Fire and Life Safety Analysis for Municipality of Anchorage Public Works Building

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FPE 596 Culminating Experience in Fire
Protection Engineering

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Presentation Outline

- **Building Codes and Standards**
 - **Building Overview**
- **Prescriptive Life Safety Code Analysis**
 - **Egress Analysis**
 - *Hand Calculations - RSET*
 - *Pathfinder Model - RSET*
- **Performance Based Analysis – ASET**
 - *PyroSim - FDS - Smokeview*
- **Results and Recommendations**

Building Codes and Standards

- **Uniform Building Code (UBC)**
Original Building Construction 1997
- **International Building Code (IBC), 2009**
 - **International Fire Code (IFC), 2009**
- **NFPA 13 - 2010 Installation of Sprinkler Systems**
- **NFPA 72 – 2010 National Fire Alarm and Signaling Code**

Building Overview

2002 Addition

International Building Code

Type II-B

1997 Building

Uniform Building Code

Type II-N

Two Story Building

1st Floor = 46,585 ft²;

2nd Floor = 36,396 ft²

Automatic Fire Sprinkler System

(IBC 903.3.1.1)

Occupancy

Group B- Business (IBC304)

Accessory Occupancies (IBC 508.2)

A3– Assembly; S1 – Storage;

S2 Storage; M - Mercantile

1ST Floor – Plan View

Main Entrance

Two 72" Double Door
(Opens to two story Atrium)

Secondary Entrance

One 72" Double Door

Additional Exits

Four 34" Single Door

Conference Room

Additional 34" Single Door

2nd Floor – Plan View

2nd Floor Vertical Egress

Main Stair
(6'-0" Wide)

3 Additional Stairs
(44" Wide)

Prescriptive Life Safety Analysis

Allowable Building Height, Stories, and Area (IBC Table 503)

GROUP		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
	HEIGHT(feet)	UL	160	65	55	65	55	65	50	40
		STORIES(S) AREA (A)								
A-1	S A	UL UL	5 UL	3 15,500	2 8,500	3 14,000	2 8,500	3 15,000	2 11,500	1 5,500
A-2	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-3	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-4	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-5	S A	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL
B	S A	UL UL	11 UL	5 37,500	3 23,000	5 28,500	3 19,000	5 36,000	3 18,000	2 9,000

Unlimited Area Buildings (IBC 507.4)

*“For **Group B** buildings no more than **2 stories** above grade the area shall not be limited when equipped throughout with an **automatic sprinkler system**..., and is surrounded and adjoined by public ways or yards not less than **60 feet** in width.”*

Unlimited Area ✓

Fire Resistance Rating Requirements for Building Elements (IBC Table 601)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	Ad	B	Ad	B	HT	Ad	B
Primary structural frame ^g (see Section 202)	3 ^a	2 ^a	1	0	1	0	HT	1	0
Bearing walls									
Exterior ^{f, g}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior					See Table 602				
Nonbearing walls and partitions Interior ^e	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and secondary members (see Section 202)	1½ ^b	1 _{b, c}	1 _{b, c}	0 _c	1 _{b, c}	0	HT	1 _{b, c}	0

Fire Resistance Rating = 0 hrs ✓

Fire Resistance Rating Requirements for Exterior Walls (IBC Table 602)

FIRE SEPARATION DISTANCE =X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP ^f	OCCUPANCY GROUP F-1, M, S-1 ^g	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2 ^g , U ^b
$X < 5^c$	All	3	2	1
$5 \leq X < 10$	IA Others	3 2	2 1	1 1
$10 \leq X < 30$	IA, IB IIB, VB Others	2 1 1	1 0 1	1 ^d 0 1 ^d
$X \geq 30$	All	0	0	0

Fire Resistance Rating for Exterior Walls = 0 hrs ✓

Corridor Fire-Resistance Rating

(IBC Table 1018.1)

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system ^c
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	Not Permitted	0.5
1-2 ³ , 1-4	All	Not Permitted	0
1-1, 1-3	All	Not Permitted	1 ^b

Fire Resistance Rating for Corridors = 0 hrs ✓

Atrium

(IBC 404.1.1) “*An opening connection two or more stories other than enclosed stairways, elevators, hoist way, ...*”

(IBC 404.3) “*An approved automatic sprinkler system shall be installed throughout the entire building.*”

Atrium Smoke Control

(IBC 404.5) *“A smoke control system shall be installed in accordance with Section 909.*

Exception: Smoke control is not required for atriums that connect only two stories.”

