construction:

(Parking/Retail) -

■ Major Occupancies	-	Group S2 - Parking Garage Group M – Mercantile Group A2 – Assembly (Amenity)
■ IBC Requirement	-	Type I A (Ref. 508.2)
■ Construction Type	-	Non-combustible
■ Floor Fire Ratings	-	2 h between lower and upper parking levels
■ Structural frame	-	3 h columns
■ Podium Fire Rating	-	3 h - Parking Garage to Residential
■ Building Height	-	One underground and one above ground levels
■ Building Area	-	66,300 sq.ft (Unlimited permitted)
■ Sprinkler System	-	Required (NFPA 13)
■ Fire Alarm System	-	Required (NFPA 72)
■ Standpipe System	-	Required (NFPA 14)

Note: 3h Slab (Post-Tensioned)
FT (Fire and Temperature) rating required (IBC 2000 Sec. 711.4.1.2)

Code Mark-up Drawings

- Fire Department Access Plan (site plan)
 - Structural Fire Protection
 - fire barriers and separations
 - Travel distances to exits
 - 2 ½" hose connections and hose stations locations
-

Fire Department Access Plan - Site

Table 601 Structural Requirement (Type IA) Parking/Retail Bldg

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A ^d	B	A ^d	B	HT	A ^d	B
Structural frame ^a Including columns, girders, trusses	3 ^b	2 ^b	1	0	1	0	HT	1	0
Bearing walls									
Exterior ^f	3	2	1	0	2	2	2	1	0
Interior	3 ^b	2 ^b	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions									
Exterior									
Interior ^e									
			See Table 602 See Section 602						
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	1 1/2 ^c	1 ^c	1 ^c	0 ^c	1 ^c	0	HT	1 ^c	0

Note:

Roof construction is indicated as 1 1/2 -hr, for this project a 3-hr fire barrier will be constructed in accordance with Section 508.2

3-h Columns to Support a 3-h Fire Barrier

Table 601 Structural Requirements (Type III A) Residential Bldg A and B

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A ^d	B	A ^d	B	HT	A ^d	B
Structural frame ^a Including columns, girders, trusses	3 ^b	2 ^b	1	0	1	0	HT	1	0
Bearing walls									
Exterior ^f	3	2	1	0	2	2	2	1	0
Interior	3 ^b	2 ^b	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602 See Section 602								
Exterior									
Interior ^e									
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	1 1/2 ^c	1 ^c	1 ^c	0 ^c	1 ^c	0	HT	1 ^c	0

Required Separation of Occupancies

- For Mixed Occupancies fire separations are in accordance with Table 302.3.3 of IBC 2000
 - For areas that are incidental to the main occupancy fire separations are in accordance with Table 302.1.1 of IBC 2000
-

RESIDENTIAL LEVEL 3 - 5

Buildings Section

Egress Analysis (Prescriptive) Parking/Retail Building

Table 1 - Parking Garage / Mercantile / Assembly (Building 1)
LSC Table 7.3.3.1 Capacity Factors

Floor Area	Area (sq. m)	Occupant Load Factor	Capacity (persons)	Exit Capacity - persons (metric)
Perking P0	6130	18.6 gross	330	<u>434 persons</u> (3 x 1,100 mm stairs @ 7.6 mm/ person)
Parking P1	3677	18.6 gross	198	<u>365 persons</u> (2 x 914 mm door @ 5 mm/person)
Amenity Area	355	1.4 net	253	<u>365 persons</u> (2 x 914 mm door @ 5 mm/person)
Retail				<u>365 persons</u> per each CRU (typ)
- CRU1	125	2.8	45	(2 x 914 mm/door @ 5 mm/person)
- CRU2	178	--	64	
- CRU3	212	--	76	
- CRU4	180	--	65	
- CRU5	150	--	54	
- CRU6	214	--	78	

Egress Analysis (Prescriptive) Residential Building A (Similar to Bldg B)

Table 2 - Building 2 (Residential Tower A)
LSC Table 7.3.3.1 Capacity Factors

Floor Area	Area (sq. m)	Occupant Load Factor (sq.m/per)	Capacity (persons)	Exit Capacity (metric)
Level 2	2297 (21 units)	18.6	124	<u>365 persons</u> (2 x 914 mm door @ 5 mm/person)
Level 3	2297 (23 units)	18.6	124	<u>289 persons</u> (2 x 1,100 mm stairs @ 7.6 mm/ person)
Level 4	2297 (23 units)	18.6	124	<u>289 persons</u> (2 x 1,100 mm stairs @ 7.6 mm/ person)
Level 5	2297 (23 units)	18.6	124	<u>289 persons</u> (2 x 1,100 mm stairs @ 7.6 mm/ person)
Total			496	

