COMPREHENSIVE FIRE AND LIFE SAFETY ANALYSIS

MOA PUBLIC WORKS BUILDING

ANCHORAGE, ALASKA

FPE 596 Culminating Project

presented to

the Faculty of California Polytechnic State University,

San Luis Obispo

in Partial Fulfillment

of the Requirements for the Degree

Master of Fire Protection Engineering

by

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June 2014

Abstract

COMPREHENSIVE LIFE AND LIFE SAFETY ANALYSIS
MOA PUBLIC WORKS BUILDING
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Andrew James Bigalke

This report is a Comprehensive Fire and Life Safety Analysis addressing both prescriptive and performance based engineering analysis of the MOA Public Works building located in the Municipality of Anchorage, Alaska. The Public Works building was originally built in 1997 under the code requirements of the Uniform Building Code, as a Type II-N building. An addition was constructed in 2002 using the International Building Code (IBC), 2000 Edition. A prescriptive analysis is performed using the requisite building code and standards currently adopted by the State of Alaska, and by the Municipality of Anchorage. The currently adopted building codes and standards include the 2009 Edition of the International Building Code (IBC), the 2009 Edition of the International Fire Code (IFC), the 2010 Standard of NFPA 13, 2010, Standard for the installation of Sprinkler Systems, and the 2010 Edition of NFPA 72, National Fire Alarm and Signaling Code. The prescriptive analysis reviews the occupancy type and load, construction type, allowable area of construction per floor, the use of an atrium, fire resistance ratings for building elements, means of egress, fire protection systems including water based sprinkler system, and alarm, detection, and notification system requirements. The required safe egress time (RSET) is also determined using a calculation method outlined in the SFPE Handbook of Fire Protection Engineering, and by the use of the egress model simulation software PyroSim by Thunderhead Engineering. (Pathfinder 2014). The performance based analysis addresses the ability of the occupants to egress the building within an available safe egress time (ASET) before tenable conditions are reached. Two potential fire conditions are analyzed using representative heat release rate curves as determined from full scale testing and by references. A model is created and analyzed using a computational fluid dynamics simulator program, otherwise known as FDS. (NIST 2014) The simulation results are then used to determine if untenable conditions of visibility and heat are reached. The data file for the FDS simulation was created using the graphical interface program PyroSim, by Thunderhead Engineering (PyroSim 2014). RSET values are compared to ASET values, to determine whether or not all persons can egress safely from the building during a significant fire before untenable conditions area reached. The end result of this project study is that if the fire sprinklers operate as expected, the calculated RSET value is less than the performance based ASET value, by a margin of safety. This allows enough time for all occupant to egress before untenable conditions are reached. Assuming the sprinklers do not operate as expected, the calculated RSET value is greater than or equal to the performance based ASET value. In this case the performance based objectives are not met, meaning untenable conditions are reached, and/or no safety factor exist before untenable conditions are reached. Suggestions of improving the RSET is given, along with suggestions of improving the performance based model. Appendix F provides questions and answers asked by the project reviewers during the project presentation on June 12, 2014.

Keywords

Performance Based Design, RSET, ASET, Tenable Conditions, Fire Dynamics Simulator (FDS)

Statement of Disclaimer

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Acknowledgments

I would like to express my gratitude to the entire faculty of the Cal Poly College of Engineering, Fire Projection Engineering, for 2½ years of a challenging and rewarding education in fire protection engineering. I would also like to thank Mark Warren, Anchorage Fire Department, Fire Systems Plan Review, for meeting with me numerous time to walk the building and to discuss issues at hand. Most importantly I'd like to thank my wife Yvonne for encouraging me throughout this time, and my son Sam for entertaining me whenever he could.

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Chapter 1 – Prescriptive Analysis

1.1 Building Codes, Standards, and Engineering References

- (ICC) - International Code Council
  - International Building Code (IBC) 2009
  - International Fire Code (IFC) 2009
- (NFPA) - National Fire Protection Association Codes and Standards
  - NFPA 13 - Standard for the Installation of Sprinkler Systems (2010)
  - NFPA 72 - National Fire Alarm and Signaling Code (2010)
- (SFPE) - Society of Fire Protection Engineering
  - SFPE Handbook of Fire Protection Engineering, 4th Edition

The State of Alaska and the Municipality of Anchorage, adopted the 2000 Edition of the International Building Code in 2003. Immediately prior to that time, and during the original construction of the MOA Public Works Building, the 1997 Uniform Building Code was in use. NFPA 101 - Life Safety Code is not used within the Municipality of Anchorage, but can be utilized as long as the references sections of the code meets or exceeds the requirements established by the International Building Code. Since NFPA 101 - Life Safety Code is not often used, the analysis performed in this project report is based on the International Building Code, 2009 Edition. (MOA 2014)

1.2 Project Building Overview

The Municipality of Anchorage (MOA) Public Works Building is a two story building located in Anchorage, Alaska. See Picture 1 for an exterior view of the building looking toward its main entrance. The building was originally constructed in 1997 with an addition added in 2002. Reference Figure 1 and Figure 2, respectively, for 1st and 2nd floor plans, and years of construction.

Picture 1 - Exterior Front View of MOA Public Works Building

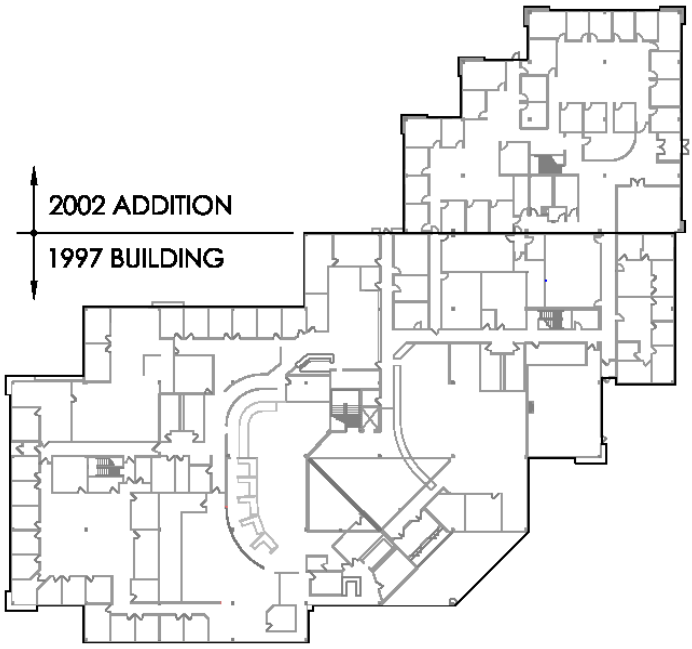


Figure 1 - 1st Floor Plan

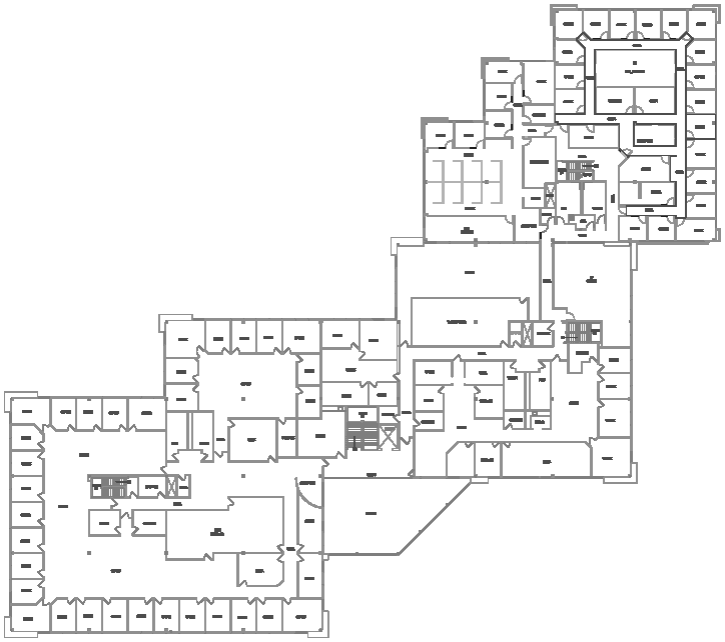


Figure 2 - 2nd Floor Plan

The building serves as an office location for Anchorage's Administration, Maintenance and Operations Division, Traffic Division, Project Management and Engineering Division, and Life Safety Division, which includes plan review and permitting functions, fire investigations, etc.... The building consists of open work areas, office spaces, storage rooms, conference rooms, utility rooms, and a coffee shop. The main entrance consists of two 72" double doors which enters a mini-atrium. The atrium is open to both the first and second floors. The first floor also has five additional exits, one of which consists of a set of 72" double doors, and the remaining four consist of single 34" doors. The second floor has four interior stairways which serve as the vertical means of egress from the second floor. The main central stairway is 6'-0" wide and is located at the atrium. The remaining three stairs are each 44" wide. All of the stairways are open to the second floor, with the exception of one. Per the original building construction type II-N in 1997, under the Uniform Building Code, it is my understanding that one stairway required a 1 hour rating, and an enclosed horizontal exit path to the exterior. A single elevator is located at the main entrance

atrium and serves the second floor Lobby. The building is fully sprinklered throughout, and has a fire alarm and detection system. The extent of these systems will be discussed later in this report.

The gross square footage of each floor is given in Table 1.

Table 1 - Area per Floor

Floor	Gross Area (ft2)
Floor 1	46,585
Floor 2	36,396
Total	82,981 Gross ft2

1.2.1 Occupancy

The primary Occupancy Classification of the MOA Public Works Building is Business- Group B. The Occupancy Classifications for individual areas within the building are outlined Table 2, followed by descriptions of each occupancy classification as given in the IBC.

Table 2 - Occupancy Type by Area

Building Use	Occupancy
Offices	B
Conference Rooms (< 50 People)	B
Conference Rooms (>50 People or > 750sq.ft.)	A-3
Library	A-3
Lobbies	A-3
Mechanical / Utility Rooms	S-1
Storage Rooms	S-2
Coffee Shop	M

Occupancy Definitions:

- *Group A-3: Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A including, but not limited to: i.e. Lecture Halls, Libraries.*
- *Group B: Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts.*
- *Group S: Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.*
- *Group S-1: Moderate-hazard storage.*
- *Group S-2: Low hazard storage.*
- *Group M: Mercantile Group M occupancy includes, among others, the use of a building or structure or a portion thereof, for the display and sale of merchandise incidental to such purposes and accessible to the public.*

1.2.2 Type and Rating of Construction

The original building was constructed in 1997 under the Uniform Building Code as a Type II-N construction type. The building addition was added in 2002 under the newly adopted 2000 Edition of the International Building Code, with a construction type of IIB. The building elements under a type IIB construction type are of noncombustible construction, with a 0 hour rating, as shown in Table 3.

IBC Table 602, provides the fire resistance rating requirements for exterior walls based on fire separation distance, per occupancy type. With a building separation distance greater than 72 feet from the closest property, the fire resistance rating of the exterior walls is 0 hours, as shown in Table 4.

IBC Section 1018 Corridors, Table 1018.1 shows that for a Type B Occupancy, with an occupancy load greater than 30, and that is fully sprinklered in accordance with Section 903.3.1.1, has a required corridor rating of 0 hours, as shown in Table 5.

IBC Section 803 Wall and Ceiling Finished, Table 803.9 requires that for a Group B Occupancy, in a fully sprinklered building, require that the interior wall and ceiling finish material requirements be Class C for corridors, rooms, and finished spaces, as shown in Table 6. The Table specifies a Class B finish material for Exit Enclosures and Exit Passageways, however, note b) states that for buildings less than 3 stories in height, Class C interior finish materials for sprinklered buildings is acceptable.

Table 3 - IBC Table 601 Fire-Resistance Rating Requirements for Building Elements (hours)

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] Interior	3 3[a]	2 2[a]	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 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)	1 1/2[b]	1[b, c]	1[b, c]	oc	1[b, c]	0	HT	1[b, c]	0

Table 4 - IBC Table 602 Fire-Resistance Rating Requirements
for Exterior Walls Based On Fire Separation Distance

FIRE SEPARATION DISTANCE =X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUPH[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 ≤ X <10	IA Others	3 2	2 1	1 1
10 ≤ X < 30	IA,IB lIB, VB Others	2 1 1	1 0 1	I[d] 0 I[d]
X ≥ 30	All	0	0	0

Table 5 - IBC Table 1018.1 Corridor Fire-Resistance Rating

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	I[b]

Table 6 - IBC Table 803.9 Interior Wall and Ceiling Finish by Occupancy

GROUP	SPRINKLERE0[1]			NONSPRINKLEREO		
	Exit enclosures and exit passagewaysa, b	Corridors	Rooms and enclosed spaces[c]	Exit enclosures and exit passagewaysa, b	Corridors	Rooms and enclosed spaces[c]
A-I & A-2	B	B	C	A	Ad	Be
A-3[4] A-4, A-5	B	B	C	A	Ad	C
B, E, M, R-I	B	C	C	A	B	C
R-4	B	C	C	A	B	B
F	C	C	C	B	C	C
H	B	B	cg	A	A	B
1-1	B	C	C	A	B	B
1-2	B	B	Bh,i	A	A	B
1-3	A	Aj	C	A	A	B
1-4	B	B	Bh,i	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No restrictions			No restrictions		

1.2.3 Allowable Building Height and Area

IBC Table 503 allows for a maximum of a 3 story building up to 55 ft high, with a maximum area of 24,000 ft^2 per floor, for a Type IIB building. See Table 7.

However, IBC 507.4 specifies that..

"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 in accordance with Section 903.3.1.1, and is surrounded and adjoined by public ways or yards not less than 60 ft in width"

The MOA Public Works Building is a two story building, fully sprinklered, and is surrounded by public ways or yards greater than 60 ft. The next closest building is 72'-6" away. See Picture 2. This being the case, the building can have an unlimited area per floor.

Table 7 - IBC Table 503 Allowable Building Heights and Areas

		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
GROUP		STORIES(S) AREA (A)								
A-I	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

Picture 2 - Birds Eye View of MOA Public Works Building

1.2.4 Occupant Load

IBC Section 1004 Occupant Load, Table 1004.1 establishes the maximum floor area per occupant required based upon occupancy type. The occupant load is used to establish the required means of egress. Table 8 and Table 9 below summarize the floor area per occupancy type, the allowable floor area per occupant per occupancy type, and the calculated occupant load, for the 1st floor and 2nd floor, respectively.

Table 8 - 1st Floor Occupant Load

Occupancy	Gross or Net Area (sq.ft.)	Occupant Load Factor (sq.ft./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

Table 9 - 2nd Floor Occupant Load

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

Total Building Occupant Load = 641 + 373 = 1014 Occupants.

1.2.5 Existing Means of Egress

The first floor has a total of six exits, consisting of two (2) 72" double doors at the Main Entrance, one (1) 72" double door at a Secondary Entrance, and four (4) 34" single doors as additional exits. The large Conference Room on the first floor also has one (1) additional 34" single door exit. See Figure 3 for first floor means of egress plan and egress door locations.

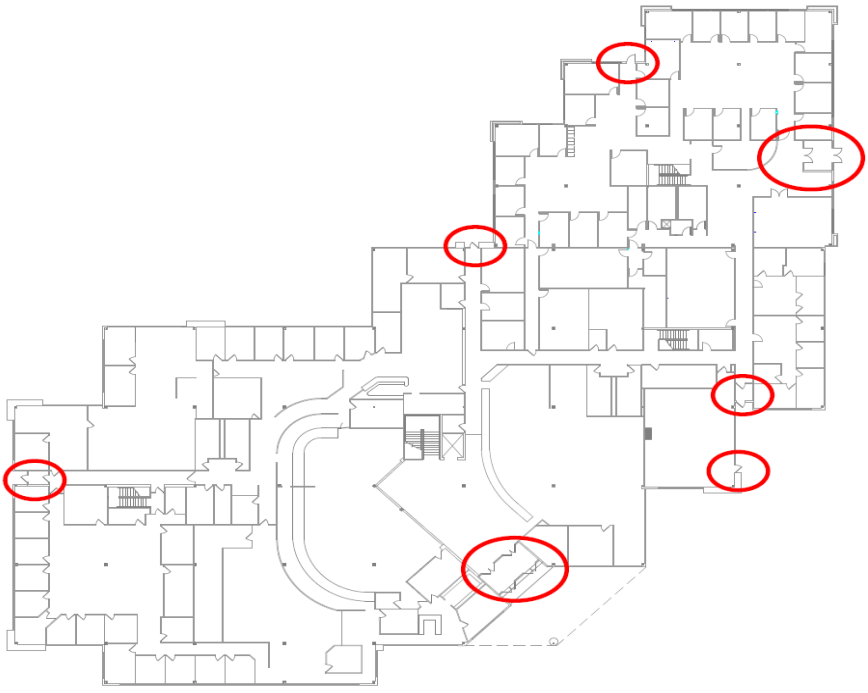


Figure 3 - 1st Floor Means of Egress Plan

The second floor has a total of four vertical exits, or stairways. The main entrance lobby has one (1) open 6'-0" wide stair to the 2nd floor lobby. The three (3) additional stairs are 44" wide stairs. See Figure 4 for the second floor means of egress plan and vertical exit locations. Note that one of the stairs is enclosed in a one hour enclosure. Per my conversations with the MOA Fire Department, this was a UBC requirement per the original building construction in 1997. Under the 2009 IBC, for an unrated building, this would no longer be required. All of the remaining stairs are open vertical exits to the first floor.

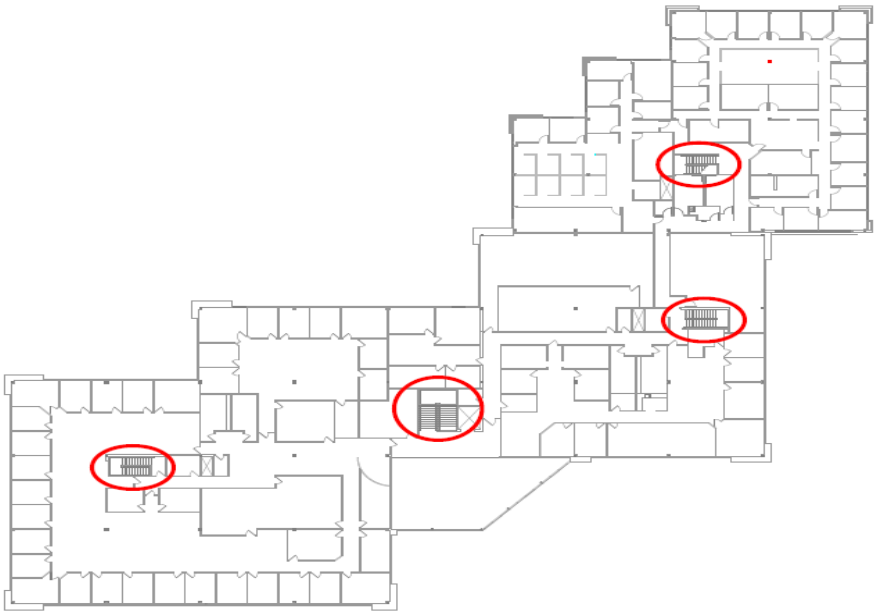


Figure 4 - 2nd Floor Means of Egress Plan

The required number of exits per IBC Table 1021.1 per floor based on occupant load is provided in Table 10 below.

Table 10 - IBC Table 1021.1 Minimum Number of Exits for Occupant Load

OCCUPANT LOAD (persons per story)	MINIMUM NUMBER OF EXITS (per story)
1-500	2
501-1,000	3
More than 1,000	4

When comparing the number of exits provided with the number required, the minimum number of exits required by the IBC is met. For the first floor, with a total building occupant load of 1014, four (4) exits are required. Six (6) exits are provided. For the second floor, with an occupant load of 373, two (2) exits are required. Four (4) exits are provided.

1.2.6 Exit Capacity

The exit capacity is determined by dividing the total exit width by a factor as given in IBC Section 1005.1 Minimum Exit Width. For a stair, the factor is 0.3 per occupant, and for a door,

the factor is 0.2 per occupant. Table 11 and 12 below summarizes the total 1st floor and 2nd floor exit capacities.

Table 11 - 1st Floor Exit Capacity

Exit	Total Door Width (inches)	Door Capacity (inches/0.2)
Main Entrance #1	2 x 72	720
Secondary Entrance #2	72	360
Exit #3, #4, #5, #6	4 x 34	680
Total		1760

Table 12 - 2nd Floor Exit Capacity

Stair	Stair Width (inches)	Stair Capacity (inches/0.3)	Door Width (inches)	Door Capacity (inches/0.2)
#1	72	240	N/A	-
#2, #3, #4	44	3 x 147	34"	170
Total		681		

In addition, IBC Section 1005.1 requires that ...

"multiple means of egress be sized such that loss of any one means of egress shall no reduce the available capacity to less than 50 percent of the required capacity."

or the MOA Public Works Building, the loss of any stair or exit door does not reduce the exit capacity to less than 50%.

1.2.7 Exit Travel Distance

For a B Occupancy in a fully sprinklered building, the exit travel distance is 300 ft, as shown in Table 13 below. The travel distance requirement is satisfied.

Table 13 - IBC Table 1016.1 Exit Access Travel Distance

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, M, R, 5-1	200	250[b]
1-1	Not Permitted	250[e]
B	200	300[e]
F-2, 5-2, U	300	400[e]
H-1	Not Permitted	75[e]
H-2	Not Permitted	100[e]
H-3	Not Permitted	150[e]
H-4	Not Permitted	175[e]
H-5	Not Permitted	200[e]
1-2,1-3,1-4	Not Permitted	200[e]

1.2.8 Corridor Dead Ends

IBC Section 1018.4 requires that the corridor dead ends be limited to 20 ft. However, exception 2 allows Group B Occupancies equipped throughout with an automatic sprinkler system to have dead end corridors up to 50 ft in length. The MOA Public Works Building does not have any corridor dead ends greater than 50 ft in length.

1.2.9 Exit Signs

IBC Section 1011.1 requires that exit sign placement...

"shall be such that no point in an exit access corridor or exit passageway is more than 100 feet, or the listed viewing distance for the sign, whichever is less, from the nearest visible exit sign."

Figure 5 shows the maximum viewing distance for exit sign placement for the 1st floor Lobby area of the MOA Public Works Building. All exit sign viewing distances are less than 100 ft for the 1st and 2nd floors.

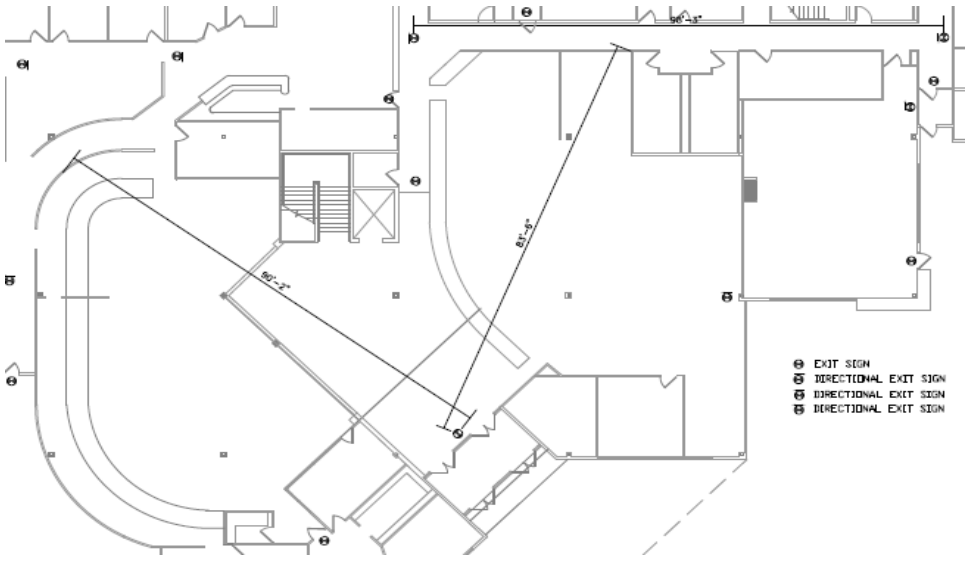


Figure 5 - 1st Floor Lobby Exit Sign Viewing Distance Plan

1.2.10 Atriums

The main entrance of the MOA Public Works Building opens up into a two story atrium. Reference Picture 3 for an interior view of the Atrium looking up to the 2nd Floor Lobby.

Picture 3 - Interior Atrium and 2nd Floor Lobby

IBC Section 404.1.1 describes an atrium as...

"An opening connecting two or more stories other than enclosed stairways, elevators, hoistway,.."

IBC Section 404.2 Use specifies that...

"floor of the atrium shall not be used for other than low fire hazard uses, with only approved materials and decorations in accordance with the International Fire Code shall be used in the space."

Exception 1 allows that the space be allowed to be used for any approved use if it is equipped with an automatic sprinkler system. The atrium at the MOA Public Works building is protected with automatic sprinkler protection, so the space may be used for other approved uses.

Section 404.3 Automatic Sprinkler Protection states that an approved automatic sprinkler system shall be provided throughout the entire building. Exception 1 allows for areas adjacent to or above the atrium not to be sprinklered provided the atrium is separated from the adjacent area by a 2-hour fire barrier.

Since the MOA Public Works Building is a Type IIB construction type, is a 0 hour rated building, and is equipped throughout with an automatic fire sprinkler system, the atrium is not required to be separated from the 2nd floor by a fire rated assembly.

1.2.11 Smoke Control System

IBC Section 404.5 Smoke Control requires a smoke control system be installed in atriums in accordance with IBC Section 909, with an exception. The exception is that for atriums connecting only two stories, the smoke control system is not required. For the MOA Public Works Building, the atrium only connects two stories, so a smoke control system is not required.

1.3 Fire Sprinkler System Analysis

The MOA Public Works building is equipped throughout with an automatic wet pipe sprinkler system. IBC 903.3.1.1 states that the automatic sprinkler system is to be installed in accordance with NFPA 13. The MOA Public Works Building is an office building, which per NFPA 13 would translate into a Light Hazard Occupancy. Since original sprinkler design drawings were not available, my original assumption was that the building sprinkler system was designed and installed in accordance with a Light Hazard Occupancy, with incidental areas of Ordinary Hazard Group I Occupancy. Upon investigation of the type and model of sprinklers protecting the 1st floor Permitting area, it was noticed that the existing sprinklers are extended coverage sprinklers spaced up to 16'-0" x 16'-0" on center. The exact model of the sprinkler head was found by accessing the sprinkler riser room and looking in the spare sprinkler box. The sprinkler in use in portions of the MOA Public Works building is the Central Model ESLO Extended Coverage Ordinary Hazard (ECOH) Quick Response Sprinkler. See Picture 4 below for a picture of the recalled Central ESLO ECOH sprinkler.

Picture 4 - Recalled Central ESLO ECOH Sprinkler

First, knowing that ECOH, it is apparent that large open 1st floor permitting areas were designed to NFPA 13, Ordinary Hazard Group I Occupancy. Secondly, knowing that many Central sprinklers were voluntarily recalled from 2001 to 2007, and checking against a recall list, it was found that the Central Model ESLO sprinklers currently installed have been recalled. The recall took effect mainly because it was found that the rubber o-rings used in the sprinkler degrade over time due to minerals or other contaminants in the water, potentially causing the sprinkler not to activate (or open) in the event of a fire. However, the majority of office's or office areas have quick response standard coverage recessed pendent sprinklers installed. These areas would be considered Light Hazard areas in accordance with NFPA 13. The remainder of this portion of this project report will use Light Hazard Occupancy in its analysis.

1.3.1 NFPA 13 Occupancy Classification

NFPA 13, Paragraph 5.2, Light Hazard Occupancies are defined as...

"occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fire with relatively low rates of heat release are expected."

NFPA 13, Paragraph 5.3.1, Ordinary Hazard Group I Occupancies are defined as...

"occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stockpiles of combustibles do not exceed 8 ft (2.4 m), and fires with moderate rates of heat release are expected."

When referring to Appendix A.5.2, Offices, Libraries (except large stack rooms) are considered Light Hazard Occupancies. Based upon the definition of Ordinary Hazard Group I Occupancy, and relying upon the type of sprinkler used in the 1st Floor Permitting area (i.e. the Central Model ESLO ECOH Sprinkler), one could conclude that the original design bases for this area was Ordinary Hazard Group I.

1.3.2 System Protection Area Limitations

NFPA 13, Section 8.2.1 specifies that the...

"maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser....shall be as follows:

(1) Light Hazard - 52,000 ft^2
(2) Ordinary Hazard - 52,000 ft^2

As given in Table 1, both the 1st floor and 2nd floor areas are less than 52,000 ft^2, verifying that only one wet pipe sprinkler system is required to protect the entire MOA Public Works Building.

1.3.3 Wet Pipe Sprinkler System

NFPA 13, Paragraph 3.4.10 defines a wet pipe sprinkler system as...

"A sprinkler system employing automatic sprinklers that are attached to a piping system containing water and connected to a water supply so that water discharges immediately form sprinklers opened by heat from a fire."

A typical single wet pipe sprinkler system riser, similar to what is installed in the MOA Public Works Building, is shown in Figure 6.

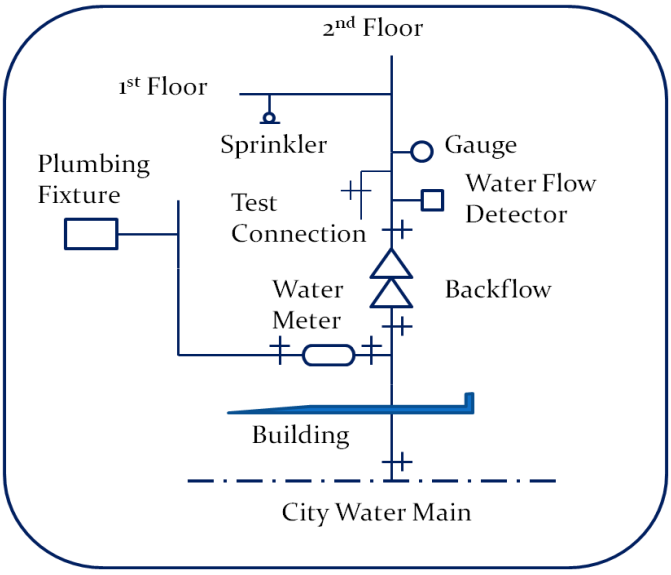


Figure 6 - Wet Pipe Sprinkler System Riser Diagram

1.3.4 Design Density and Area Requirements

Figure 7 below provides the Density/Area Curve for the different NFPA 13 Hazard Classifications, as given in NFPA 13, Figure 11.2.3.1.1. Based upon this curve, the sprinkler system is to be designed at:

- Light Hazard Occupancy: 0.10 gpm/ft^2 over 1500 ft^2
- Ordinary Group I Occupancy: 0.15 gpm/ft^2 over 1500 ft^2

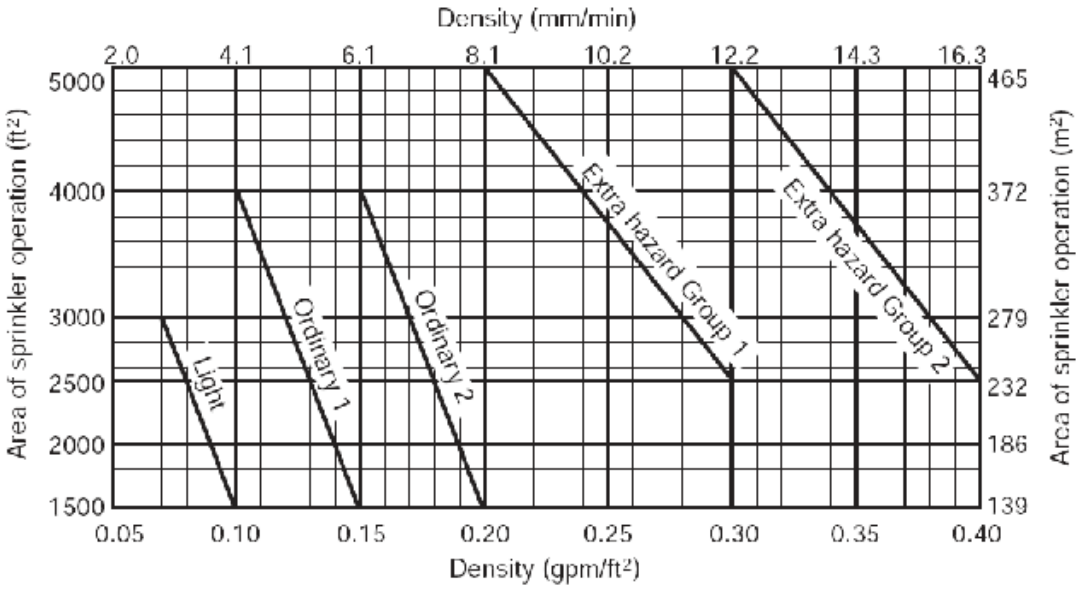


Figure 7 - NFPA 13 Figure 11.2.3.1.1 Density/Area Curve

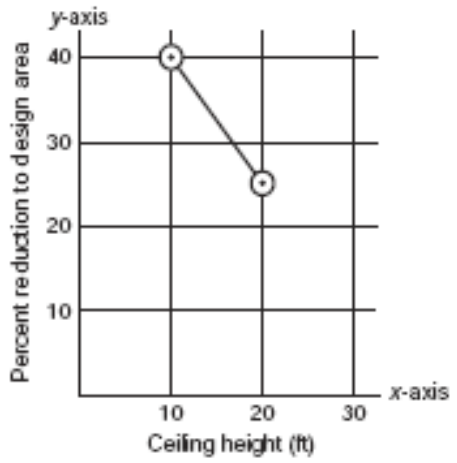
NPFA 13, Section 11.2.3.2.3 Quick Response Sprinklers, allows that the area be reduced if the following four conditions are met:

(1) Wet pipe system
(2) Light hazard or ordinary hazard occupancy
(3) 20 ft maximum ceiling height
(4) There are no unprotected ceiling pockets exceeding 32 ft^2

Using the Design Area Reduction Curve, NFPA 13 Figure 11.2.3.2.3.1, given below as Figure 8, the remote area reduction allowed for all areas of the building with 9'-0" ceiling heights is 40%.

Since the Atrium has a ceiling height greater than 20 ft, the Atrium remote area is not allowed to be reduced. Based upon the area reduction, the following design requirements with reduced remote areas meet the intent of NFPA 13.

- Light Hazard Occupancy: 0.10 gpm/ft^2 over 900 ft^2
- Ordinary Group I Occupancy: 0.15 gpm/ft^2 over 900 ft^2
- Atrium (Light Hazard Occupancy): 0.10 gpm/ft^2 over 1500 ft^2



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

For ceiling height ≥10 ft and ≤20 ft, $y = \frac{-3x}{2} + 55$
For ceiling height <10 ft, $y = 40$
For ceiling height >20, $y = 0$
For SI units, 1 ft = 0.31 m.

FIGURE 11.2.3.2.3.1 Design Area Reduction for Quick-Response Sprinklers.

Figure 8 - NFPA 13 Figure 11.2.3.2.3.1 Design Area Reduction for Quick Response Sprinklers

1.3.5 Hose Stream Allowance and Water Supply Duration

NFPA Figure 11.2.3.1.2 provides the hose stream allowance and water supply duration requirements for hydraulically calculated systems, based upon NFPA 13 occupancy hazard, as shown in Table 14 below.

Table 14 - NFPA 13 Table 11.2.3.1.2 Hose Stream Allowance and Water Supply Duration

Occupancy	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
	gpm	L/min	gpm	L/min	
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

- Light Hazard areas: 100 gpm Hose Demand for 30 minutes
- Ordinary Group I areas: 250 gpm Hose Demand for 60 minutes

1.3.6 Maximum Protection Area and Spacing for Sprinklers

Table 15 and Table 16 provide the maximum protection area and sprinkler spacing requirements for Light Hazard and Ordinary Hazard Occupancies, as determined in NFPA 13, Table 8.6.2.2.1.a and Table 8.8.2.1.2, respectively.

Table 15 - NFPA 13 Table 8.6.2.2.1(a) Protection Area and Maximum Spacing for Standard Coverage Sprinklers

TABLE 8.6.2.2.1(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 16 - NFPA 13 Table 8.8.2.1.2 Protection Area
and Maximum Spacing for Extended Coverage Sprinklers

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

	Light Hazard		Ordinary Hazard		Extra Hazard	
Construction Type	Protection Area (ft^2)	Spacing (ft)	Protection Area (ft^2)	Spacing (ft)	Protection 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

1.3.7 Water Supply

In the Municipality of Anchorage, water supply information is provided by the water purveyor, Anchorage Water and Wastewater Utility (AWWU). The water supply information is generated from a computer model, and provides water flow estimates based upon max day demand, max hour demand, etc.. For sprinkler design requirements, the max day demand is acceptable to the MOA Fire Plan Review. Figure 8 below is a copy of the water flow information provided by AWWU for the MOA Public Works Building. As can be seen from Figure 9, the available water supply at the closest fire hydrant to the point of connection to the water main than supplies the MOA Permit Building, is as follows:

57 psi static, 20 psi residual with 2,727 gpm flowing

It should be noted that although the water supply information provided by AWWU is from a computer model, there is an inherent safety factor built into it. Because of this, hydraulic calculations are allowed to calculated up to the water supply curve. If an actual water flow test is conducted from a fire hydrant, then the MOA Fire Department, Plan Review, would require a 10% safety factor pressure demand vs. available pressure.

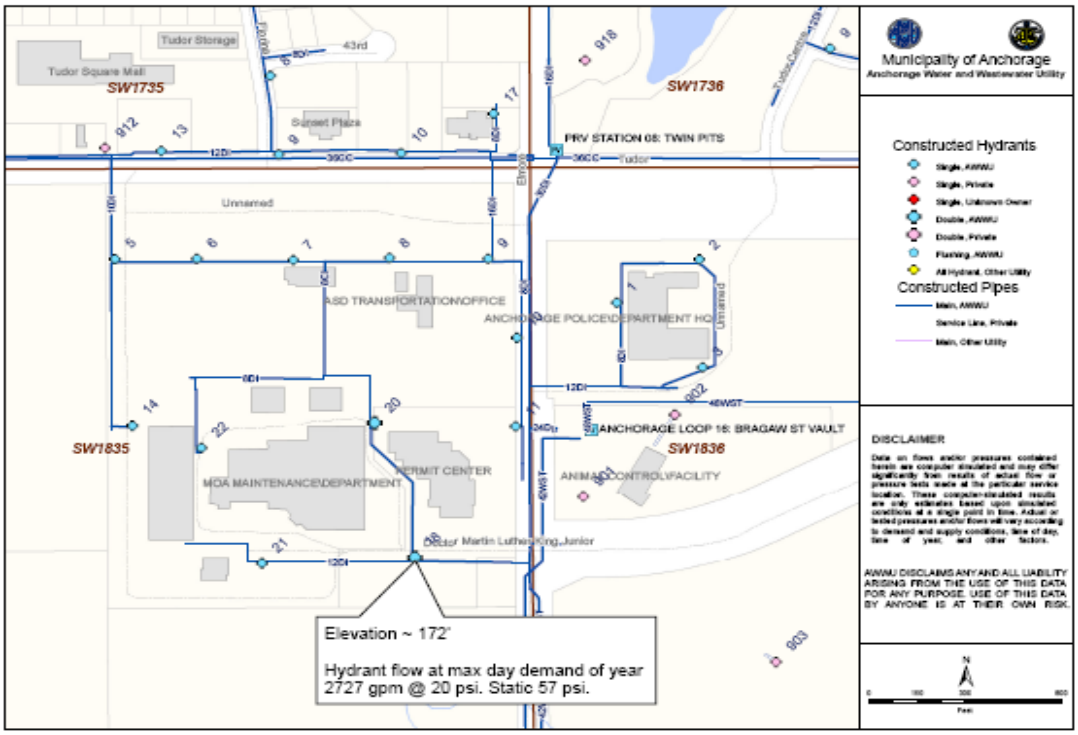


Figure 9 - AWWU Model Water Supply Diagram

1.3.8 Hydraulic Calculation

Figure 10 shows a portion of an assumed 2nd floor sprinkler system layout for the 2002 Addition, hydraulically calculated at a design density of 0.1 gpm/ft^2 over 969 ft^2, with 9 sprinklers flowing. The hydraulic calculations were performed using the program HASS, a sprinkler system analysis program by HRS Systems. A copy of the hydraulic calculation can be found in Appendix A The remote area has been reduced as discussed as discussed in Paragraph 1.3.4 of this report. Figure 11 shows a section view of the existing wet pipe sprinkler riser, and pipe routing to the 2nd floor.. Lastly the 2002 building addition sprinkler plans are located in Appendix B for reference only.

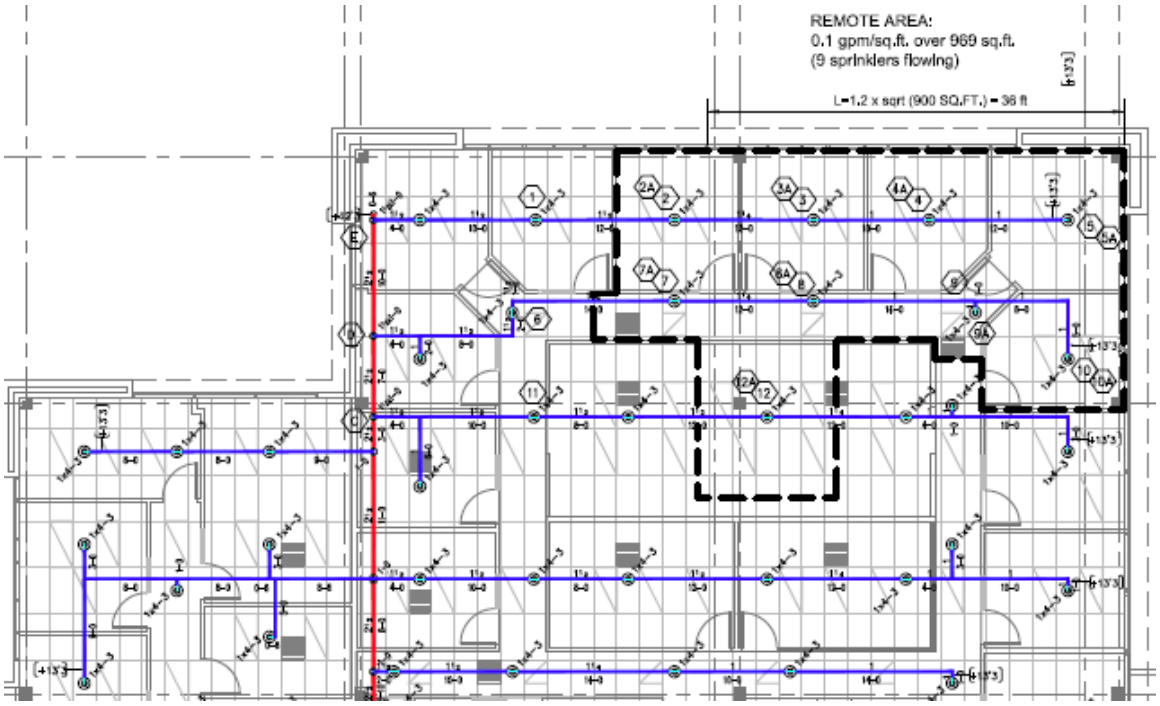


Figure 10 - Partial 2nd Floor Sprinkler Plan and Remote Area

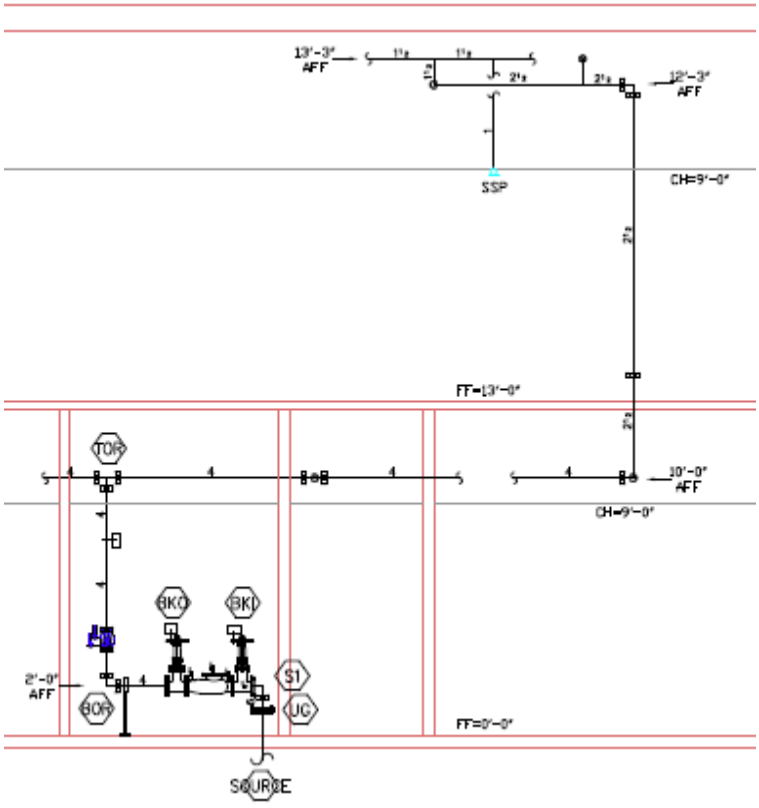


Figure 11 - Wet Pipe Sprinkler System Riser and Partial Building Section

1.3.9 System Demand Analysis

Figure 12 shows that the hydraulically calculated sprinkler system demand is below the water supply curve. The sprinkler system demand was calculated to be 280.7 gpm total, which includes the 100 gpm hose demand, at a required pressure of 50.42 psi at the point of connection to the city supply. The available pressure at the city supply, based upon a demand of 280.7 psi, is 56.45 psi. The sprinkler system demand is 6 psi below the available water supply pressure.