Smoke control system not required! ✓

Fire Sprinkler System Analysis

NFPA #13 Standard for the Installation of Sprinkler Systems

Occupancy Classification (NFPA13 - 5.2)

- Light Hazard Occupancy
- Ordinary Hazard Group 1 (Permit Work Area)
(Determined by on-site inspection of sprinkler system)

System Protection Area Limitations (NFPA 13 – 8.2.1)

52,000 ft² max system coverage

1st and 2nd Floors each < 52,000 ft²

One Wet Pipe System OK ✓

Design Density/Area Curve (NFPA 13 - Fig. 11.2.3.1.1)

FIGURE 11.2.3.1.1 Density/Area Curves.

Hose Stream Allowance and Water Supply Duration

TABLE 11.2.3.1.2 Hose Stream Allowance and Water Supply Duration Requirements for Hydraulically Calculated Systems

<i>Occupancy</i>	<i>Inside Hose</i>		<i>Total Combined Inside and Outside Hose</i>		<i>Duration (minutes)</i>
	<i>gpm</i>	<i>L/min</i>	<i>gpm</i>	<i>L/min</i>	
Light hazard	0, 50, or 100	0, 189, or 379	100	379	30
Ordinary hazard	0, 50, or 100	0, 189, or 379	250	946	60–90
Extra hazard	0, 50, or 100	0, 189, or 379	500	1893	90–120

Public Water Supply Main: Duration > 60 minutes ✓

Quick Response Sprinklers (NFPA 13 - 11.2.3.2.3)

Remote Area Reduction

- Wet pipe system
- Light or ordinary hazard occupancy
 - 20 ft max ceiling height
- No unprotected ceiling pockets ($>32 \text{ ft}^2$)

Note: $y = \frac{-3x}{2} + 55$

For ceiling height $\geq 10 \text{ ft}$ and $\leq 20 \text{ ft}$, $y = \frac{-3x}{2} + 55$

For ceiling height $< 10 \text{ ft}$, $y = 40$

For ceiling height > 20 , $y = 0$

For SI units, $1 \text{ ft} = 0.31 \text{ m}$.

FIGURE 11.2.3.2.3.1 Design Area Reduction for Quick-Response Sprinklers.

Ceiling Height 10 ft or less

Remote Area Reduction = 40%

▪ **Min Remote Area = 900 ft²**

Atrium Ceiling Height > 20 ft

Remote Area Reduction = 0%

Remote Area Increase = 30%

(due to slope)

▪ **Min Remote Area = 1950 ft²**

Max Sprinkler Coverage & Spacing

TABLE 8.6.2.1(a) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Light Hazard

Construction Type	System Type	Maximum Protection Area		Maximum Spacing	
		ft ²	m ²	ft	m
Noncombustible unobstructed	Hydraulically calculated	225	20.9	15	4.6
Noncombustible unobstructed	Pipe schedule	200	18.6	15	4.6
Noncombustible obstructed	Hydraulically calculated	225	20.9	15	4.6
Noncombustible obstructed	Pipe schedule	200	18.6	15	4.6

TABLE 8.8.2.1.2 Protection Areas and Maximum Spacing (Extended Coverage Upright and Pendent Spray Sprinklers)

Construction Type	Light Hazard		Ordinary Hazard		Extra Hazard	
	Protection		Protection		Protection	
	Area (ft ²)	Spacing (ft)	Area (ft ²)	Spacing (ft)	Area (ft ²)	Spacing (ft)
Unobstructed	400	20	400	20	—	—
	324	18	324	18	—	—
	256	16	256	16	—	—
	—	—	196	14	196	14
	—	—	144	12	144	15

Water Supply – AWWU Computer Model

Hydraulic Calculation – 2nd Floor Addition

0.1 gpm / 969 ft² with 100 gpm Hose Demand

Hydraulic Calculation Analysis

Fire Alarm and Notification Analysis

Where Required – New Buildings and Structures (IBC 907.2)

“An approved fire alarm system installed in accordance with the provisions of this code and NFPA 72...”