Phased Evacuation Concept (Smoke Control Measures)

- Section 909 of IBC – set of requirements for limiting smoke movement between connected buildings
- Existing evacuation concept is on Figure 1
 - Bldg A + Parking/Retail evacuate simultaneously
 - No smoke protected vestibule for Bldg A
 - Vestibule/Stair to Bldg A would require min. 12Pa pressure difference
 - Fire Department will respond to Bldg A lobby

Figure 1: Existing

Figure 2: Alternative Arrangement

Smoke Control Measures (Phased Evac.)

LEGEND	
1HR FIRE BARRIER	---
2HR FIRE BARRIER	---
SMOKE PROTECTED VESTIBULE/STAIR MIN. PRESSURE 12 Pa	
SMOKE DETECTOR	●
STROBE LIGHT: "BLDG ABOVE FIRE ALARM ACTIVATED"	■

Fire Protection Systems:

- Fire Sprinkler System

- Water Supply: 85 psi static with 5000 gpm flow @ 20 psi residual pressure
 - Parking/Retail Building
 - Parking = OH I (0.15 gpm/1950 sq.ft) 30% remote area increase for dry system
 - Storage = OH II (0.20 gpm/1950 sq.ft) 30% remote area increase for dry system
 - Mercantile = OH II (0.20 gpm/1500 sq.ft) wet system (no area modification)
 - Steel pipe – Dynaflo for mains & dyna-thread for branchlines
 - 6" Feed main for Bldg A & B installed above insulation. Heat traced in one location between Bldg A and B.
 - Buildings A and B
 - Residential = 4 sprinklers calculated at 0.10 density on Level 5
 - CPVC plastic pipe (1" – 2" pipe)
 - Pre-manufactured trash chute sprinklers (connect to system)
 - Concealed floor joist spaces are not sprinklered (based on floor assembly)
 - All outside balconies are sprinklered
 - Building A & B Attic Sprinkler System
 - Tyco Attic Back-to-Back Sprinklers
 - Seven sprinkler calculation per Manufacturer specification
 - Dry system. Dynaflo for main & dyna-thread for branchlines
-

Fire Sprinkler Hydraulic Calculations

7700 Central Remote Area: GARAGE # 1

CALCULATION DESIGN CRITERIA:	
STANDARD <u>NFPA #13-2007</u>	
OCCUPANCY CLASS <u>Ordinary Hazard I</u>	
MAX. COVERAGE per HEAD	<u>256</u> Ft ²
DENSITY <u>.15</u> GPM / Ft ² for	<u>1950</u> Ft ²
SPRINKLER <u>Viking M ECOH ELO</u>	
ORIFICE <u>17/32"</u>	K= <u>11.2</u>
WATER FLOW INFORMATION:	
STATIC	<u>85</u> PSI
RESIDUAL	<u>20</u> PSI
FLOW	<u>5000</u> GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
<u>477.17</u> GPM @	<u>63.304</u> PSI

* At time of Design

Outside Hose Allowance: 250 gpm
Safety Factor: +19.860 psi (23.9%)

7700 Central Remote Area: RETAIL

CALCULATION DESIGN CRITERIA:	
STANDARD <u>NFPA #13-2007</u>	
OCCUPANCY CLASS <u>Ordinary Hazard II</u>	
MAX. COVERAGE per HEAD	<u>120</u> Ft ²
DENSITY <u>.20</u> GPM / Ft ² for	<u>1500</u> Ft ²
SPRINKLER <u>Reliable F1FR Upright</u>	
ORIFICE <u>17/32"</u>	K= <u>8.0</u>
WATER FLOW INFORMATION:	
STATIC	<u>85</u> PSI
RESIDUAL	<u>20</u> PSI
FLOW	<u>5000</u> GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
<u>366.00</u> GPM @	<u>67.869</u> PSI

* At time of Design

Outside Hose Allowance: 250 gpm
Safety Factor: +15.780 psi (18.9%)