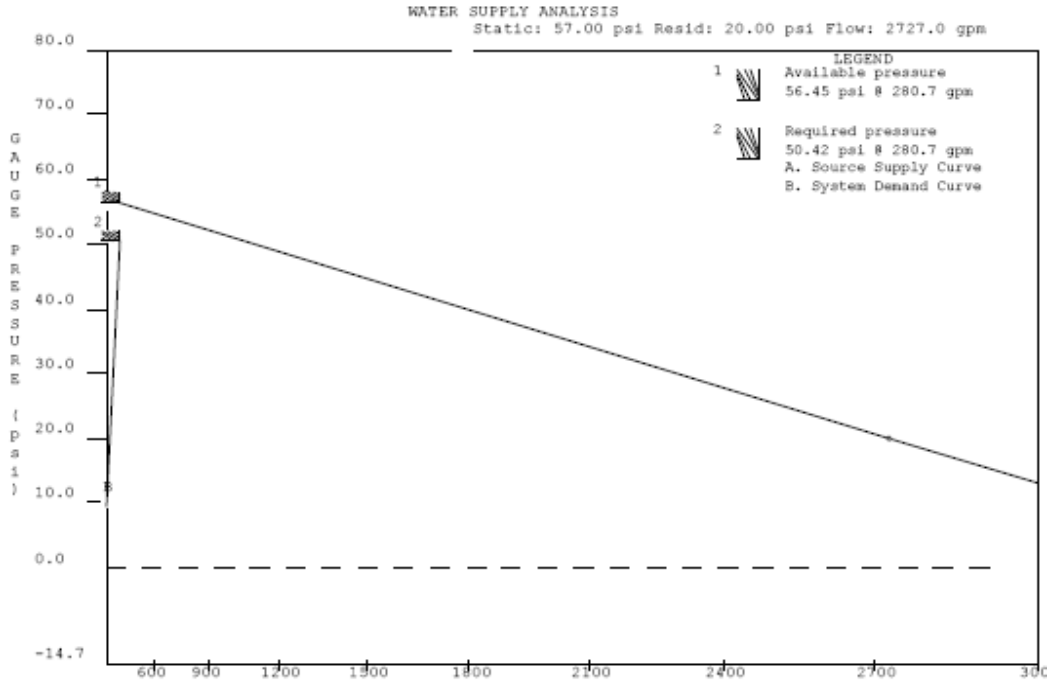


Figure 12 - Water Supply and System Demand Graph

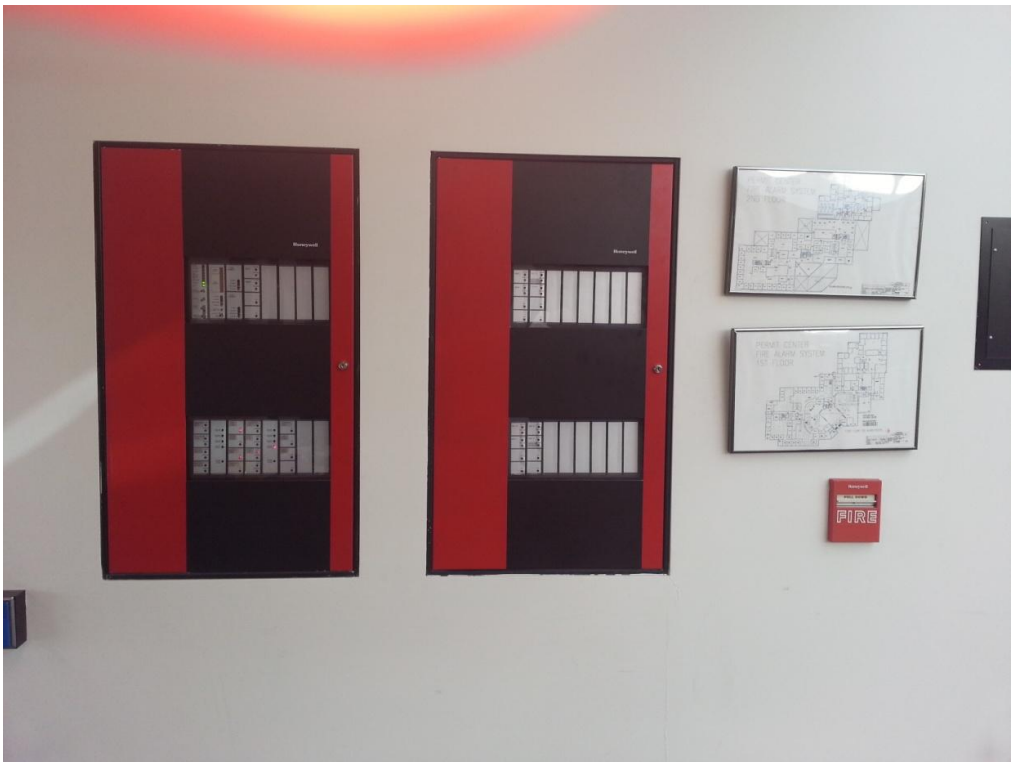
1.4 Fire Alarm and Notification System

The MOA Public Works building is equipped with a Fire Alarm, Security and Notification System. A Honeywell FS-90 Fire and Security Panel, and Annunciator, is located at the Main Entrance in the Atrium Lobby. See Picture 5 for a photograph of the Honeywell FS-90 Fire and Security Panel and Annunciator.

IBC 907.2, states that for new buildings and structures, that....

"an approved fire alarm system installed in accordance with the provisions of this code and NFPA 72 shall be provided....and provide occupant notification in accordance with Section 907.5."

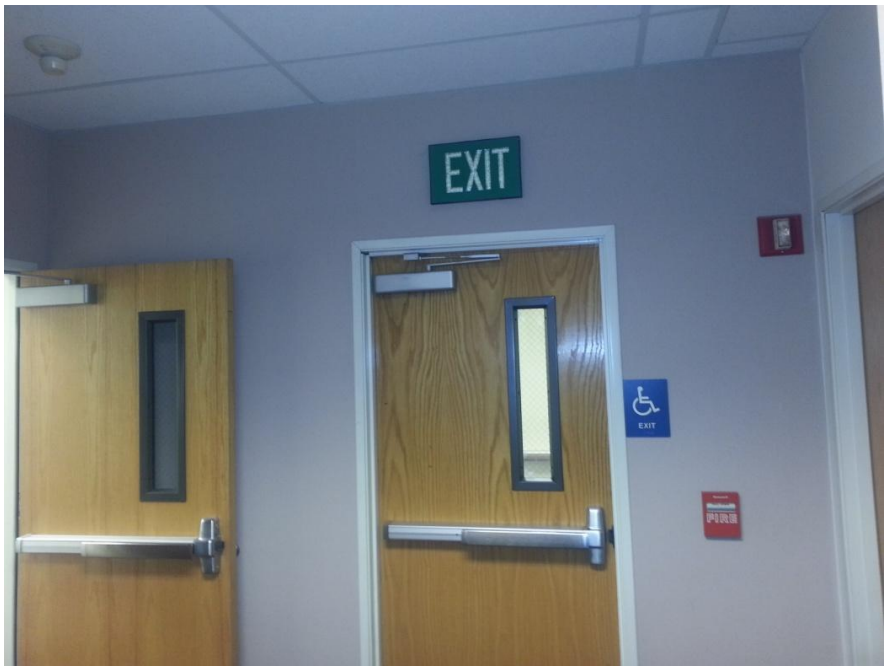
Reference Appendix B for 11"x17" reduced size Fire Alarm and Security Design Drawings for the 1997 building and for the 2002 building addition.



Picture 5 - Honeywell FS-90 Fire & Security Panel and Annunciator

1.4.1 Devices

The MOA Public Works building has ionization type smoke detectors located mainly in open public areas, such as in Elevator Lobbies, Hoistway and Machine Room; Atrium; Corridors; and above the Permit area workstations. Heat detectors are provided in the Elevator Machine Room, Boiler, and Generator Room. Duct detectors are provided also, exact locations other than in the Mechanical Room are not know. Manual Pull Stations are located at each exit. Alarm notification appliances (horn-strobe devices), are provided throughout all areas of the building. The 1997 and 2002 fire alarm and detection plans are located in Appendix C for reference only. The main detection device located throughout the property are the fire sprinklers, off of the monitored wet pipe sprinkler system. Picture 6 shows a typical exit with Smoke Alarm, Horn-Strobe, Manual Pull Station, and Exit Sign.



Picture 6 - Typical 1st Floor Exit with Smoke Detector, Horn-Strobe, Manual Pull Station, and Exit Sign

1.4.2 Audible Alarms

IBC 907.5.2.1 states that *"audible alarm notification appliances shall be provided."*

Horn-Strobe devices are located throughout the building. IBC 907.5.2.1.1 and 907.5.2.1.2 state that the average sound pressure shall be...

"15 dBA above average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater; a minimum of 90dBA in mechanical rooms; 60 dBA in all other occupancies; the maximum sound pressure level for audible alarm notification appliances shall be 110 dBA at the minimum hearing distance from the audible appliance."

Per the original Honeywell Fire Alarm and Security Plans, the sound level is at lead 65 dBA or greater for all office rooms. The sound level is not called out in the mechanical rooms, but individual horn-strobes are provided in each.

1.4.3 Visible Alarms

IBC 907.5.2.2 requires that *"visible alarm appliances shall be provided..."* and IBC 907.5.2.3.1 requires that *"visible alarm appliances shall be provided in public and common areas."* The MOA Public Works Building has visual alarm appliances (horn-strobes) located throughout all open and public areas, including corridors, open work areas, conference rooms, lobby, atrium, and coffee shop.

1.4.4 Fire Safety Functions and Operational Matrix

IBC 907.3 states that...

"Automatic fire detectors utilized for the purpose of performing fire safety functions shall be connected to the buildings fire alarm control unit."

An example would be the smoke detectors provided in the Elevator Lobby Smoke Detectors would initiate the elevator recall function, as would the Elevator Hoistway and/or Elevator Machine Room smoke detectors. Another example would be that any activated device would shut down the air handler equipment. The Operational Matrix shows what alarm or fire safety functions are to be activated in the event any of the initiating devices are activated due to smoke, heat, or manually activated. Figure 13 shows the Operational Matrix for the 1997 building Fire Alarm and Security design drawings.

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

Figure 13 - Fire Alarm System Operational Matrix

1.5 RSET Egress Analysis

Egress analysis considers the total time required for the occupants to evacuate a building from fire ignition, to detection and alarm, to recognition of the alarm and pre-movement time of the occupants, to the final evacuation time for all occupants. This total time frame to evacuate a building is referred to as the required safe egress time, or RSET. The RSET value can be determined through a calculation method as outlined in the SFPE Handbook of Fire Protection Engineering, which will be explained later in this project paper. The goal of an egress analysis is to verify that the required safe egress time (RSET) is less than the allowable safe egress time (ASET), with some factor of safety. Figure 14 below shows a graphical representation of the RSET versus ASET egress model.

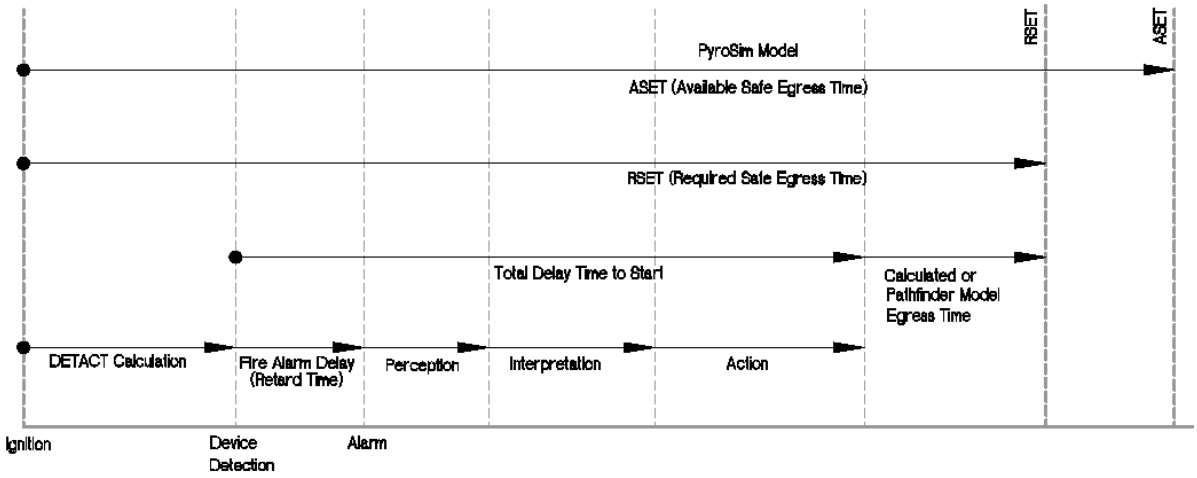


Figure 14 - RSET and ASET Egress Model

1.5.1 Occupant Characteristics

The MOA Public Works building is largely occupied by long term employees of the Municipality of Anchorage, and as such, are familiar with the layout of the building, and therefore, the egress capacities of the building. Although the general public does utilize the building, they will mostly be located on the first level, near the main entry and at the permit and plan review counters. Both the employees and the general public are able bodied and will be capable of exiting the building

through their respective egress discharge points, without much delay. People with disabilities could be present anywhere throughout the building, but most likely would be in areas with able bodied employees and the general public. The biggest delay after the recognition time of an fire alarm, would be the pre-movement time of the employees of the building. Since the building is located in Anchorage, Alaska, where winter exterior ambient temperatures can be as low as -40° F, additional time to put on a winter jacket and/or winter gear would be used in all but the most extreme fire conditions. One could also expect employees to grab important papers, save items on a computer, or even shut a computer down. These few items would definitely increase the pre-movement time of the municipal employees. The general public, on the other hand, visit the building on a short term basis, and would generally have their winter gear either already on or at least with them. They would most likely evacuate the building quicker than the employees, but might delay waiting for an evacuation response from the employees.

1.5.2 Fire Scenario #1

Fire Scenario #1 consists of the permitting area work stations located adjacent to the main atrium lobby. The ceiling heights in this area are 9'-0", with Central ESLO ECOH sprinklers and ionization type smoke detectors above the workstations. Figure 15 provides a plan view of the sprinklers and detector locations, in relation to the work stations. Pictures 7 and 8 provide additional visual images of the location and hazards involved with Fire Scenario #1. Combustible items located at a typical workstation include the following items: Computer Tower; Computer Screen; Key Board; Particle Board Work Surface with Laminate Surface, Metal File Cabinets, Material Covered Work Station Side Panels, Waste Basket, Office Chair, Paper Products, Plastic Products, Carpeted Floors, Ceiling Tiles, etc...

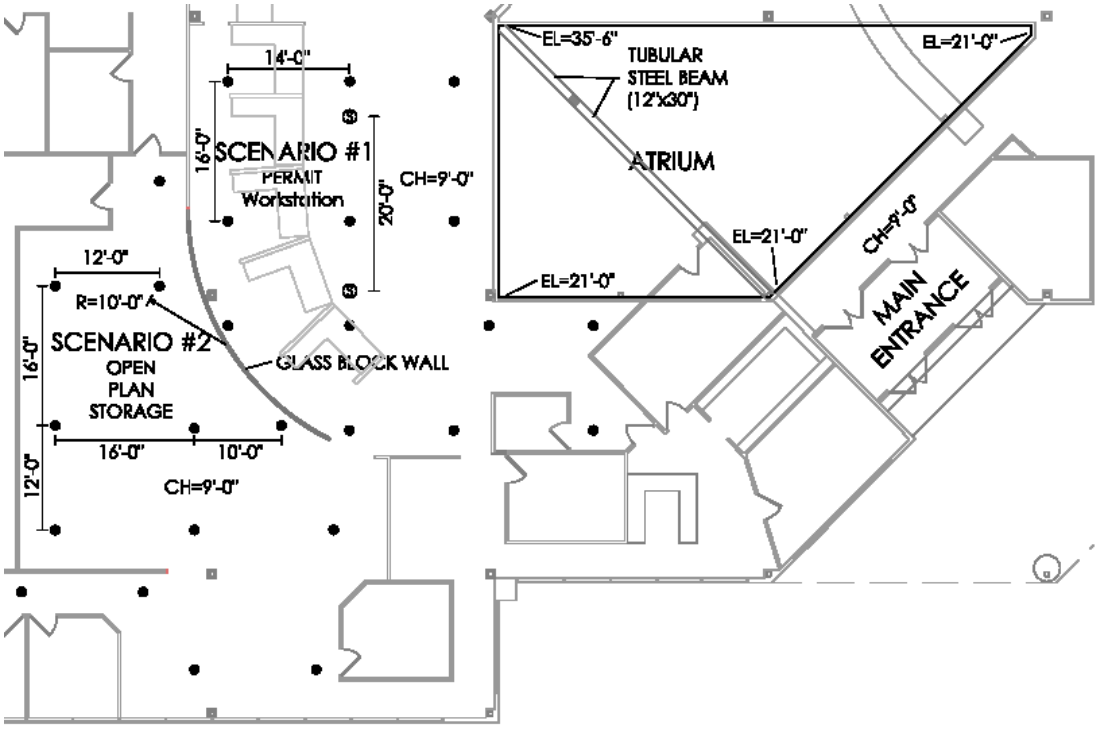
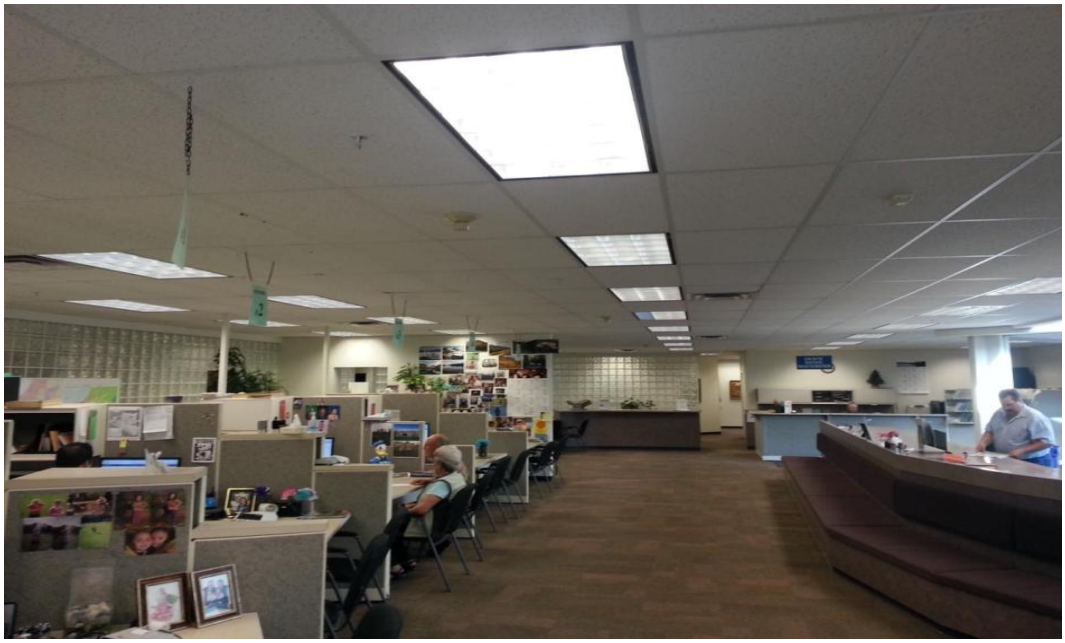


Figure 15 - Scenario Location, Sprinklers and Smoke Detector Plan



Picture 7 - Scenario #1 General Permitting Work Station Area

Picture 8 - Scenario #1 Close-up of Single Permitting Work Station

1.5.3 Fire Scenario #2

Fire Scenario #2 consists of a plan storage area behind a glass block wall that is adjacent to the permitting workstation area. The plan storage system consists of large wooded slotted shelving units that hold rolled large format construction plans horizontally. Each of the rolled plans have small paper tags in the vertical position attached to it with string. The length of this plan storage system is the entire length of the glass block wall, with the exception of two plastic recycle trash bins located next to the storage system, at the entrance into the area. Reference Figure 15 for the location of Scenario #1, and Picture #9 for a visual representation of the hazard. Note that there

are the Central ESLO ECOH Sprinklers in the area, but no ionization smoke detectors. The height of the taller storage unit is 7'-3", where the ceiling height remains at 9'-0".

Picture 9 - Scenario #2 Plan Storage Area

1.5.4 DETACT Detection Time

The time for detector activation and due to a fire scenario can be estimated using various calculation methods as outlined in the SFPE Handbook of Fire Protection Engineering, or other engineering reference sources. The calculation method I choose to use is the DETACT method. The DETACT method is used to calculate the ceiling jet temperature and velocity at a particular radius from a fire, for different t^2 fire growth rates. Figure 16 depicts the the general arrangement of the fire in relation to a detector. The detector can be either a sprinkler or an smoke detector.

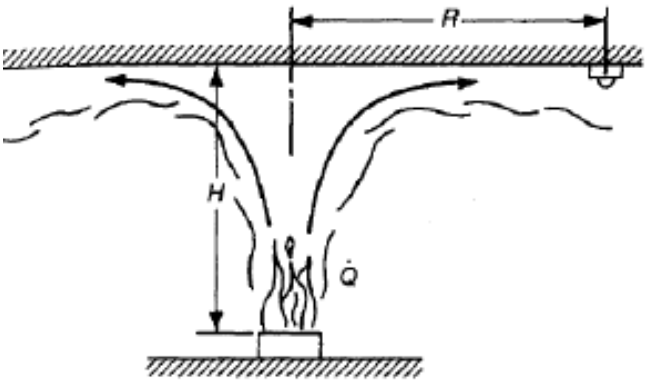


Figure 16 - Schematic of a Ceiling Jet from a Fire

Scenario #1 - Sprinkler Activation

For Scenario #1 - sprinkler activation, the relevant input data used in the DETACT Model is given in Table 17. Note that the ceiling height is the distance between the elevation of the surface of the fire and the 9'-0" ceiling height, or H = 9'-0" - 3'-0" = 6'-0" (1.8 m). The radial distance is the radius of a fire located in the center of the four of the sprinklers spaced at 16'-0" x 14'-0" on center, or R = 10'-8" (3.25 m). The activation temperature of the sprinklers in the scenario area is 68° C (155° F) with a quick response RTI of 50 (m-s)½. Lastly, based upon fire test data of a workstation fire, it appears the fire will have a medium growth rate.

Table 17 - Scenario #1 - Sprinkler DETACT Model Input Data

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

Based upon the DETACT Model, the sprinkler will activate at 196 seconds when the HRR of the fire is 461 kW. Figure 17 shows a plot of the HRR, the gas jet temperature, and the detector temperature at activation for Scenario #1 Sprinkler Activation.

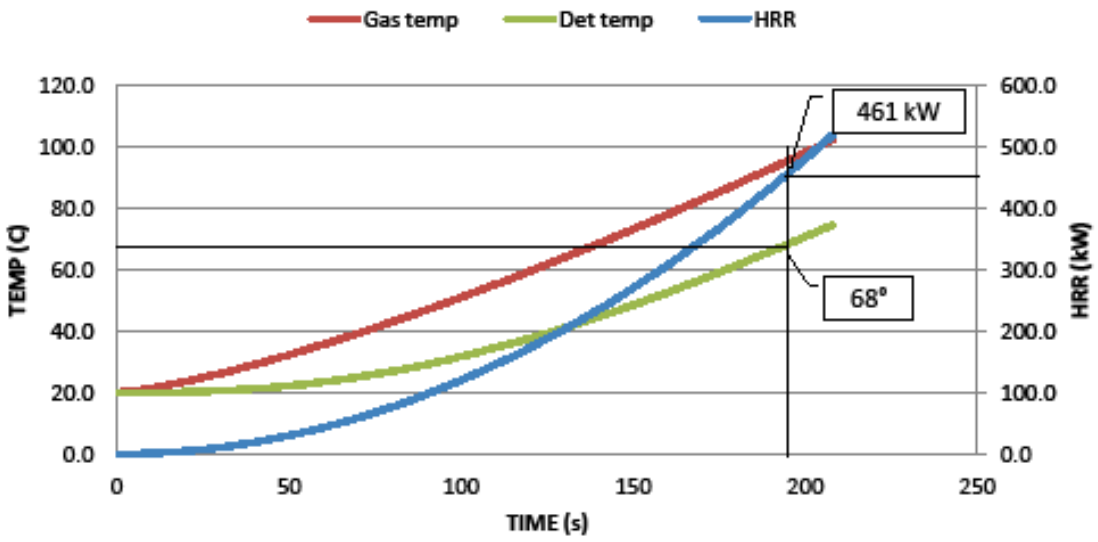


Figure 17 - Scenario #1 - Sprinkler DETACT Plot of Gas Temp, Detector Temp, and HRR

Scenario #1 - Smoke Detector Activation

For Scenario #1 - Smoke Detector Activation, the relevant input data used in the DETACT Model is given in Table 18. Again note that the ceiling height is the distance between the elevation of the surface of the fire and the 9'-0" ceiling height, or H = 9'-0" - 3'-0" = 6'-0" (1.8 m). The radial distance is the radius of a fire located in the center of the two smoke detectors spaced at 20'-0" on center, or R = 10'-0" (3.05 m). The activation temperature of the smoke detector is on average 27.8° C (82° F) with an RTI of 2 (m-s)½. The fire growth rate would stay the same as a medium growth rate.

Table 18 - Scenario #1 - Smoke Detector DETACT Model Input Data

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

Based upon the DETACT Model, the smoke detector will activate at 38 seconds when the HRR of the fire is 17 kW. Figure 18 shows a plot of the HRR, the gas jet temperature, and the detector temperature at activation for Scenario #1 Smoke Detector Activation.

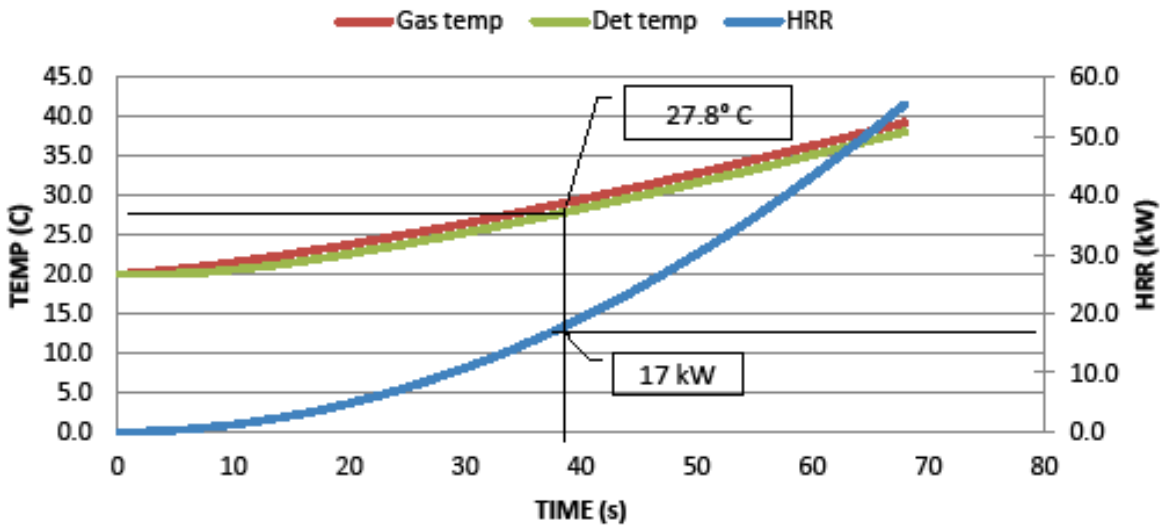


Figure 18 - Scenario #1 - Smoke Detecor DETACT Plot of Gas Temp, Detector Temp, and HRR

Scenario #2 - Sprinkler Activation

For Scenario #2 - sprinkler activation, the relevant input data used in the DETACT Model is given in Table 19. Note that the ceiling height is the distance between the elevation of the surface of the fire and the 9'-0" ceiling height, or H = 9'-0" - 7'-3" = 1'-9" (0.54 m). Due to the location of the sprinklers above or near the fire, the radial distance is assumed to be the radius of a fire located in the center of sprinklers spaced at 10'-0" x 10'-0" on center, or R = 9'-5" (2.2 m). The activation temperature of the sprinklers in the area is 68° C (155° F) with a quick response RTI of 50 (m-s)½. Lastly, based upon fire test data of a workstation fire, it appears the fire will have a fast growth rate.

Table 19 - Scenario #2 - Sprinkler DETACT Model Input Data

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

Based upon the DETACT Model, the sprinkler will activate at 66 seconds when the HRR of the fire is 205 kW. Figure 19 shows a plot of the HRR, the gas jet temperature, and the detector temperature at activation for Scenario #2 Sprinkler Activation.

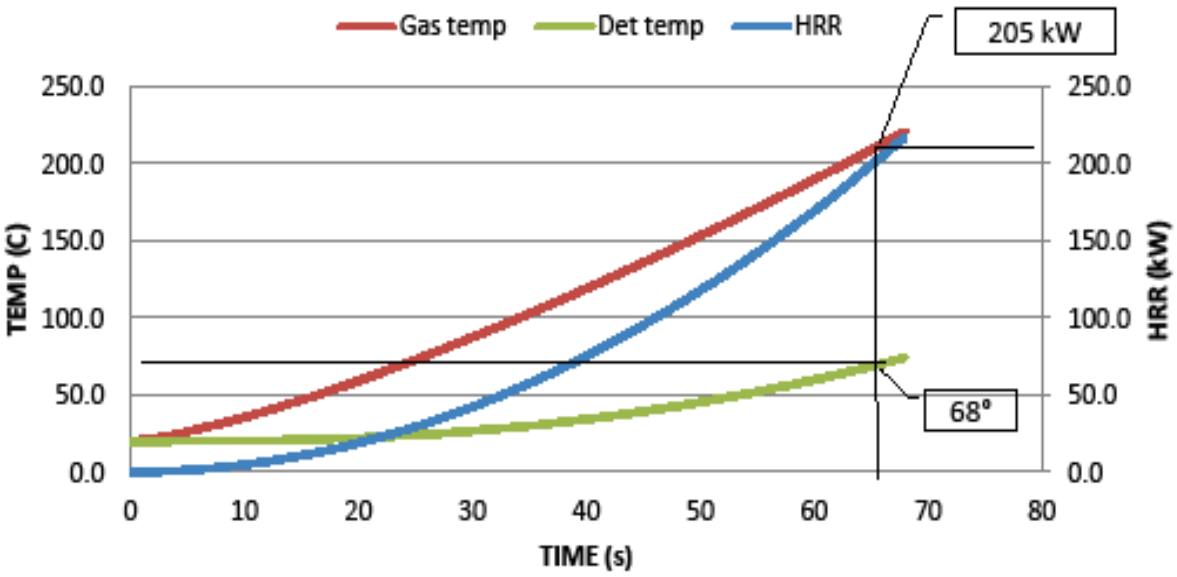


Figure 19 - Scenario #2 - Sprinkler DETACT Plot of Gas Temp, Detector Temp, and HRR

1.5.5 Fire Alarm Delay Time

The time when the detection device activates to the time when the fire alarm system notification devices (horn-strobes) activate, is called a fire alarm delay. This time delay can be either programmed directly into the fire alarm panel, or can be selected on individual initiation devices. For this project, I assumed that the water flow switch with a built-in delay is provided. Using a data sheet for a Potter Electric Water Flow Switch as a guide, a selector switch is provided on the device which allows different delay (or retard) times to be chosen. Using the minimum time delay selector setting of 10 to 25 seconds, I assumed a delay time of 25 seconds for this project.

1.5.6 Pre-movement Time

Pre-movement activity time is the time from when an occupant hears the fire alarm and decides to actually start to evacuate. For this project, considering its location in a cold climate, could be substantial. Although the occupants are alert and in an office building, time would lapse due to putting on jackets, gathering personal materials, shutting down computers, etc.... Referencing SFPE Table 3-12.2, Delay Times Derived from Actual Fires and Evacuation Exercises Reported in the Referenced Literature, for a mid-rise office building, for an unannounced drill, good alarm performance, with fire wardens, and on a cold day, a mean delay time of 1.1 minutes (66 seconds) was experienced out of N=99 reported subjects.

1.5.7 Egress Time Calculations

1.5.7.1 2nd Floor Egress Time Calculation

The flow capacities from the 2nd floor are limited by the egress components, in this case, the stairs. The individual flow capacity calculated for each stairway is given in Table 20, taking into consideration the effective width of each stairway. Note that the maximum specific flow rates of 18.5 persons/min/ft of effective width for stairs, and 24 persons/min/ft of effective width for doors, is found in the SFPE Handbook Table 3-13.5. (SFPE HFPE 2008). From this calculation, the flow rate of persons per minute total is equal to the sum of the flow capacities for each egress component, or 235 persons per minute.

Table 20 - Calculated Flow Capacities from 2nd Floor Egress Components

Egress Component	Width (inches)	Effective Width (We) (inches)	Effective Width (We) (feet)	Flow Capacity (persons per minute)
Stair #1	72	72 – 12 = 60	5.0	18.5 x 5.0 = 93
Stair #2 , #4	44	44 – 12 = 32	2.67	18.5 x2.67 = 49
Stair #3	44	44 – 12 = 32	2.67	18.5 x 2.67 = 49
Door #3	34	34 – 12 = 22	1.83	24.0 x 1.83 = 44

The travel speed down each stairway is based upon the following equation found in the SFPE Handbook, page 3-379. (SFPE HFPE 2008).

$$S = k - akD$$

where S = Speed along the line of travel

a = 2.86 ft/min

k = Constant = 212 for a 7" riser and 11" tread

D = Population Density = 0.175 persons/ft^2

Based on Equation 1, the travel speed down each stairway is 105.9 ft/min.

The travel time down each individual stair is dependent upon the length of travel. The length of travel is equal to a converted vertical distance for each stair plus the landing distance traveled. Referring to the SFPE Handbook, Table 3-13.7 Conversion Factors Relating Line of Travel Distance to Vertical Distance (SFPE HFPE 2008), provides a conversion factor of 1.85 for 7" risers and 11" treads. Table 21 below provides the results for length of travel and travel time for each stair.

Table 21 - Calculated Travel Time for 2nd Floor Egress Components

Stair No.	Vertical Distance x 1.85 (ft)	Landing Horizontal Distance (ft)	Total Distance (ft)	Travel Time = Distance /Speed of Travel
1	13 x 1.85	14.7	38.7	38.7/105.9 = 0.37 min
2, 3, 4	13 x 1.85	16	40.5	40.5/105.9 = 0.38 min

The total 2nd floor egress time is equal to the 2nd floor occupant load divided by the total stair flow capacity, plus the maximum stair travel time. For the 2nd floor, the total egress time is calculated as follows:

$$2nd\ Floor\ Egress\ Time = \frac{Occupant\ Load}{Total\ Egress\ Capacity} + Max\ Stair\ Travel\ Time$$

$$= \frac{373\ persons}{235\ persons/min} + 0.38\ \text{min} = 1.97\ \text{min}\ \ (118\ seconds)$$

1.5.7.2 1st Floor Egress Time Calculation

The flow capacities from the 1st floor are also limited by the egress components, in this case, the exit doors. The individual flow capacity calculated for each exit door is given in Table 22, taking into consideration the effective width of each doorway. Note that the maximum specific flow rates of 24 persons/min/ft of effective width for doors, is found in the SFPE Handbook Table 3-13.5. (SFPE HFPE 2008). From this calculation, the flow rate of persons per minute total is equal to the sum of the flow capacities for each egress component, or 512 persons per minute.

Table 22 - Calculated Flow Capacities from 1st Floor Egress Components

Egress Component	Width (inches)	Effective Width (We) (inches)	Effective Width (We) (feet)	Flow Capacity (persons per minute)
Main Entrance #1	2 (68)	2(68 – 12) = 112	9.33	24.0 x 9.33 = 224
Secondary Entrance #2	68	68– 12 = 56	4.67	24 x4.67 = 112
Exits #3 to #6	4(34)	4(34 – 12) = 88	7.33	24 x 7.33 = 176

The total 1st floor egress time is equal to the total building occupant load divided by the total egress flow capacity. For the 1st floor, the total egress time is calculated as follows:

$$1st\ Floor\ Egress\ Time = \frac{Building\ Occupant\ Load}{Total\ Egress\ Capacity} = \frac{1014\ persons}{512\ persons/minute}$$

$$= 1.98\ Minutes\ (119\ seconds)$$

1.5.8 Calculated Required Safe Egress Time (RSET)

Referring back to Figure 14- RSET and ASET Model, the total required safe egress time is equal to the sum of time from fire ignition to detection, alarm delay, pre-movement time, and egress time. Table 23below summarizes the calculated RSET values for each of the fire scenarios. When looking at the different scenarios, it becomes apparent that Scenario #1-Sprinkler activation will not occur before the smoke detectors activate in Scenario 1-Detectors. They are both located in the area. As a result, the alarm and notification time for Scenario #1 - Smoke Detector, will occur first, where the required safe egress time (RSET) is 248 seconds (4.1 minutes). The next scenario is that of Scenario #2-Sprinkler activation, where the required safe egress time (RSET) is 276 seconds (4.6 minutes).

Table 23 - Calculated RSET Values for each Scenario

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]**

1.5.9 Pathfinder Model Egress Time

The agent based egress and human movement simulator '*Pathfinder*,' 2012 Version, by Thunderhead Engineering, was utilized to simulate the entire MOA Public Works building. The simulation was based upon a fully occupied building, using SFPE Behavior Mode, a default speed of 3.9 ft/s, and with the criteria of 'Go to Any Exit' with all exits available. Because the building has an emergency management plan, certain agents, or sweepers, are assigned the task to roam their assigned areas, or waypoints, and wait for a few seconds before evacuating the building. The results of running the Pathfinder Model for the MOA Public Works building showed that the egress time from the start of the movement was 273 seconds for an occupant load of 1014 people. This is more than double the egress movement time from the hand calculation. Figure 20 through 25 show 60 second time interval pictures, and the number of agents that have exited the building at each time interval. The interesting discovery is that the South end of the building has the slowest evacuation from the 2nd floor, down the enclosed stairway, into the exit passageway, and out the South exit door #273. It is at this exit door on the South side of the building where bottle-necking is occurring. From a time of approximately 216 seconds to the time the last agent exited through the South exit door #273 (273 seconds), no other exits were being utilized. This accounts for almost an entire extra minute of evacuation time for the building. Referring to Figure 26 and

Figure 27 below, the graphs show that Door 272 has a consistent flow rate and a large number of occupants exiting through this door. This is suggestive of bottle-necking occurring at this exit.