**Honeywell
FS-90
Fire & Security
Panel &
Annunciator**

- **Smoke Detectors**

(Elevator Lobbies, Hoist way & Machine Room, Atrium, Corridors, and above Permit Counter)

- **Manual Pull Stations**

- **Alarm Notification Appliances**

(Horn/Strobe)

Typical Exit Corridor

- Smoke Detector
- Horn/Strobe
- Manual Pull Station
- Exit Sign

- **Automatic Sprinkler (Detection) System**

- **Heat Detectors**

- (Elevator Machine, Boiler, & Generator Room)*

- **Duct Detectors**

- **Proprietary Supervising Station**

- Non-contiguous Properties*

Fire Safety Functions

Shut-Down Air Handlers

Elevator Recall Function

Sequence of Operation Matrix

FIRE ALARM SYSTEM AUTOMATIC SEQUENCE OF OPERATION MATRIX							
	HEAT SENSORS	SMOKE SENSORS	AHU DUCT DETECTORS	MANUAL PULL STATIONS	ELV LOBBY SMOKE SENSORS	ELV HOISTWAY & MACHINE RM SMOKE SENSORS	ELV HOISTWAY & MACHINE RM HEAT SENSORS
ANNUNCIATE AT FIRE ALARM CONTROL PANEL (ALARM OR TROUBLE)	YES	YES	YES	YES	YES	YES	YES
ANNUNCIATE AT CENTRAL SYSTEM DISPLAY	YES	YES	YES	YES	YES	YES	YES
ACTIVATE AUDIBLE & VISUAL ALARM SIGNALS THROUGHOUT BUILDING	YES	YES	YES	YES	YES	YES	YES
SHUTDOWN AIR HANDLERS	YES	YES	YES	YES	YES	YES	YES
INITIATE ELEVATOR RECALL SEQUENCE PER NFPA 72 3-8.14	NO	NO	NO	NO	YES	YES	NO
ACTIVATE ELEVATOR SHUTDOWN SHUNT TRIP ELECTRICAL BREAKER PER ELV INSPECTOR	NO	NO	NO	NO	YES	NO	NO

Prescriptive Egress Analysis

1st Floor Occupant Loads (IBC Table 1004.101)

Occupancy	Gross or Net Area (ft ²)	Occupant Load Factor (ft ² /occupant)	Calculated Occupant Load
B	38,632	100	386
A3	3,553	15	237
S1	1,155	300	4
S2	3,036	300	10
M	209	60	4
Total	45,585	-	641

2nd Floor Occupant Loads (IBC Table 1004.101)

Occupancy	Gross or Net Area (ft ²)	Occupant Load Factor (ft ² /occupant)	Calculated Occupant Load
B	36,100	100	361
S1	137	300	1
S2	3,159	300	11
Total	39,396	-	373

$$\text{Total} = 641 + 373 = 1014$$

2nd Floor Exit Capacity (IBC 1005.1)

Stair	Stair Width (inches)	Stair Capacity (inches/o.3)	Door Width (inches)	Door Capacity (inches/o.2)
#1	72	240	N/A	-
#2, #3, #4	44	3 x 147	34"	170
Total		681		

- 2nd Floor Occupant Load 373 < 681 Exit Capacity ✓
- Loss of any one egress does not reduce capacity to less than 50% ✓

Minimum Number of Exits (IBC Table 1021.1)

2nd Floor Occupant Load 373
 (Exits required = 2) < (Exits provided = 4) ✓

1st Floor (Building) Exit Capacity (IBC 1005.1)

Exit	Total Door Width (inches)	Door Capacity (inches/o.2)
Main Entrance #1	2 x 72	720
Secondary Entrance #2	72	360
Exit #3, #4, #5, #6	4 x 34	680
Total		1760