7700 Central Remote Area: STORAGE

CALCULATION DESIGN CRITERIA:	
STANDARD <u>NFPA #13-2007</u>	
OCCUPANCY CLASS <u>Ordinary Hazard II</u>	
MAX. COVERAGE per HEAD	<u>120</u> Ft ²
DENSITY <u>.20</u> GPM / Ft ² for	<u>1950</u> Ft ²
SPRINKLER <u>Reliable F1FR Upright</u>	
ORIFICE <u>17/32"</u>	K= <u>8.0</u>
WATER FLOW INFORMATION:	
STATIC	<u>85</u> PSI
RESIDUAL	<u>20</u> PSI
FLOW	<u>5000</u> GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
<u>583.78</u> GPM @	<u>57.756</u> PSI

* At time of Design

Outside Hose Allowance: 250 gpm
Safety Factor: +24.880 psi (30.1%)

7700 Central Remote Area: Residential Unit

CALCULATION DESIGN CRITERIA:	
STANDARD <u>NFPA #13-2007</u>	
OCCUPANCY CLASS <u>Light Hazard</u>	
MAX. COVERAGE per HEAD	<u>144</u> Ft ²
DENSITY <u>.10</u> GPM / Ft ² for	<u>4 Heads</u> Ft ²
SPRINKLER <u>Reliable Model F1 Res 58</u>	
ORIFICE <u>1/2"</u>	K= <u>5.8</u>
WATER FLOW INFORMATION:	
STATIC	<u>85</u> PSI
RESIDUAL	<u>20</u> PSI
FLOW	<u>5000</u> GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
<u>69.66</u> GPM @	<u>71.743</u> PSI

* At time of Design

Outside Hose Allowance Req'd: 100 gpm (LH)
Outside Hose Allowance Added: 250 gpm
Safety Factor: +12.855 psi (15.2%)

7700 Central Remote Area: Attic System

CALCULATION DESIGN CRITERIA:	
STANDARD <u>NFPA #13-2007</u>	
OCCUPANCY CLASS <u>Light Hazard</u>	
MAX. COVERAGE per HEAD	<u>102</u> Ft ²
DENSITY <u>.10</u> GPM / Ft ² for	<u>7 Heads</u> Ft ²
SPRINKLER <u>Tyco Attic Sprinkler</u>	
ORIFICE <u>17/32"</u>	K= <u>8.0</u>
WATER FLOW INFORMATION:	
STATIC	<u>85</u> PSI
RESIDUAL	<u>20</u> PSI
FLOW	<u>5000</u> GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
<u>280.35</u> GPM @	<u>74.923</u> PSI

* At time of Design

Outside Hose Allowance Req'd: 100 gpm (LH)
Outside Hose Allowance Added: 250 gpm
Safety Factor: +9.053 psi (10.8%)

Fire Sprinkler Hydraulic Calculations

7700 Central Remote Area: GARAGE # 1

CALCULATION DESIGN CRITERIA:	
STANDARD	NFPA #13-2007
OCCUPANCY CLASS	Ordinary Hazard I
MAX. COVERAGE per HEAD	256 Ft ²
DENSITY	.15 GPM / Ft ² for 1950 Ft ²
SPRINKLER	Viking M ECOH ELO
ORIFICE	17/32" K= 11.2
WATER FLOW INFORMATION*:	
STATIC	85 PSI
RESIDUAL	20 PSI
FLOW	5000 GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
477.17 GPM @	63.304 PSI

* At time of Design

Outside Hose Allowance: 250 gpm
Safety Factor: +19.860 psi (23.9%)

7700 Central Remote Area: STORAGE

CALCULATION DESIGN CRITERIA:	
STANDARD	NFPA #13-2007
OCCUPANCY CLASS	Ordinary Hazard II
MAX. COVERAGE per HEAD	120 Ft ²
DENSITY	.20 GPM / Ft ² for 1950 Ft ²
SPRINKLER	Reliable F1FR Upright
ORIFICE	17/32" K= 8.0
WATER FLOW INFORMATION*:	
STATIC	85 PSI
RESIDUAL	20 PSI
FLOW	5000 GPM
AT BASE OF RISER, SYSTEM REQUIRES:	
583.78 GPM @	57.756 PSI

* At time of Design

Outside Hose Allowance: 250 gpm
Safety Factor: +24.880 psi (30.1%)

Fire Protection Systems:

- Parking P1/Level 1 Distribution piping

Residential Level 2 Sprinkler System SE Enlarged view

Attic Sprinklers. Tyco Back-to-Back

- Dual directional specialty sprinkler that throws a narrow, but long pattern in two directions.
- Very efficient attic system design (vs. standard area/density method)

Fire Protection Systems:

- Fire Alarm

- The development is considered as a single building for fire alarm system installation
 - A single-stage fire alarm system is provided
 - Manual pull stations are installed at every floor near every exit and near the principal entrances to buildings.
 - Smoke detectors are provided in each exit stairway, in public corridors in residential portions of the development and in all dwelling unit bedrooms and outside of bedrooms.
 - Smoke detector in Smoke Protected Vestibule
 - The fire alarm system will automatically transmit alarm signals and supervisory signals to the Fire Department.
 - Bldg A + Parking/Retail = 2630 77th Ave SE
 - Bldg B = 7785 Sunset Drive
 - Emergency generator will supply power for approximately 90 minutes. (IBC 1003.2.11.2)
 - Phased Evacuation (Smoke Protected Vestibules) – discussed earlier in Exit Systems
 - Bldg A + Parking/Retail
 - Bldg B
-

Performance-Based Approach Outline:

- ❑ Scenario # 1
 - Garage Automobile Fire
- ❑ Scenario # 2
 - Amenity Room Fire
- ❑ Scenario #3
 - Level 5 Mezzanine Kitchen Fire

Approach: Scenario-based analysis (design fires) will be used.
Tenability: 10m visibility and 60 deg. C temperature
FDS setup: All surfaces are modeled as “inert” (do not absorb any heat)

Design Fire :

1. Heat Release Rate (t-squared fire) UON
 2. Smoke production rate (Propane is a default setting in FDS)
 - ❑ For more accurate fire scenarios soot yields appropriate for each fire should be selected.
 - ❑ My analysis is based on the default value (propane)
-

Scenario #1 (Garage Automobile Fire)

- SFPE Handbook 4th Edition. Pg 3-41. Figure 3-1.79 Data from FRS and VTT laboratories
- NFPA 101 (2003) Ch. 5 Section 5.5.3.8 Design Fire Scenario # 8
 - This scenario addresses concerns regarding unreliability of the fire protection systems. One system must be disabled.
 - Fire resistance rating between the parking garage and the Amenity space will be compromised (open door)
 - Sprinkler system will remain active.
- NFPA 101 (2003) Ch. 5 Section 5.2 Performance Criteria
 - Method 4 – must demonstrate that no fire effects will reach any occupied room. Very conservative approach.
 - Advantage – no need to account for occupant movement, location or pre-fire characteristics.
- $HRR = 6\text{MW}$ (car fire)
 - Assumed steady state fire

Scenario # 1 cont. (FDS results)

- Steady state fire - early sprinkler activation does not have any effect on smoke development in FDS, on temp. only
- Parking garage area was confined for modeling purposes (very conservative)
- High ceiling height in the Parking garage (4m) reduces smoke migration to the Amenity
- This scenario meets the selected Tenability Criteria and LSC Method 4. RSET analysis is not required.

Smokeview 5.6 - Oct 29 2010

Frame: 49
Time: 12.3

Smokeview 5.6 - Oct 29 2010

Frame: 1258
Time: 298.8

Scenario #2 (Amenity Room Fire)

- SFPE Handbook 4th Edition. Pg 3-48. Figure 3-1.102 Data from NIST.
- NFPA 101 (2003) Ch. 5 Section 5.5.3.8 Design Fire Scenario # 8
 - This scenario addresses concerns regarding unreliability of the fire protection systems. One system must be disabled.
 - Sprinkler system will NOT be active.
- NFPA 101 (2003) Ch. 5 Section 5.2 Performance Criteria
 - Method 2 – must meet tenability criteria for visibility and temperature until all occupant safely evacuate
 - ASET vs. RSET will be required
- $HRR = 3MW$ (Upholstered furniture)
 - Fast growth rate fire
 - Fire will compromise one of the exits out of the Amenity space

Scenario # 2 cont. (FDS setup)

- Fire located in the corner of the room
- Visually open space
- 1 exit will be compromised

Smokeview 5.6 - Oct 29 2010

After 5 minutes

Smokeview 5.6 - Oct 29 2010

Frame: 993
Time: 297.9

>153 (kW/m³)

Scenario # 2 cont. (FDS results - ASET)

- Visibility criteria of 10m is reached at approximately 165 sec. (2.75 min)
- Maximum temperature criteria of 60 deg. C is reached at approximately 125 sec. (2.08 min)
- Most conservative time of 125 sec. (2.08 min) will be used for ASET.