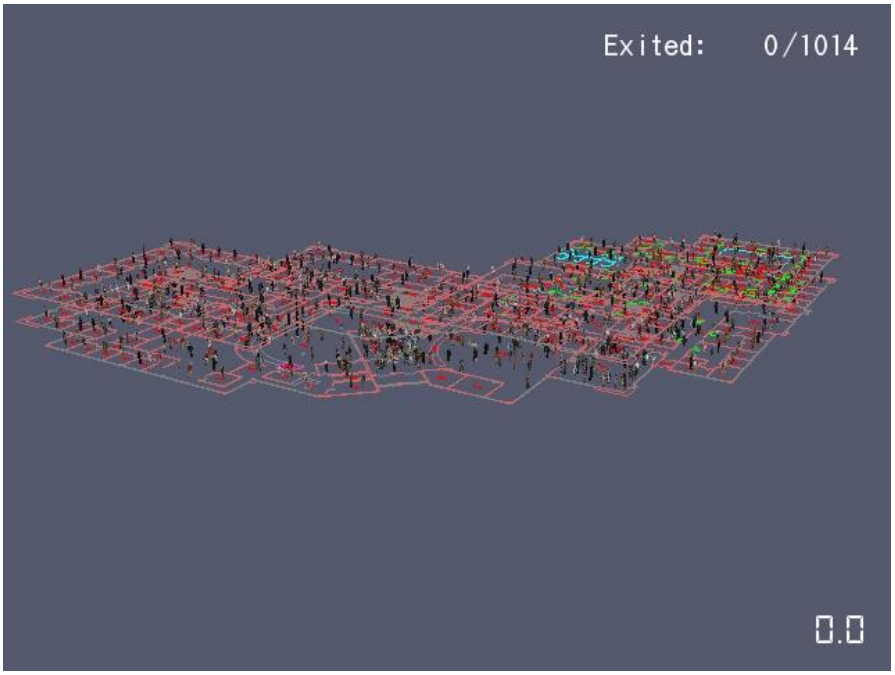


Figure 20 - Pathfinder Model at 0.0 Seconds

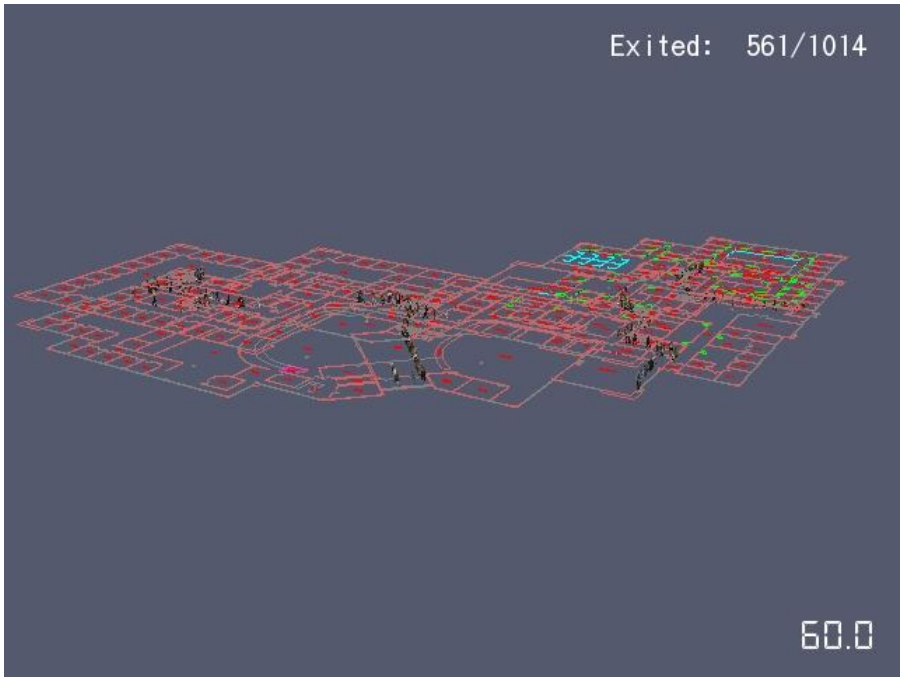


Figure 21 - Pathfinder Model at 60 Seconds

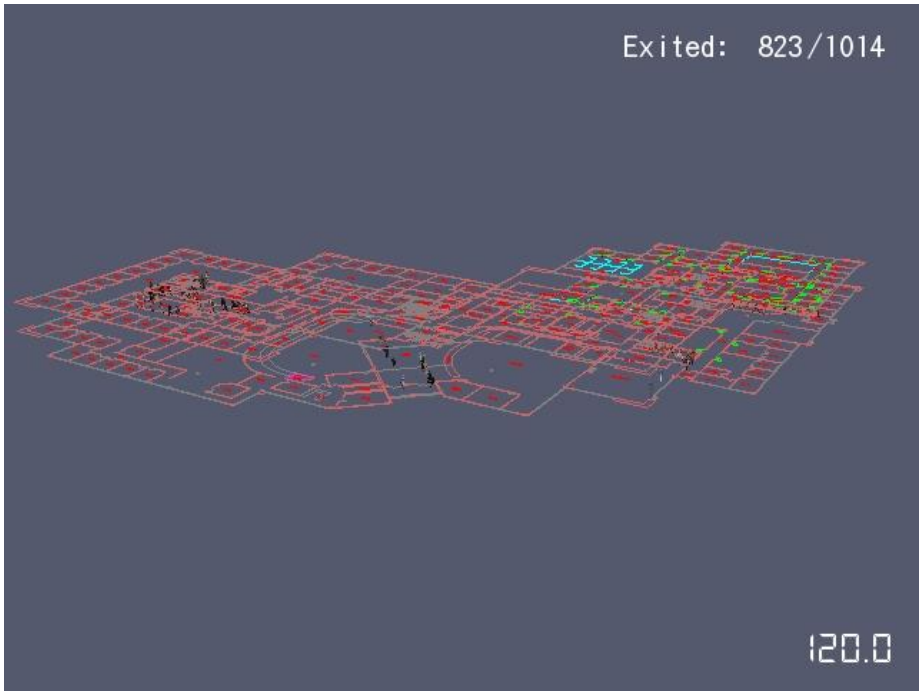


Figure 22 - Pathfinder Model at 120 Seconds

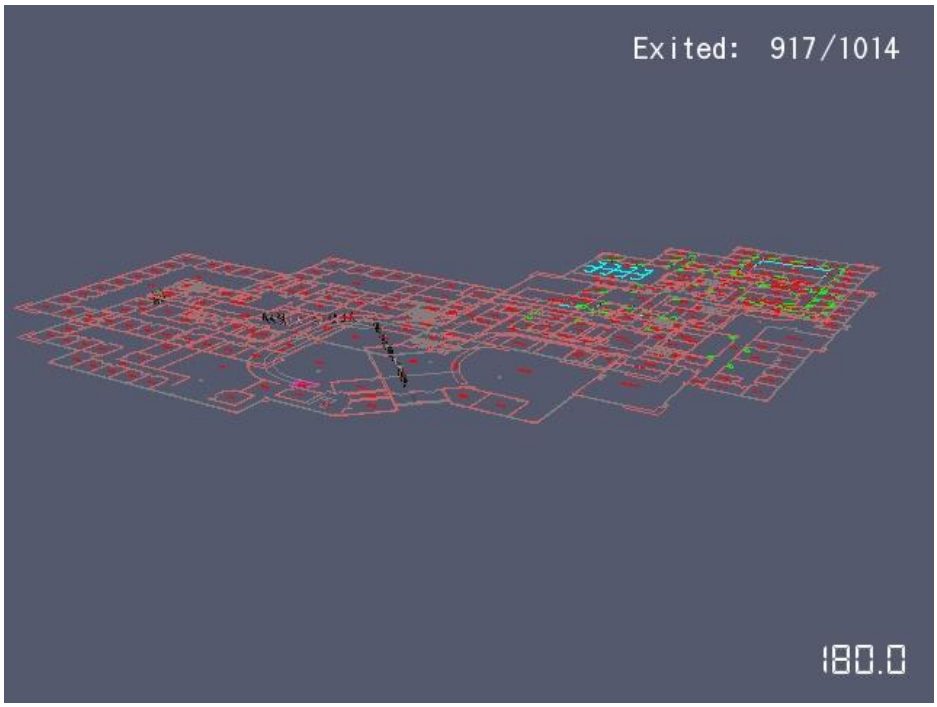


Figure 23 - Pathfinder Model at 180 Seconds

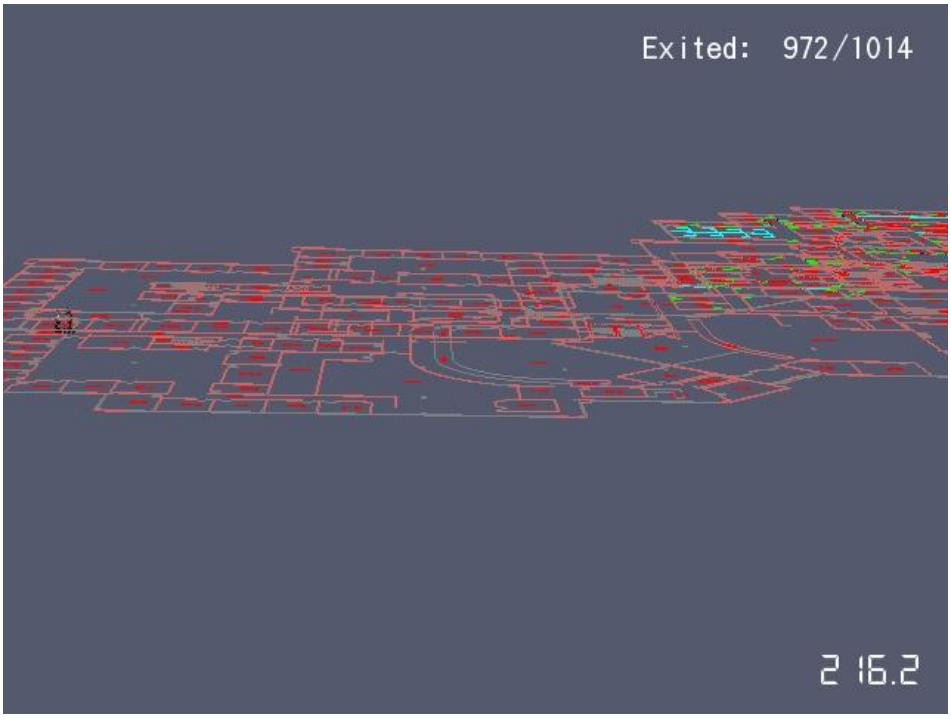


Figure 24 - Pathfinder Model at 216 Seconds

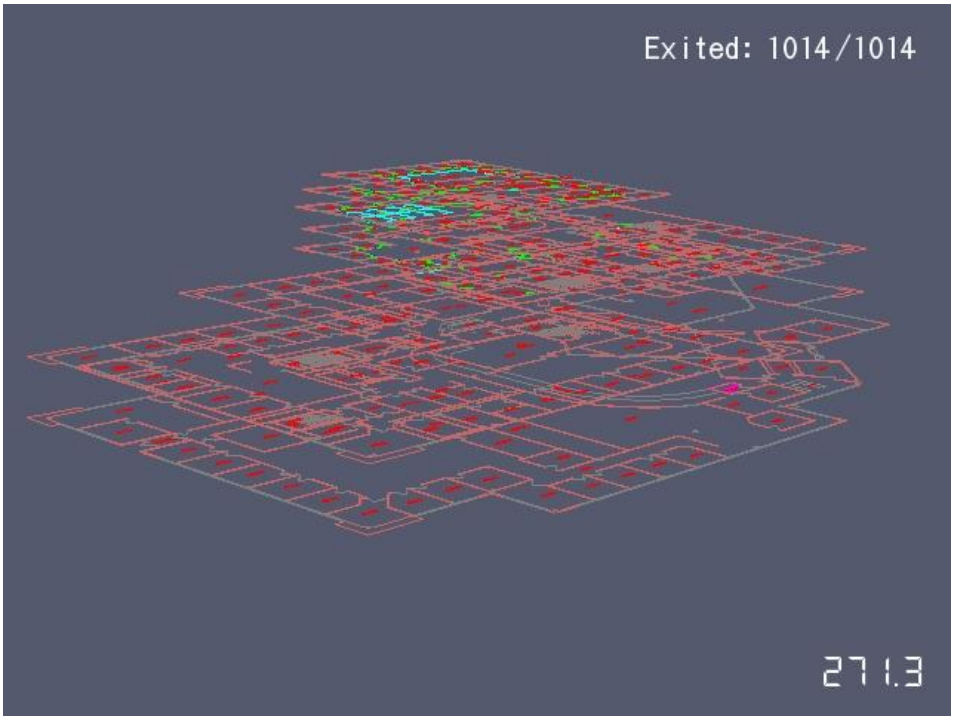


Figure 25 - Pathfinder Model at 271 Seconds

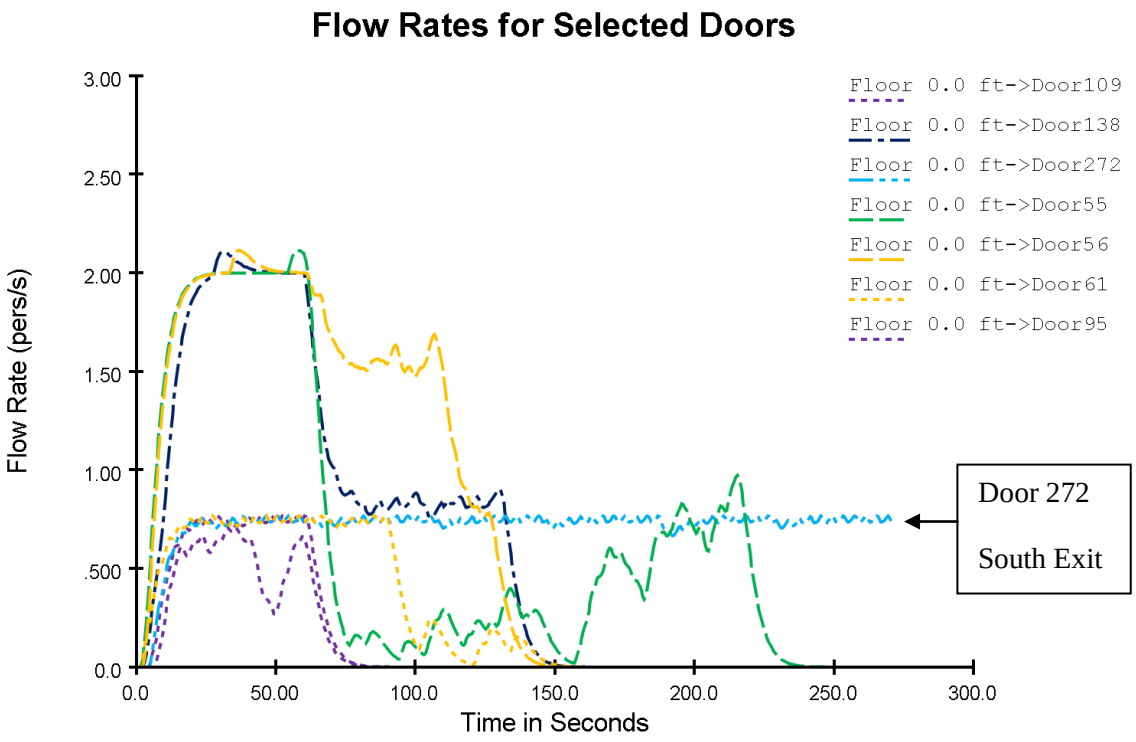


Figure 26 - Pathfinder Model Flow Rates for Exit Doors

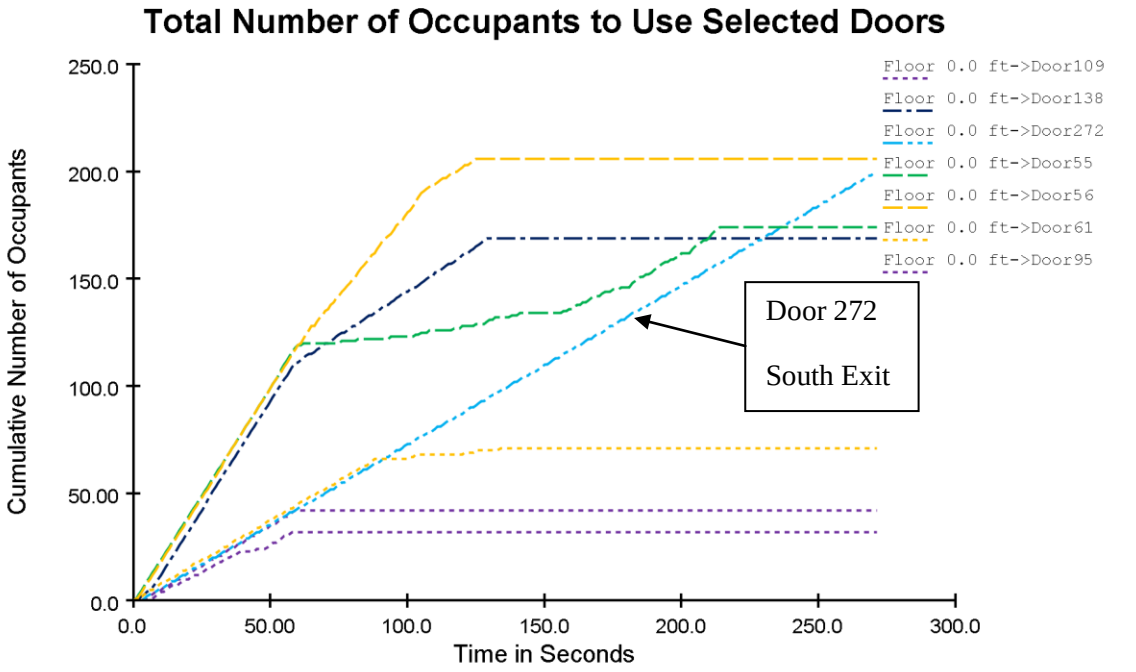


Figure 27 - Pathfinder Model Number of Occupants to Use Exit Doors

1.5.10 Pathfinder Required Safe Egress Time (RSET)

Table 24 - Calculated RSET Values using Pathfinder Egress Time for each Scenario

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]**

As before, Scenario #1-Sprinkler activation has a greater detection time than the smoke detectors in Scenario #1-Detector activation. Reference Table 24. The alarm and notification time for Scenario #1 - Smoke Detector will occur before Scenario #1 - Sprinkler. As a result, the required safe egress time (RSET) for Scenario #1 is 402 seconds (6.7 minutes). For Scenario #2-Sprinkler activation, the required safe egress time (RSET) is 430 seconds (7.2 minutes).

Chapter 2 – Performance Based Analysis

2.1 Performance Based Analysis

Performance based analysis can be used as an alternate means to design the fire performance of materials, building design or method of construction of a building. IBC Section 104.11 states that an...

"alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety."

NPFA 101 - Life Safety Code, Section 4.4.3 Performance Based Option, allows for a performance based life safety design. Chapter 5 of NFPA 101 provides the general requirements, performance criteria, design fires scenarios, data requirements, etc... for a performance based design. The specific performance criteria, as stated in NFPA 101 Section 5.2.2 is that...

"Any occupant who is not intimate with ignition shall not be exposed to instantaneous or cumulative untenable conditions." (NFPA 101 2012).

Although the Municipality uses the IBC, NFPA 101 can be used as an alternate method to determine code compliance, as long as the requirements of the IBC are also satisfied.

For this project paper, the specific performance criteria that is being studied is that tenable conditions are being satisfied for the two design fire scenarios. The exact tenability criteria limits being met are discussed in the next section of this project report. The specific area of the MOA Public Works building where tenable conditions are being looked at is the 2nd floor lobby. If the second floor lobby develops untenable conditions before the building is completely evacuated, the south end 2nd floor of the building would be limited to only one egress component.

2.2 Reasoning and Assumptions

There are a few different reasons why the two fire scenario's were chosen to use in this performance based design. As a result of the pathfinder egress model, it was noted that bottle-necking was occurring at exit door #272, which is located on the south end of the building. Since this door is located off of an existing exit passageway (from the original construction in 1997), a large portion of the 1st floor south end of the building, along with the 2nd floor south end of the building, exits through this passageway and door #272. This 2nd floor area has one other exit which discharges through the 2nd floor lobby, which stated again, is open to the atrium. My concern with the 2nd floor lobby is that if a fire were to occur from either scenario #1 or #2, that untenable conditions could be achieved at or below a 6 ft (2 m) level at the 2nd floor lobby.

A few assumptions were made in choosing both scenario's. The first is that since both scenario's are in large open areas, and as such, the resulting fires will be fuel controlled. Being such large areas, mechanical ventilation would have minimum impact on the fire size and growth. A second assumption is that the fires will not spread to adjacent workstations or combustible materials. The last assumption made was that without sprinkler activation, the maximum design HRR will be reached and then maintain that level for the duration of the simulation. Inversely, with sprinkler activation, the maximum HRR reached will be the HRR at the time of sprinkler activation which will then maintain that level for the duration of the simulation.

2.3 Tenability Criteria

Tenability criteria are limits at which people exposed to them might not enter a space to egress, and instead might turn around and try to find another means of escape. Tenability criteria limits shown in Table 25 below are limits that are found in the NFPA handbook of Fire Protection Engineering. The two tenability criteria that is focused on in this project report is that of visibility

and temperature. SFPE Handbook proposes that for large enclosures a visibility limit of 10 meters (30 ft), where "concentrations exceeding these levels could impair or even prevent occupants' safe escape." (SFPE HFPE 2008). SFPE Handbook also proposed that the "highest temperature at which saturated air can be breathed for more than a few minutes is 60° C." (SFPE HFPE 2008). In the NFPA article 'Fire Dynamics Simulator,' by Michael Ferreira, he established that 10 m (30 ft) was a "critical visibility distance to a normal object ." (Ferreira 2008).

Table 25 - Tenability Criteria Limits

Tenability Criteria 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

2.4 Scenario #1 Design Fire HRR

For Scenario #1, in a report issued by NIST on the Cook County Administration Building Fire, full scale fire test data was available for a single office workstation fire, similar to the workstations found at the MOA Public Works building permitting area. Picture 10 below shows the full scale test fire at its peak HRR of 3.3 MW. (D. Madrzykowski 2003). Figure 28 shows the plot of the HRR over time for this fire. For scenario #1, a HRR of 3.3 MW at 360 seconds is used in the FDS simulation.

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

Picture 10 - Workstation Test Fire Photo

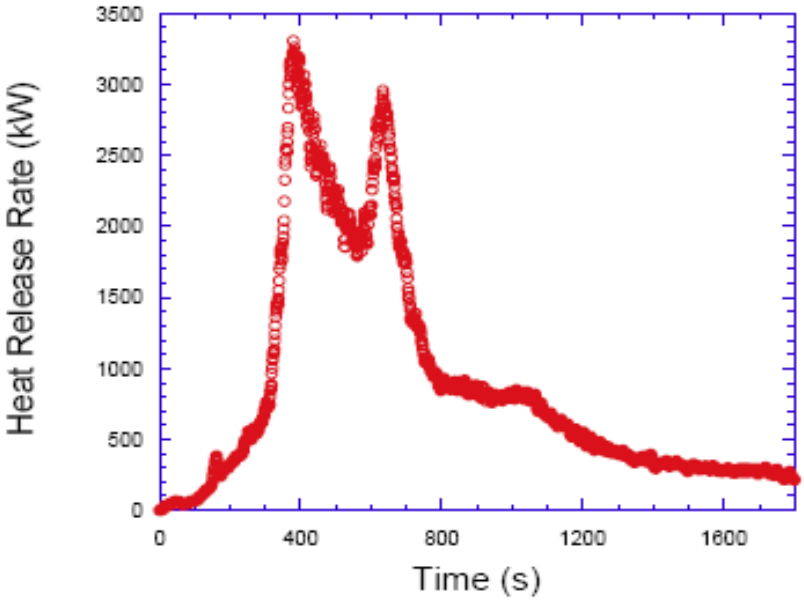


Figure 28 - Workstation HRR Plot

2.5 Scenario #2 Design Fire HRR

For Scenario #2, it was much more difficult finding a representative full scale fire test to use to model the plan storage system fire hazard. Refer to Picture 8 - Scenario #2 Plan Storage Area. Instead, the NFPA Handbook of Fire Protection Engineering had two somewhat similar HRR curve references, one of a magazine rack, and one of a newsstand shop display. Refer to Figure 29 and Figure 30 below. Both of these references has test items similar in height to that of the MOA Public Works building plan storage system. Although not completely the same (i.e. wood storage system vs. metal magazine rack), the two chosen are the closest representative HRR curves that could be found. Using these HRR curves, I assumed a Scenario #2 design fire HRR of 3.5 MW at 300 seconds, which is used in the FDS simulation.

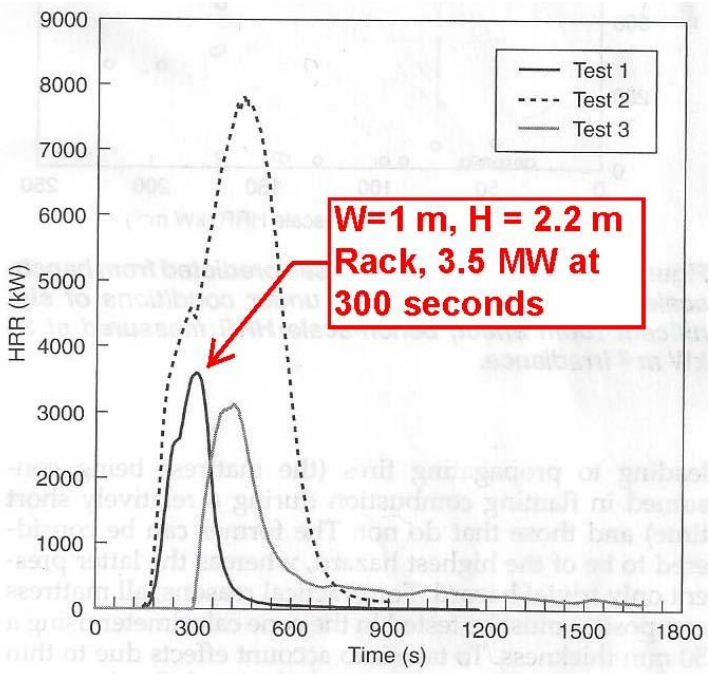


Figure 3-1.56. ***HRR of magazine racks loaded with magazines, newspapers, and books.***

Figure 29 - Magazine Rack HRR Plot

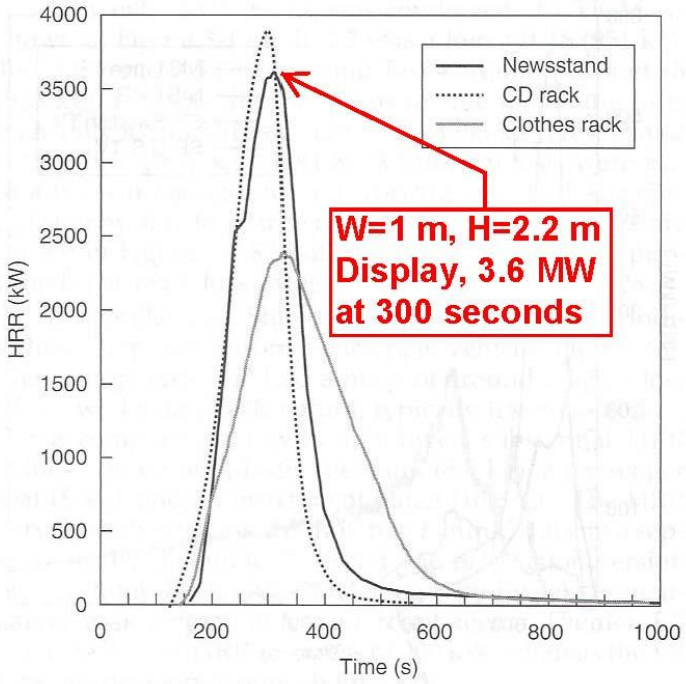


Figure 3-1.75. ***HRR of various shop-display commodities tested by Chow.[178]***

Figure 30 - Newsstand Display HRR Plot

2.6 PyroSim - FDS Model

The 3-D model of the MOA Public Works building was created using PyroSim, which is a graphical user interface with the Fire Dynamics Simulator (FDS) and Smokeview. (PyroSim 2014). Using PyroSim, a two dimensional AutoCAD .dwg was imported, and the 3-D model created using the features of PyroSim. The 3-D model created consisted of the entire south end of the 1st floor to the atrium, , the atrium, and the 2nd floor Lobby area. Reference Figure 31 for a snapshot of the entire model, and Figure 32 for a close-up of the Atrium and Fire Scenario area. Fire sprinklers and smoke detectors are located within the model, where surveyed from the actual location within the building. The glass block wall separating the permit workstations (Scenario #1) from the plan storage area (Scenario #2). Control functions added for the glass wall, where segments of the glass wall would disappear when a thermocouple placed at the wall reached a temperature of 600° C, the critical temperature of glass. The design fires were located in critical

areas of both the permitting workstations, and in the storage area, where they were the furthest from the sprinklers. Doing so resulted in a larger radius value (R) used in the DETACT calculation, and therefore longer activation times.

I have to mention that the geometry of the model varies with curved walls, sloped atrium structure, etc.. which made modeling this a challenge. With that said, I did manage to create a representative model. However, the Grid Size I left at the default value of 0.5 m, due to the overall size of the model, and the run time. When trying to reduce the Grid size by half, the model would run for more than a day, maybe two, so I stopped it at that point. Using a 0.5 m grid size, the model ran for approximately 4 hours. Lastly, slice files were added for both temperature and visibility at the 2nd floor Lobby, in both the x and y dimensions.

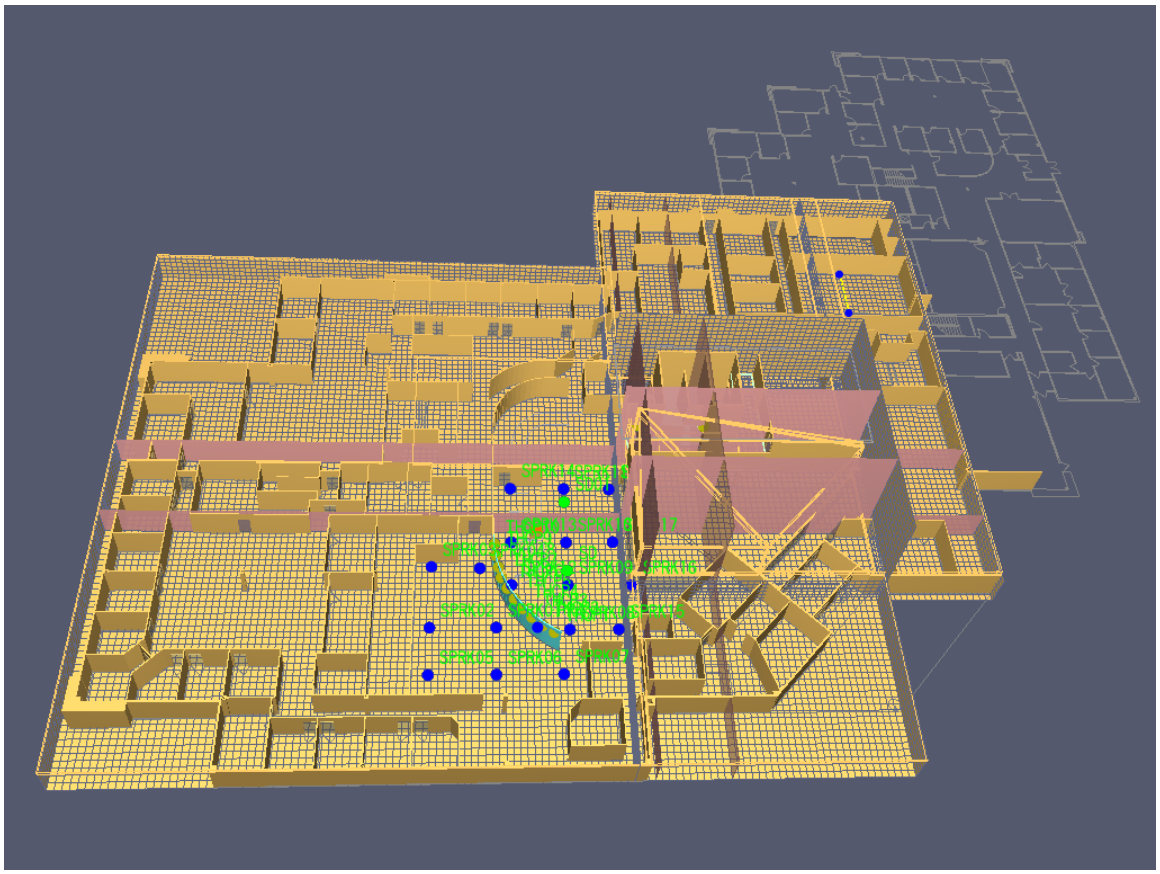


Figure 31 - FDS Model of the MOA Public Works Building

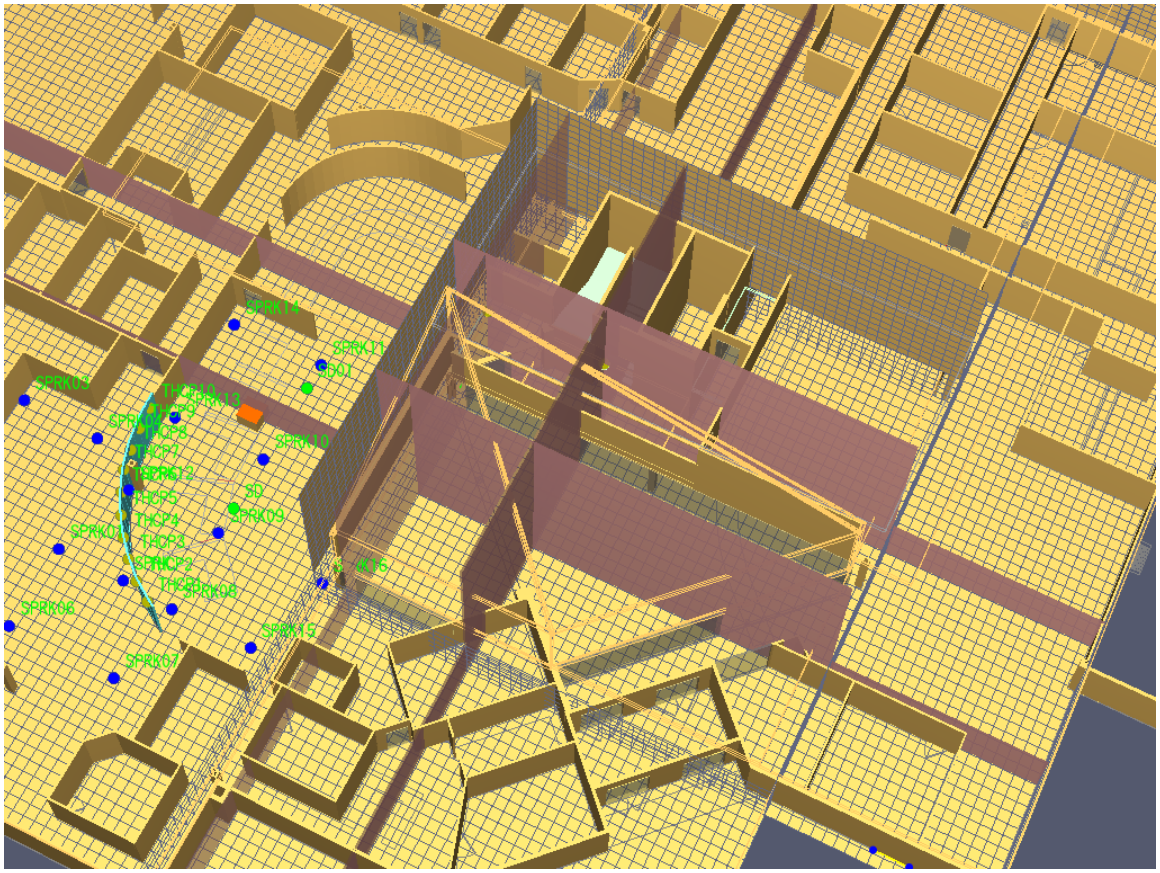


Figure 32 - Close-up of FDS Model

Using the HRR curves presented before, where Scenario #1 had a HRR of 3.3 MW at 360 seconds, and Scenario #2 had a HRR of 3.5 MW at 300 seconds, the simulation was run for a total of 600 seconds (10 minutes). For both design fires, a soot yield $Y_s = 0.01$ g/g was used, noting that a large composition of materials would burn in either fire. Also noting that within the SFPE handbook, the smoke yield for most types of wood was $Y_s = 0.015$ g/g.

After the initial run, the time and HRR that the first sprinkler activated was noted. A second run of the FDS model for each scenario was made, using the HRR from the first run results at the time of sprinkler activation. The assumption being made is that the sprinklers operate and control

the fire growth. The results of both the visibility and temperature from slice files for the 2nd floor Lobby are presented next.

2.7 FDS Results of Fire Scenario #1 FDS

Using a design fire of HRR of 3.3 MW at 360 seconds, the first sprinkler activated at 1.3 MW in 235 seconds. Re-running the simulation using at 1.3 MW fire, the same results for sprinkler activation was achieved at 235 seconds. Figure 33 is a snapshot taken of the model when the first sprinkler activates, and Figure 34 is a HRR plot of the design fire. The results of the simulation is as follows:

- The visibility of the 2nd floor Lobby is 10 m at 2 m (6 ft) at approximately 578 seconds. Reference Figure 35 for a snapshot of the 2nd floor Lobby visibility.
- The temperature of the 2nd floor Lobby is less than 55° C. Reference Figure 36 for a snapshot the 2nd floor Lobby temperature.
- The available safe egress time (ASET) = 578 seconds (9.6 minutes).

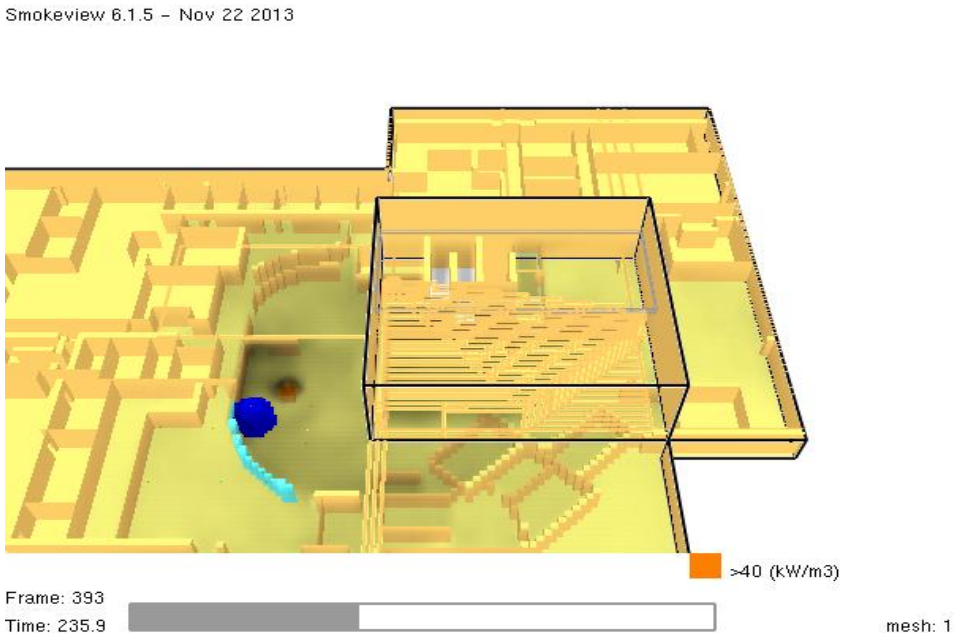


Figure 33 - Scenario #1 - Model Snapshot at 235 Seconds & HRR = 1.3 MW

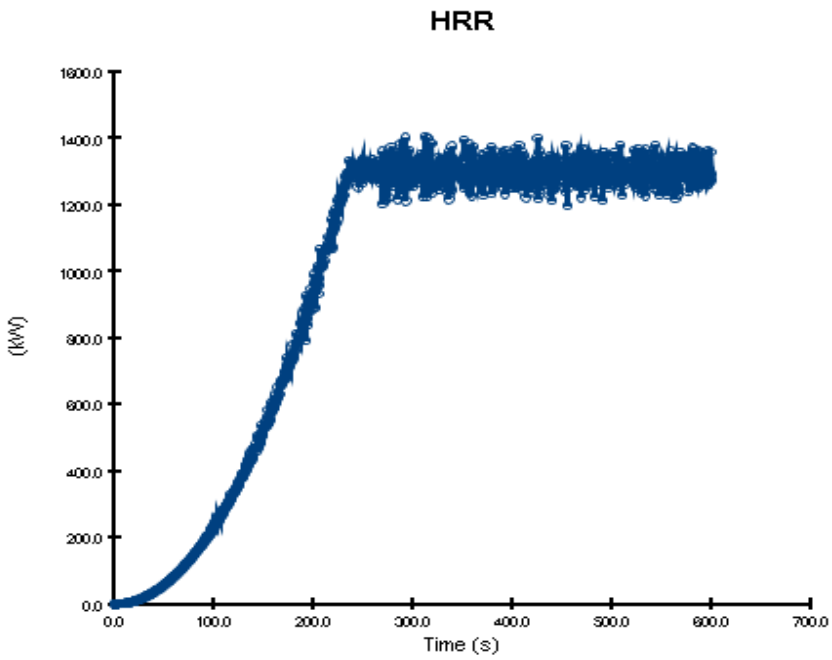


Figure 34 - Scenario #1 Design Fire HRR Plot at 1.3 MW

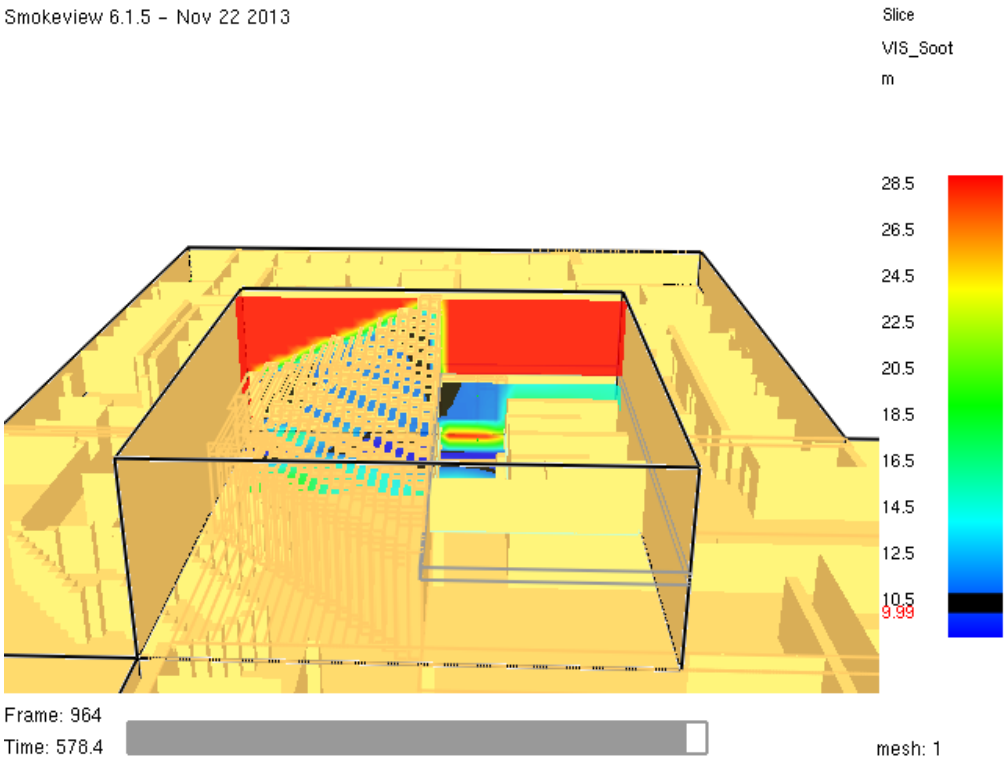


Figure 35 - Scenario #1 2nd Floor Lobby Snapshot of Visibility *with* Sprinklers

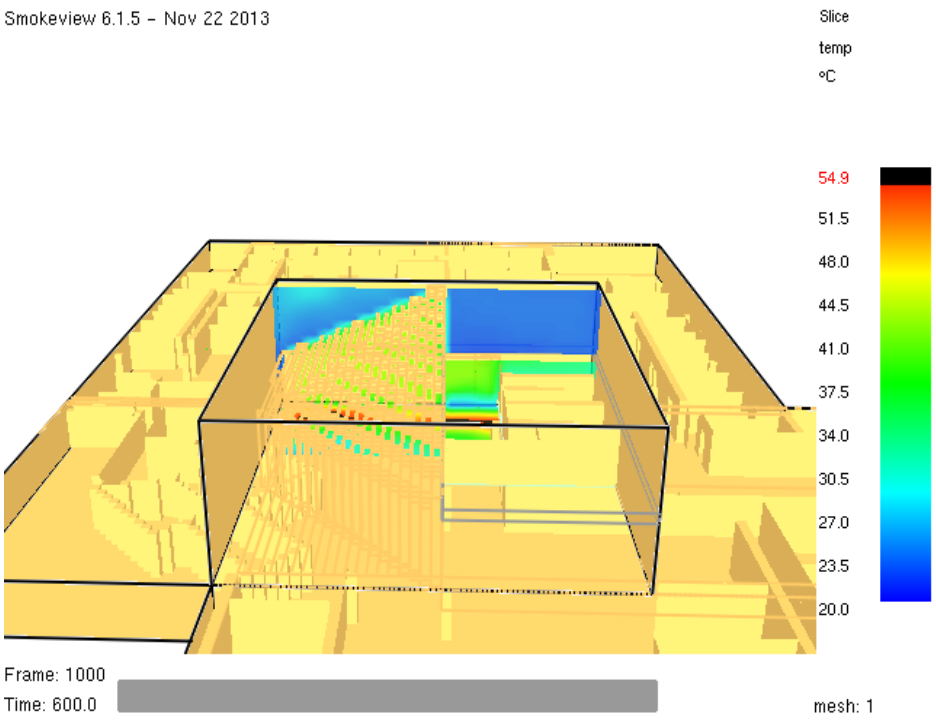


Figure 36 - Scenario #1 2nd Floor Lobby Snapshot of Temperature *with* Sprinklers

Since the sprinklers in the area turned out to be recalled Central Model ESLO ECOH sprinklers, the possibility that the sprinkler might not operate because the sprinkler o-rings might have degraded is a reality. Running the simulation without sprinklers, that is assuming they will not operate, the results are very different. Figure 37 shows that at 382 seconds (6.4 minutes), the visibility is reduced to less than 10 ft at a 2 m (6 ft) high elevation above the 2nd floor Lobby. Figure 38 shows that the temperature for the 2nd floor Lobby below 60° C up to 480 seconds (8 minutes). Using these tenability criteria, the available safe egress time (ASET) for the 2nd floor would be 382 second (6.4 minutes).

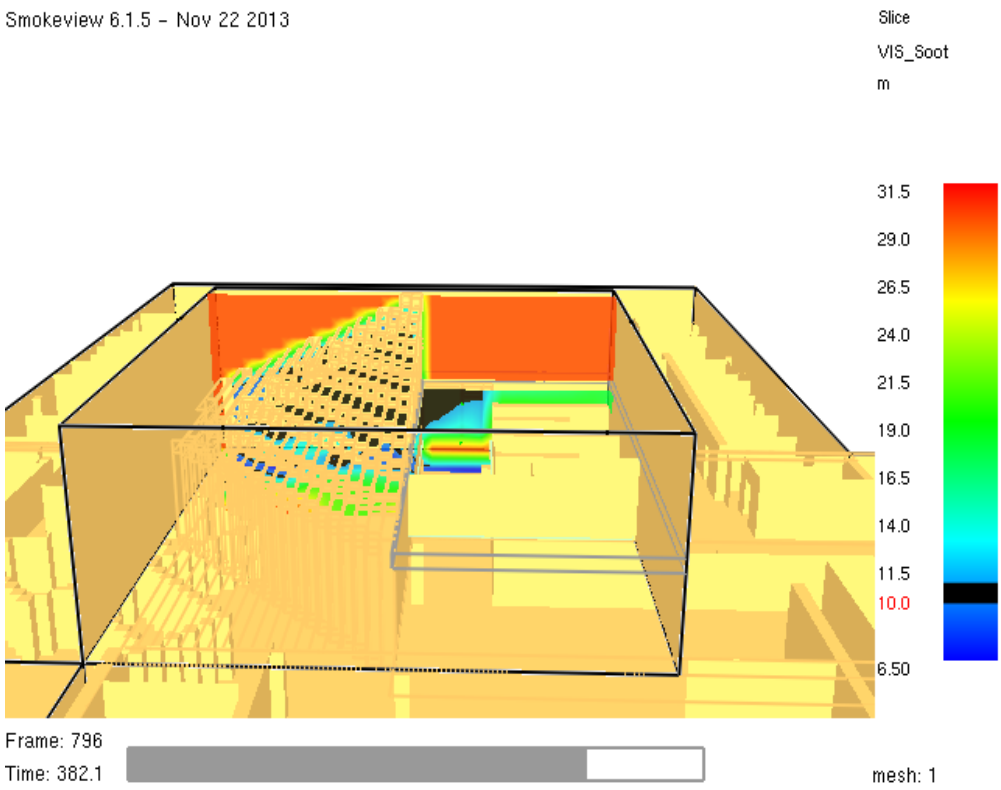


Figure 37 - Scenario #1 2nd Floor Lobby Snapshot of Visibility *without* Sprinklers

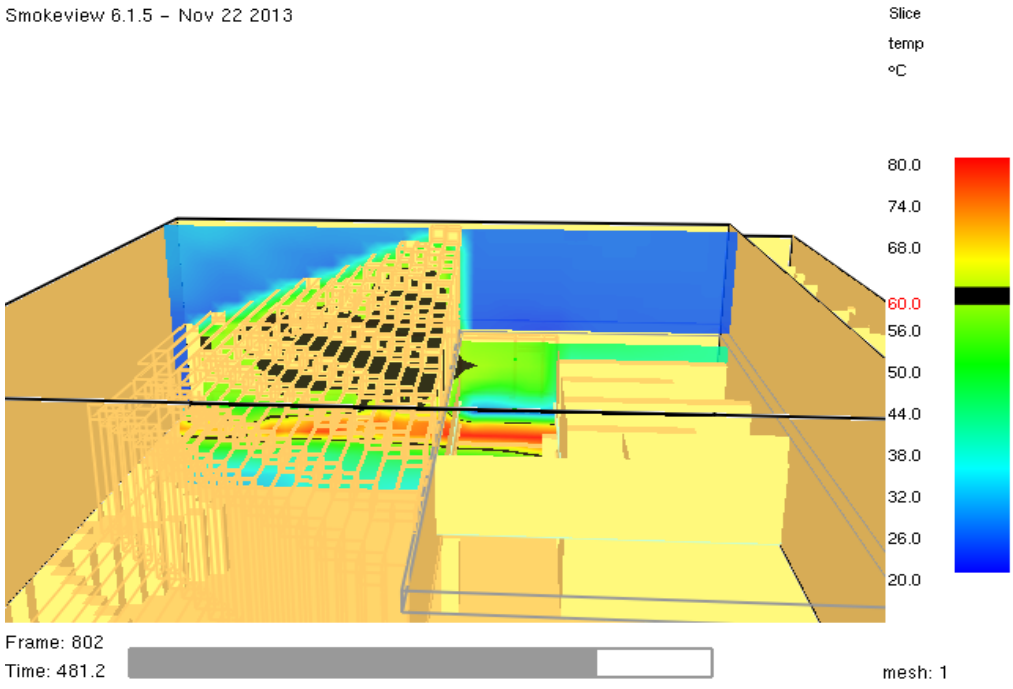


Figure 38 - Scenario #1 2nd Floor Lobby Snapshot of Temperature *without* Sprinklers

2.8 FDS Results of Fire Scenario #2

Using a design fire of HRR of 3.5 MW at 300 seconds, the first sprinkler activated at 567 kW in 121 seconds. Re-running the simulation using at 567 kW fire, the same results for sprinkler activation was achieved at 121 seconds. Figure 39 is a snapshot taken of the model when the first sprinkler activates, and Figure 40 is a HRR plot of the design fire. The results of the simulation is as follows:

- The visibility of the 2nd floor Lobby is greater than 10 m visibility at 2 m (6 ft) at 600 seconds. Reference Figure 41 for a snapshot of the 2nd floor Lobby visibility.
- The temperature of the 2nd floor Lobby is less than 25° C at 600 seconds. Reference Figure 42 for a snapshot the 2nd floor Lobby temperature.
- The available safe egress time (ASET) = 600 seconds (10 minutes).

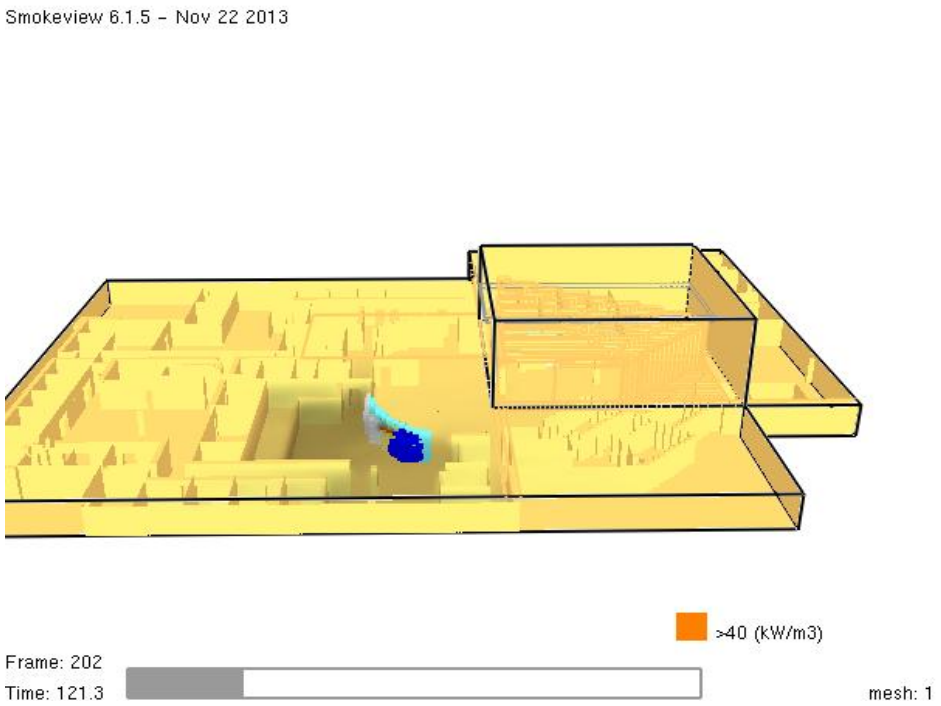


Figure 39 - Scenario #2 - Model Snapshot at 121 Seconds & HRR = 567 kW

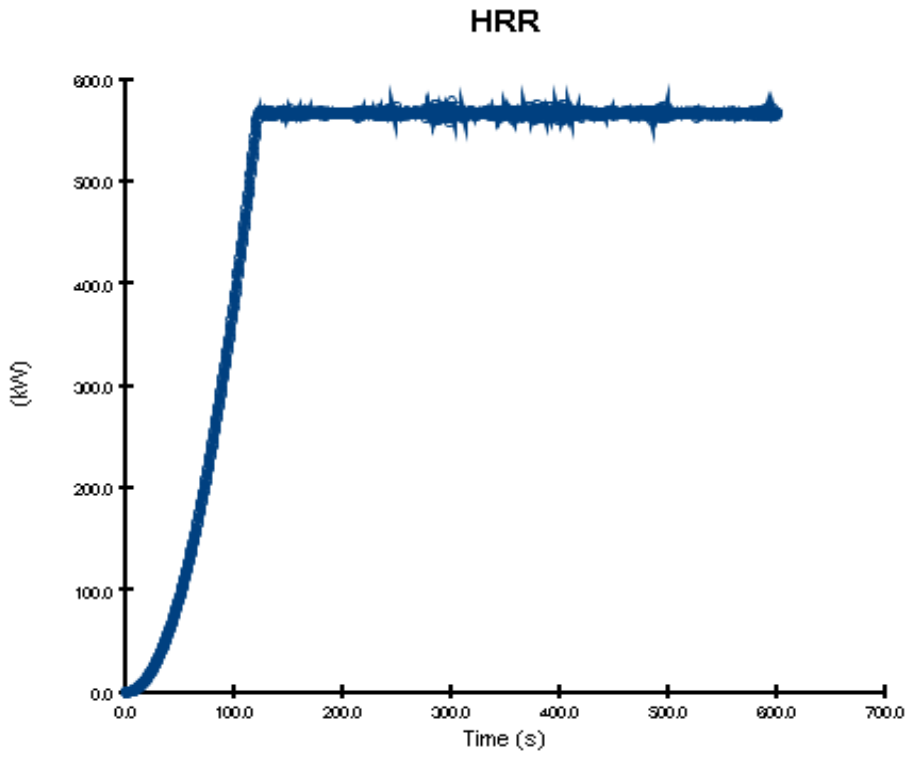


Figure 40 - Scenario #2 Design Fire HRR Plot at 567 kW

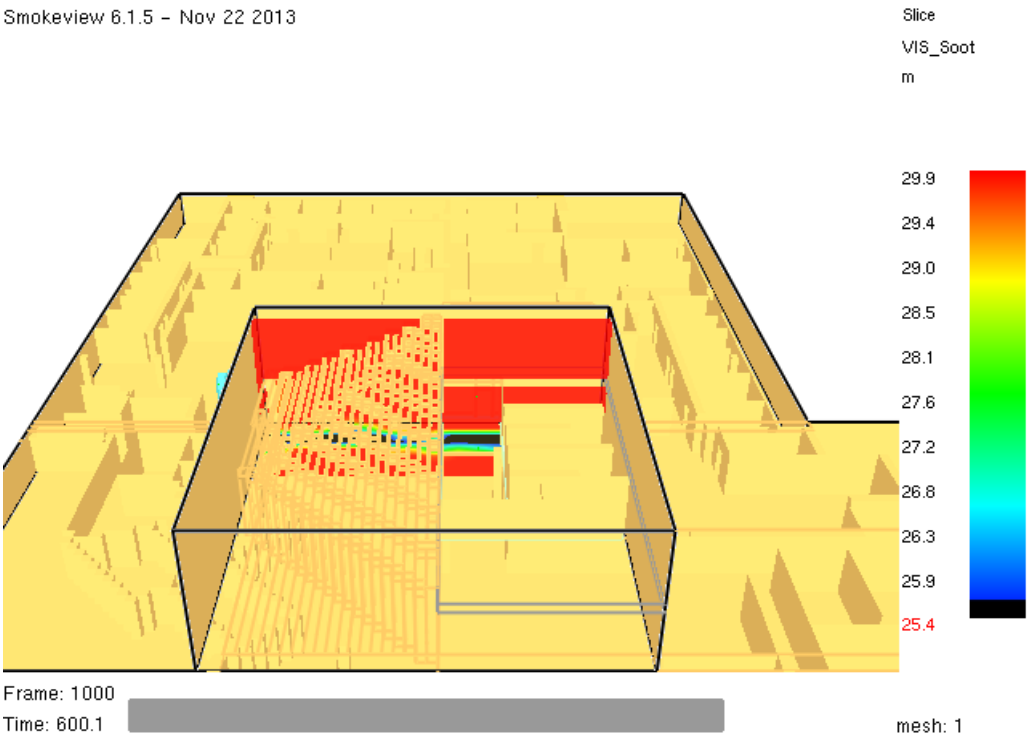


Figure 41 - Scenario #2 2nd Floor Lobby Snapshot of Visibility *with* Sprinklers

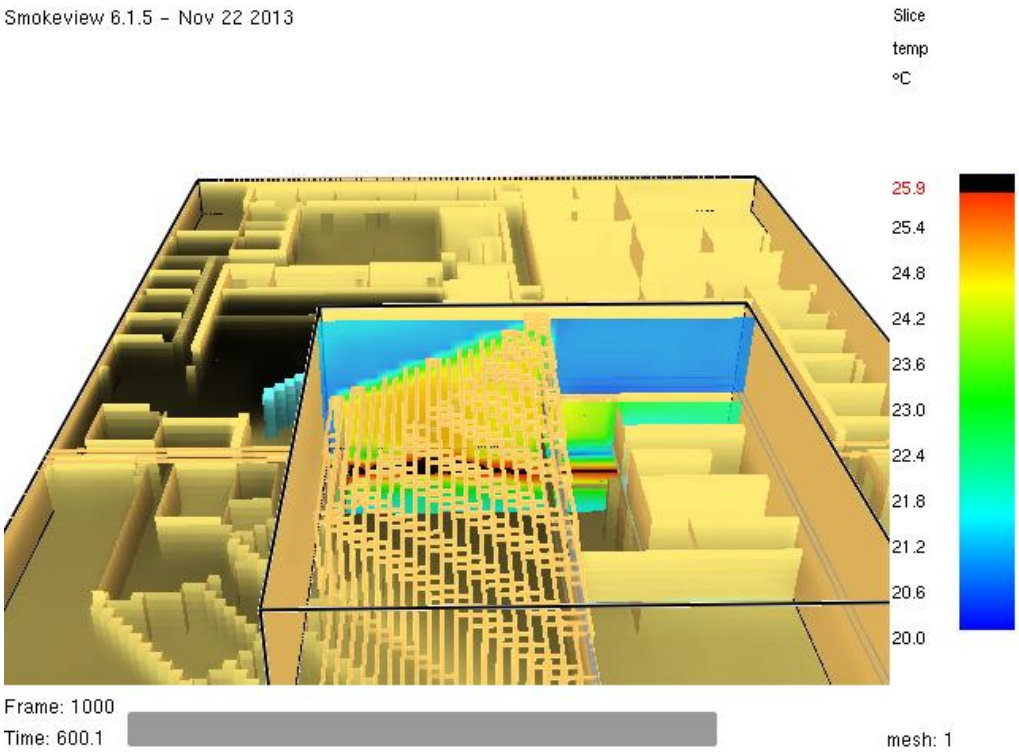


Figure 42 - Scenario #2 2nd Floor Lobby Snapshot of Temperature *with* Sprinklers

Similar to Scenario #1, since the sprinklers in the area turned out to be recalled Central Model ESLO ECOH sprinklers, the possibility that the sprinkler might not operate because the sprinkler o-rings might have degraded has credibility. Running the simulation without sprinklers, that is assuming they will not operate, the results are again very different. Figure 43 shows that at 432 seconds (7.2 minutes), the visibility is reduced to less than 10 ft at a 2 m (6 ft) high elevation above the 2nd floor Lobby. Figure 44 shows that the temperature for the 2nd floor Lobby is below 60° C, somewhere around 48° C to 52° C at the end of the 600 second (10 minute) simulation. Using these tenability criteria, the available safe egress time (ASET) for the 2nd floor would be 432 second (7.2 minutes).