- Total Occupant Load 1014 < 1760 Exit Capacity ✓

- Loss of any one Egress does not reduce capacity to less than 50% ✓

Minimum Number of Exits (IBC Table 1021.1)

1st Floor (Total) Occupant Load 1014

(Exits required = 4) < (Exits provided = 6) ✓

Exit Access Travel Distance (IBC Table 1016.1)

For a Group B with Sprinkler System
Maximum Travel Distance = 300 ft

Corridor Width (IBC 1018.2)

Minimum corridor width not less than 44 inches

Corridor Dead Ends (IBC 1018.4)

For a Group B with Sprinkler System
Maximum Dead End Corridor = 50 ft

Exit Signs (IBC 1011.1)

All exit sign viewing distances are less than
100 ft for 1st and 2nd floors ✓

RSET < ASET

Fire Alarm Delay = 25 seconds¹ ✓

Delay Time to Start Evacuation = 66 seconds² ✓

1. Material Data Sheet for Water Flow Switch (Lowest Setting at 10 – 25 seconds)
2. SFPE Table 3-12.2: Delay time for mid-rise office building

Influencing Factors of Egress

Characteristics of Occupants

- *Majority long term employees familiar with surroundings*
 - *Able-bodied*
- *Potentially disabled persons*
 - *General public access*

Fire Scenario #1 and #2

Reasoning

- Both are located in close proximity to atrium.
- Both appear to have a substantial amount of fuel load.
- Both are well-ventilated areas where fuel controlled fires might result.
- Central ESLO ECOH Sprinklers

Permitting Area Work Station

Fire Scenario #1:

- Wastebasket
- Computer tower
- Paper combustibles
- Plastic Products
- 16'x16' ECOH Sprinklers
 - Smoke Detectors
- Ceiling Height = 9'-0"
 - In open work area
- Near Entrance/Atrium
 - Medium t^2 fire

Fire Scenario #1:

Permitting Work Station Area

Smoke detectors 20' o.c.
above work stations

Central ESLO ECOH Sprinklers

- Central Voluntary Replacement Program (2001 – 2007)
- O-Rings degrade over time
- Sprinklers may not activate

Open Plan Storage Area

Fire Scenario #2:

- Open Storage
- Wood / Paper combustibles
- 16'x16" ECOH Sprinklers
 - No Smoke Detectors
- Plastic trash containers
- Ceiling Height = 9'-0"
 - Glass block wall
 - Fast t^2 fire

DETECT Calculation

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	1.82	m	R/H	1.780
Radial distance (R)	3.2	m	$dT(cj)/dT(pl)$	0.204
Ambient temperature (To)	20	C	$u(cj)/u(pl)$	0.124
Actuation temperature (Td)	68	C	Rep. t2 coeff.	k
Response time index (RTI)	50	(m-s) ^{1/2}	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.012	kW/s ⁿ	Fast	0.047
Time step (dt)	2	s	Ultrafast	0.400

DETECT Scenario 1 Sprinkler

Fire Scenario #1 (Sprinkler Activation)

- Activates at 196 seconds
- HRR = 461 kW

DETECT Calculation

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	1.82	m	R/H	1.676
Radial distance (R)	3.1	m	$dT(cj)/dT(pl)$	0.213
Ambient temperature (To)	20	C	$u(cj)/u(pl)$	0.130
Actuation temperature (Td)	27.8	C	Rep. t2 coeff.	k
Response time index (RTI)	2	(m-s) ^{1/2}	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.012	kW/s ⁿ	Fast	0.047
Time step (dt)	2	s	Ultrafast	0.400

DETECT Scenario 1 Smoke Detector

Fire Scenario #1 (Detector Activation)