Visibility Slice File

Smokeyview 5.6 - Oct 29 2010

Temperature Slice File

Smokeyview 5.6 - Oct 29 2010

RSET (Amenity Room Fire)

- Fire alarm activation
 - ❑ Visually open space
 - ❑ 10 sec (pull station activated)
- Pre-movement time
 - ❑ Table 3-12.1 of SFPE Handbook (4th Edition) NFPA Timetable of Station Nightclub Fire
 - ❑ 19 sec. – crowd begins to react.
- Movement Time:
 - ❑ 91.5 seconds based on Pathfinder (Steering mode)
 - ❑ 259 occupant load
 - ❑ 2 exits only (1 is compromised)
 - ❑ Sprinklers are not active
- RSET Time = 120.5 sec.
- Safety factor built into the tenability criteria (compromised exit)

Scenario # 2 cont. (ASET vs RSET)

- ASET = 125 sec. (2.08 min) based on FDS simulation
- RSET = 120.5 sec. (2.0 min) – 1 exit door is compromised
- ASET > RSET (MoS – built into the Tenability Criteria. 1 exit compromised)
- Performance objective is met

Scenario #3 (Level 5 Residential Kitchen Fire)

- HRR data for Kitchen fire is from paper by NIST.
- NFPA 101 (2003) Ch. 5 Section 5.5.3.8 Design Fire Scenario # 8
 - ❑ Sprinkler system will NOT be active
 - ❑ Smoke detector at mezzanine level
- NFPA 101 (2003) Ch. 5 Section 5.2 Performance Criteria
 - ❑ Method 2 – must meet tenability criteria for visibility and temperature until all occupant safely evacuate
 - ❑ ASET vs. RSET will be required
- HRR = 700 kW (Pan fire)
 - ❑ Account for possibility of multiple pans catching on fire
 - ❑ Fast growth rate fire

UL 300A Fire Characterization

Pan Diam (in)	Time to Ignition (min)	HRR max (kW)	Oil Type	Stove Type
4" pan	18	70 to 100	corn	electric
4" pan	18	65	peanut	gas
10" pot	78	400	corn	electric
10" pot	145		peanut	gas
13" skillet	>93*	-	peanut	gas
13" skillet	61	>100**	peanut	electric
13" skillet	57	>100**	corn	electric
18 x 21 pan	24	>100**	corn	gas

* Ignition not observed
** stopped before
maximum achieved

Scenario # 3 cont. (FDS results - ASET)

- Kitchen fire (700 kW)
- Smoke detector at mezzanine level activates at approximately 36 seconds
- Tenability temperature limit on main level is reached at approximately 145 seconds @ elevation of 1.8m

Smokeyview 5.6 - Oct 29 2010

Smokeyview 5.6 - Oct 29 2010

Slide
Temp
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RSET (Mezzanine Kitchen Fire)

- Smoke detector activation
 - 36 sec.
- Pre-movement time
 - 60 sec. (reasonable estimation)
- Movement Time:
 - 15.5 seconds based on Pathfinder (Steering mode)
 - 12 persons occupant load
 - 1 exits
 - Sprinklers are not active
- RSET Time = 111.5 sec.
- Safety factor built into the tenability criteria (large HRR)

Scenario # 3 cont. (ASET vs RSET)

- ASET = 145 sec. (2.41 min)
- RSET = 111.5 sec. (1.9 min)
- $ASET > RSET \times$ (MoS – built into Tenability Criteria. Large HRR)
- Performance objective is met

Exited: 1/12

4.5

Recommendations:

Item 1

- ❑ 45% of unprotected openings are permitted per Table 704.3 (Exceeded)
- ❑ Further review of the architectural elevation drawings are needed to verify

Recommendations:

Item 2

- ❑ Travel distance deficiency on the parking level P1.
 - 60 m (200 ft) travel distance is exceeded from the Sprinkler Riser Room

Item 3

- ❑ Garbage room door (1 hr rated closure) in the garage was propped open during my site visit. This appears to be typical during the regular business hours.
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Thank you!

Comments or questions?