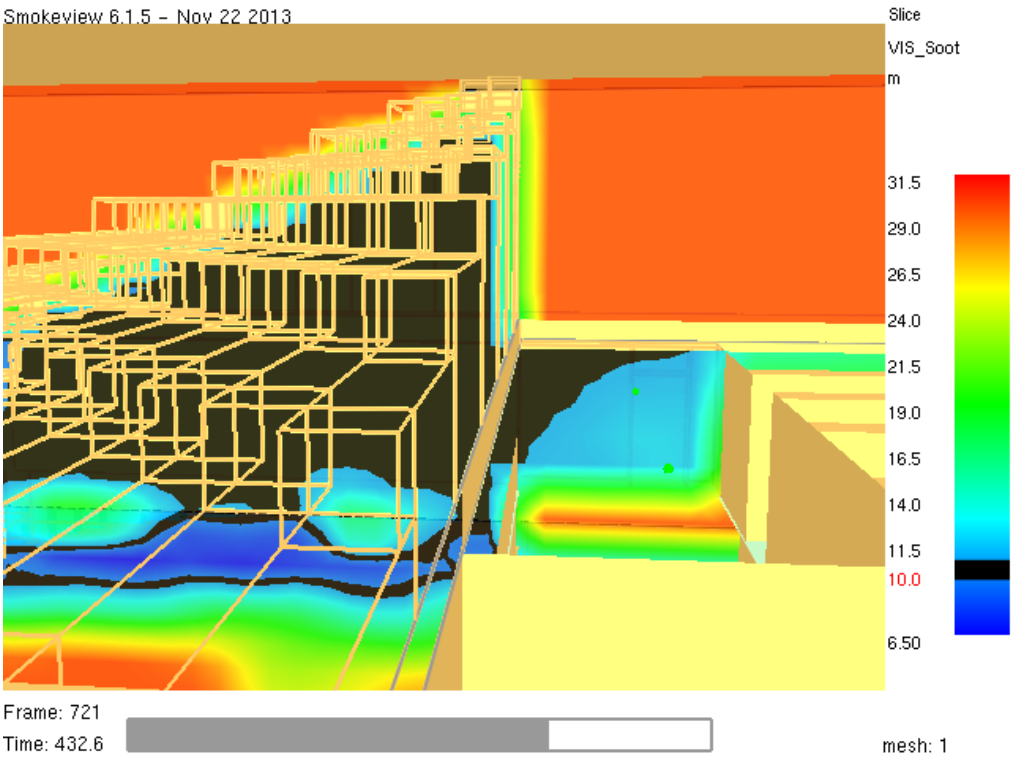


Figure 43 - Scenario #2 2nd Floor Lobby Snapshot of Visibility *without* Sprinklers

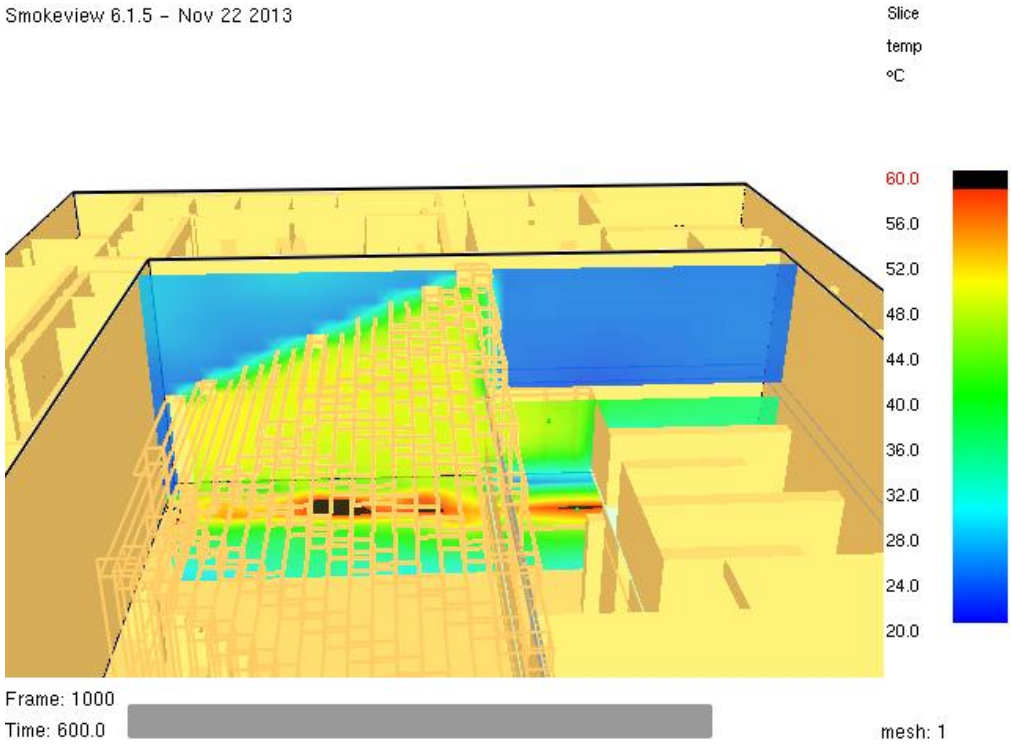


Figure 44 - Scenario #2 2nd Floor Lobby Snapshot of Temperature *without* Sprinklers

2.9 REST vs. ASET

Reference Table 26 below for a summary of both RSET and ASET values for Scenario #1. For Scenario #1, when considering the worst case RSET and ASET values, using the pathfinder egress time for calculation of RSET, with bottle-necking occurring, and without the sprinklers operating, the RSET value is greater than the simulated ASET value. The end result is that the system fails the performance based objectives.

RSET = 430 seconds > ASET = 382 seconds

When the sprinklers do operate and control the growth of the fire, a factor of safety exists. With the sprinklers operating, the factor of safety is less than a recommended 150%, but still passes the performance based design objectives.

RSET = 430 seconds < ASET = 578 seconds

Table 26 - Scenario #1 RSET vs. ASET 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)**

See Table 27 below for a summary of both RSET and ASET values for Scenario #2. For Scenario #2, when considering the worst case RSET and ASET values, using the pathfinder egress time for calculation of RSET, with bottle-necking occurring, and without the sprinklers operating, the RSET value is less than the simulated ASET value by a very small margin of safety, similar to Scenario #1. The end result is that the system passes the performance based design objectives, but without any factor of safety.

RSET = 430 seconds < ASET = 432 seconds

When the sprinklers do operate and control the growth of the fire, a factor of safety exists. With the sprinklers operating, the factor of safety is less than a recommended 150%, but still passes the performance based design objectives.

RSET = 430 seconds < ASET = 600 seconds

Table 27 - Scenario #2 RSET vs. ASET 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)**

Chapter 3 – Conclusions and Recommendations

3.1 Conclusions

The prescriptive code requirements meet the intent of the IBC 2009 Edition. Although the building is rated a IIB construction type under the IBC, with a zero (0) hour fire resistance rating for the building elements, the building was originally built using the Uniform Building Code as a type II-N, which apparently required one exit stairway (Stair 3) to be rating 1 hour and to have a 1 hour rated exit corridor. Stair #3 is located at the south end of building. This is interesting to me because the exit capacity of this stairway is slightly reduced by the 34 inch doorways when compared to the other open exit stairways. In addition, during my walkthrough of the building, I found that the exit corridor doors are often open to the stairway #3 or other adjacent rooms or areas. It is at this exit corridor that bottle-necking occurs from three separate areas discharging into the exit corridor and then discharging through the exit Door 272. This was demonstrated by the Pathfinder results. It is my believe that if exit Door 272 were increased in size, to a double door, than bottle-necking might not occur. Note that the bottle-necking at Door 272 resulted in almost another 60 seconds of egress time while still in use when all of the other exits were no longer being used. Since the 2nd floor of the south end of the building has two exits, either through the south Stair 3, or through the Lobby stairway into the atrium, I thought that if a fire were to occur near the atrium, that the Lobby stairway might be lost due to untenable conditions. If this were to occur, the egress time from the south end of the building would likely increase. Looking at the potential impact of this situation, while considering the two separate fire scenarios outlined in this report, became the purpose of this project. However, to compound matters for the worse was the finding that re-called Central ESLO Extended Coverage Ordinary Hazard Sprinklers where still being utilized throughout the large open permitting area, near the main entrance and atrium. Actually they are being utilized in other large work areas of the building. A

real possibility exists that these sprinklers may not operate during an actual fire event, because of deterioration of the sprinkler's o-rings.

Using prescriptive and performance based engineering methods, the required safe egress time (RSET) for the building, and the available safe egress time (ASET) was determined for each fire scenario.

For Scenario #1, the results were as expected when the assumption that the sprinklers operate and control or extinguish the fire, that is....

RSET = 375 seconds < ASET = 578 seconds

However, when the assumption that the sprinklers will not operate because of a faulty o-ring, the results did not provide much of a safety factor, that is...

RSET = 375 seconds < ASET = 382 seconds

For Scenario #2, the results were slightly better than scenario #1 when the assumption that the sprinklers operate and control or extinguish the fire, that is....

RSET = 375 seconds < ASET = 600 seconds

When the assumption that the sprinklers will not operate because of a faulty o-ring, the results also provided a small margin of safety, that is

RSET = 403 seconds < ASET = 432 seconds

The final result is that for these two fire scenarios, the required safe egress time is less than the allowable safe egress time. However, the margin of safety is lessened by the fact that recalled sprinkler heads exist.

3.2 Recommendations

The first recommendation is to change out all of the existing recalled Central Model ESLO ECOH sprinklers with a newer glass bulb model. Since the original sprinkler plans for the 1997 building were not available, I also suggest that a survey of the existing sprinkler system be completed and new hydraulic calculations be performed using the replacement sprinklers listing design information. I further recommend that all other types of existing sprinklers that are found in the building be verified that they too are not recalled sprinklers. If the sprinklers operate as intended, then the required safe egress time is well below the available safe egress time.

A second recommendation would be to look at increasing the size of exit Door 272 to a double door. This would likely reduce the simulated egress time (using Pathfinder), which would result in a reduced required safe egress time.

3.3 Future Work

Even though this project is an exercise, I believe that this project could be improved upon by finding actual full scale fire test data for the storage system used in Scenario #2, Plan Storage area. The full scale fire test data for Scenario #1 appeared to be a very good match to me, however, there were other office furniture full scale test data available, with lower and/or much higher HRR's. The smoke yield used for both of the fire scenarios were not exact nor found from the full scale test results. More study into the smoke yield for the fire scenarios would be recommended by the author. See Appendix F for questions asked by the project reviews after my project presentation on June 12, 2014, along with a Code analysis and corresponding statement.

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Appendix A - Sprinkler System Hydraulic Calculation

DATE: 3/19/2013\DOCUMENTS\CAL POLY 523\PROJECT DATA\MOA PW ALT DESIGN.SDF
JOB TITLE: MOA Public Works Bldg Alt Sprinkler Layout HASS Hyd. Calc

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
SOURCE	57.0	20.0	2727.0	56.4	280.7	50.4

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	280.7 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	100.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	180.7 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
TOR	10.0	- - - -	43.3	- - -
BOR	2.0	- - - -	47.1	- - -
BKO	2.0	- - - -	47.1	- - -
BKI	2.0	- - - -	49.3	- - -
S1	1.6	- - - -	49.6	- - -
UG	1.0	- - - -	49.9	- - -
SL1	10.0	- - - -	41.9	- - -
SL2	10.0	- - - -	39.5	- - -
A	10.0	- - - -	39.5	- - -
B	25.2	- - - -	31.1	- - -
C	25.2	- - - -	24.2	- - -
D	25.2	- - - -	23.8	- - -
E	26.2	- - - -	23.2	- - -
1	26.2	- - - -	17.9	- - -
2	26.2	- - - -	15.7	- - -
2A	22.0	K= 5.60	16.1	22.5
3	26.2	- - - -	13.1	- - -
3A	22.0	K= 5.60	13.7	20.8
4	26.2	- - - -	9.8	- - -
4A	22.0	K= 5.60	10.6	18.3
5	26.2	- - - -	8.7	- - -
5A	22.0	K= 5.60	9.9	17.7
6	26.2	- - - -	17.8	- - -
7	26.2	- - - -	14.5	- - -
7A	22.0	K= 5.60	15.1	21.7
8	26.2	- - - -	12.3	- - -
8A	22.0	K= 5.60	13.0	20.2
9	26.2	- - - -	8.3	- - -
9A	22.0	K= 5.60	9.0	16.8
10	26.2	- - - -	7.1	- - -
10A	22.0	K= 5.60	8.4	16.2
11	26.2	- - - -	23.1	- - -
12	26.2	- - - -	22.6	- - -
12A	22.0	K= 5.60	22.5	26.6

DATE: 3/19/2013\DOCUMENTS\CAL POLY 523\PROJECT DATA\MOA PW ALT DESIGN.SDF
JOB TITLE: MOA Public Works Bldg Alt Sprinkler Layout HASS Hyd. Calc

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
SOURCE	0.0	SOURCE	50.4	180.7

DATE: 3/19/2013\DOCUMENTS\CAL POLY 523\PROJECT DATA\MOA PW ALT DESIGN.SDF
JOB TITLE: MOA Public Works Bldg Alt Sprinkler Layout HASS Hyd. Calc

PIPE DATA

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 1					180.7	4.310 PL	98.50	PF	1.3
TOR	10.0	0.0	43.3	0.0	4.0	120 FTG	3ET	PE	0.0
SL1	10.0	0.0	41.9	0.0		0.008 TL	168.18	PV	
Pipe: 2					FIXED PRESSURE LOSS DEVICE				
SL1	10.0	0.0	41.9	0.0	2.4 psi, 180.7 gpm				
SL2	10.0	0.0	39.5	0.0					
Pipe: 3					180.7	4.310 PL	3.42	PF	0.0
SL2	10.0	0.0	39.5	0.0	4.0	120 FTG	----	PE	0.0
A	10.0	0.0	39.5	0.0		0.008 TL	3.42	PV	
Pipe: 4					180.7	2.727 PL	15.25	PF	1.8
A	10.0	0.0	39.5	0.0	9.9	120 FTG	E	PE	-6.6
B	25.2	0.0	31.1	0.0		0.073 TL	24.99	PV	
Pipe: 5					180.7	2.727 PL	75.17	PF	6.9
B	25.2	0.0	31.1	0.0	9.9	120 FTG	2E	PE	0.0
C	25.2	0.0	24.2	0.0		0.073 TL	94.64	PV	
Pipe: 6					154.1	2.727 PL	7.00	PF	0.4
C	25.2	0.0	24.2	0.0	8.5	120 FTG	----	PE	0.0
D	25.2	0.0	23.8	0.0		0.054 TL	7.00	PV	
Pipe: 7					79.2	2.727 PL	10.00	PF	0.2
D	25.2	0.0	23.8	0.0	4.3	120 FTG	----	PE	-0.4
E	26.2	0.0	23.2	0.0		0.016 TL	10.00	PV	
Pipe: 8					79.2	1.639 PL	15.00	PF	5.3
E	26.2	0.0	23.2	0.0	12.0	120 FTG	ET	PE	0.0
1	26.2	0.0	17.9	0.0		0.189 TL	28.09	PV	
Pipe: 9					79.2	1.639 PL	12.00	PF	2.3
1	26.2	0.0	17.9	0.0	12.0	120 FTG	----	PE	0.0
2	26.2	0.0	15.7	0.0		0.189 TL	12.00	PV	
Pipe: 10					56.7	1.408 PL	12.00	PF	2.6
2	26.2	0.0	15.7	0.0	11.7	120 FTG	----	PE	0.0
3	26.2	0.0	13.1	0.0		0.213 TL	12.00	PV	
Pipe: 11					35.9	1.080 PL	10.00	PF	3.3
3	26.2	0.0	13.1	0.0	12.6	120 FTG	----	PE	0.0
4	26.2	0.0	9.8	0.0		0.334 TL	10.00	PV	
Pipe: 12					17.7	1.080 PL	12.00	PF	1.1
4	26.2	0.0	9.8	0.0	6.2	120 FTG	----	PE	0.0
5	26.2	0.0	8.7	0.0		0.090 TL	12.00	PV	

DATE: 3/19/2013\DOCUMENTS\CAL POLY 523\PROJECT DATA\MOA PW ALT DESIGN.SDF
JOB TITLE: MOA Public Works Bldg Alt Sprinkler Layout HASS Hyd. Calc

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)	PRESS. SUM. (PSI)
Pipe: 13					75.0	1.639 PL	15.00 PF	5.5
D	25.2	0.0	23.8	0.0	11.4	120 FTG	2ET PE	-0.4
6	26.2	0.0	17.8	0.0		0.171 TL	32.45 PV	
Pipe: 14					75.0	1.639 PL	15.00 PF	3.3
6	26.2	0.0	17.8	0.0	11.4	120 FTG	E PE	0.0
7	26.2	0.0	14.5	0.0		0.171 TL	19.36 PV	
Pipe: 15					53.2	1.408 PL	12.00 PF	2.3
7	26.2	0.0	14.5	0.0	11.0	120 FTG	---- PE	0.0
8	26.2	0.0	12.3	0.0		0.190 TL	12.00 PV	
Pipe: 16					33.1	1.080 PL	14.00 PF	4.0
8	26.2	0.0	12.3	0.0	11.6	120 FTG	---- PE	0.0
9	26.2	0.0	8.3	0.0		0.286 TL	14.00 PV	
Pipe: 17					16.2	1.080 PL	13.00 PF	1.2
9	26.2	0.0	8.3	0.0	5.7	120 FTG	E PE	0.0
10	26.2	0.0	7.1	0.0		0.077 TL	15.30 PV	
Pipe: 18					26.6	1.639 PL	15.00 PF	0.7
C	25.2	0.0	24.2	0.0	4.0	120 FTG	ET PE	-0.4
11	26.2	0.0	23.1	0.0		0.025 TL	28.09 PV	
Pipe: 19					26.6	1.639 PL	20.00 PF	0.5
11	26.2	0.0	23.1	0.0	4.0	120 FTG	---- PE	0.0
12	26.2	0.0	22.6	0.0		0.025 TL	20.00 PV	
Pipe: 20					-22.5	1.080 PL	4.25 PF	1.4
2A	22.0	5.6	16.1	22.5	7.9	120 FTG	T PE	-1.8
2	26.2	0.0	15.7	0.0		0.140 TL	10.01 PV	
Pipe: 21					-20.8	1.080 PL	4.25 PF	1.2
3A	22.0	5.6	13.7	20.8	7.3	120 FTG	T PE	-1.8
3	26.2	0.0	13.1	0.0		0.121 TL	10.01 PV	
Pipe: 22					-18.3	1.080 PL	4.25 PF	1.0
4A	22.0	5.6	10.6	18.3	6.4	120 FTG	T PE	-1.8
4	26.2	0.0	9.8	0.0		0.096 TL	10.01 PV	
Pipe: 23					-17.7	1.080 PL	4.25 PF	0.6
5A	22.0	5.6	9.9	17.7	6.2	120 FTG	E PE	-1.8
5	26.2	0.0	8.7	0.0		0.090 TL	6.55 PV	
Pipe: 24					-21.7	1.080 PL	4.25 PF	1.3
7A	22.0	5.6	15.1	21.7	7.6	120 FTG	T PE	-1.8
7	26.2	0.0	14.5	0.0		0.132 TL	10.01 PV	
Pipe: 25					-20.2	1.080 PL	4.25 PF	1.1
8A	22.0	5.6	13.0	20.2	7.1	120 FTG	T PE	-1.8
8	26.2	0.0	12.3	0.0		0.115 TL	10.01 PV	

DATE: 3/19/2013\DOCUMENTS\CAL POLY 523\PROJECT DATA\MOA PW ALT DESIGN.SDF
JOB TITLE: MOA Public Works Bldg Alt Sprinkler Layout HASS Hyd. Calc

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)	PRESS. SUM. (PSI)
Pipe: 26					-16.8	1.080 PL	5.25 PF	1.1
9A	22.0	5.6	9.0	16.8	5.9	120 FTG	ET PE	-1.8
9	26.2	0.0	8.3	0.0		0.082 TL	13.32 PV	
Pipe: 27					-16.2	1.080 PL	4.25 PF	0.5
10A	22.0	5.6	8.4	16.2	5.7	120 FTG	E PE	-1.8
10	26.2	0.0	7.1	0.0		0.077 TL	6.55 PV	
Pipe: 28					-26.6	1.080 PL	4.25 PF	1.9
12A	22.0	5.6	22.5	26.6	9.3	120 FTG	T PE	-1.8
12	26.2	0.0	22.6	0.0		0.191 TL	10.01 PV	
Pipe: 29					-180.7	4.310 PL	8.00 PF	0.4
TOR	10.0	0.0	43.3	0.0	4.0	120 FTG	EA PE	3.5
BOR	2.0	0.0	47.1	0.0		0.008 TL	49.81 PV	
Pipe: 30					-180.7	4.310 PL	2.42 PF	0.0
BOR	2.0	0.0	47.1	0.0	4.0	120 FTG	---- PE	0.0
BKO	2.0	0.0	47.1	0.0		0.008 TL	2.42 PV	
Pipe: 31					FIXED PRESSURE LOSS DEVICE			
BKI	2.0	0.0	49.3	0.0	2.2 psi, 180.7 gpm			
BKO	2.0	0.0	47.1	0.0				
Pipe: 32					-180.7	4.310 PL	0.83 PF	0.1
BKI	2.0	0.0	49.3	0.0	4.0	120 FTG	E PE	0.2
S1	1.6	0.0	49.6	0.0		0.008 TL	14.77 PV	
Pipe: 33					-180.7	6.357 PL	0.58 PF	0.0
S1	1.6	0.0	49.6	0.0	1.8	120 FTG	---- PE	0.3
UG	1.0	0.0	49.9	0.0		0.001 TL	0.58 PV	
Pipe: 34					-180.7	6.280 PL	50.00 PF	0.1
UG	1.0	0.0	49.9	0.0	1.9	140 FTG	ETG PE	0.4
SOURCE	0.0	SRCE	50.4	(N/A)		0.001 TL	124.00 PV	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.3 computer program under license no. 2708113238 granted by

HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average imbalance at each node of 0.004 gpm and a maximum imbalance at any node of 0.127 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 12.6 ft/sec at pipe 11.

(4) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(5) PIPE FITTINGS TABLE

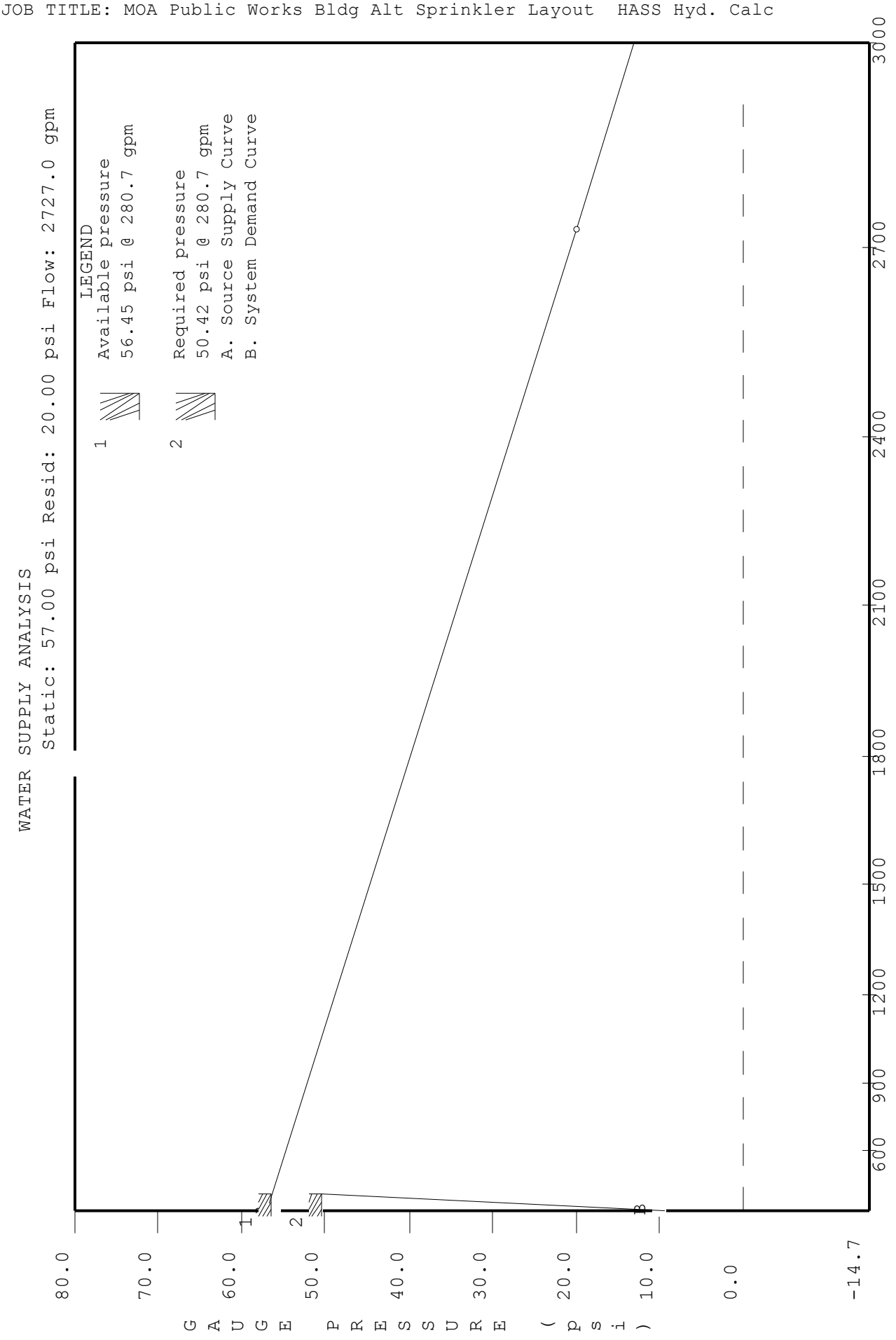
Pipe Table Name: STANDARD.PIP

PAGE: * MATERIAL: S40 HWC: 120

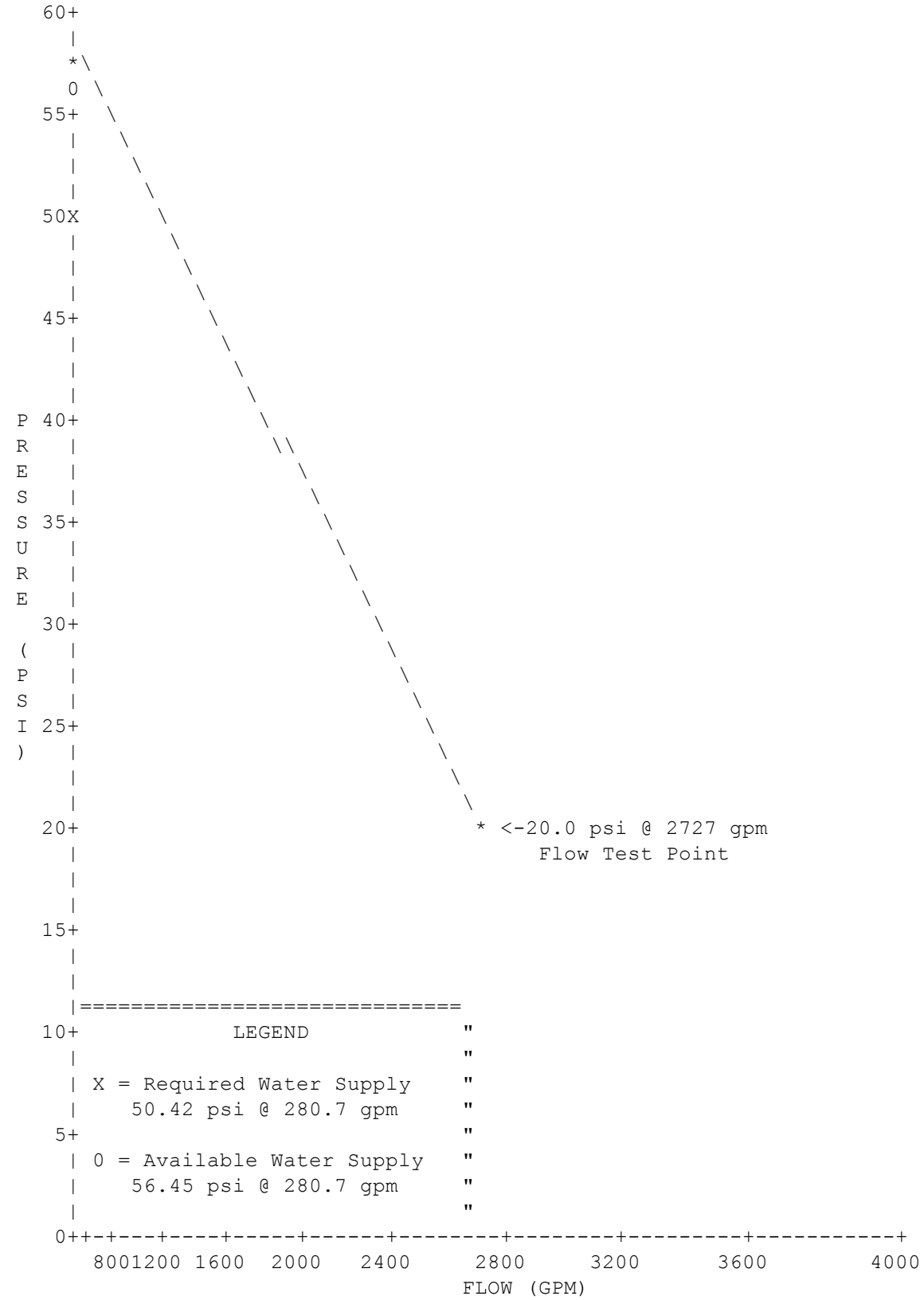
Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NPTee
1.080	2.30	5.76	2.30	5.76	6.91	1.15	11.52	11.52	5.76
1.408	3.31	6.62	2.21	7.72	6.62	1.10	11.03	11.03	6.62
1.639	4.36	8.73	2.18	9.82	6.54	1.09	10.91	10.91	8.73
2.727	9.74	19.47	6.49	22.72	11.36	1.62	16.23	16.23	19.47
4.310	13.94	27.87	8.36	30.66	16.72	2.79	27.87	27.87	27.87
6.357	17.60	37.72	11.32	40.23	12.57	3.77	35.21	35.21	37.72

PAGE: D MATERIAL: DIRON HWC: 140

Diameter (in)	Equivalent Fitting Lengths in Feet						
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	N NPTee
6.280	22.00	47.00	14.00	51.00	16.00	5.00	47.00

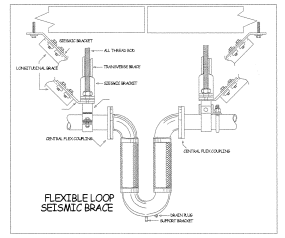

WATER SUPPLY ANALYSIS
Static: 57.00 psi Resid: 20.00 psi Flow: 2727.0 gpm
LEGEND
1 Available pressure
56.45 psi @ 280.7 gpm
2 Required pressure
50.42 psi @ 280.7 gpm
A. Source Supply Curve
B. System Demand Curve
GAUGE PRESSURE (psi)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-14.7
600
900
1200
1500
1800
2100
2400
2700
3000

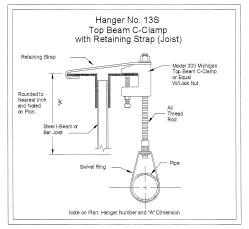
WATER SUPPLY CURVE

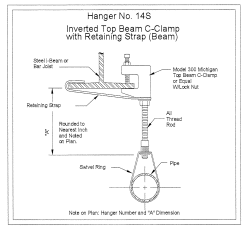


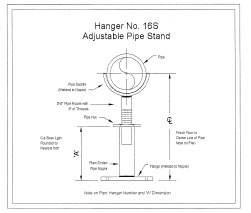
Appendix B - Existing Sprinkler Plans for 2002 Addition (reduced to 11x17)

BUILDING CROSS SECTION
NOT TO SCALE

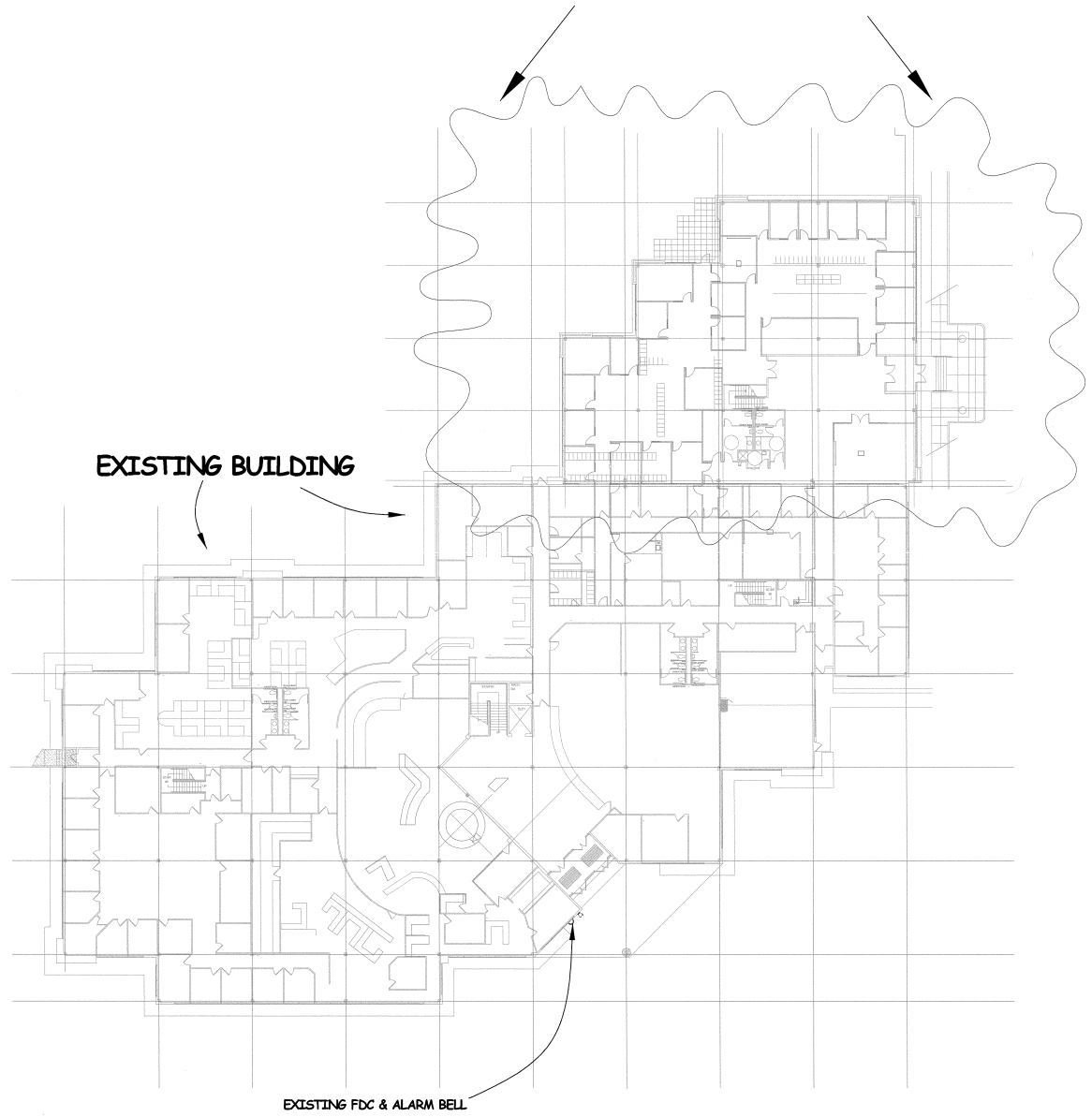


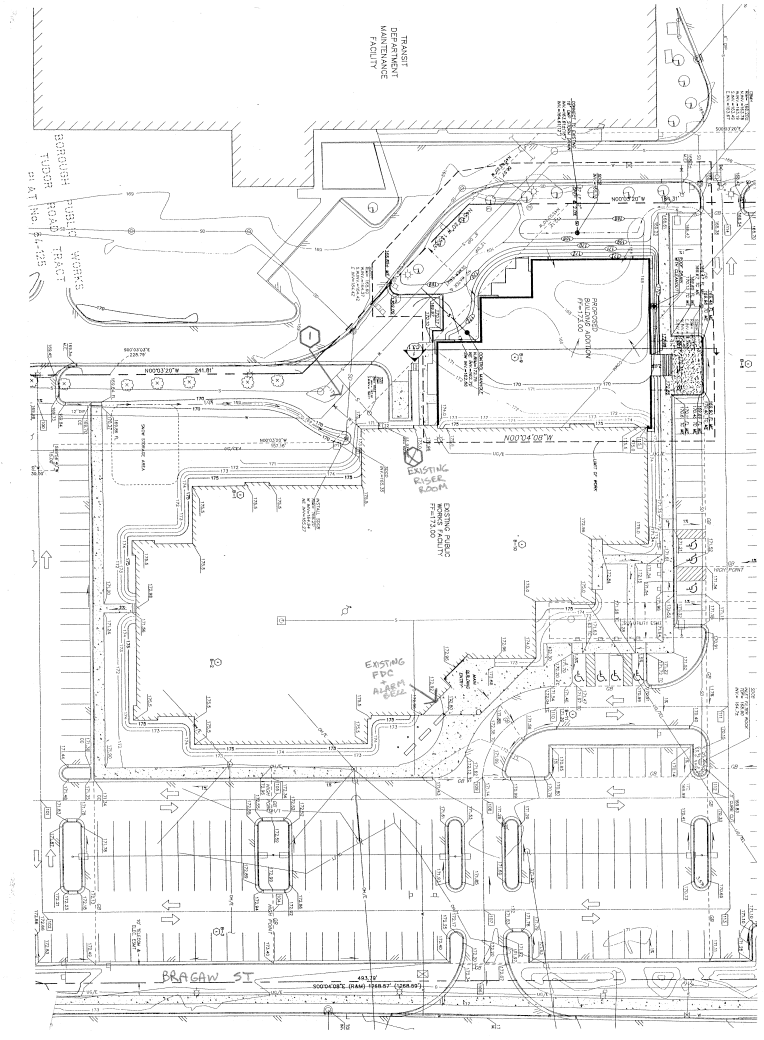






AREA OF WORK FOR THIS PROJECT
NOT TO SCALE





PLOT PLAN OF AREA
NOT TO SCALE

SCOPE OF WORK:

1. INSTALL A WET PIPE FIRE PROTECTION SPRINKLER SYSTEM IN A NEW ADDITION COVERING APROXIMATELY 21,000 SQUARE FEET. BUILDING IS LOCATED AT TUDOR ROAD AND BRAGAW STREET IN ANCHORAGE, ALASKA.

GENERAL NOTES:

1. ALL PIPING AND SYSTEM COMPONENTS ARE TO BE INSTALLED IN ACCORDANCE WITH NFPA-13, 1999 EDITION. SYSTEM COMPONENTS ARE TO BE LISTED FOR THEIR INTENDED APPLICATION AND INSTALLED PER MANUFACTURERS RECOMMENDATIONS.

2. ALL PIPING IS SIZED PER HYDRAULIC CALCULATIONS. OCCUPANCY IS LIGHT HAZARD. SPRINKLER SPACING IS 100 SQ. FT. MAXIMUM.

3. MAIN PIPING 2" AND LARGER IS TO BE BLACK SCHEDULE 10, THIN WALL WITH MECHANICAL FITTINGS AND SHOP WELDED OR FIELD INSTALLED MECHANICAL TEES.

4. BRANCHLINE PIPING 2" AND SMALLER IS TO BE BLACK SUPER 40 WITH THREADED ENDS AND BLACK THREADED FITTINGS.

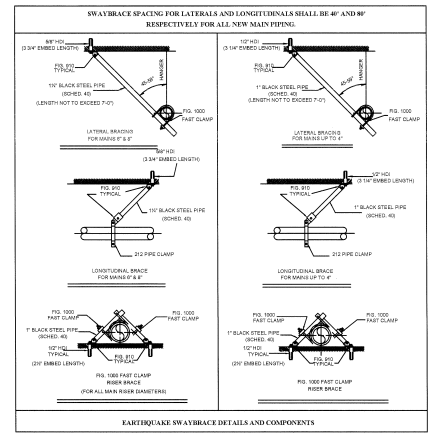
5. ALL PIPE HANGER LOCATIONS INDICATED ON DRAWINGS TO BE FIELD VERIFIED. SYSTEM HANGERS TO BE INSTALLED AS REQUIRED BY NFPA-13, 1999 EDITION.

6. ALL PIPING 2-1/2" AND LARGER TO BE SEISMICALLY BRACED TO THE BUILDING STRUCTURE AS REQUIRED BY CODE.

7. STRUCTURAL LOAD BEARING ANALYSIS OF THE BUILDING OR ITS COMPONENTS IS NOT INCLUDED AS PART OF THIS SYSTEM DESIGN.

8. OWNER TO MAINTAIN A MINIMUM TEMPERATURE OF 40 DEGREES FAHRENHEIT IN ALL AREAS OF THE BUILDING PROTECTED WITH A WET PIPE SPRINKLER SYSTEM.

9. ALL ALARM CONNECTIONS AND LOCAL ALARMS PROVIDED UNDER THIS CONTRACT ARE TO BE WIRED UNDER THE ELECTRICAL/ALARM SCOPE. ALL ALARMS MUST BE MONITORED.



SWAYBRACE LOAD CALCULATIONS

PIPE SIZE	BRACE SIZE	BRACE SPACING LAT	BRACE SPACING LONG	ASSIGNED LOAD (lbs.) MULTIPLYING FACTOR = .8	NFPA #13 TABLE 4-6.4.3.5.3 BRACE TYPE	ATTACHMENT TYPE W MAX. LOAD VALUE (lbs.)
8"	1¼" SCH 40	30'	60'	2196	TYPE "B"	5/8" BOLT = 2857
6"	1" SCH 40	40'	80'	2088	TYPE "B"	5/8" BOLT = 2857
4"	1" SCH 40	40'	80'	1392	TYPE "B"	1/2" BOLT = 1782
3"	1" SCH 40	40'	80'	1044	TYPE "B"	1/2" BOLT = 1782
2½"	1" SCH 40	40'	80'	1266	TYPE "B"	1/2" BOLT = 1782

SWAY BRACING NOTE:
PER NFPA 13 (1999 ed) 6-4.5.3 EXEPTION # 2
LATERAL SWAY BRACING SHALL NOT BE REQUIRED ON PIPES INDIVIDUALY SUPPORTED BY RODS LESS THAN 6" IN LONG MEASURED BETWEEN THE TOP OF THE PIPE AND THE POINT OF ATTACHMENT TO THE BUILDING STRUCTURE.