- Activates at 38 seconds
- HRR = 17 kW

DETECT Calculation

INPUT PARAMETERS			CALC. PARAMETERS	
Ceiling height (H)	0.54	m	R/H	4.074
Radial distance (R)	2.2	m	$dT(cj)/dT(pl)$	0.118
Ambient temperature (To)	20	C	$u(cj)/u(pl)$	0.062
Actuation temperature (Td)	68	C	Rep. t2 coeff.	k
Response time index (RTI)	50	(m-s) ^{1/2}	Slow	0.003
Fire growth power (n)	2	-	Medium	0.012
Fire growth coefficient (k)	0.047	kW/s ⁿ	Fast	0.047
Time step (dt)	2	s	Ultrafast	0.400

DETECT Scenario 2 Sprinkler

Fire Scenario #2 (Sprinkler Activation)

- Activates at 66 seconds
- HRR = 205 kW

Total Building Egress Time

Egress Component	Width (inches)	Effective Width (W_e) (inches)	Effective Width (W_e) (feet)	Flow Capacity (persons per minute)
Main Entrance #1	2 (68)	$2(68 - 12) = 112$	9.33	$24 \times 9.33 = 224$
Secondary Entrance #2	68	$68 - 12 = 56$	4.67	$24 \times 4.67 = 112$
Exits #3 to #6	4 (34)	$4(34 - 12) = 88$	7.33	$24 \times 7.33 = 176$

Total 1st floor flow capacity = 512 persons/minute

Total 1st Floor Evacuation Time
 = Occupancy Load / Total Stair Capacity
 = 1014 persons / 512 persons/min
 = 1.98 min (119 sec) ✓

Calculated (DETECT) RSET

= Detection & Notification (Retard Time)
+ Pre-Movement + Total Evacuation

Scenario #	Detection Time (s)	Pre-Movement Time (s)	Egress Time (s)	RSET (s) [min]
1 - Sprinkler	196 + 25	66	119	406 [6.7]
1 - Detector	38 + 25	66	119	248 [4.1]
2 - Sprinkler	66 + 25	66	119	276 [4.6]

Scenario #1 RSET = 4.1 minutes

Scenario #2 RSET = 4.6 minutes

Pathfinder Egress Simulation Model

Model Based Upon

- **Maximum Occupant Load**
- **Occupant Behavior**
 - SFPE Behavior Mode
 - Go to Any Exit
 - Default Speed 3.9 ft/s
- **Assigned Sweepers**
 - Waypoints
 - Wait Times

(Pathfinder) RSET

Number of Occupants in Selected Rooms

Scenario #	Detection Time (s)	Pre-Movement Time (s)	Pathfinder Time (s)	RSET (s) [min]
1 - Sprinkler	196 + 25	66	273	560 [9.3]
1 - Detector	38 + 25	66	273	402 [6.7]
2 - Sprinkler	66 + 25	66	273	430 [7.2]

Scenario #1 RSET = 6.7 minutes ✓

Scenario #2 RSET = 7.2 minutes ✓

Pathfinder Results

Flow Rates for Selected Doors

- Door 272 has a relatively constant flow rate.
- Bottle necking occurring. ✓

Pathfinder Results

- Door 272: South Exit Door

Performance Based Design

Reasoning

- Bottle necking occurring at 1st floor south exist door #272.
 - Focus on loss of the *second* 2nd floor egress.
(*south end of building through 2nd floor lobby*)
 - Due to potential untenable conditions being reached.
(*thermal hazard of heat, or due to the non-thermal hazard of reduced visibility*)
- Maintain 6 ft (2 m) tenable conditions on 2nd floor lobby.

Assumptions

- Well ventilated – fuel controlled fire.
- Mechanical ventilation – i.e. air injection or exhaust is negligible.
- Fire does not spread to adjacent work stations.
 - Medium t^2 fire (≈ 1055 kW in 300 s)
 - Fast t^2 fire (≈ 1055 kW in 150 s)
 - Soot yield = 0.01 g/g (≈ 0.015 Wood)
- Without sprinkler activation: Maximum HRR is reached and maintained throughout the simulation.
- With sprinkler activation: HRR at which a sprinkler is activated is maintained throughout the simulation.

Performance Based Design

PyroSim / FDS Model

- Model Resolution: 0.5 m grid size.
- 600 second simulation.