Revisions	Date	By

HEAD COUNT ON THIS SHEET

Sprinkler Head Description	Finish	Orifice Size	K Factor	Temperature	Symbol	Qty
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	155°	●	
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	200°	●	

Standard Symbols
- Fire Dept. Connection
- Gate Valve
- Flange X Groove Dry Pipe Valve
- Check Valve
- Alarm Valve
- Public Hydrant

Standard Symbols
- O.S.&Y. Gate Valve
- Backflow Preventer

Sprinkler Head Symbols
- SSU On Line 1/2" Outlet
- SSU On Line 3/4" Outlet
- SSU On Sprig 1" Outlet

Sprinkler Head Symbols
- SSP On Line 1/2" Outlet
- SSP On 1" Outlet (401 Canopy)
- SSP On 1" Outlet (Recessed)
- Double Compliment (SSU / SSP)
- Dry Pendent On 1" Outlet
- Attic Sprinkler (Back to Back)
- SideWall On 1/2" Outlet
- Sidewall On 1" Outlet

Reviewed By
NICET III 72987

Pre-List Review By:
PERMIT #
LEGAL DESCRIPTION:

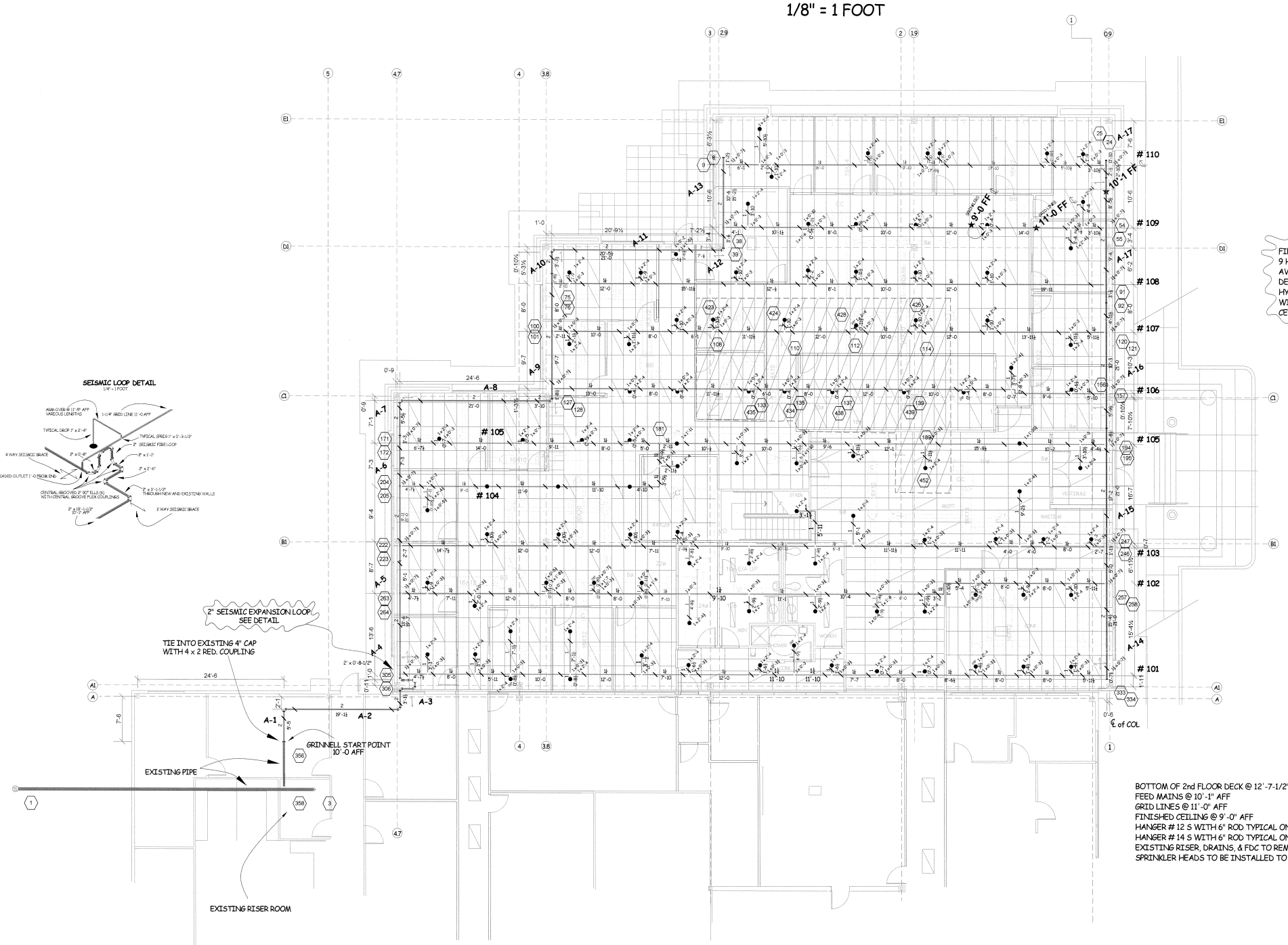
tyco Fire & Security
Phone (907) 561-1911
SimplexGrinnell Fire Protection
5430 FAIRBANKS STREET # 7
Anchorage, Alaska 99518
A tyco INTERNATIONAL LTD. COMPANY
Fax (907) 743-9144

MUNICIPALITY PERMIT CENTER

Plot Date:	08/16/02	SITE PLOT PLAN & DETAIL SHEET	Drawing #P- 1 of 3
DRAWN BY:	HAROLD CAPPS	DEVELOPMENT & PERMIT CENTER	Job No: 050.317755-A1
Scale:	AS NOTED	ANCHORAGE , ALASKA	ANC # 04467

FIRST FLOOR PIPING PLAN

1/8" = 1 FOOT



SEISMIC LOOP DETAIL

1/4" = 1 FOOT

FIRST FLOOR REMOTE AREA:
9 HEADS FLOWING 5.6 K FACTOR SYSTEM
AVAILABLE = 55.48 PSI 2350 GPM
DEMAND = 33.76 PSI @ 237.21 GPM INCLUDING OUTSIDE HOSE 100 GPM
HYDRAULIC CALCULATIONS BASED ON .10/900 SQ. FT LIGHT HAZZARD OCCUPANCY
WITH QUICK RESPONSE HEADS. REMOTE AREA REDUCTION PER NFPA 13 SEC 7-2.3.2.4
CEILING HEIGHT IS LESS THAN 10 FEET

BOTTOM OF 2nd FLOOR DECK @ 12'-7-1/2" AFF
FEED MAINS @ 10'-1" AFF
GRID LINES @ 11'-0" AFF
FINISHED CEILING @ 9'-0" AFF
HANGER # 12 S WITH 6" ROD TYPICAL ON FIRST FLOOR GRID LINES AND ARM-OVERS
HANGER # 14 S WITH 6" ROD TYPICAL ON FIRST FLOOR FEED MAINS
EXISTING RISER, DRAINS, & FDC TO REMAIN IN SERVICE
SPRINKLER HEADS TO BE INSTALLED TO CENTER OF CEILING TILE

Revisions	Date	By

HEAD COUNT ON THIS SHEET

Sprinkler Head Description	Finish	Orifice Size	K Factor	Temperature	Symbol	Qty
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	155°	●	91
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	200°	● SP	8
						99

Standard Symbols

- Fire Dept. Connection
- Gate Valve
- Flange X Groove Dry Pipe Valve
- Check Valve
- Alarm Valve
- Public Hydrant

Standard Symbols

- O.S.&Y. Gate Valve
- Backflow Preventer

Sprinkler Head Symbols

- SSU On Line 1/2" Outlet
- SSU On Line 3/4" Outlet
- SSU On Sprig 1" Outlet

Sprinkler Head Symbols

- ∅ - SSP On Line 1/2" Outlet
- ● - SSP On 1" Outlet (401 Canopy)
- ◉ - SSP On 1" Outlet (Recessed)
- ◐ - Double Compliment (SSU / SSP)
- ○ - Dry Pendent On 1" Outlet
- ⊕ - Attic Sprinkler (Back to Back)
- ▼ - SideWall On 1/2" Outlet
- ▽ - Sidewall On 1" Outlet

Reviewed By

Jeffrey M. Wakefield NICET III 72987

Pre-List Review By:

PERMIT #

LEGAL DESCRIPTION:

tyco Fire & Security

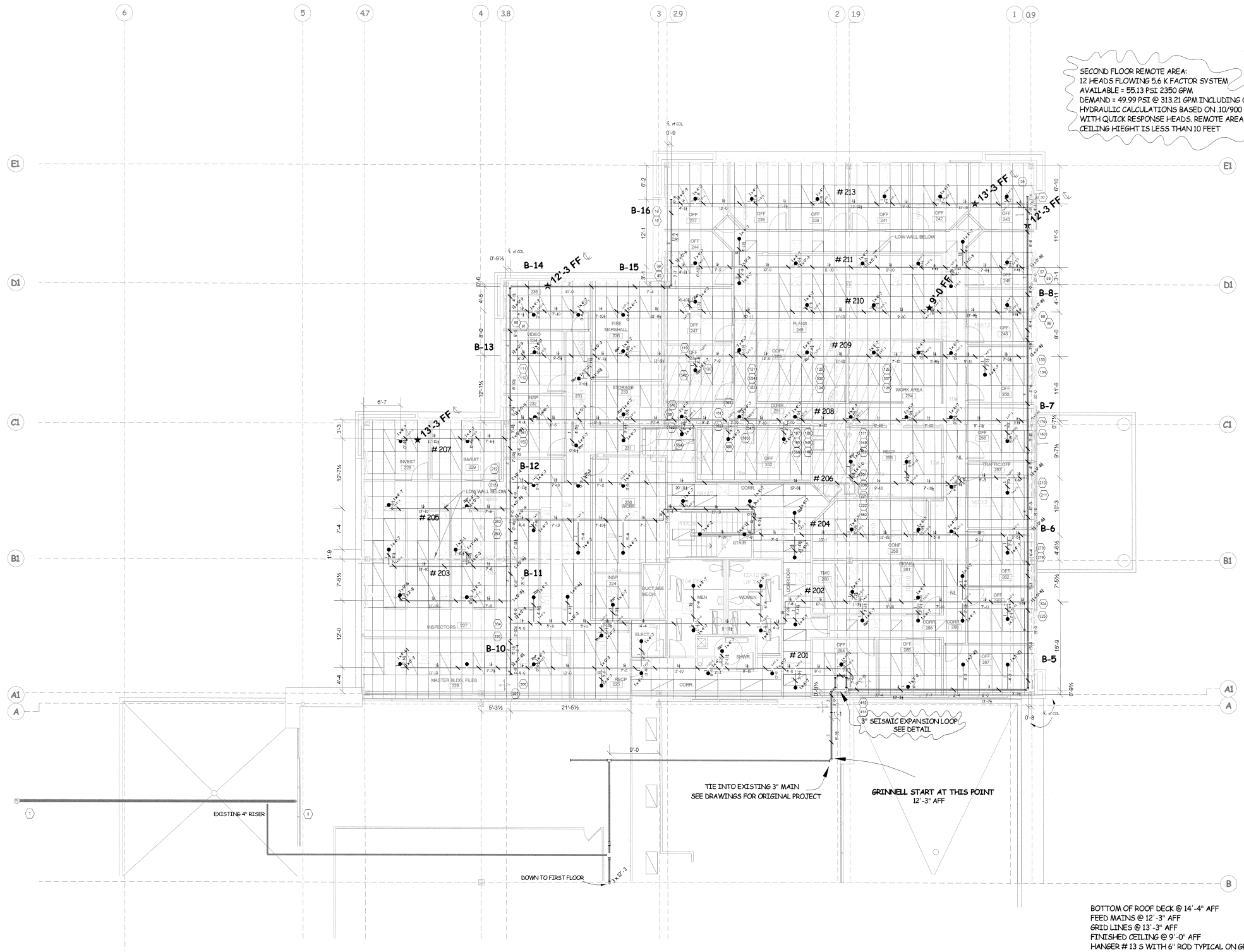
SimplexGrinnell Fire Protection
5430 FAIRBANKS STREET # 7
Anchorage, Alaska 99518
A tyco INTERNATIONAL LTD. COMPANY
Phone (907) 561-1911 Fax (907) 743-9144

MUNICIPALITY PERMIT CENTER

Plot Date:	08/21/02	FIRST FLOOR FIRE SPRINKLER PLAN	Drawing FP- 2 of 3
DRAWN BY:	HAROLD CAPPS	4700 BRAGAW STREET	Job No 050.317755-A1
Scale:	1/8" = 1 FOOT	ANCHORAGE, ALASKA	ANC # 04167

SECOND FLOOR SPRINKLER PIPING PLAN

1/8" = 1 FOOT



BOTTOM OF ROOF DECK @ 14'-4" AFF
FEED MAINS @ 12'-3" AFF
GRID LINES @ 13'-3" AFF
FINISHED CEILING @ 9'-0" AFF
HANGER # 13 S WITH 6" ROD TYPICAL ON GRID LINES AND ARM-OVERS
HANGER # 12 S WITH 6" ROD TYPICAL ON FEED MAINS
HANGER 14 S WITH 6" ROD TYPICAL
EXISTING RISER, DRAINS, & FDC TO REMAIN IN SERVICE

Revisions	Date	By

HEAD COUNT ON THIS SHEET

Sprinkler Head Description	Finish	Orifice Size	K Factor	Temperature	Symbol	Qty
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	155°	●	88
GRINNELL MODEL A QUICK RESPONSE PENDANT	Brass	1/2"	5.6	200°	● SP	17
						105

Standard Symbols

- Fire Dept. Connection
- Gate Valve
- Flange X Groove Dry Pipe Valve
- Check Valve
- Alarm Valve
- Public Hydrant

Standard Symbols

- O.S.&Y. Gate Valve
- Backflow Preventer

Sprinkler Head Symbols

- SSU On Line 1/2" Outlet
- SSU On Line 3/4" Outlet
- SSU On Sprig 1" Outlet

Sprinkler Head Symbols

- ∅ - SSP On Line 1/2" Outlet
- ● - SSP On 1" Outlet (401 Canopy)
- ◉ - SSP On 1" Outlet (Recessed)
- ◐ - Double Compliment (SSU / SSP)
- ○ - Dry Pendent On 1" Outlet
- ⏀ - Attic Sprinkler (Back to Back)
- ▼ - SideWall On 1/2" Outlet
- ⧖ - Sidewall On 1" Outlet

Reviewed By

M. Wiedbrauk NICET III 72987

Pre-List Review By:

PERMIT #

LEGAL DESCRIPTION:

tyco Fire & Security
Phone (907) 561-1911

SimplexGrinnell Fire Protection
5430 FAIRBANKS STREET # 7
Anchorage, Alaska 99518
A tyco INTERNATIONAL LTD. COMPANY
Fax (907) 743-9144

MUNICIPALITY PERMIT CENTER

Plot Date:	08/22/02	SECOND FLOOR FIRE SPRINKLER PLAN	Drawing FP- 3 of 3
DRAWN BY:	HAROLD CAPPS	4700 BRAGAW STREET	Job No. 050.317755-A1
Scale:	1/8" = 1 FOOT	ANCHORAGE , ALASKA	ANC # 0461

Appendix C - Existing Fire Alarm & Security Plans for 1997 Building and 2002 Addition (reduced to 11x17)

MUNICIPALITY OF ANCHORAGE
DEVELOPMENT AND PERMITTING CENTER
FIRE DETECTION AND ALARM
AND CARD ACCESS SYSTEM

ANCHORAGE, ALASKA
TUDOR ROAD AND BRAGAW STREET

DRAWING	TITLE
984-28621-01	TITLE AND INDEX SHEET
984-28621-02	LEGENDS & SCHEDULES
984-28621-03	FIRE ALARM BOARD/DEVICE WIRING
984-28621-04	CARD ACCESS BOARD/DEVICE WIRING
984-28621-05	SYSTEM RISER DIAGRAM
984-28621-06	FS90 PANEL CONFIGURATION
984-28621-07	FS90 MOTHERBOARD 1 TERMINATIONS
984-28621-08	FS90 MOTHERBOARD 2 TERMINATIONS
984-28621-09	FS90 MOTHERBOARD 3 & 4 TERMINATIONS
984-28621-10	FIRST FLOOR FLOORPLAN AND DEVICE LAYOUT
984-28621-11	SECOND FLOOR FLOORPLAN AND DEVICE LAYOUT

Honeywell

HOME & BUILDING CONTROL

ALASKA BRANCH
4500 BUSINESS PARK, BLDG. C
ANCHORAGE, ALASKA 99503
(907)561-5253

CONTRACT NUMBER: 984-28621
SALES PERSON: DOUG KADRICH
INSTALL SUPERVISOR: DOUG KADRICH
FIRE ALARM SYSTEMS DESIGNER: DOUG KADRICH

SYSTEM PROVIDED

FS90 FIRE DETECTION SYSTEMS
STYLE 4 CLASS B SIGNALING LINE CIRCUITS
STYLE Y CLASS B NOTIFICATION APPLIANCE CIRCUITS

ARCHITECT

PORATH ARCHITECTS
4300 "B" STREET, SUITE 604
ANCHORAGE, ALASKA 99503

ENGINEER

RSA ENGINEERING, INC
2522 ARCTIC BLVD., SUITE 200
ANCHORAGE, ALASKA 99503

ELECTRICAL CONTRACTOR

AURORA ELECTRIC / AURORA DATATEL
1118 EAST 70TH AVENUE
ANCHORAGE, AK 99518

APPLICATION DESIGN CERTIFICATIONS

DOUGLAS A. KADRICH
STATE PERMIT FIRE ALARM SYSTEMS ENGINEERING PERMIT: 98-068
NICET FIRE ALARM SYSTEMS LV IV - 091830

HONEYWELL

REVISIONS	DATE	APPD.
C		
B		
A		

TITLE AND INDEX SHEET

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

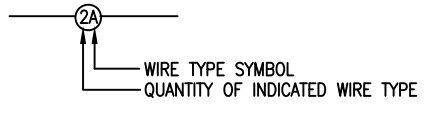
SUPERSEDES	DRAWN BY: DAK	DATE 4/26/99	DRAWING NUMBER 984-28621-01	REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 1 OF 8		

FIRE ALARM SYSTEM LEGEND		
SYMBOL	DESCRIPTION	PART#
(2)	IONIZATION SMOKE SENSOR	TC807A1036 W/ 14506414–001 BASE
—(2)	IONIZATION DUCT SMOKE SENSOR	TC807A1036 W/ 14506873–001 HOUSING
(4)	THERMAL SENSOR	TC808A1027 W/ 14506414–001 BASE
(4) 200°	THERMAL SENSOR 200°F	T4057B1013
•	MANUAL PULL STATION	S464A1144
MM	ADDRESSABLE MONITOR MODULE	TC809A1059
CM	ADDRESSABLE CONTROL MODULE	TC810A1057
FS	SPRINKLER FLOW SWITCH	BY OTHERS
TS	SPRINKLER TAMPER SWITCH	BY OTHERS
M	MAGNETIC 120VAC DOOR HOLDER	S4003A1037
	HORN/STROBE 15/75 CD	XLS–757–7A–HS
M	MINI–HORN/STROBE 15/75 CD	XLS–692–7A–003
CR	CARD ACCESS CARD READER	TC818A1025
EP	CARD ACCESS EXIT PIR	RTE1000
DC	CARD ACCESS DOOR STATUS CONTACT	1076W
DS	24VDC DOOR STRIKE	BY OTHERS
GB	GLASSBREAK DETECTOR W/TRIM PLATE	5810EZ–W & 5811EZ–W
FCP	FIRE ALARM CONTROL PANEL	FS90

WIRE & CABLE LEGEND				
SYMBOL	AWG (SOLID)	NO. OF CONDUCTORS	TWISTED	CIRCUIT TYPE
A	14	2	YES	INITIATING (SLC)
B	12	2	NO	INDICATING (NAC)
C	12	3	NO	120VAC POWER
D	22	4 PAIR	YES	COMMUNICATIONS
E	18	5	YES	CARD READER – BELDEN #8465
F	16	2	YES	SEC PWR – HNWL 3712 (OR EQUAL)
G	18	2	YES	SECURITY – HNWL 3712 (OR EQUAL)

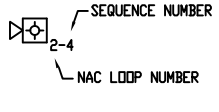
LOW VOLTAGE WIRING

LINE VOLTAGE WIRING



WIRING NOTES:

1. ALL WIRING MUST CONFORM TO NEC ARTICLES 725 AND 760, AND TO NFPA–72, "LOCAL PROTECTIVE SIGNALING SYSTEMS".
2. ALL NOTIFICATION APPLIANCE CIRCUITS ARE CLASS B WITH A 1.91K EOLR.
3. HORN/STROBE LOOP AND SEQUENCE DESIGNATED BY #–#.



HONEYWELL INC. SCOPE OF WORK

TO FURNISH A HONEYWELL INC. FS90 PLUS ADDRESSABLE FIRE ALARM SYSTEM FOR PER NFPA 70, 72 & 101, ADAAG, LOCAL CODES, AND AS DESCRIBED BELOW:

INCLUSIONS:

1. PROVIDE SHOP DRAWINGS AND SUBMITTALS.
2. PROVIDE NEW FIRE ALARM DEVICES AND PANELS AS SHOWN ON SHOP DRAWINGS.
3. PROVIDE SYSTEM START–UP, CHECK–OUT AND DEMONSTRATION TO THE A.H.J. AND OWNER.
4. PROVIDE TRAINING TO PERSONNEL DESIGNATED BY THE OWNER.
5. SUPERVISE THE INSTALLING CONTRACTOR.
6. GUARANTEE THE SYSTEM FOR A PERIOD OF ONE YEAR.
7. PROVIDE AS–INSTALLED DRAWINGS AT COMPLETION OF PROJECT.
8. PROVIDE CENTRAL SYSTEM GRAPHICS.
9. PROVIDE PROVIDE CENTRAL SYSTEM PROGRAMMING.
10. PROVIDE PROVIDE PANEL PROGRAMMING.
11. PROVIDE NFPA RECORD OF COMPLETION.

EXCLUSIONS:

1. INSTALLATION MATERIAL.
2. TERMINATION OF DEVICES AND PANELS.

INSTALLING CONTRACTOR SCOPE OF WORK

TO INSTALL A HONEYWELL INC. FS90 PLUS ADDRESSABLE FIRE ALARM SYSTEM PER NFPA 70, 72 & 101, ADAAG, LOCAL CODES, AND AS DESCRIBED

1. INSTALL FIRE ALARM SYSTEM AS SHOWN ON THESE DRAWINGS AND PER PLANS AND SPECS.
2. PROVIDE INSTALLATION LABOR, CONDUIT, FITTINGS, WIRE, CABLE, BACK BOXES, ETC.
3. OBTAIN ALL NECESSARY PERMITS.
4. ASSIST DURING SYSTEM START–UP, CHECK–OUT AND DEMONSTRATION TO THE A.H.J. AND OWNER.
5. INSTALL SYSTEM IN A NEAT AND WORKMAN LIKE MANNER.
6. MAINTAIN A SET OF AS–BUILT FIRE ALARM DRAWINGS. TURNOVER TO HONEYWELL AT THE COMPLETION OF THE PROJECT.
7. GUARANTEE THE INSTALLATION FOR A PERIOD OF YEAR.

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

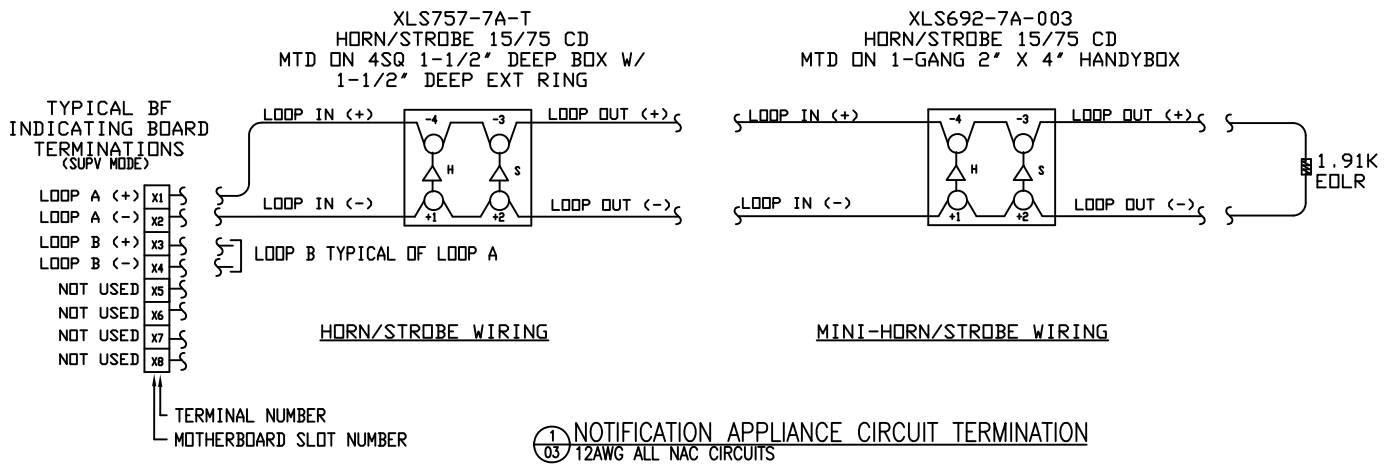
HONEYWELL

REVISIONS		DATE	APPD.
C			
B			
A	SECURITY SYSTEM ADD	8/17/99	DAK

LEGENDS & SCHEDULES

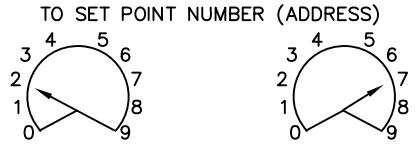
DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99	DRAWING NUMBER 984-28621-02 REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 2 OF 11	



1/03 NOTIFICATION APPLIANCE CIRCUIT TERMINATION
12AWG ALL NAC CIRCUITS

USE TWO DECADE SWITCHES ON DEVICES
TO SET POINT NUMBER (ADDRESS)



NOTES:

1. DO NOT SET MORE THAN ONE MODULE OR ONE SENSOR WITH THE SAME ADDRESS ON THE SAME LOOP.
2. A SENSOR AND MODULE CAN HAVE THE SAME ADDRESS ON THE SAME LOOP.
3. THE ABOVE EXAMPLE SHOWS SENSOR POINT 027 AND MODULE POINT 127
4. MONITOR & CONTROL MODULE POINT ADDRESSES RANGE FROM 101 THRU 199
5. SENSOR POINT ADDRESSES RANGE FROM 001 THRU 099.

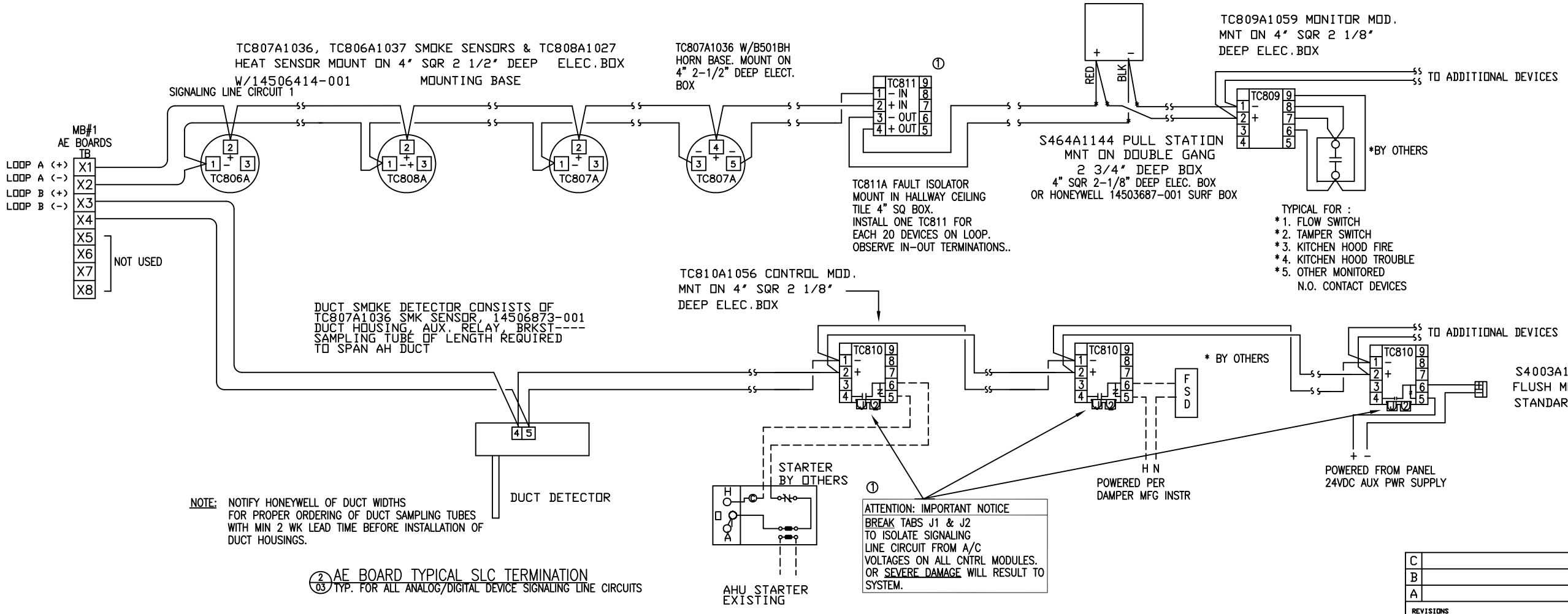
TYPICAL INTELLIGENT MODULE ADDRESS AS SHOWN ON DRAWING AND ADDRESS SCHEDULES: 1 (INDICATES AE SLC LOOP NUMBER WITHIN RESPECTIVE FS90 CONTROLLER); 127 (ADDRESS; '1' INDICATES MODULE ADDRESS; '0' INDICATES SENSOR ADDRESS)

SENSOR/MODULE POINT SETTING

SEE FLOOR PLAN FOR DEVICE COUNT, ADDRESS, AND LOCATIONS.
DEVICES MAY OCCUR ON LOOP IN ANY ORDER, BUT ADDRESS SETTING MUST BE THE SAME AS SHOWN ON FLOOR PLANS.

CAUTION!!!

① BREAK TABS J1 & J2 ON CONTROL MODULES USED AS FORM C RELAYS.



2/03 AE BOARD TYPICAL SLC TERMINATION
TYP. FOR ALL ANALOG/DIGITAL DEVICE SIGNALING LINE CIRCUITS

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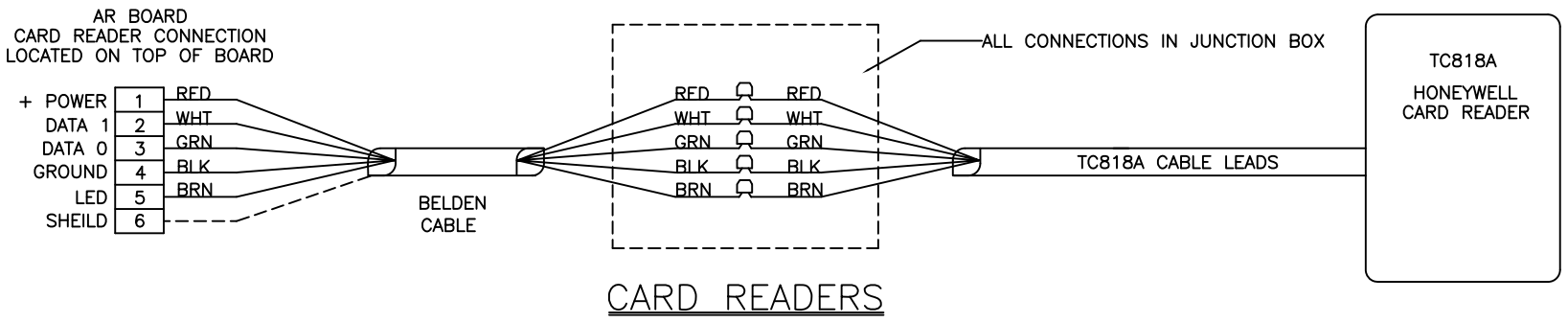
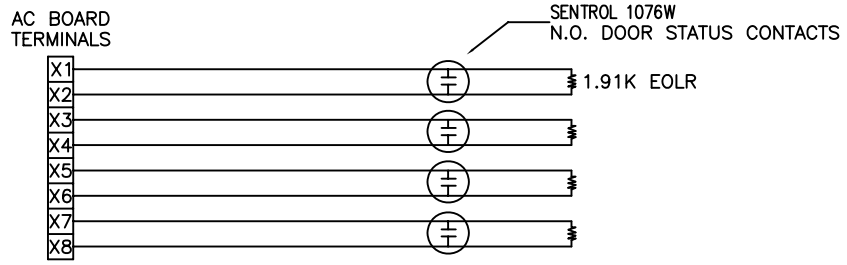
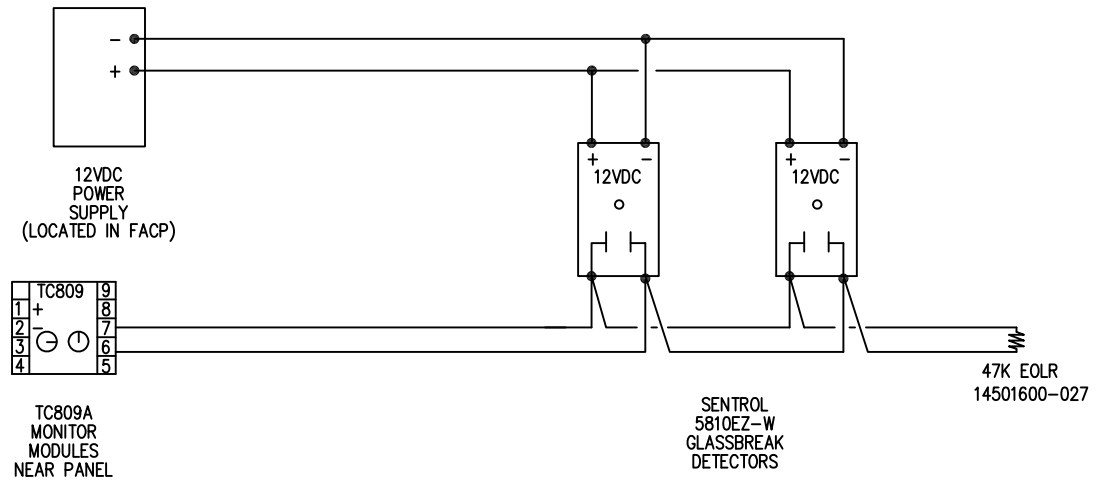
C				FIRE ALARM BOARD/DEVICE WIRING
B				DEVELOPEMENT AND PERMITTING CENTER
A				TUDOR ROAD AND BRAGAW STREET
REVISIONS		DATE	APPD.	ANCHORAGE, ALASKA
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-03 REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 3 OF 11		



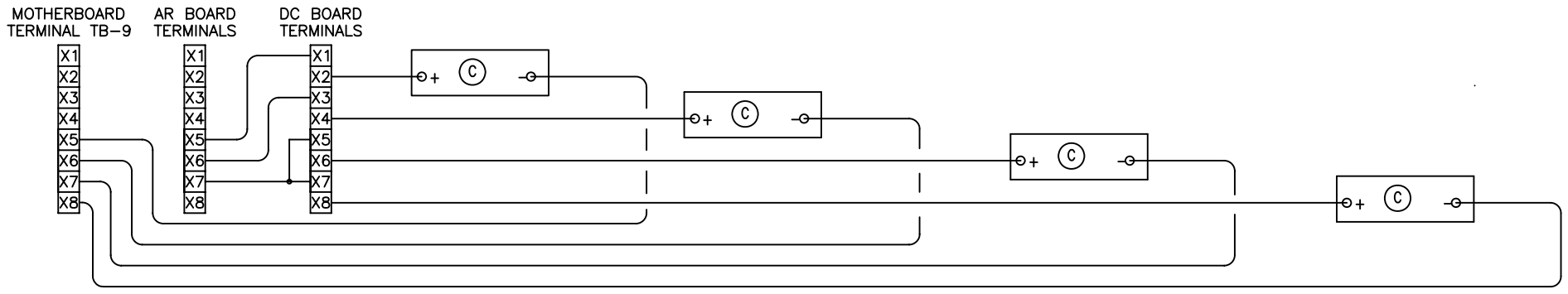
CARD READERS



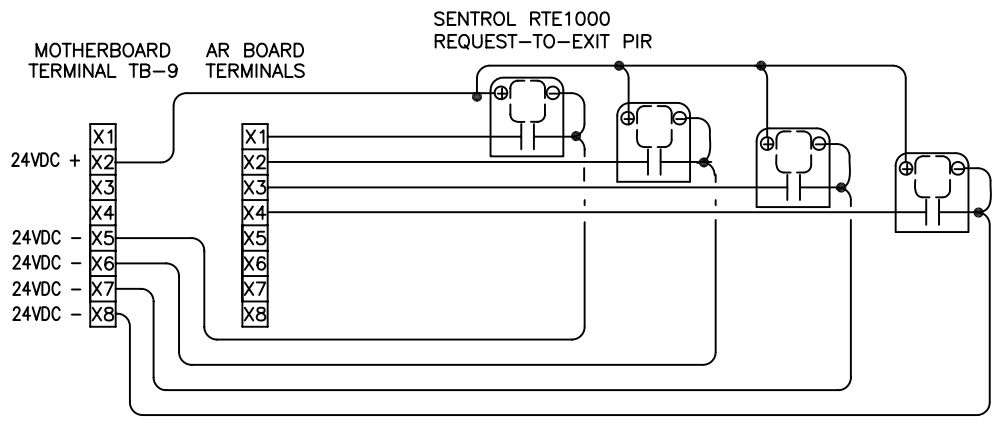
DOOR CONTACTS



GLASSBREAK SENSORS



DOOR STRIKES*



REQUEST TO EXIT PASSIVE INFARED DETECTORS

* PROVIDED BY OTHERS

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Patent #4885694

REVISIONS		DATE	APPD.
C			
B			
A	SECURITY SYSTEM ADD	8/21/99	DAK

CARD ACCESS BOARD/DEVICE WIRING

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99	DRAWING NUMBER 984-28621-04	REV.
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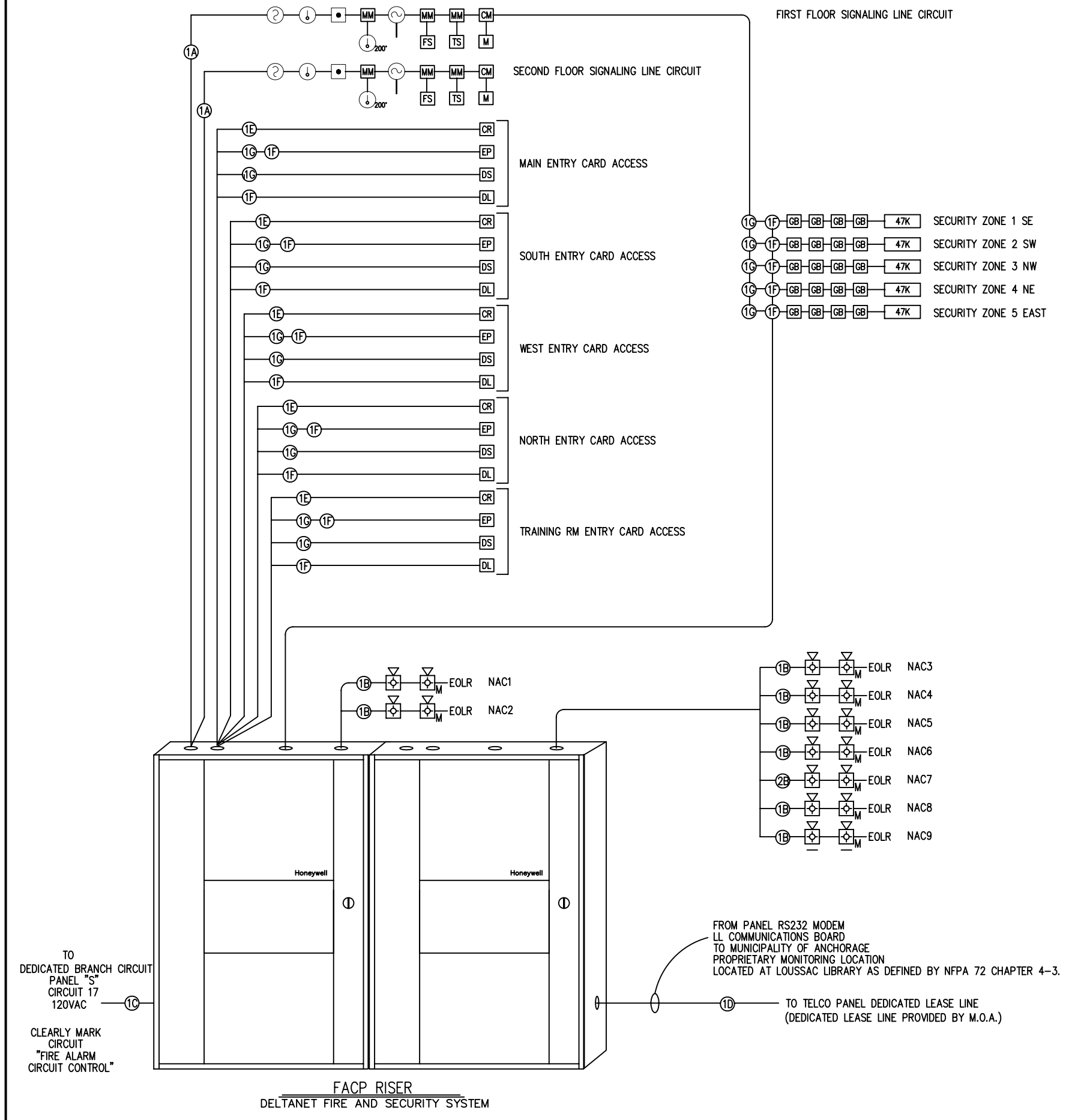
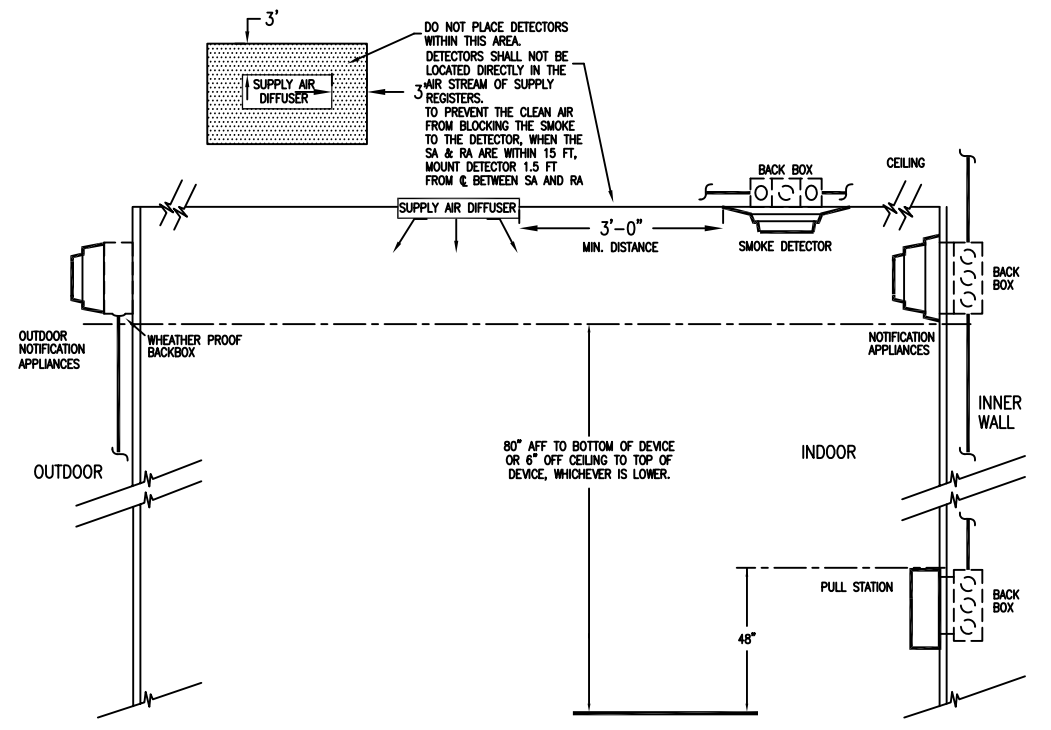


FACP RISER
DELTANET FIRE AND SECURITY SYSTEM

PROPRIETARY SUPERVISING STATION SYSTEM

THE FIRE ALARM AND REPORTING SYSTEM IDENTIFIED BY THESE DRAWINGS IS A PROPRIETARY SUPERVISING STATION SYSTEM AS DEFINED UNDER NFPA 72 CHAPTER 4-3 "PROPRIETARY SUPERVISING STATION SYSTEMS". THE SYSTEM REPORTS CONTINUOUSLY TO THE OWNER'S CENTRAL MONITORING STATION, LOCATED AT THE MUNICIPALITY OF ANCHORAGE LOUSSAC LIBRARY FACILITY. THE COMMUNICATIONS FROM PANEL IS VIA THE LL COMMUNICATIONS BOARD VIA RS232 COMMUNICATIONS SIGNAL TRANSMITTED OVER TELEPHONE LEASE LINE PROVIED BY THE LOCAL TELEPHONE COMPANY. THE FS90 PLUS FIRE ALARM PANEL IS THE TRANSMITTING DEVICE THRU THE USE OF THE STANDARD LL RS232 COMMUNICATIONS BOARD AS REFERENCED ON DRAWINGS 984-28621 PAGES 05, 06, AND 07.



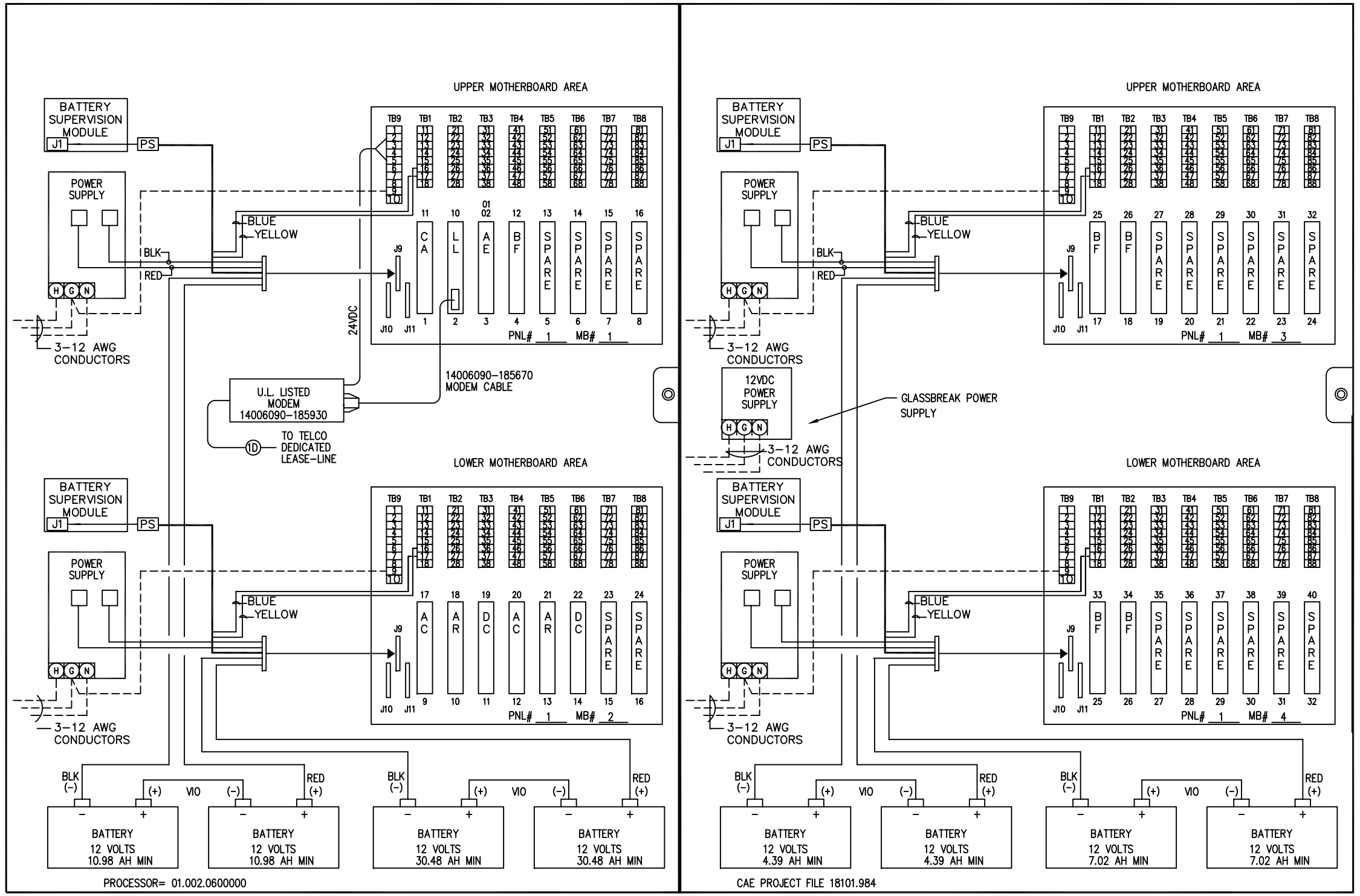
1/04 FIRE ALARM DEVICE ELEVATIONS

GENERAL NOTES:

A. DO NOT APPLY POWER TO ANY DEVICE UNTIL AUTHORIZED BY A HONEYWELL REPRESENTATIVE.
B. SEE FLOOR PLANS FOR ALL DEVICE LOCATIONS, DEVICE COUNTS, AND DEVICE ADDRESSES.
C. FOLLOW DEVICE INSTALLATION INSTRUCTIONS INCLUDED WITH DEVICES.

HONEYWELL

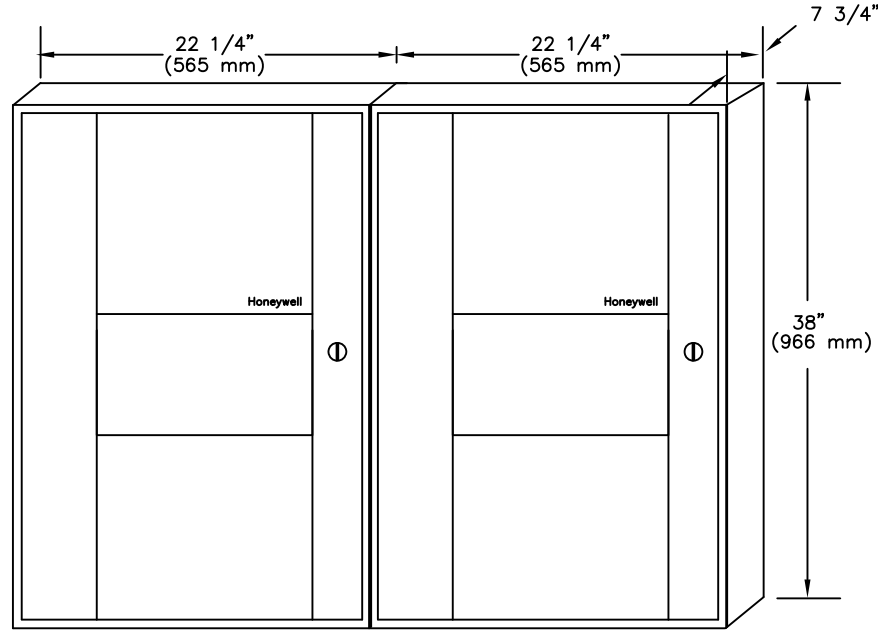
C				FIRE ALARM SYSTEM RISER DIAGRAM
B	SECURITY ADD	8/17/99	DAK	DEVELOPMENT AND PERMITTING CENTER
A	FIRE DEPARTMENT COMMENTS	6/4/99	DAK	TUDOR ROAD AND BRAGAW STREET
REVISIONS		DATE	APPD.	ANCHORAGE, ALASKA
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-05 REV.
SUPERSEDED BY	APPROVED BY:	SHEET 5 OF 11		



DEVELOPMENT AND PERMITTING CENTER FS90 PLUS – INTERIOR DETAIL

PANEL MATERIAL

QTY	PART NUMBER	DESCRIPTION
2	14505151-005	FS90 ENCLOSURE
2	14505152-002	FS90 DOOR
4	14505102-004	FS90 MOTHERBOARD
4	14505145-002	POWER SUPPLY CABLE
4	14505148-001	POWER SUPLY
4	14505146-001	CARD RETAINER
8	14501847-001	FUSE HOLDER
1	14505104-005	CA CONTROL BOARD
1	14505132-002	AE INTELEGENT LOOP INTERFACE BOARD
5	14505110-003	BF NOTIFICATION APPLIANCE CIRCUIT BOARD
2	14506930-002	AR CARD READER BOARD
2	14505112-002	DC RELAY BOARD
2	14505106-001	AC INITIATOR BOARD
2	14505188-001	AF SECURITY BOARD
1	14006690-001	LL COMMUNICATIONS BOARD
4	14506408-002	BATTERY SUPERVISION MODULE
8	12V16A	BATTERIES
2	14502412-014	LIGHTNING SUPPRESSORS
1	14006090-185670	MODEM CABLE
1	14006090-185930	2400 BAUD UL MODEM
2	14505154-001	INSIDE RIBBON CONNECTOR
1	14505154-002	OUTSIDE RIBBON CONNECTOR
1	12VDC	POWER SUPPLY



FACP EXTERIOR DETAIL
DELTANET FIRE AND SECURITY SYSTEM
LOCATED IN ENTRY

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REVISIONS		DATE	APPD.
C			
B			
A	FIRE DEPT COMMENTS	6/4/99	DAK

FS90 PANEL CONFIGURATION
DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99	DRAWING NUMBER 984-28621-06	REV.
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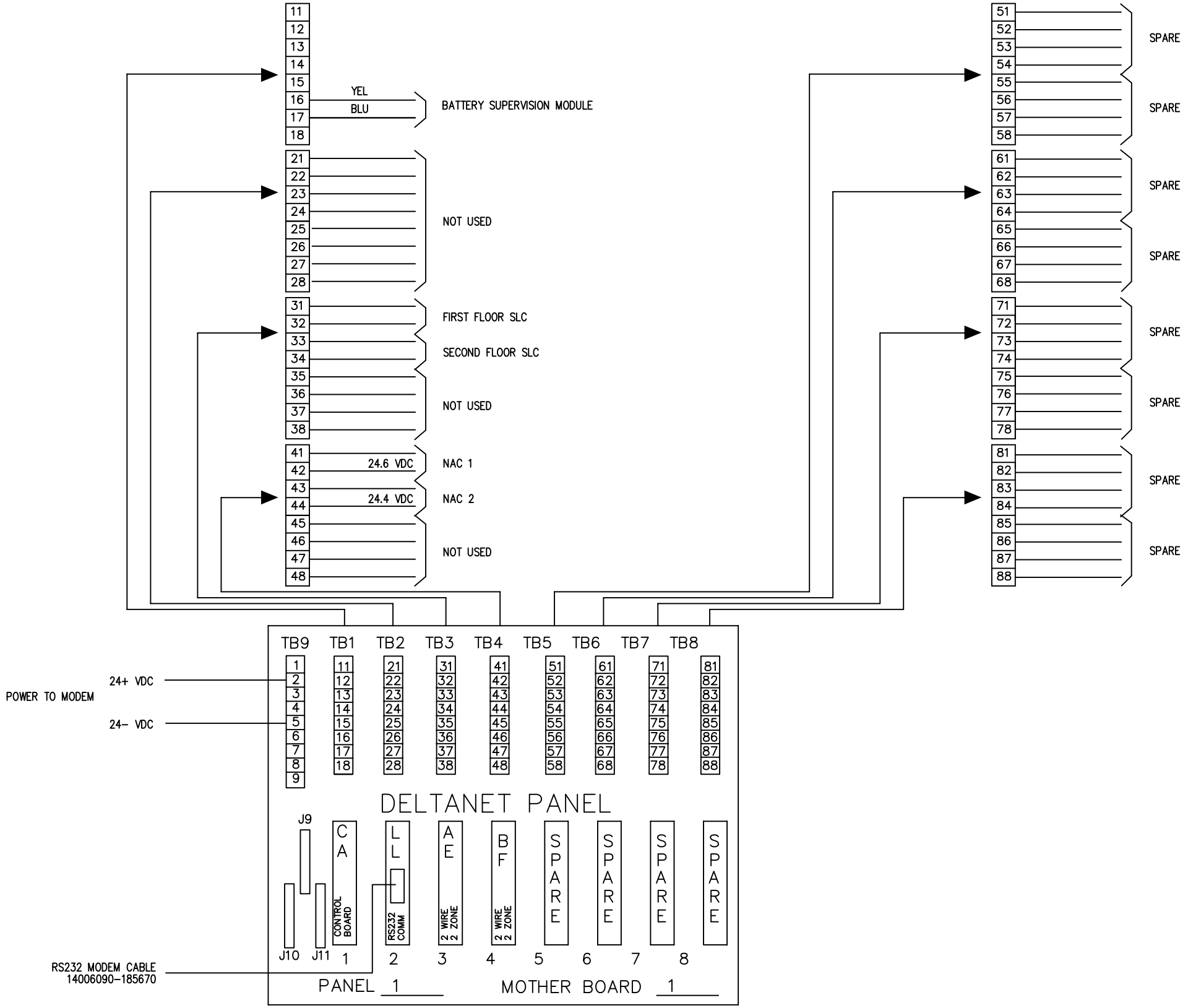

FACP MOTHERBOARD TERMINATIONS

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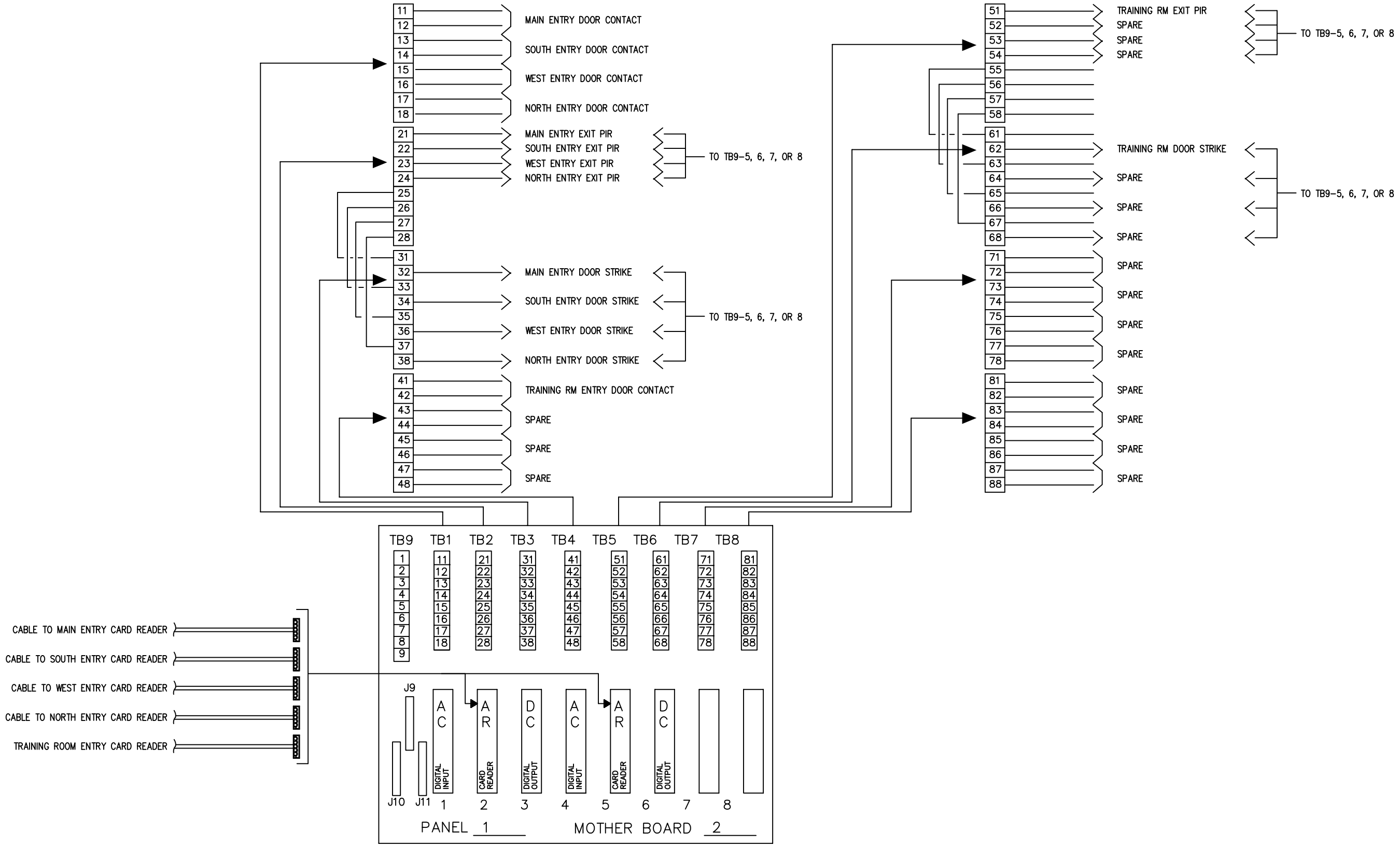
C				FS90 MOTHERBOARD 1 TERMINATIONS
B				DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
A				
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-07 REV.
SUPERSEDED BY	APPROVED BY:	SHEET 7 OF 11		



FACP MOTHERBOARD TERMINATIONS

HONEYWELL

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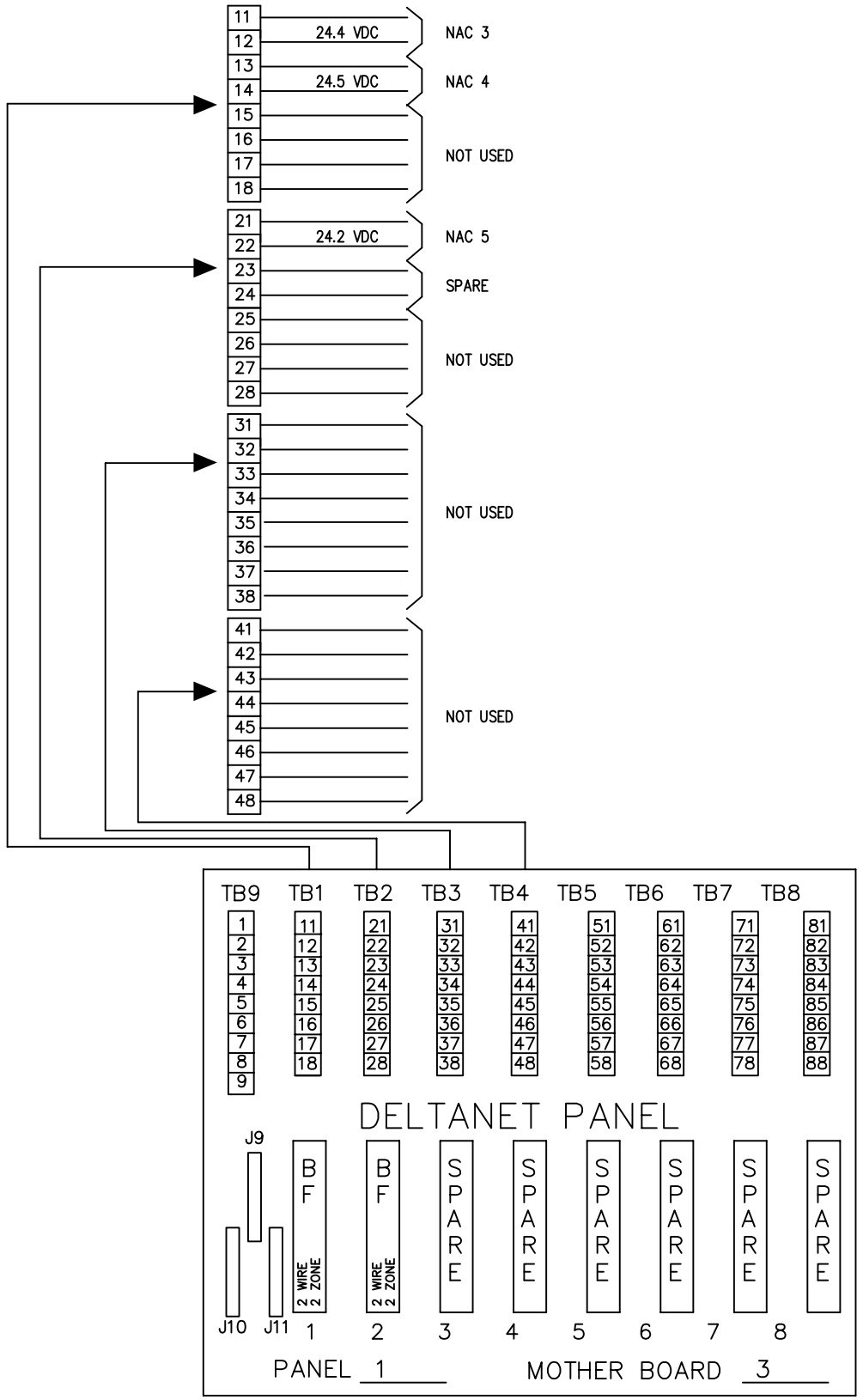
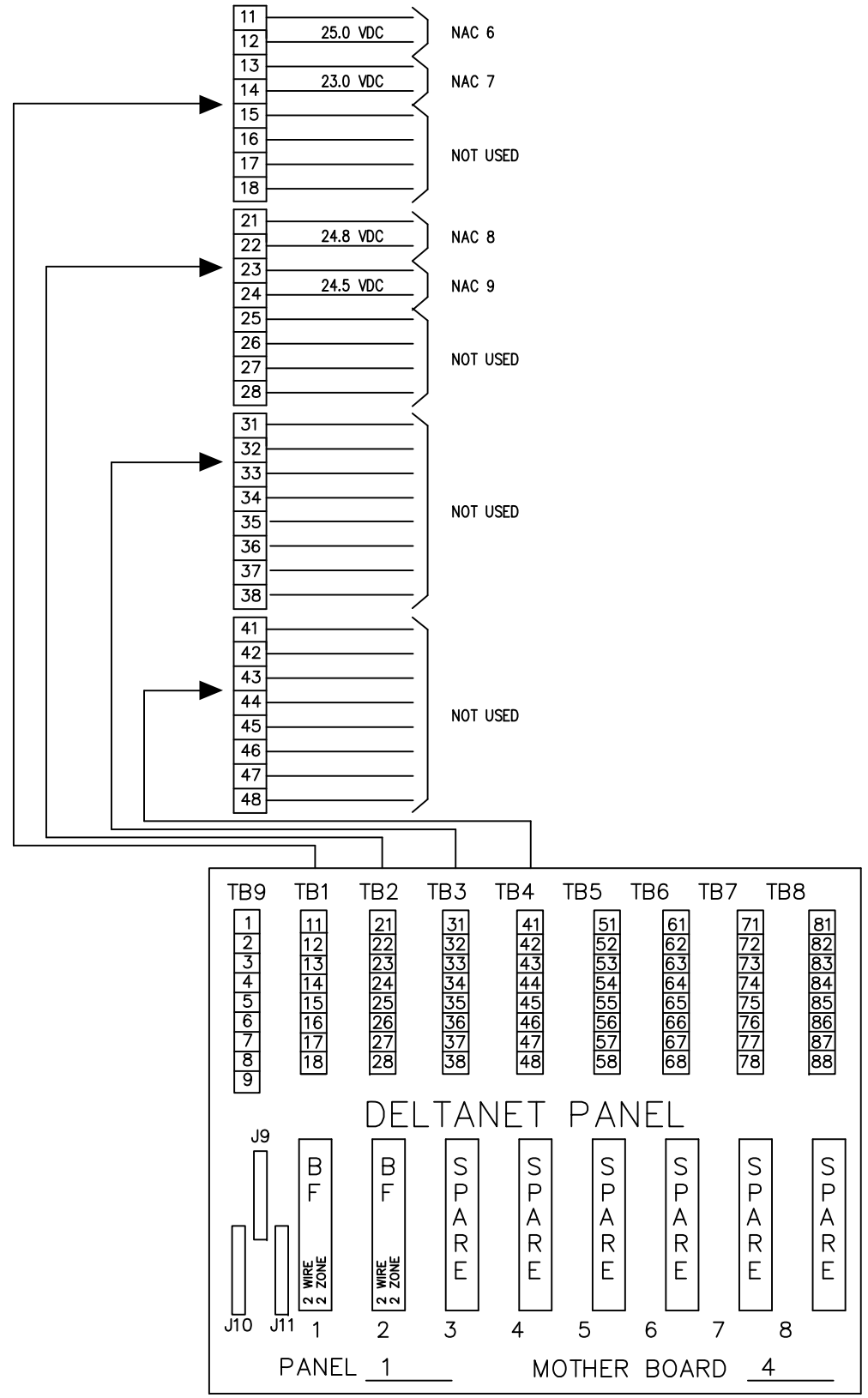
C				FS90 MOTHERBOARD 2 TERMINATIONS
B				
A	SECURITY SYSTEM ADD	8/21/99	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-08 REV.
SUPERSEDED BY	APPROVED BY:	SHEET 8 OF 11		



FACP MOTHERBOARD 3 TERMINATIONS



FACP MOTHERBOARD 4 TERMINATIONS

HONEYWELL

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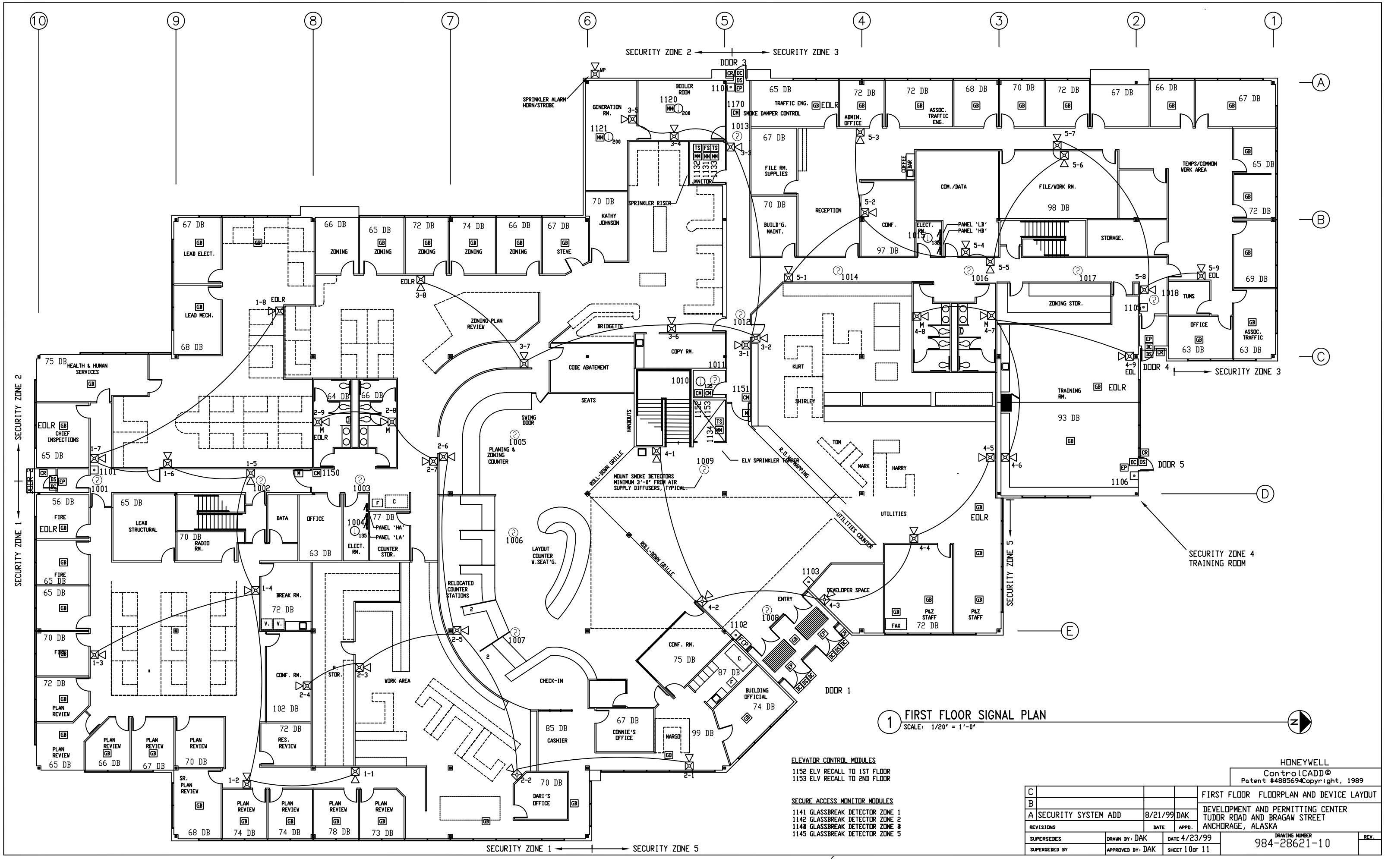
C				FS90 MOTHERBOARD 3 & 4 TERMINATIONS
B				
A	SECURITY SYSTEM ADD	8/21/99	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-09 REV.
SUPERSEDED BY	APPROVED BY:	SHEET 9 OF 11		



1 FIRST FLOOR SIGNAL PLAN
SCALE: 1/20" = 1'-0"

ELEVATOR CONTROL MODULES

1152 ELV RECALL TO 1ST FLOOR
1153 ELV RECALL TO 2ND FLOOR

SECURE ACCESS MONITOR MODULES

1141 GLASSBREAK DETECTOR ZONE 1
1142 GLASSBREAK DETECTOR ZONE 2
1143 GLASSBREAK DETECTOR ZONE 3
1145 GLASSBREAK DETECTOR ZONE 5

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C				FIRST FLOOR FLOORPLAN AND DEVICE LAYOUT
B				
A	SECURITY SYSTEM ADD	8/21/99	DAK	DEVELOPMENT AND PERMITTING CENTER
REVISIONS		DATE	APPD.	TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-10 REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 10 OF 11		

SECURITY ZONE 2 ◄ ► SECURITY ZONE 3

SECURITY ZONE 1 ◄ ► SECURITY ZONE 5

SECURITY ZONE 5 ◄ ► SECURITY ZONE 1

SECURITY ZONE 4 TRAINING ROOM

EXTEND SECURITY ZONE 3

DOOR 1 · DOOR 3 · DOOR 4 · DOOR 5 · DOOR 6

SPRINKLER ALARM HORN/STROBE

SPRINKLER RISER

SMOKE DAMPER CONTROL

MOUNT SMOKE DETECTORS MINIMUM 3'-0" FROM AIR SUPPLY DIFFUSERS, TYPICAL.

ELV SPRINKLER TAMPER

R.I.D. WATER FLOW

NEW CARD READER & MANUAL STAT

RELOCATED READER & MANUAL STATION

NEW NAC LOOP 10

RELOCATED COUNTER STATIONS

= REMOVE AND RELOCATE AT NEW LOCATION

1 FIRST FLOOR SIGNAL PLAN
NOT TO SCALE

ELEVATOR CONTROL MODULES

1152 ELV RECALL TO 1ST FLOOR
1153 ELV RECALL TO 2ND FLOOR

SECURE ACCESS MONITOR MODULES

1141 GLASSBREAK DETECTOR ZONE 1
1142 GLASSBREAK DETECTOR ZONE 2
1148 GLASSBREAK DETECTOR ZONE 8
1145 GLASSBREAK DETECTOR ZONE 5

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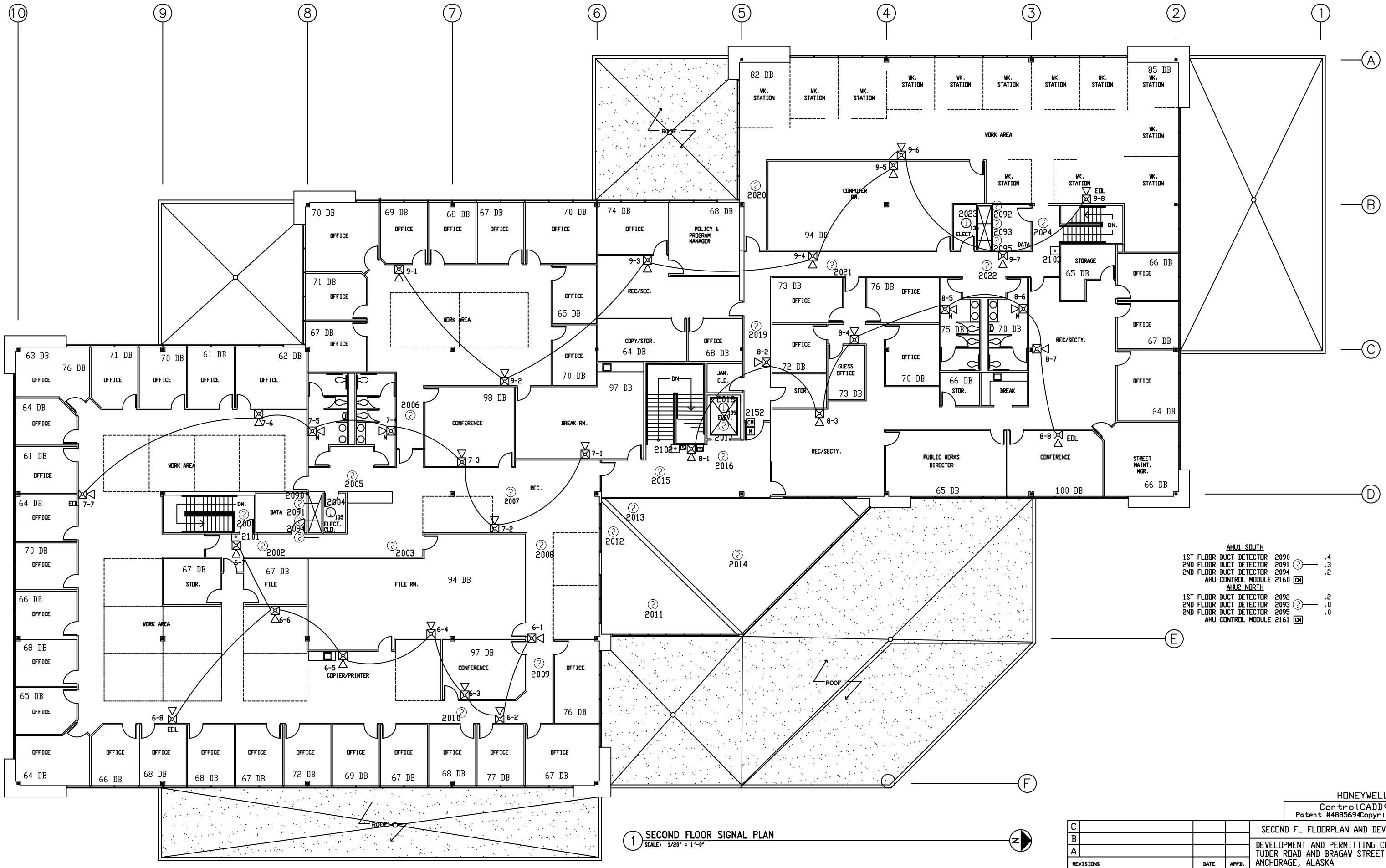
C				FIRST FLOOR FLOORPLAN AND DEVICE LAYOUT
B				
A	SECURITY SYSTEM ADD	8/21/99	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-10 REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 10 OF 11		



1 SECOND FLOOR SIGNAL PLAN
SCALE: 1/20" = 1'-0"

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C				SECOND FL FLOORPLAN AND DEVICE LAYOUT
B				DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
A				
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 4/23/99		DRAWING NUMBER 984-28621-11 REV.
SUPERSEDED BY	APPROVED BY: DAK	SHEET 11 OF 11		

MUNICIPALITY OF ANCHORAGE
DEVELOPMENT AND PERMITTING CENTER
FIRE DETECTION AND ALARM
AND CARD ACCESS SYSTEM
MODIFICATIONS AND ADDITIONS
ANCHORAGE, ALASKA
TUDOR ROAD AND BRAGAW STREET

DRAWING	TITLE
984-22608-01	TITLE AND INDEX SHEET
984-22608-02	LEGENDS & SCHEDULES
984-22608-03	FIRE ALARM BOARD/DEVICE WIRING
984-22608-04	CARD ACCESS BOARD/DEVICE WIRING
984-22608-05	SYSTEM RISER DIAGRAM
984-22608-06	FS90 PANEL CONFIGURATION
984-22608-07	FS90 MOTHERBOARD 1 TERMINATIONS
984-22608-08	FS90 MOTHERBOARD 2 TERMINATIONS
984-22608-09	FS90 MOTHERBOARD 3 & 4 TERMINATIONS
984-22608-10	FIRST FLOOR REMODEL AREA DEVICE LAYOUT
984-22608-11	SECOND FLOOR REMODEL AREA DEVICE LAYOUT
984-22608-12	FIRST FLOOR ADDITION DEVICE LAYOUT
984-22608-13	SECOND FLOOR ADDITION DEVICE LAYOUT

Honeywell

HOME & BUILDING CONTROL

ALASKA BRANCH
4500 BUSINESS PARK, BLDG. C
ANCHORAGE, ALASKA 99503
(907)561-5253

CONTRACT NUMBER: 984-22608
SALES PERSON: DOUG KADRICH
INSTALL SUPERVISOR: BRUCE GRAY
FIRE ALARM SYSTEMS DESIGNER: DOUG KADRICH

SYSTEM PROVIDED

MODIFICATIONS AND ADDITIONS TO FS90 FIRE DETECTION SYSTEMS
STYLE 4 CLASS B SIGNALING LINE CIRCUITS
STYLE Y CLASS B NOTIFICATION APPLIANCE CIRCUITS

ELECTRICAL CONTRACTOR

AURORA ELECTRIC / AURORA DATATEL
1118 EAST 70TH AVENUE
ANCHORAGE, AK 99518

APPLICATION DESIGN CERTIFICATIONS

DOUGLAS A. KADRICH
STATE PERMIT FIRE ALARM SYSTEMS ENGINEERING PERMIT: 98-068
NICET FIRE ALARM SYSTEMS LV IV - 091830

HONEYWELL

C				TITLE AND INDEX SHEET
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	

SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	DRAWING NUMBER 984-22608	REV. A
SUPERSEDED BY	APPROVED BY: DAK	SHEET 1 OF 13		

FIRE ALARM SYSTEM LEGEND		
SYMBOL	DESCRIPTION	PART#
(2)	IONIZATION SMOKE SENSOR	TC807B1000 W/ 14507371-001 BASE
—(2)	IONIZATION DUCT SMOKE SENSOR	TC806D1011
(T)	THERMAL SENSOR	TC808B1002 W/ 14507371-001 BASE
(T)200°	THERMAL SENSOR 200°F	T4057B1013
•	MANUAL PULL STATION	S464A1144
MM	ADDRESSABLE MONITOR MODULE	TC809A1059
CM	ADDRESSABLE CONTROL MODULE	TC810A1057
FS	SPRINKLER FLOW SWITCH	BY OTHERS
TS	SPRINKLER TAMPER SWITCH	BY OTHERS
M	MAGNETIC 120VAC DOOR HOLDER	S4003A1037
	HORN/STROBE 15/75 CD	XLS-757-7A-T
15	MINI-HORN/STROBE 15 CD	G1-HV15
CR	CARD ACCESS CARD READER	TC818A1025
EP	CARD ACCESS EXIT PIR	RTE1000
DC	CARD ACCESS DOOR STATUS CONTACT	1078CW
DS	24VDC DOOR STRIKE	BY OTHERS
GB	GLASSBREAK DETECTOR W/TRIM PLATE	5812NT
FCP	FIRE ALARM CONTROL PANEL	FS90
NAC	NOTIFICATION APPLIANCE POWER	XLS-BPS

WIRE & CABLE LEGEND				
SYMBOL	AWG (SOLID)	NO. OF CONDUCTORS	TWISTED	CIRCUIT TYPE
A	14	2	YES	INITIATING (SLC)
B	12	2	NO	INDICATING (NAC)
C	12	3	NO	120VAC POWER
D	22	4 PAIR	YES	COMMUNICATIONS
E	18	5	YES	CARD READER - BELDEN #8465
F	16	2	YES	SEC PWR - HNWL 3712 (OR EQUAL)
G	18	2	YES	SECURITY - HNWL 3712 (OR EQUAL)

LOW VOLTAGE WIRING

LINE VOLTAGE WIRING

2A

WIRE TYPE SYMBOL
QUANTITY OF INDICATED WIRE TYPE

WIRING NOTES:

1. ALL WIRING MUST CONFORM TO NEC ARTICLES 725 AND 760, AND TO NFPA-72, "LOCAL PROTECTIVE SIGNALING SYSTEMS".
2. ALL NOTIFICATION APPLIANCE CIRCUITS ARE CLASS B WITH A 1.91K EOLR.
3. HORN/STROBE LOOP AND SEQUENCE DESIGNATED BY #-#.

2-4
SEQUENCE NUMBER
NAC LOOP NUMBER

HONEYWELL INC. SCOPE OF WORK

TO FURNISH A HONEYWELL INC. FS90 PLUS ADDRESSABLE FIRE ALARM SYSTEM FOR PER NFPA 70, 72 & 101, ADAAG, LOCAL CODES, AND AS DESCRIBED BELOW:

INCLUSIONS:

1. PROVIDE SHOP DRAWINGS AND SUBMITTALS.
2. PROVIDE NEW FIRE ALARM DEVICES AND PANELS AS SHOWN ON SHOP DRAWINGS.
3. PROVIDE SYSTEM START-UP, CHECK-OUT AND DEMONSTRATION TO THE A.H.J. AND OWNER.
4. PROVIDE TRAINING TO PERSONNEL DESIGNATED BY THE OWNER.
5. SUPERVISE THE INSTALLING CONTRACTOR.
6. GUARANTEE THE SYSTEM FOR A PERIOD OF ONE YEAR.
7. PROVIDE AS-INSTALLED DRAWINGS AT COMPLETION OF PROJECT.
8. PROVIDE CENTRAL SYSTEM GRAPHICS.
9. PROVIDE PROVIDE CENTRAL SYSTEM PROGRAMMING.
10. PROVIDE PROVIDE PANEL PROGRAMMING.
11. PROVIDE NFPA RECORD OF COMPLETION.

EXCLUSIONS:

1. INSTALLATION MATERIAL.
2. TERMINATION OF DEVICES AND PANELS.

INSTALLING CONTRACTOR SCOPE OF WORK

TO INSTALL A HONEYWELL INC. FS90 PLUS ADDRESSABLE FIRE ALARM SYSTEM PER NFPA 70, 72 & 101, ADAAG, LOCAL CODES, AND AS DESCRIBED

1. INSTALL FIRE ALARM SYSTEM AS SHOWN ON THESE DRAWINGS AND PER PLANS AND SPECS.
2. PROVIDE INSTALLATION LABOR, CONDUIT, FITTINGS, WIRE, CABLE, BACK BOXES, ETC.
3. OBTAIN ALL NECESSARY PERMITS.
4. ASSIST DURING SYSTEM START-UP, CHECK-OUT AND DEMONSTRATION TO THE A.H.J. AND OWNER.
5. INSTALL SYSTEM IN A NEAT AND WORKMAN LIKE MANNER.
6. MAINTAIN A SET OF AS-BUILT FIRE ALARM DRAWINGS. TURNOVER TO HONEYWELL AT THE COMPLETION OF THE PROJECT.
7. GUARANTEE THE INSTALLATION FOR A PERIOD OF YEAR.

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

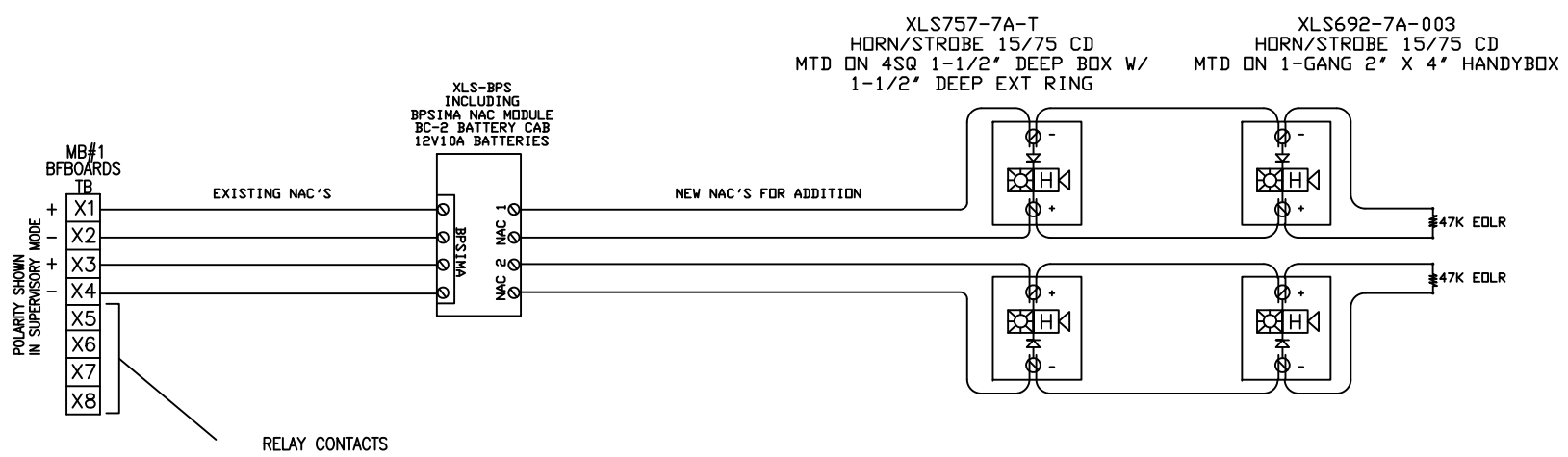
HONEYWELL

REVISIONS		DATE	APPD.
C			
B			
A	RECORD DRAWINGS	11/26/02	DAK

LEGENDS & SCHEDULES

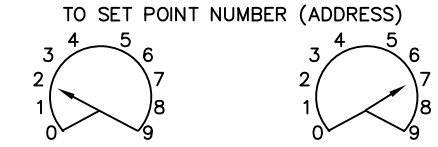
DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY: DAK	DATE 5/14/02	DRAWING NUMBER 984-22608	REV. A
SUPERSEDED BY	APPROVED BY: DAK	SHEET 2 OF 13		



1/03 TYP. FOR NEW NOTIFICATION APPLIANCE CIRCUIT ZONES

USE TWO DECADE SWITCHES ON DEVICES
TO SET POINT NUMBER (ADDRESS)



NOTES:

1) DO NOT SET MORE THAN ONE MODULE OR ONE SENSOR WITH THE SAME ADDRESS ON THE SAME LOOP.
2) A SENSOR AND MODULE CAN HAVE THE SAME ADDRESS ON THE SAME LOOP.
3) THE ABOVE EXAMPLE SHOWS SENSOR POINT 027 AND MODULE POINT 127
4) MONITOR & CONTROL MODULE POINT ADDRESSES RANGE FROM 101 THRU 199
5) SENSOR POINT ADDRESSES RANGE FROM 001 THRU 099.

TYPICAL INTELLIGENT MODULE ADDRESS AS SHOWN ON DRAWING AND ADDRESS SCHEDULES: 1 127

INDICATES AE SLC LOOP NUMBER WITHIN RESPECTIVE FS90 CONTROLLER

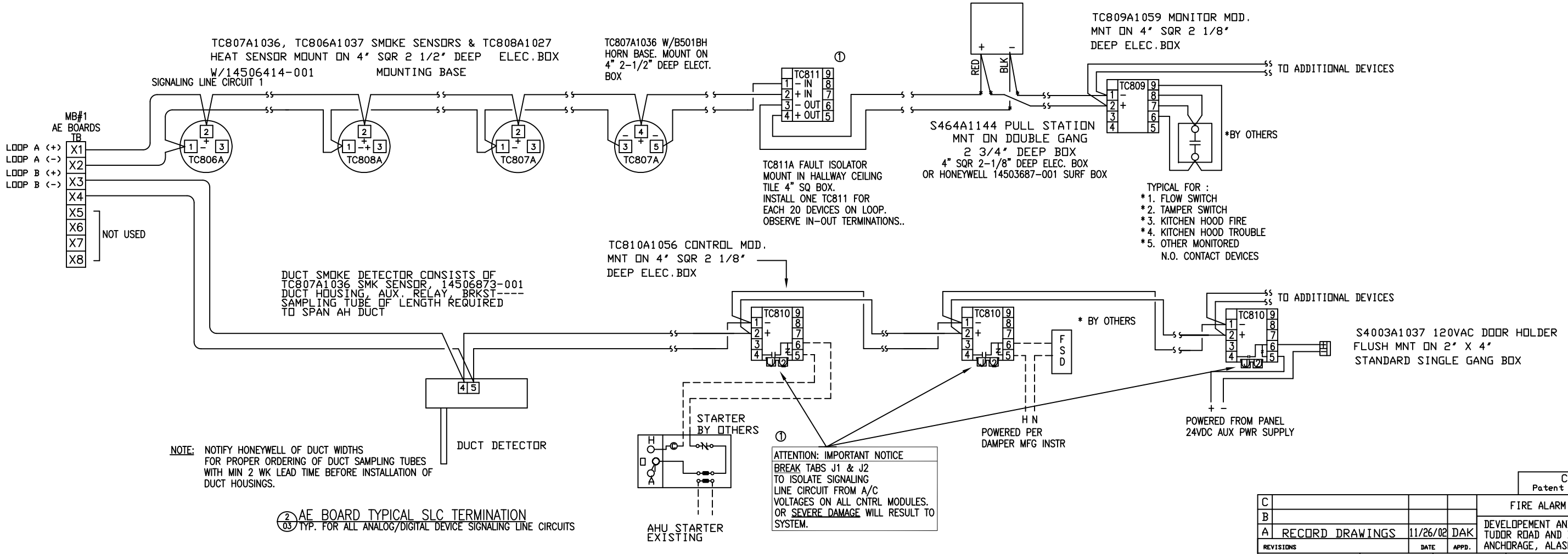
ADDRESS
'1' INDICATES MODULE ADDRESS
'0' INDICATES SENSOR ADDRESS

SENSOR/MODULE POINT SETTING

SEE FLOOR PLAN FOR DEVICE COUNT, ADDRESS, AND LOCATIONS.
DEVICES MAY OCCUR ON LOOP IN ANY ORDER, BUT ADDRESS SETTING MUST BE THE SAME AS SHOWN ON FLOOR PLANS.

CAUTION!!!

① BREAK TABS J1 & J2 ON CONTROL MODULES USED AS FORM C RELAYS.