Close-up of Model

**2nd Floor Lobby
(Open to Atrium
& 1st Floor below)**

Tenability Limits

Visibility	> 10 m (30 ft)	✓	SFPE HFPE pg. 2-180
Temperature	< 60 °C	✓	SFPE HFPE pg. 2-184
Heat Flux	< 2.5 kW/m ²		SFPE HFPE pg. 2-184

Scenario #1 Workstation HRR

Figure 69. Single workstation, 360 s after ignition, near peak HRR of 3.3 MW

Model HRR = 3.3 MW at 360 seconds

NIST Special Publication SP-1021
Cook County Administration Building Fire

Scenario #1 Results

(without sprinkler activation)

Smokeyview 6.1.5 - Nov 22 2013

Visibility > 10 m

- Less than 10 m at 382 seconds at 2 m (6 ft) AFF.

Smokeyview 6.1.5 - Nov 22 2013

Temperature < 60° C

- 60°C Encroaches 2nd Floor Lobby at 480 seconds

Scenario #1

(*with* sprinkler activation)

Smokeview 6.1.5 - Nov 22 2013

Frame: 393

Time: 235.9

mesh: 1

Sprinkler Activates

- 235 seconds
- HRR at activation
= 1.3 MW

Scenario #1 Results

(with sprinkler activation)

Smokeyview 6.1.5 - Nov 22 2013

Visibility > 10 m

- Less than 10 m at 578 seconds at 2 m (6 ft) AFF.

Smokeyview 6.1.5 - Nov 22 2013

Temperature < 60° C

- < 55° C at 600 seconds

Scenario #1: Summary of Results

REST		ASET	
Hand Calc.	276 s (4.6 min)	w/ Sprinklers	578 s (9.6 min)
Pathfinder	430 s (7.2 min)	w/o Sprinklers	382 s (6.4 min)

With Sprinklers Operating
(RSET = 430 s) < (ASET = 578 s)
Passes with Margin of Safety! ✓

Without Sprinklers Operating
(RSET = 430 s) > (ASET = 382 s)
Fails! ✗

Scenario #2 Plan Storage HRR

Figure 3-1.56. HRR of magazine racks loaded with magazines, newspapers, and books.

Figure 3-1.75. HRR of various shop-display commodities tested by Chow.¹⁷⁸

Model HRR = 3.5 MW at 300 seconds

SFPE Handbook of Fire Protection Engineering, 4th Edition
Figures 3-1.56 and 3-1.75

Scenario #2 Results

(*without* sprinkler activation)

Visibility: Less than 10 m at 432 seconds

Temperature: < 60° C at 600 seconds

(*with* sprinkler activation)

Sprinkler Activates: At 121 seconds at a HRR = 567 kW

Visibility: >10 m at 600 seconds

Temperature: < 25° C at 600 seconds

Scenario #2: Summary of Results

REST		ASET	
Hand Calc.	276 s (4.6 min)	w/ Sprinklers	600 s (10 min)
Pathfinder	430 s (7.2 min)	w/o Sprinklers	432 s (7.2 min)

With Sprinklers Operating
(RSET = 430 s) < (ASET = 600 s)
Passes with Margin of Safety!

Without Sprinklers Operating
(RSET = 430 s) ≤ (ASET = 432 s)
Passes, but NO Safety Factor!

Results & Recommendations

- Calculated RSET < ASET w/ sprinklers operating
- Pathfinder RSET ≥ ASET w/o sprinklers operating
- Bottle necking occurring at Door 272. Possible recommendation of enlarging exit to double doors to reduce RSET.
- Loss of Lobby exit for 2nd floor south end of the building a possibility due to untenable conditions being reached, without sprinklers operating.
- Recommend that recalled ESLO ECOH sprinkler heads be replaced ASAP to insure operation of sprinkler system.
- Recommend that hydraulic calculations be performed for to verify existing system pipe sizes are adequate for replacement sprinklers.

Model Improvements?

- Decrease model grid size to improve FDS model resolution.
- Use actual smoke yield from full scale test results.
- Add CO yield to model.

Thank you!

Questions?