2/03 AE BOARD TYPICAL SLC TERMINATION
TYP. FOR ALL ANALOG/DIGITAL DEVICE SIGNALING LINE CIRCUITS

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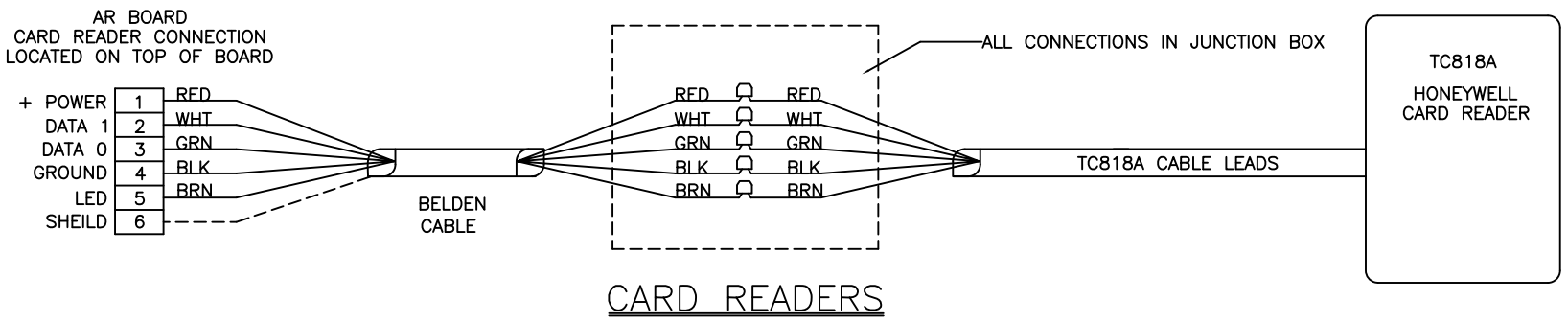
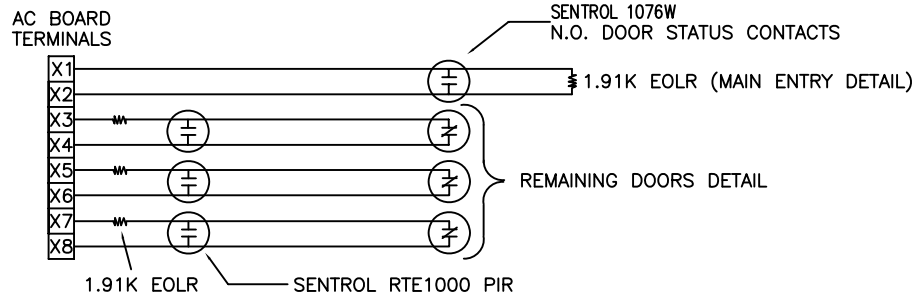
C				FIRE ALARM BOARD/DEVICE WIRING
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPEMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	

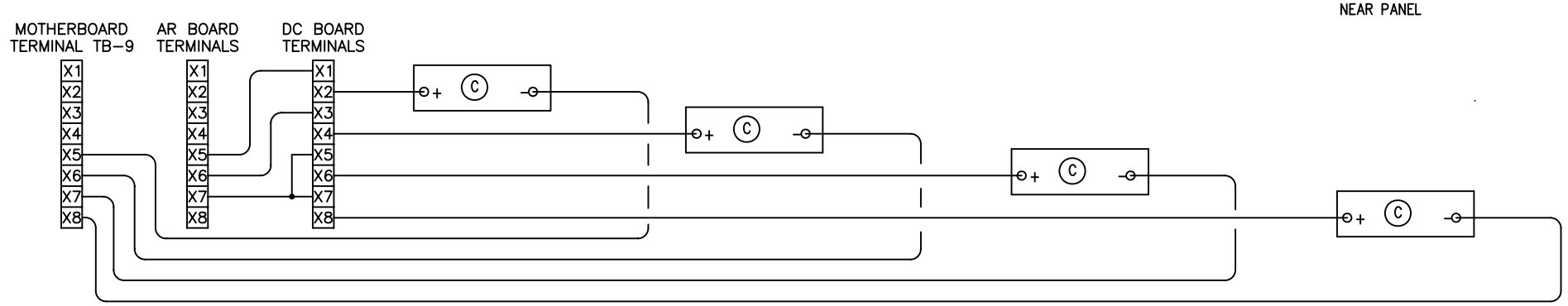
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	DRAWING NUMBER 984-22608	REV. A
SUPERSEDED BY	APPROVED BY: DAK	SHEET 3 OF 13		



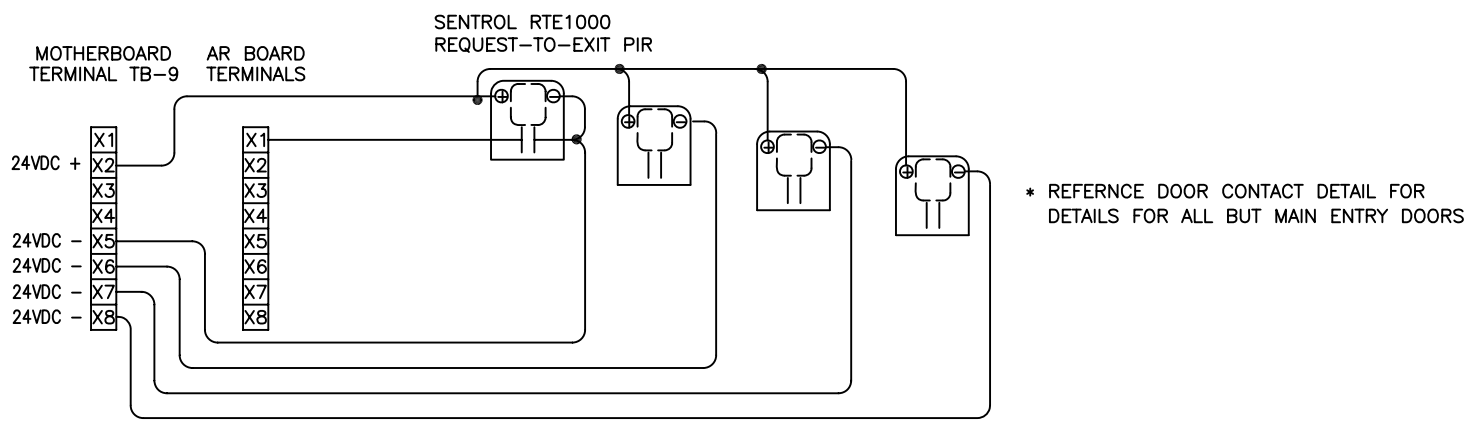
CARD READERS



DOOR CONTACTS

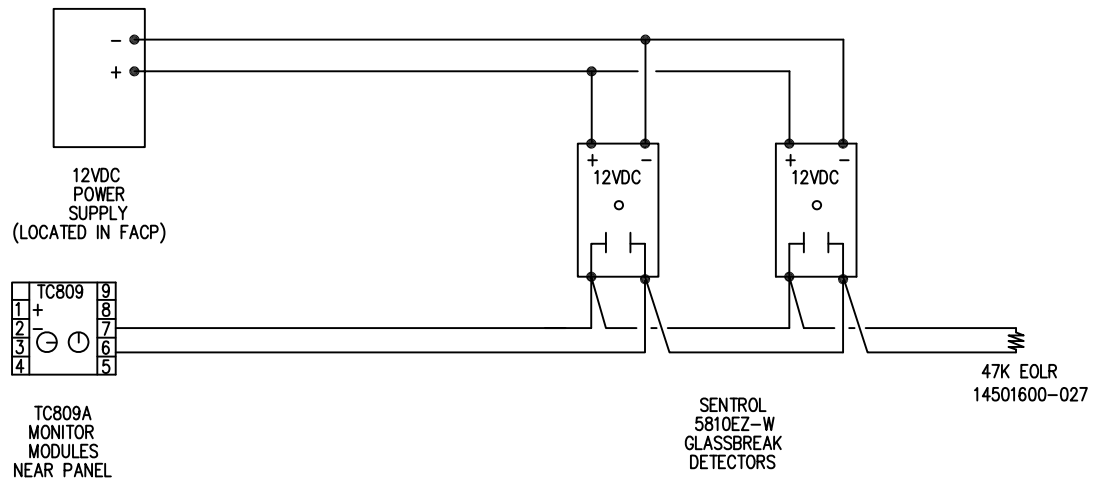


DOOR STRIKES*



* REFERNCE DOOR CONTACT DETAIL FOR DETAILS FOR ALL BUT MAIN ENTRY DOORS

REQUEST TO EXIT PASSIVE INFARED DETECTORS



GLASSBREAK SENSORS

* PROVIDED BY OTHERS

HONEYWELL

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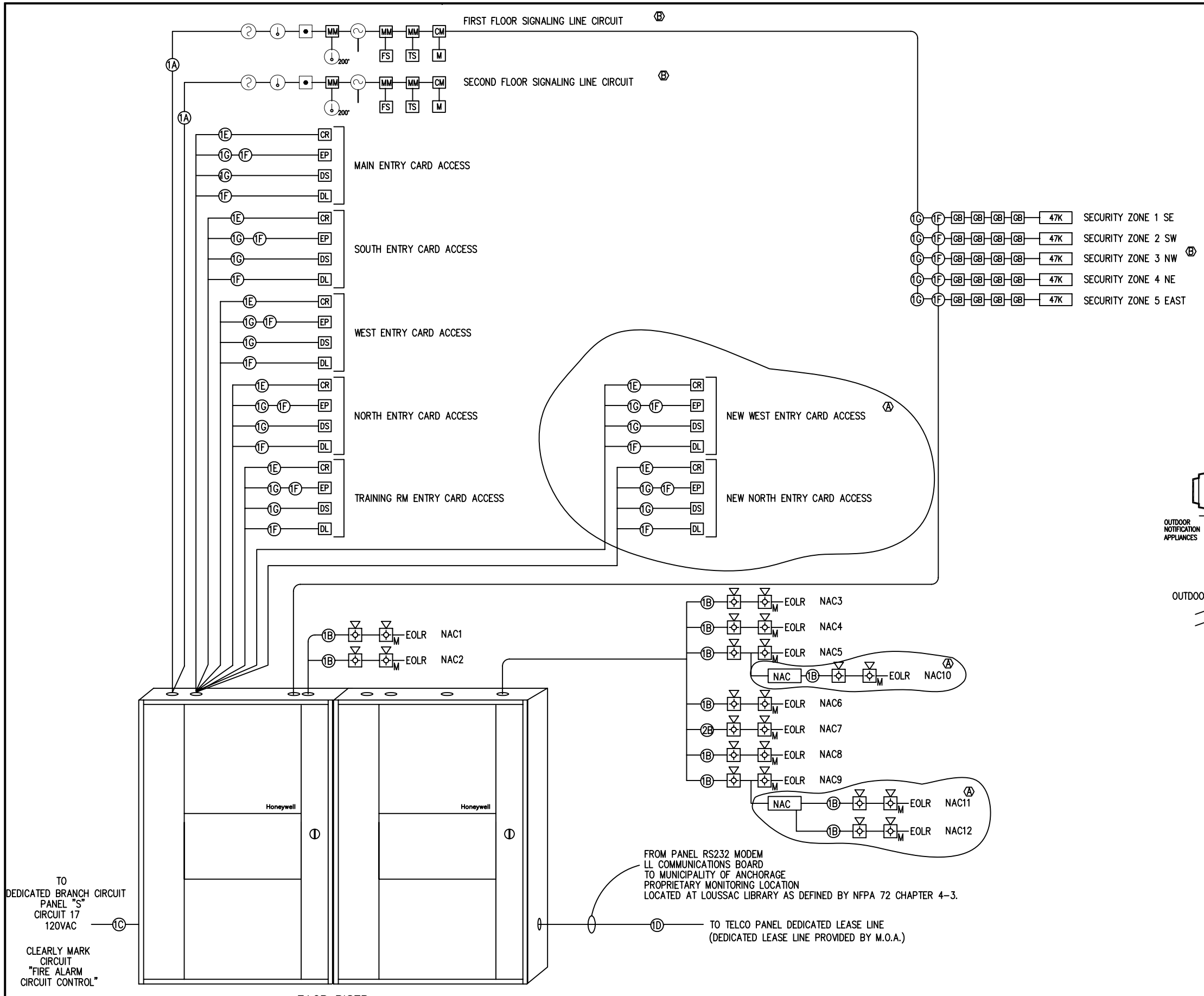
C				CARD ACCESS BOARD/DEVICE WIRING
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	

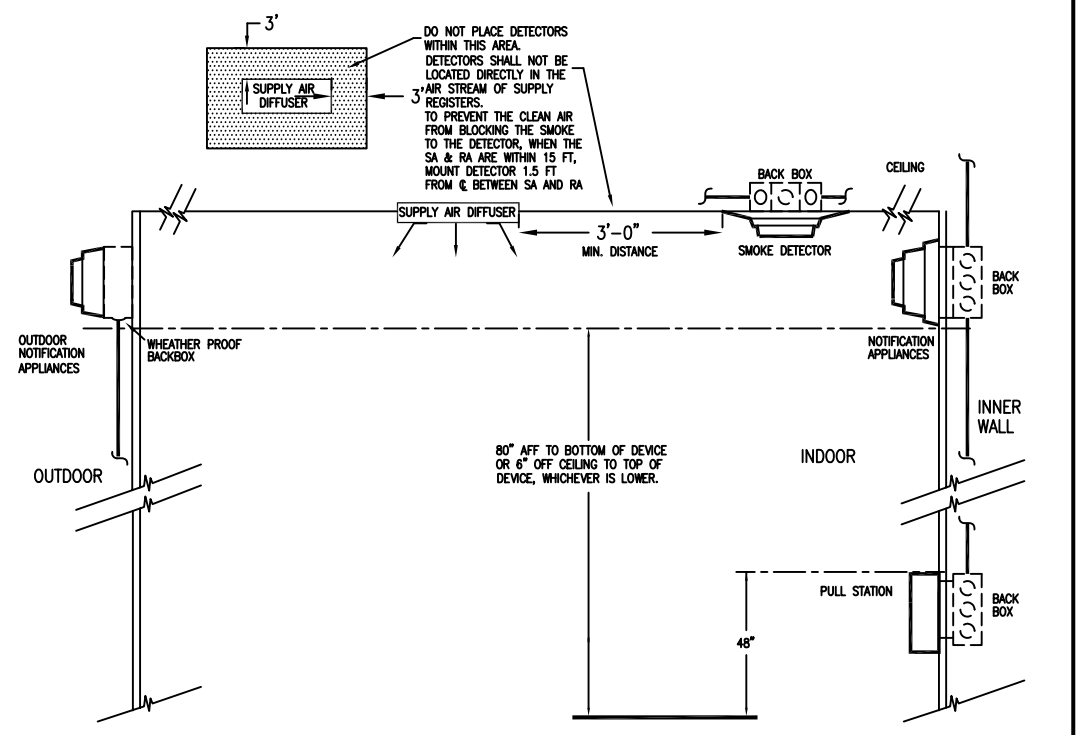
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	DRAWING NUMBER 984-22608	REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 4 OF 13		



FACP RISER
DELTANET FIRE AND SECURITY SYSTEM

PROPRIETARY SUPERVISING STATION SYSTEM

THE FIRE ALARM AND REPORTING SYSTEM IDENTIFIED BY THESE DRAWINGS IS A PROPRIETARY SUPERVISING STATION SYSTEM AS DEFINED UNDER NFPA 72 CHAPTER 4-3 "PROPRIETARY SUPERVISING STATION SYSTEMS". THE SYSTEM REPORTS CONTINUOUSLY TO THE OWNER'S CENTRAL MONITORING STATION, LOCATED AT THE MUNICIPALITY OF ANCHORAGE LOUSSAC LIBRARY FACILITY. THE COMMUNICATIONS FROM PANEL IS VIA THE LL COMMUNICATIONS BOARD VIA RS232 COMMUNICATIONS SIGNAL TRANSMITTED OVER TELEPHONE LEASE LINE PROVIED BY THE LOCAL TELEPHONE COMPANY. THE FS90 PLUS FIRE ALARM PANEL IS THE TRANSMIITING DEVICE THRU THE USE OF THE STANDARD LL RS232 COMMUNICATIONS BOARD AS REFERENCED ON DRAWINGS 984-28621 PAGES 05, 06, AND 07.



1/04 FIRE ALARM DEVICE ELEVATIONS

GENERAL NOTES:

A. DO NOT APPLY POWER TO ANY DEVICE UNTIL AUTHORIZED BY A HONEYWELL REPRESENTATIVE.
B. SEE FLOOR PLANS FOR ALL DEVICE LOCATIONS, DEVICE COUNTS, AND DEVICE ADDRESSES.
C. FOLLOW DEVICE INSTALLATION INSTRUCTIONS INCLUDED WITH DEVICES.

SHEET NOTES:

Ⓐ NEW THIS PROJECT (OTHERWISE EXISTING)
Ⓑ MODIFIED THIS PROJECT (OTHERWISE EXISTING)

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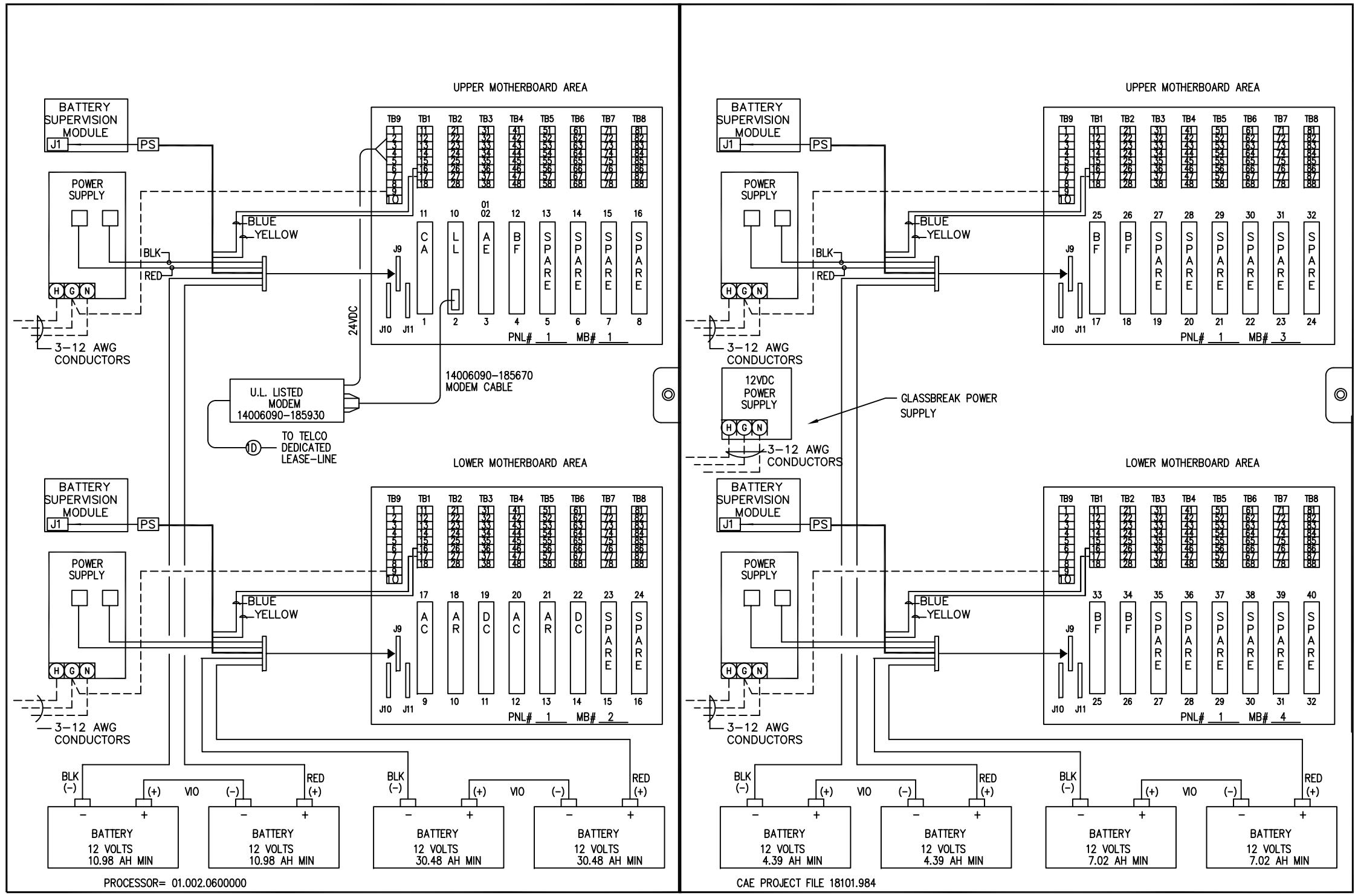
C				FIRE ALARM SYSTEM RISER DIAGRAM
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	

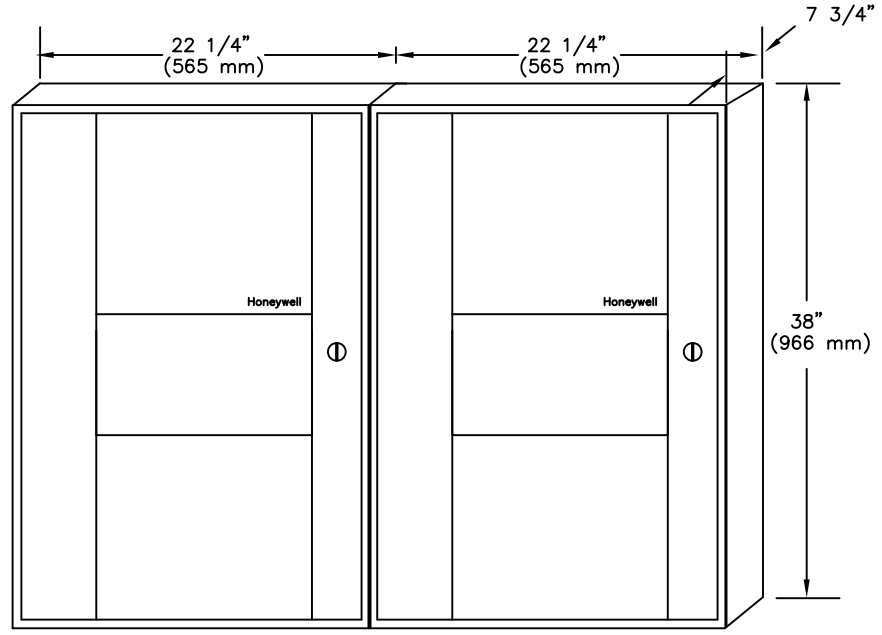
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	DRAWING NUMBER 984-22608	REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 5 OF 13		



DEVELOPMENT AND PERMITTING CENTER FS90 PLUS – INTERIOR DETAIL

PANEL MATERIAL

QTY	PART NUMBER	DESCRIPTION
2	14505151–005	FS90 ENCLOSURE
2	14505152–002	FS90 DOOR
4	14505102–004	FS90 MOTHERBOARD
4	14505145–002	POWER SUPPLY CABLE
4	14505148–001	POWER SUPLY
4	14505146–001	CARD RETAINER
8	14501847–001	FUSE HOLDER
1	14505104–005	CA CONTROL BOARD
1	14505132–002	AE INTELEGENT LOOP INTERFACE BOARD
5	14505110–003	BF NOTIFICATION APPLIANCE CIRCUIT BOARD
2	14506930–002	AR CARD READER BOARD
2	14505112–002	DC RELAY BOARD
2	14505106–001	AC INITIATOR BOARD
2	14505188–001	AF SECURITY BOARD
1	14006690–001	LL COMMUNICATIONS BOARD
4	14506408–002	BATTERY SUPERVISION MODULE
8	12V16A	BATTERIES
2	14502412–014	LIGHTNING SUPPRESSORS
1	14006090–185670	MODEM CABLE
1	14006090–185930	2400 BAUD UL MODEM
2	14505154–001	INSIDE RIBBON CONNECTOR
1	14505154–002	OUTSIDE RIBBON CONNECTOR
1	12VDC	POWER SUPPLY



FACP EXTERIOR DETAIL
DELTANET FIRE AND SECURITY SYSTEM
LOCATED IN ENTRY

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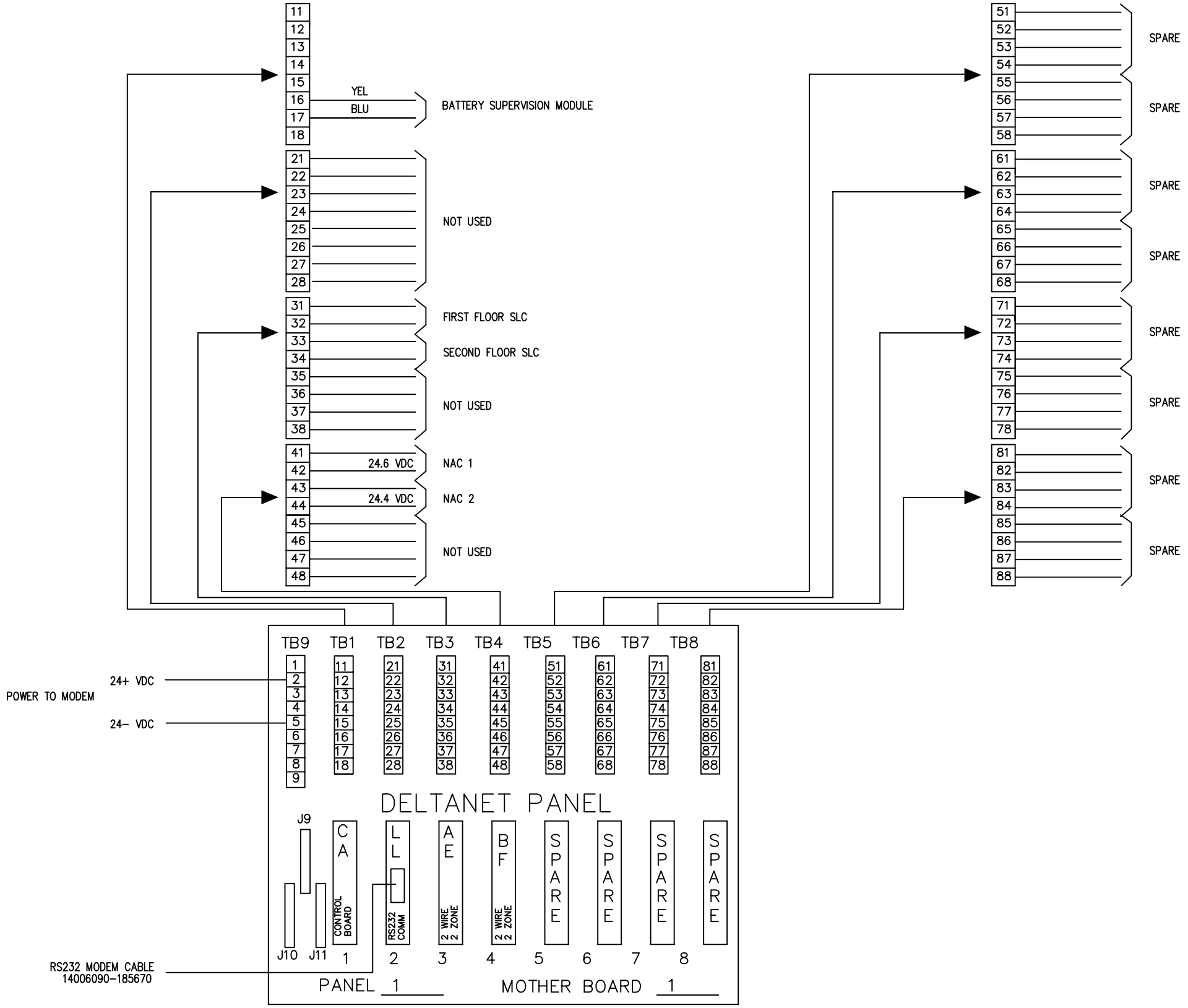
REVISIONS	DATE	APPD.
C		
B		
A RECORD DRAWINGS	11/26/02	DAK

FS90 PANEL CONFIGURATION
DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

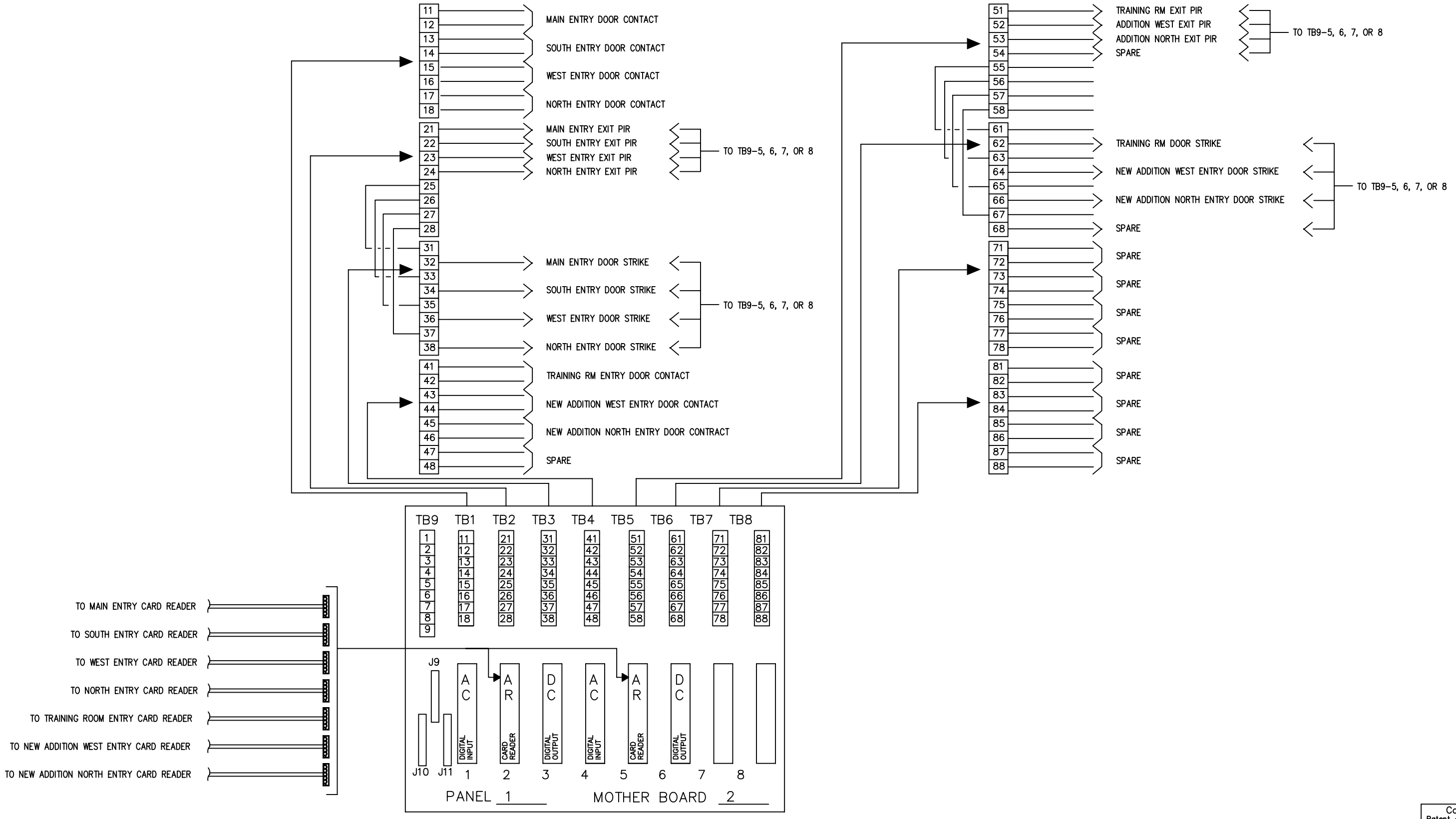
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	DRAWING NUMBER 984–22608	REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 6 OF 13		



FACP MOTHERBOARD TERMINATIONS

HONEYWELL

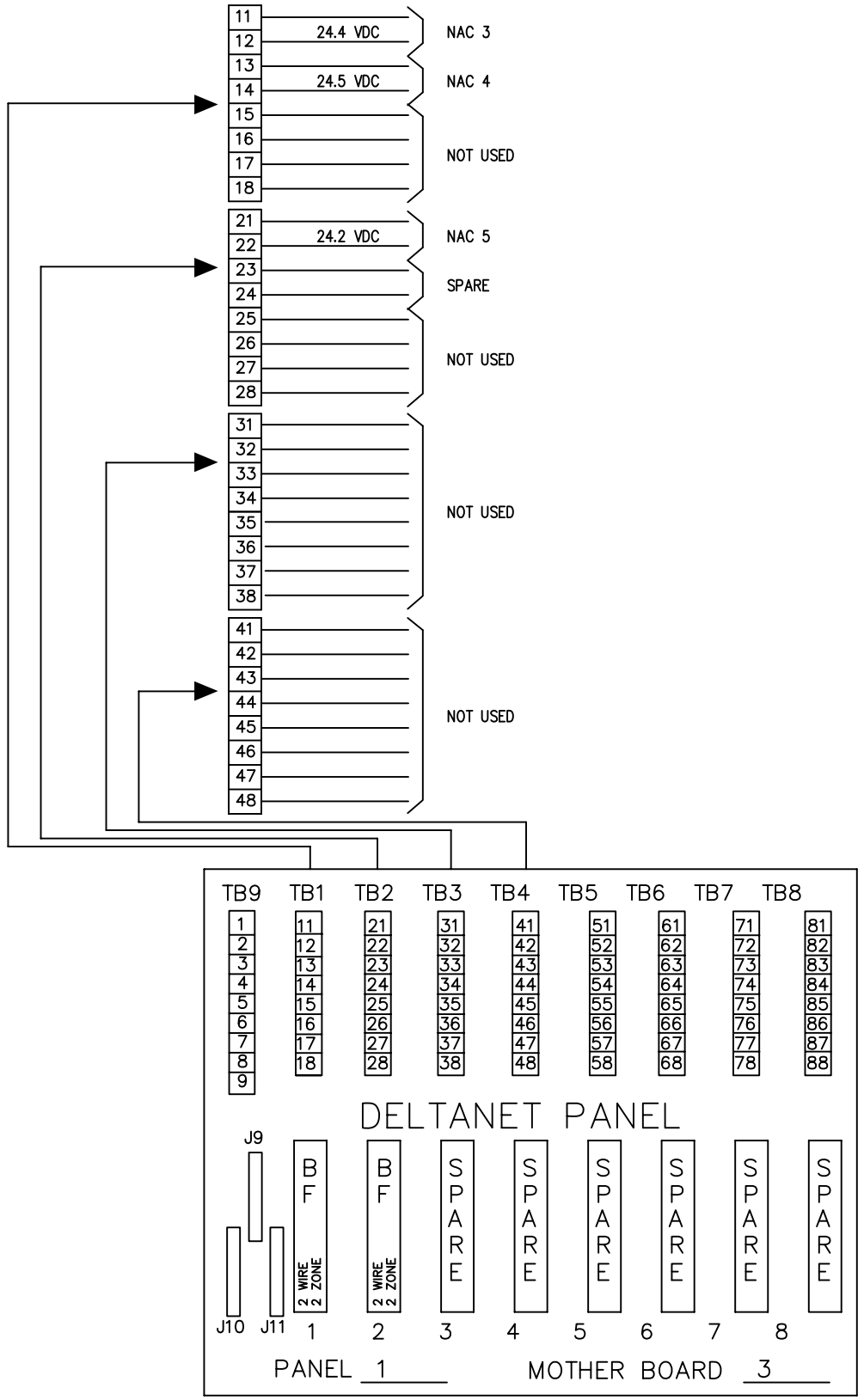
C				FS90 MOTHERBOARD 1 TERMINATIONS
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02		DRAWING NUMBER 984-22608 — REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 7 OF 13		



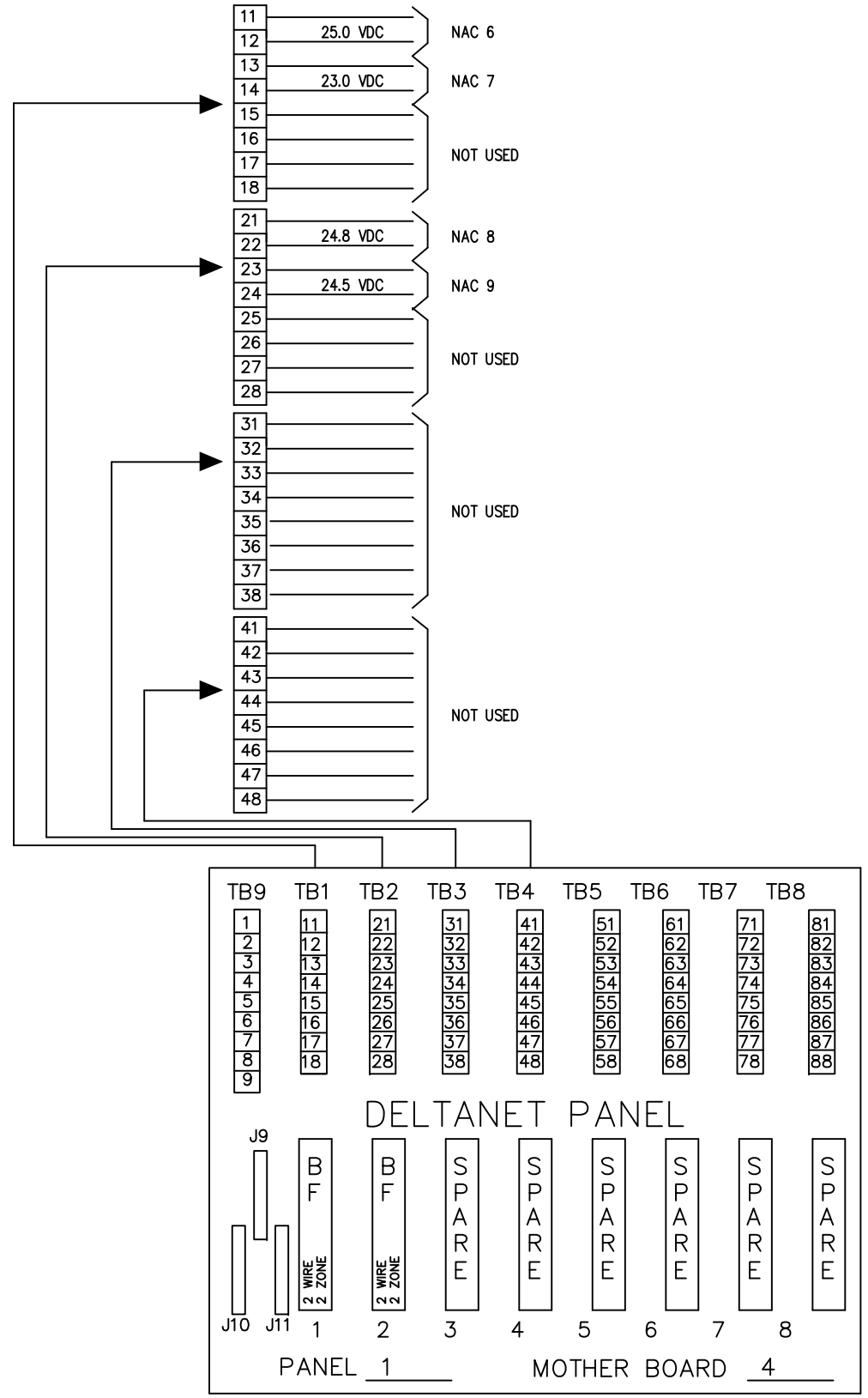
FACP MOTHERBOARD TERMINATIONS

HONEYWELL

C				FS90 MOTHERBOARD 2 TERMINATIONS
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02		DRAWING NUMBER 984-22608 REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 8 OF 13		



FACP MOTHERBOARD 3 TERMINATIONS



FACP MOTHERBOARD 4 TERMINATIONS

HONEYWELL

C				FS90 MOTHERBOARD 3 & 4 TERMINATIONS
B				
A	RECORD DRAWINGS	11/26/02	DAK	DEVELOPMENT AND PERMITTING CENTER TUDOR ROAD AND BRAGAW STREET ANCHORAGE, ALASKA
REVISIONS		DATE	APPD.	
SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02		DRAWING NUMBER 984-22608 REV. A
SUPERSEDED BY	APPROVED BY:	SHEET 9 OF 13		

SHEET NOTES:

Ⓐ CONNECT NEW GLASSBREAKS TO EXISTING SECURITY ZONE 3 MONITOR MODULE 1143 THIS LOCATION

Ⓑ REMOVE GLASSBREAK

Ⓒ RELOCATE DEVICE FROM SYMBOL (Ⓒ) LOCATION TO NEW LOCATION

Ⓓ NEW DEVICE

MATCH LINE (A) NEW ADDITION REMODEL AREA

SECURITY ZONE 2

SECURITY ZONE 3

SECURITY ZONE 1

SECURITY ZONE 5

SECURITY ZONE 4 TRAINING ROOM

DOOR 1

DOOR 3

DOOR 4

DOOR 5

SPRINKLER ALARM HORN/STROBE

GENERATION RM.

BOILER ROOM

SMOKE DAMPER CONTROL

SPRINKLER RISER

KATHY JOHNSON

LEAD ELECT.

LEAD MECH.

ZONING

STEVE

HEALTH & HUMAN SERVICES

CHIEF INSPECTIONS

FIRE

LEAD STRUCTURAL

RADIO RM.

DATA

OFFICE

ELECT. RM.

COUNTER STOR.

PANEL 'HA'

PANEL 'LA'

BREAK RM.

CONF. RM.

P STOR.

WORK AREA

RES. REVIEW

PLAN REVIEW

SR. PLAN REVIEW

ZONING-PLAN REVIEW

COPY RM.

CODE ABATEMENT

SEATS

SWING DOOR

PLANING & ZONING COUNTER

HANDOUTS

LAYOUT COUNTER W.SEAT'G.

RELOCATED COUNTER STATIONS

CHECK-IN

CASHIER

DARI'S OFFICE

CONNIE'S OFFICE

MARGO

KURT

SHIRLEY

TOM

MARK

HARRY

UTILITIES

UTILITIES COUNTER

BUILDING OFFICIAL

DEVELOPER SPACE

ENTRY

P&Z STAFF

FAX

BUILD'G. MAINT.

COM./DATA

NEW NAC PANEL

ELEC. RM.

STAIR #2

UP

ZONING STOR.

TRAINING RM.

TEMPS/COMMON WORK AREA

TUMS

OFFICE

ASSOC. TRAFFIC

ROLL-DOWN GRILLE

R.O. WOOD WRAPPING

ELV SPRINKLER TAMPER

MOUNT SMOKE DETECTORS MINIMUM 3'-0" FROM AIR SUPPLY DIFFUSERS, TYPICAL.

EOLR

GB

CR

DC

DS

EP

F

C

M

CM

MM

TS

FS

V.

10 FIRST FLOOR REMODEL SIGNAL PLAN

SCALE: 1/20" = 1'-0"

N

ELEVATOR CONTROL MODULES

1152 ELV RECALL TO 1ST FLOOR
1153 ELV RECALL TO 2ND FLOOR

SECURE ACCESS MONITOR MODULES

1141 GLASSBREAK DETECTOR ZONE 1
1142 GLASSBREAK DETECTOR ZONE 2
1143 GLASSBREAK DETECTOR ZONE 3
1145 GLASSBREAK DETECTOR ZONE 5

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C	RECORD DRAWINGS	11/26/02	DAK
B	FLOORPLAN REVISION	9/3/02	DAK
A	SECURITY SYSTEM ADD	8/21/99	DAK
REVISIONS		DATE	APPD.

FIRST FLOOR REMODEL AREA DEVICE LAYOUT

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY: DAK	DATE 5/14/02	DRAWING NUMBER 984-22608
SUPERSEDED BY	APPROVED BY: DAK	SHEET 10 OF 13	REV. C

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SECOND FL REMODEL AREA DEVICE LAYOUT

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

REVISIONS	DATE	APPD.
A FLOORPLAN REVISION	9/3/02	DAK
B RECORD DRAWINGS	11/26/02	DAK
C		

SUPERSEDES	DRAWN BY, DAK	DATE 6/14/02
SUPERSEDED BY	APPROVED BY, DAK	SHEET 11OF 13

DRAWING NUMBER
984-22608

REV.
B

11 SECOND FLOOR REMODEL AREA SIGNAL PLAN

SCALE: 1/20" = 1'-0"

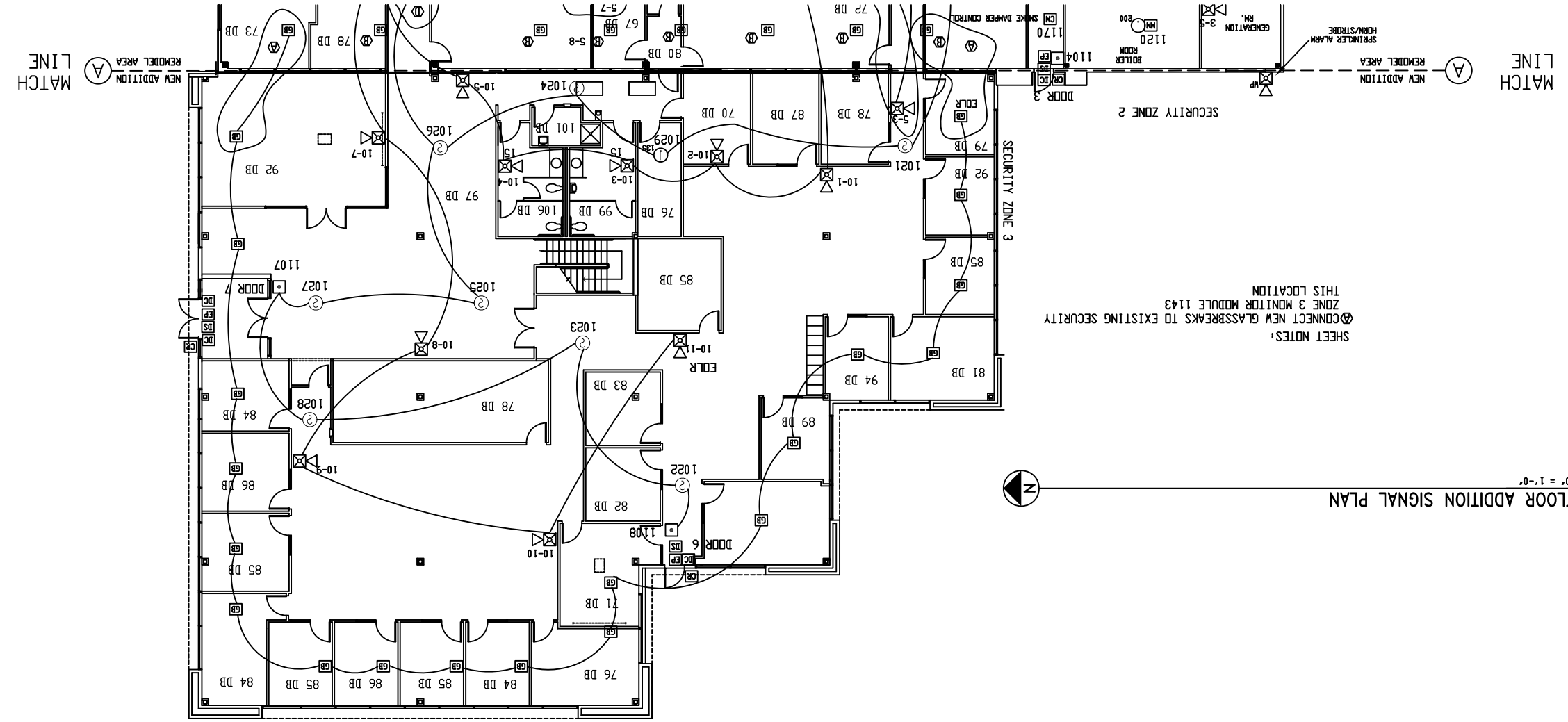
AHU1 SOUTH
1ST FLOOR DUCT DETECTOR 2090 .4
2ND FLOOR DUCT DETECTOR 2091 .3
2ND FLOOR DUCT DETECTOR 2094 .2
AHU CONTROL MODULE 2160 CM

AHU2 NORTH
1ST FLOOR DUCT DETECTOR 2092 .2
2ND FLOOR DUCT DETECTOR 2093 .0
2ND FLOOR DUCT DETECTOR 2095 .0
AHU CONTROL MODULE 2161 CM

SHEET NOTES:
ⓐNEW DEVICE IN EXISTING AREA
ADD TO EXISTING SLC LOOP IN REMODEL AREA

MATCH LINE — NEW ADDITION REMODEL AREA (A)

MATCH LINE — NEW ADDITION REMODEL AREA (A)



SHEET NOTES:

Ⓐ CONNECT NEW GLASSBREAKS TO EXISTING SECURITY ZONE 3 MONITOR MODULE 1143 THIS LOCATION

12 FIRST FLOOR ADDITION SIGNAL PLAN

SCALE: 1/20" = 1'-0"

REVISIONS			
C	RECORD DRAWINGS	11/26/02	DAK
B	FLOORPLAN REVISION	9/3/02	DAK
A	SECURITY ADDITION	8/21/99	DAK

FIRST FLOOR NEW ADDITION DEVICE LAYOUT

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

SUPERSEDES	DRAWN BY, DAK	DATE 6/14/02	SHEET 12OF 13
SUPERSEDED BY	APPROVED BY, DAK		

DRAWING NUMBER 984-22608 REV. C

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SECOND FL NEW ADDITION DEVICE LAYOUT

DEVELOPMENT AND PERMITTING CENTER
TUDOR ROAD AND BRAGAW STREET
ANCHORAGE, ALASKA

	REVISIONS	DATE	APPD.
A	FLOORPLAN REVISION	9/3/02	DAK
B	RECORD DRAWINGS	11/26/02	DAK
C			

SUPERSEDES	DRAWN BY: DAK	DATE 6/14/02	SHEET 13 OF 13	DRAWING NUMBER 984-22608	REV. B
SUPERSEDED BY	APPROVED BY: DAK				

SHEET NOTES:
ⓐ NEW DEVICE IN EXISTING AREA
ADD TO EXISTING SLC LOOP IN REMODEL AREA

(13) SECOND FLOOR NEW ADDITION AREA SIGNAL PLAN
SCALE: 1/20" = 1'-0"

Appendix D - FDS Data File Printout

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Generated by PyroSim - Version 2014.1.0110
Apr 30, 2014 9:28:21 AM

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&DEVC ID='SPRK10', PROP_ID='QRECOH_ECOHQR', XYZ=31.2312,188.005,2.71/
&DEVC ID='SPRK11', PROP_ID='QRECOH_ECOHQR', XYZ=31.2312,192.882,2.71/
&DEVC ID='SPRK12', PROP_ID='QRECOH_ECOHQR', XYZ=26.964,184.347,2.71/
&DEVC ID='SPRK13', PROP_ID='QRECOH_ECOHQR', XYZ=26.964,188.005,2.71/
&DEVC ID='SPRK14', PROP_ID='QRECOH_ECOHQR', XYZ=26.964,192.882,2.71/
&DEVC ID='SPRK15', PROP_ID='QRECOH_ECOHQR', XYZ=34.8888,180.69,2.71/
&DEVC ID='SPRK16', PROP_ID='QRECOH_ECOHQR', XYZ=36.108,184.347,2.71/
&DEVC ID='SPRK17', PROP_ID='QRECOH_ECOHQR', XYZ=34.8888,188.05,2.71/
&DEVC ID='SPRK18', PROP_ID='QRECOH_ECOHQR', XYZ=34.8888,192.882,2.71/
&DEVC ID='SD', PROP_ID='Cleary Ionization I1', XYZ=31.2312,185.566,2.71/
&DEVC ID='SD01', PROP_ID='Cleary Ionization I1', XYZ=31.2312,191.662,2.71/
&DEVC ID='THCP1', QUANTITY='THERMOCOUPLE', XYZ=30.1083,180.6,2.45/
&DEVC ID='THCP2', QUANTITY='THERMOCOUPLE', XYZ=29.25,181.15,2.45/
&DEVC ID='THCP3', QUANTITY='THERMOCOUPLE', XYZ=28.46,181.82,2.45/
&DEVC ID='THCP4', QUANTITY='THERMOCOUPLE', XYZ=27.78,182.53,2.45/
&DEVC ID='THCP5', QUANTITY='THERMOCOUPLE', XYZ=27.18,183.33,2.45/
&DEVC ID='THCP6', QUANTITY='THERMOCOUPLE', XYZ=26.65,184.21,2.45/
&DEVC ID='THCP7', QUANTITY='THERMOCOUPLE', XYZ=26.2,185.11,2.45/
&DEVC ID='THCP8', QUANTITY='THERMOCOUPLE', XYZ=26.0,186.0,2.45/
&DEVC ID='THCP9', QUANTITY='THERMOCOUPLE', XYZ=25.8,187.0,2.45/
&DEVC ID='THCP10', QUANTITY='THERMOCOUPLE', XYZ=25.7,188.0,2.45/
&DEVC ID='THCP11', QUANTITY='THERMOCOUPLE', XYZ=37.15,197.0,5.7917/
&DEVC ID='THCP12', QUANTITY='THERMOCOUPLE', XYZ=42.6,197.0,5.7917/
&DEVC ID='TIMER', QUANTITY='TIME', XYZ=-4.3552,170.483,0.0, SETPOINT=100.0,
INITIAL_STATE=.TRUE./

&CTRL ID='Control11', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
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&CTRL ID='Control10', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP9'/
&CTRL ID='Control09', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP8'/
&CTRL ID='Control08', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP7'/
&CTRL ID='Control07', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP6'/
&CTRL ID='Control06', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP5'/
&CTRL ID='Control05', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP4'/
&CTRL ID='Control04', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP3'/
&CTRL ID='Control03', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP2'/
&CTRL ID='Control02', FUNCTION_TYPE='DEADBAND', SETPOINT=599.0,600.0,
ON_BOUND='LOWER', LATCH=.FALSE., INPUT_ID='THCP1'/

&SURF ID='Burner',
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      HRRPUA=1300.0,
      TAU_Q=-235.0/

&OBST XB=12.9822,24.8789,175.72,175.812,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=23.1593,23.2513,170.635,173.627,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=12.9822,25.5593,190.311,190.403,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=23.5486,23.6406,190.403,195.275,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=20.7115,23.5486,193.934,194.027,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=20.6195,20.7115,190.311,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.8175,20.7115,195.206,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.6538,16.7459,195.298,197.026,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=13.4759,16.8175,195.07,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.7459,18.2098,197.026,197.118,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=18.1177,18.2098,197.026,198.558,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=18.1177,21.2324,198.466,198.558,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=21.1404,21.2324,197.118,198.558,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=21.1404,22.6961,197.026,197.139,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=0.850815,16.7459,197.025,197.118,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=25.5593,25.6514,188.482,190.311,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=25.5593,25.6514,190.311,198.038,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=25.6514,29.6875,194.87,194.963,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=30.918,31.01,171.934,174.525,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=31.8324,34.8804,175.347,175.439,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=34.7883,34.8804,171.934,175.439,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=31.01,34.8804,171.934,172.026,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=32.1445,35.1322,179.706,179.801,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.3597,36.5121,170.962,174.75,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.7325,36.8206,176.733,179.931,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.8245,40.914,176.733,176.825,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=40.914,41.0061,176.733,179.873,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=30.4361,30.9421,204.042,204.14,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=30.9421,31.4569,204.042,204.14,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=31.4569,32.255,204.042,204.14,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=22.604,22.6961,197.026,203.388,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=22.604,23.9153,203.388,203.48,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=23.8232,23.9153,203.388,208.617,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=18.6575,23.9153,208.525,208.617,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.7665,34.6379,210.716,210.808,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=30.2863,30.7895,205.962,206.054,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=32.7328,32.8249,207.396,209.497,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=39.3288,39.4812,198.413,204.103,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=39.3288,39.4208,204.103,206.541,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=33.4742,33.5663,202.393,205.839,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=33.4742,39.3288,202.301,202.393,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=33.4742,39.3288,205.839,205.932,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.3597,39.1555,211.631,211.723,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=39.0635,39.1555,211.631,220.225,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=39.0635,46.0479,220.225,220.317,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=39.3288,46.021,206.541,206.633,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=46.021,46.1131,201.803,206.632,0.0,6.7, SURF_ID='INERT'/ Obstruction
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&OBST XB=46.1067,46.3288,175.625,175.817,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=45.8466,46.1131,198.413,201.803,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=43.3832,45.8466,198.413,198.667,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=43.3832,43.5356,198.413,203.95,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=39.4812,46.0439,203.95,204.103,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=41.348,41.5163,198.505,202.045,0.0,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=54.9945,65.7729,185.113,185.265,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=57.248,57.3401,185.265,190.158,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=65.6205,65.7729,185.57,194.867,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=65.6112,71.9705,194.867,195.019,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=65.5191,65.6112,195.249,203.792,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=59.2754,65.6112,203.792,203.881,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=59.2754,59.3675,203.792,210.151,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=55.2052,55.2973,204.772,210.151,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=49.5083,60.7391,210.151,210.243,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=47.746,65.545,211.942,212.034,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=47.746,47.8381,211.942,224.585,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.3056,36.5128,185.189,195.143,3.95,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=13.3838,13.4759,191.714,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=6.82849,11.8094,195.044,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=2.37482,6.82849,195.206,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=2.37482,2.46689,194.298,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=0.850815,2.46689,194.206,194.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=-3.11192,0.75874,197.026,197.178,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-3.11192,0.75874,195.146,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-1.58792,-1.43552,195.298,197.026,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.5128,48.0,194.857,194.959,0.0,5.18, SURF_ID='INERT'/ Obstruction
&OBST XB=47.897,55.1502,194.857,194.959,2.61,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=36.4215,47.897,194.857,194.959,2.75,3.25, SURF_ID='INERT'/ Obstruction
&OBST XB=36.363,39.4812,198.413,198.57,3.95,6.7, SURF_ID='INERT'/ Obstruction
&OBST XB=36.5128,47.9131,194.959,198.505,3.8136,3.95, RGB=204,255,204,
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&OBST XB=39.4842,43.3832,201.864,203.95,1.8,1.98, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=41.5163,43.3832,201.585,201.864,1.62,1.8, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=41.5163,43.3832,201.305,201.585,1.44,1.62, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,201.026,201.305,1.26,1.44, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,200.746,201.026,1.08,1.26, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,200.467,200.746,0.9,1.08, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=41.5163,43.3832,200.188,200.467,0.72,0.9, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=41.5163,43.3832,199.908,200.188,0.54,0.72, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,199.629,199.908,0.36,0.54, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,199.349,199.629,0.18,0.36, RGB=204,255,204,
SURF_ID='INERT'/ Obstruction
&OBST XB=41.5163,43.3832,199.07,199.349,0.0,0.18, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,201.585,201.86,1.98,2.16, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,201.305,201.585,2.16,2.34, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,201.026,201.305,2.34,2.52, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,200.746,201.026,2.54,2.7, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
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&OBST XB=39.4842,41.348,200.467,200.747,2.7,2.88, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,200.188,200.468,2.88,3.06, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,199.909,200.188,3.06,3.24, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,199.63,199.909,3.24,3.42, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,199.351,199.63,3.42,3.6, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,199.071,199.351,3.6,3.78, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=39.4842,41.348,198.505,199.072,3.78,3.96, RGB=204,255,204, SURF_ID='INERT'/
Obstruction
&OBST XB=36.5128,47.897,194.857,194.959,6.7,6.84, SURF_ID='INERT'/ Obstruction
&OBST XB=46.1082,47.9165,198.412,203.896,3.8136,3.95, RGB=204,255,204,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=46.1082,47.9437,200.08,200.19,3.96,6.71, SURF_ID='INERT'/ Obstruction
&OBST XB=19.8948,20.0001,170.635,174.15,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.1448,56.1448,170.483,185.289,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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&OBST XB=-4.36521,36.5128,170.483,216.983,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=19.1448,39.3288,194.959,205.932,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=16.6515,16.7436,170.937,174.15,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=13.4057,13.4977,170.635,174.149,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=6.64168,6.79408,170.94,175.359,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=7.0991,10.3596,175.603,175.695,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=10.3596,10.4517,175.603,179.323,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=6.79408,6.88616,175.817,179.231,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=2.16954,10.4517,179.231,179.323,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=12.8901,12.9822,175.72,178.86,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=12.8901,16.5477,178.86,178.952,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.5477,16.6398,175.817,190.311,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=18.7494,18.8415,190.403,195.206,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=15.6095,15.7015,190.403,195.044,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=12.9822,16.5477,185.375,185.467,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=-3.72152,-2.95952,174.75,177.29,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.95952,0.444082,174.75,175.512,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=0.444082,6.79408,175.359,175.512,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=2.37482,2.46689,190.403,194.206,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=2.37482,11.3661,190.311,190.403,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=11.274,11.3661,190.311,191.622,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=11.274,15.693,191.622,191.714,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=11.9015,13.3838,194.296,194.388,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=8.54668,11.8582,193.727,193.819,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.9529,-0.368385,178.868,178.96,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=0.402807,0.444082,175.512,177.556,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.9529,0.75874,182.127,182.219,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.73316,0.75874,185.369,185.461,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.9529,0.75874,188.611,188.703,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.9529,0.75874,191.875,191.967,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-3.11192,-2.95952,177.29,195.298,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=-2.95952,0.113882,205.077,205.839,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=-3.72152,-2.95952,203.299,205.839,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=16.654,16.7461,197.118,203.48,0.0,2.72778, SURF_ID='INERT'/ Obstruction
&OBST XB=16.7665,16.8525,203.48,204.773,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=16.7461,22.604,203.388,203.48,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=18.5654,18.6575,203.48,208.525,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=18.5654,18.6575,208.525,210.716,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=23.155,23.247,210.808,214.831,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=26.3018,26.3939,210.808,214.524,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=29.6552,29.7473,210.808,214.831,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=19.9513,35.9025,214.831,214.983,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=35.9025,36.0549,214.831,224.585,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=36.0549,39.0635,216.659,216.751,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=35.9025,45.0465,224.585,224.737,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=39.7125,39.8046,220.27,224.585,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=46.0076,47.5611,224.585,224.737,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=49.2121,65.3157,224.585,224.737,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=47.8381,52.4887,219.098,219.2,0.0,2.75, SURF_ID='INERT'/ Obstruction
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&OBST XB=65.4523,65.545,211.942,214.564,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=65.3594,66.9633,214.564,214.793,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=65.4206,65.5127,214.793,219.565,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=54.1497,65.679,219.555,219.657,0.0,2.75, SURF_ID='INERT'/ Obstruction
&OBST XB=39.3288,46.0159,194.959,198.413,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=46.0159,57.8261,194.959,226.972,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=55.2903,65.7221,185.289,226.972,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=35.6448,56.1448,194.959,204.483,6.7,6.96, COLOR='GRAY 60', OUTLINE=.TRUE.,
SURF_ID='INERT'/ Obstruction
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&OBST XB=35.6448,46.0159,204.103,226.972,2.75,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.348,43.3832,198.413,198.505,3.96,6.71, SURF_ID='INERT'/ Obstruction
&OBST XB=28.6448,29.1448,181.483,181.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control04'/ GW16
&OBST XB=28.6448,28.6448,181.483,181.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control04'/ GW16
&OBST XB=27.6448,27.6448,182.483,182.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control05'/ GW13
&OBST XB=28.1448,28.6448,181.983,181.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control04'/ GW15
&OBST XB=25.6448,25.6448,186.483,186.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control10'/ GW4
&OBST XB=25.6448,25.6448,186.983,187.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control10'/ GW3
&OBST XB=27.6448,28.1448,182.483,182.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control05'/ GW14
&OBST XB=28.1448,28.1448,181.983,182.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control05'/ GW14
&OBST XB=26.6448,27.1448,183.983,183.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control07'/ GW10
&OBST XB=26.6448,26.6448,183.983,184.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control07'/ GW10
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&OBST XB=62.1448,62.1448,185.483,189.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=53.6448,56.1448,189.983,190.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
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&OBST XB=54.6448,54.6448,190.483,190.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=26.1448,26.6448,175.483,175.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=3.6448,3.6448,175.483,178.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=54.1448,54.1448,211.983,224.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=34.6448,35.6448,210.983,210.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=34.6448,34.6448,210.483,210.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=35.6448,35.6448,210.983,211.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=35.6448,36.6448,211.483,211.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=6.6448,7.1448,175.483,175.983,0.0,0.0, SURF_ID='INERT'/ Obstruction
&OBST XB=6.6448,7.1448,175.483,175.983,2.5,2.5, SURF_ID='INERT'/ Obstruction
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&OBST XB=7.1448,7.1448,175.483,175.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=45.6448,46.1448,194.983,194.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=45.6448,46.1448,195.483,195.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
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&OBST XB=46.1448,46.1448,194.983,195.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=36.1448,36.1448,214.483,214.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=52.6448,52.6448,211.983,224.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
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&OBST XB=16.6448,16.6448,210.983,214.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=20.1448,20.1448,210.983,214.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=31.1448,31.6448,174.983,174.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=31.6448,32.1448,175.483,175.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=31.1448,31.1448,174.483,174.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=31.6448,31.6448,174.983,175.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=11.6448,12.1448,191.483,192.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=7.1448,11.6448,192.483,192.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=7.1448,7.1448,192.483,194.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=47.6448,49.1448,224.483,225.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=-2.8552,-2.8552,175.483,175.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=45.1448,46.1448,224.483,225.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=45.6448,46.1448,207.983,216.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=43.1448,45.6448,216.983,216.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=46.1448,46.1448,206.483,207.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=46.1448,46.1448,216.983,224.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=19.6448,23.1448,187.483,187.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=22.6448,23.1448,187.983,190.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=19.6448,19.6448,175.983,187.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=36.1448,36.6448,194.983,195.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=36.6448,37.1448,195.483,195.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=37.1448,37.6448,195.983,196.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=37.6448,38.1448,196.483,196.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=38.1448,38.6448,196.983,197.483,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=38.6448,39.1448,197.483,197.983,0.0,2.5, SURF_ID='INERT'/ Obstruction
&OBST XB=39.1448,39.6448,197.983,198.483,0.0,3.5, SURF_ID='INERT'/ Obstruction
&OBST XB=29.6448,30.1448,180.483,180.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control02'/ GW19
&OBST XB=26.6448,27.1448,183.483,183.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control06'/ GW11
&OBST XB=48.1448,48.6448,187.483,187.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=48.6448,49.1448,187.983,188.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=49.1448,49.6448,188.483,188.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=49.6448,50.1448,188.983,189.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=50.1448,50.6448,189.483,189.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=50.6448,51.1448,189.983,190.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=51.1448,51.6448,190.483,190.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=51.6448,52.1448,190.983,191.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=52.1448,52.6448,191.483,191.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
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&OBST XB=52.6448,53.1448,191.983,192.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=53.1448,53.6448,192.483,192.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=53.6448,54.1448,192.983,193.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=54.1448,54.6448,193.483,193.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=54.6448,55.1448,193.983,194.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=46.1448,46.6448,185.483,185.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=46.6448,47.1448,185.983,185.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=47.1448,47.6448,186.483,186.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=47.6448,48.1448,186.983,186.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=46.1448,46.1448,184.983,185.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=46.6448,46.6448,185.483,185.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=47.1448,47.1448,185.983,186.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=47.6448,47.6448,186.483,186.983,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=48.1448,48.1448,186.983,187.483,2.5,6.5, PERMIT_HOLE=.FALSE.,
OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction
&OBST XB=25.6448,25.6448,187.483,187.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control11'/ GW2
&OBST XB=27.1448,27.6448,182.983,182.983,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control06'/ GW12
&OBST XB=27.1448,27.1448,182.983,183.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control06'/ GW12
&OBST XB=25.6448,25.6448,187.983,188.483,0.0,3.0, RGB=102,255,255, SURF_ID='INERT',
CTRL_ID='Control11'/ GW1
&OBST XB=46.6448,55.1448,185.483,185.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.1448,55.1448,185.983,186.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.6448,55.1448,186.483,186.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.1448,55.1448,186.983,187.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.6448,55.1448,187.483,187.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.1448,55.1448,187.983,188.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.6448,55.1448,188.483,188.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=50.1448,55.1448,188.983,189.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=50.6448,55.1448,189.483,189.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=51.1448,55.1448,189.983,190.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=51.6448,55.1448,190.483,190.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=52.1448,55.1448,190.983,191.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=52.6448,55.1448,191.483,191.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=53.1448,55.1448,191.983,192.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
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Obstruction
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Obstruction
&OBST XB=54.1448,55.1448,192.983,193.483,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=54.6448,55.1448,193.483,193.983,3.0,3.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.1448,36.6448,194.983,198.483,4.0,6.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.1448,36.6448,185.483,194.983,4.0,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.1448,40.6448,184.983,185.483,2.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.6448,37.1448,193.983,194.483,10.5,11.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.6448,38.6448,192.983,193.483,10.0,10.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.6448,41.6448,189.483,189.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=36.6448,45.1448,185.983,186.483,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=37.1448,37.6448,194.483,194.983,10.5,11.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=38.1448,39.1448,193.483,193.983,10.0,10.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=38.6448,39.6448,193.983,194.483,10.0,10.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=39.1448,39.6448,191.983,192.483,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=39.1448,40.1448,194.483,194.983,10.0,10.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=39.6448,40.1448,192.483,192.983,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=40.1448,40.6448,192.983,193.483,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=40.1448,41.1448,190.983,191.483,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=40.6448,41.1448,193.483,193.983,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=40.6448,41.6448,191.483,191.983,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=40.6448,46.1448,184.983,185.483,2.5,6.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.1448,41.6448,193.983,194.483,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.1448,42.1448,191.983,192.483,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.6448,42.1448,189.983,190.483,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.6448,42.1448,194.483,194.983,9.5,10.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=41.6448,42.6448,192.483,192.983,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=42.1448,42.6448,190.483,190.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=42.1448,43.1448,188.483,188.983,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=42.1448,43.1448,192.983,193.483,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=42.6448,43.1448,190.983,191.483,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=42.6448,43.6448,193.483,193.983,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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&OBST XB=43.1448,43.6448,188.983,189.483,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.1448,43.6448,191.483,191.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.1448,44.1448,193.983,194.483,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.6448,44.1448,187.483,187.983,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.6448,44.1448,189.483,189.983,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.6448,44.1448,191.983,192.483,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=43.6448,44.6448,194.483,194.983,9.0,9.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=44.1448,44.6448,187.983,188.483,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
&OBST XB=44.1448,44.6448,192.483,192.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=44.6448,45.1448,188.483,188.983,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
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Obstruction
&OBST XB=45.1448,45.6448,186.483,186.983,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
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Obstruction
&OBST XB=45.1448,45.6448,193.483,193.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=45.6448,46.1448,186.983,187.483,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
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Obstruction
&OBST XB=45.6448,46.1448,193.983,194.483,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=46.1448,46.6448,185.483,185.983,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=46.1448,46.6448,187.483,187.983,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
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Obstruction
&OBST XB=46.1448,46.6448,194.483,194.983,8.5,9.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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Obstruction
&OBST XB=46.6448,47.1448,187.983,188.483,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=46.6448,47.1448,190.483,190.983,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=46.6448,47.1448,192.483,192.983,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.1448,47.6448,186.483,186.983,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.1448,47.6448,188.483,188.983,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
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Obstruction
&OBST XB=47.1448,47.6448,190.983,191.483,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.1448,47.6448,192.983,193.483,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.6448,48.1448,186.983,187.483,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.6448,48.1448,188.983,189.483,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.6448,48.1448,191.483,191.983,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=47.6448,48.1448,193.483,193.983,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.1448,48.6448,187.483,187.983,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.1448,48.6448,189.483,189.983,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.1448,48.6448,191.983,192.483,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.1448,48.6448,193.983,194.483,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.6448,49.1448,187.983,188.483,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.6448,49.1448,189.983,190.483,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.6448,49.1448,192.483,192.983,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=48.6448,49.1448,194.483,194.983,8.0,8.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.1448,49.6448,188.483,188.983,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.1448,49.6448,190.483,190.983,7.0,7.5, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.1448,49.6448,192.983,193.483,7.5,8.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
&OBST XB=49.6448,50.1448,188.983,189.483,6.5,7.0, OUTLINE=.TRUE., SURF_ID='INERT'/
Obstruction
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&TAIL /
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Appendix E - Presentation Slideshow

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

Presented by: Andy Bigalke

CAL POLY

FPE 596 Culminating Experience in Fire Protection Engineering

June 12, 2014

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**

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Building Overview

2002 Addition

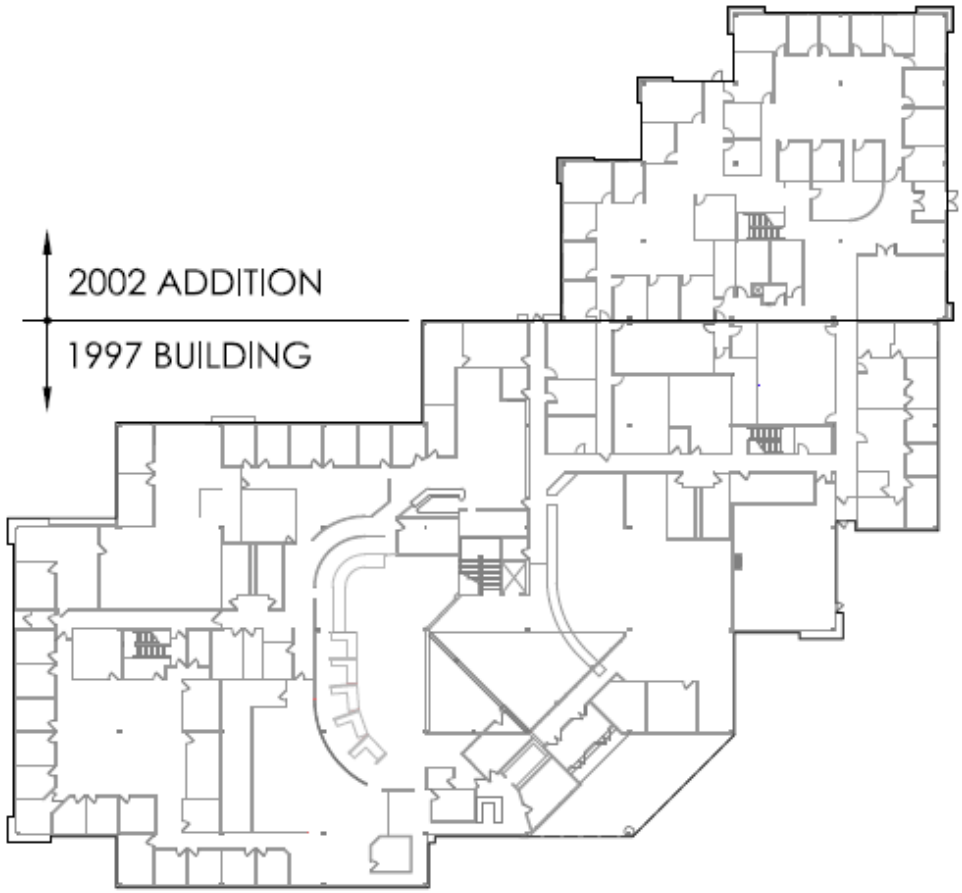
International Building Code

Type II-B

1997 Building

Uniform Building Code

Type II-N



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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

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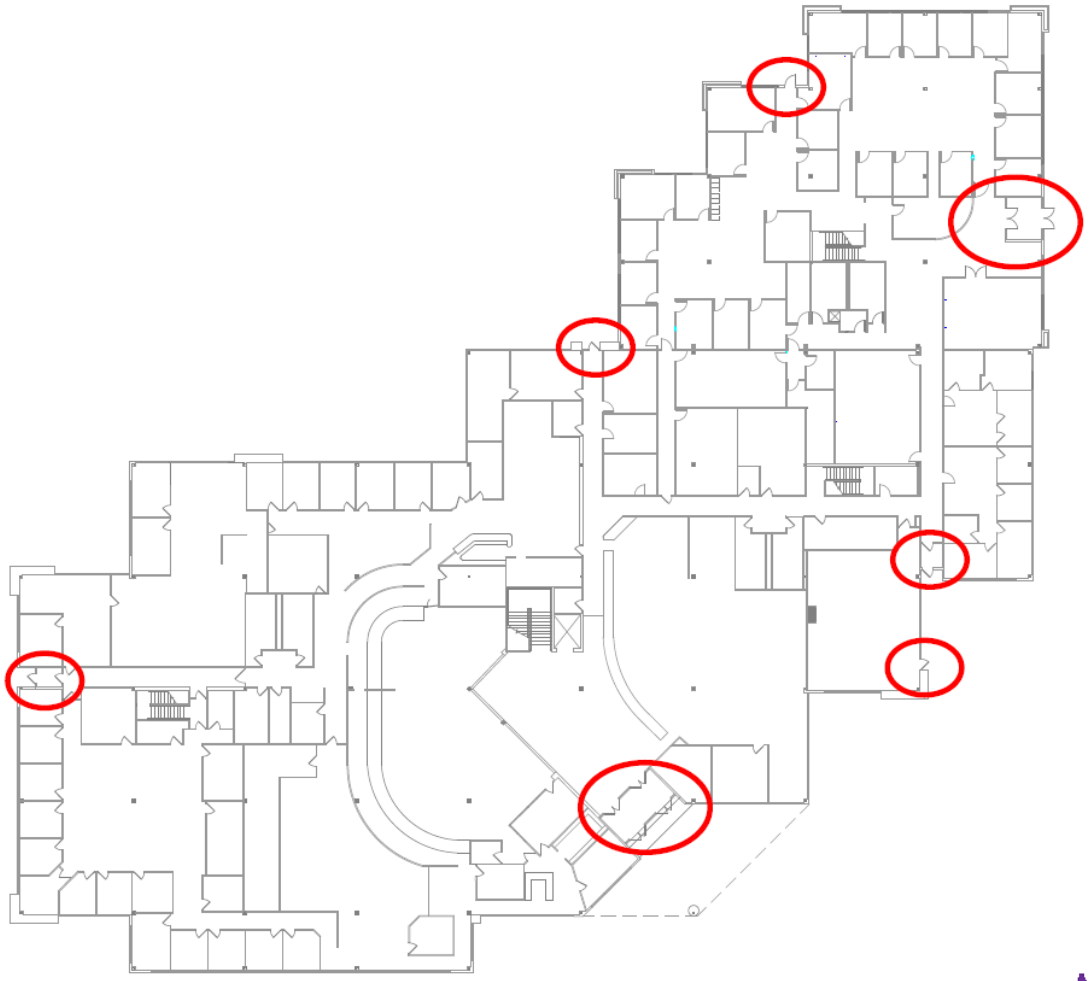

1ST Floor – Plan View

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

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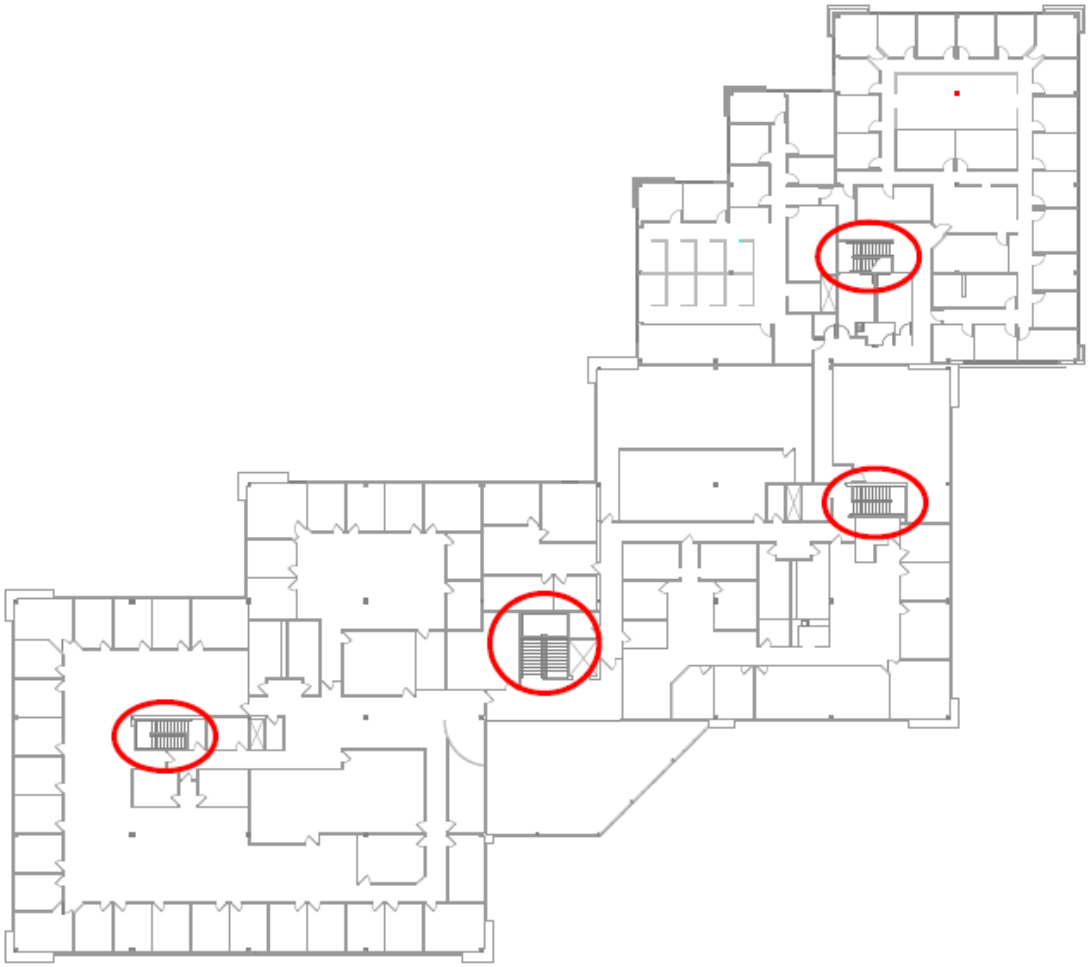

2nd Floor – Plan View

2nd Floor Vertical Egress

Main Stair
(6'-0" Wide)

3 Additional Stairs
(44" Wide)

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Prescriptive Life Safety Analysis

Allowable Building Height, Stories, and Area

(IBC Table 503)

		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
GROUP		STORIES(S) AREA (A)								
A-I	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

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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 ✔

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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] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 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)	$1^1/_2$[b]	1[b, c]	1[b, c]	oc	1[b, c]	0	HT	1[b, c]	0

Fire Resistance Rating = 0 hrs ✔

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

FIRE SEPARATION DISTANCE =X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUPH[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 ≤ X <10	IA Others	3 2	2 1	1 1
10 ≤ X < 30	IA,IB lIB, VB Others	2 1 1	1 0 1	I[d] 0 I[d]
X ≥ 30	All	0	0	0

Fire Resistance Rating for Exterior Walls = 0 hrs ✔

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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 ✔

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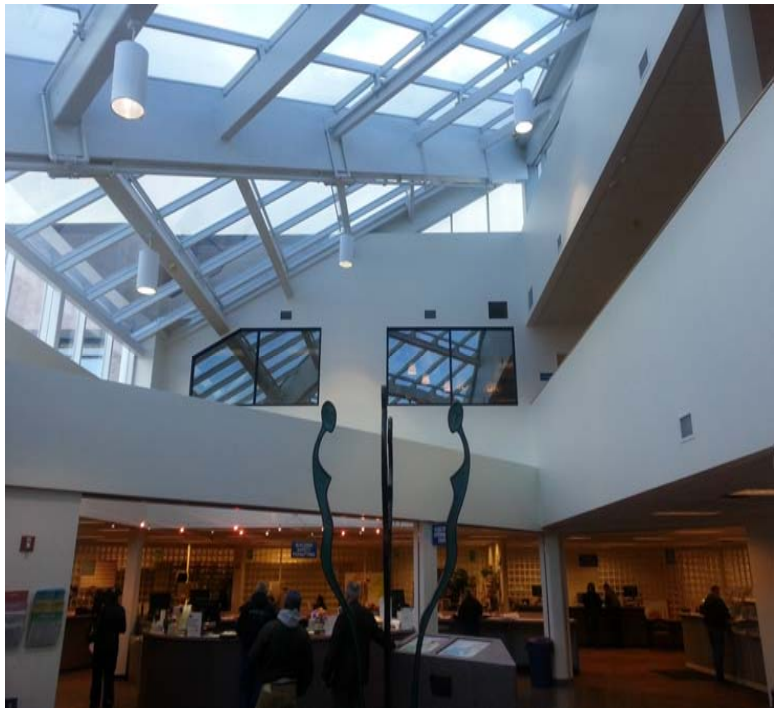
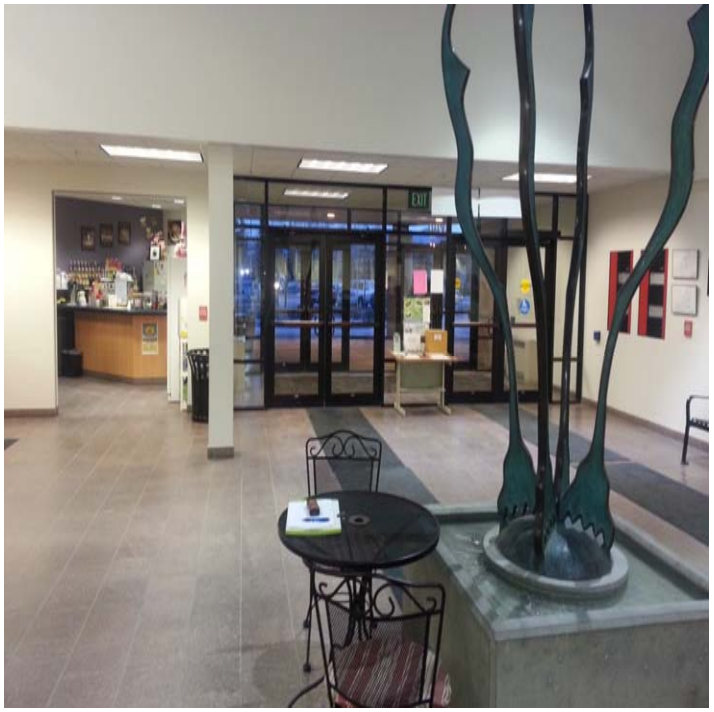
Atrium

(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.*"





CAL POLY

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! ✔

CAL POLY

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 ft^2 max system coverage

1st and 2nd Floors each < 52,000 ft^2

One Wet Pipe System OK ✔

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

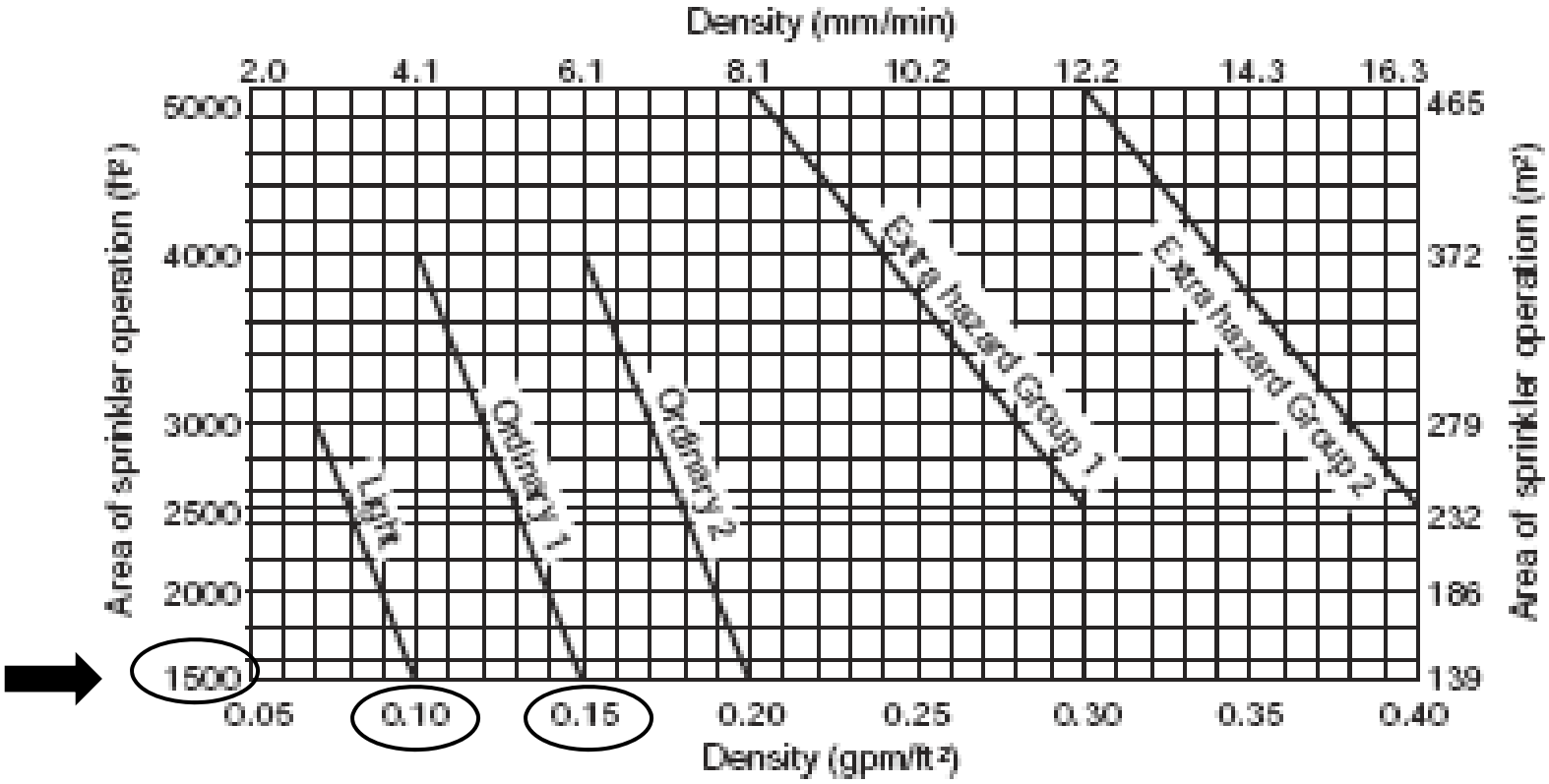

FIGURE 11.2.3.1.1 Density/Area Curves.

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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

Occupancy	*Inside Hose*		*Total Combined Inside and Outside Hose*		*Duration (minutes)*
	gpm	*L/min*	*gpm*	*L/min*	
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 ✔

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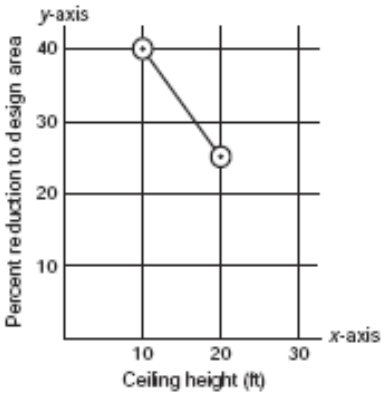
Quick Response Sprinklers (NFPA 13 - 11.2.3.2.3)

Remote Area Reduction

- Wet pipe system
- Light or ordinary hazard occupancy
- 20 ft max ceiling height
- No unprotected ceiling pockets (>32 ft²)



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

For ceiling height ≥10 ft and ≤20 ft, $y = \frac{-3x}{2} + 55$
For ceiling height <10 ft, $y = 40$
For ceiling height >20, $y = 0$
For SI units, 1 ft = 0.31 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**

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Max Sprinkler Coverage & Spacing

TABLE 8.6.2.2.1(a) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Light Hazard

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

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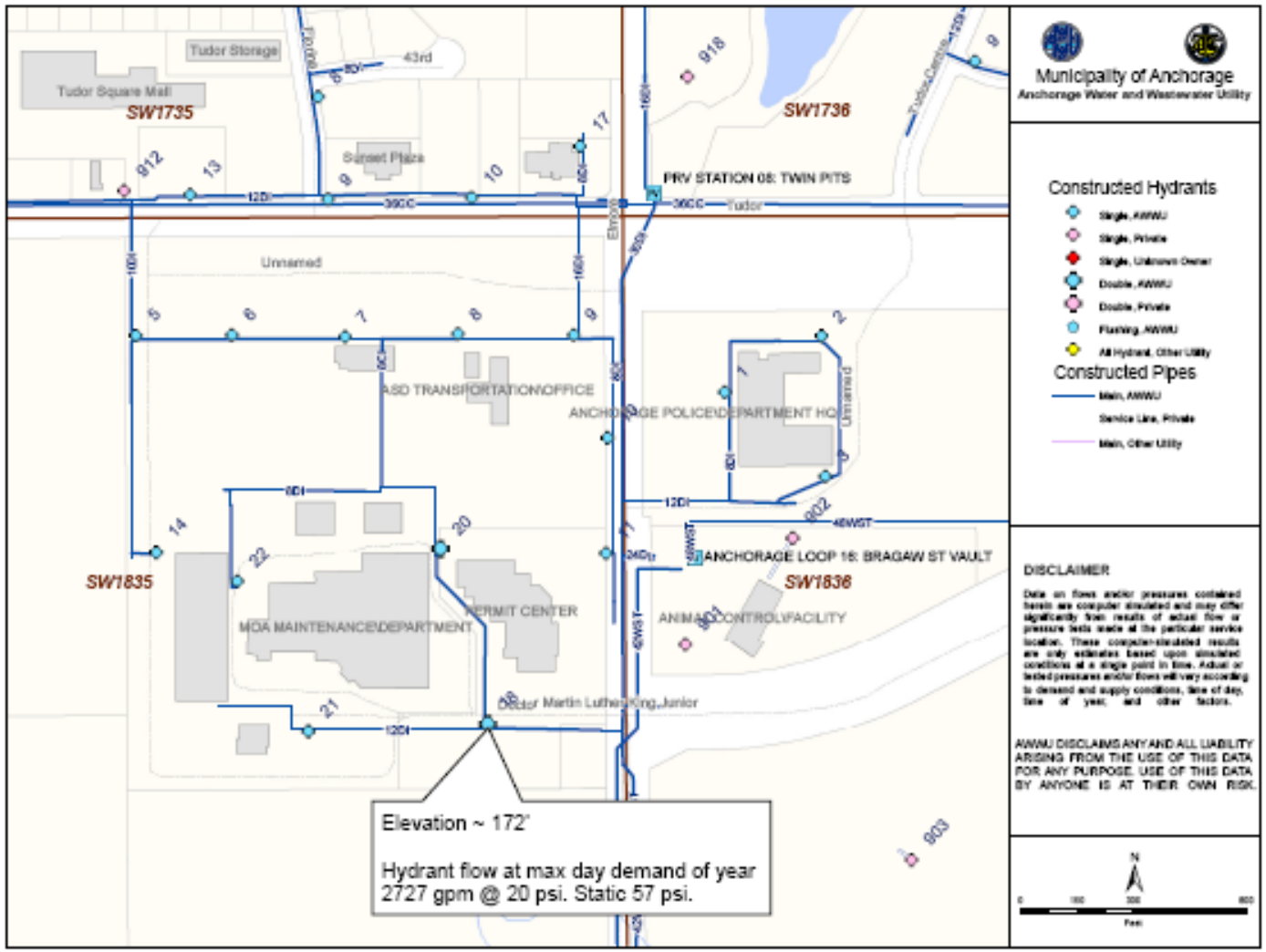
Water Supply – AWWU Computer Model



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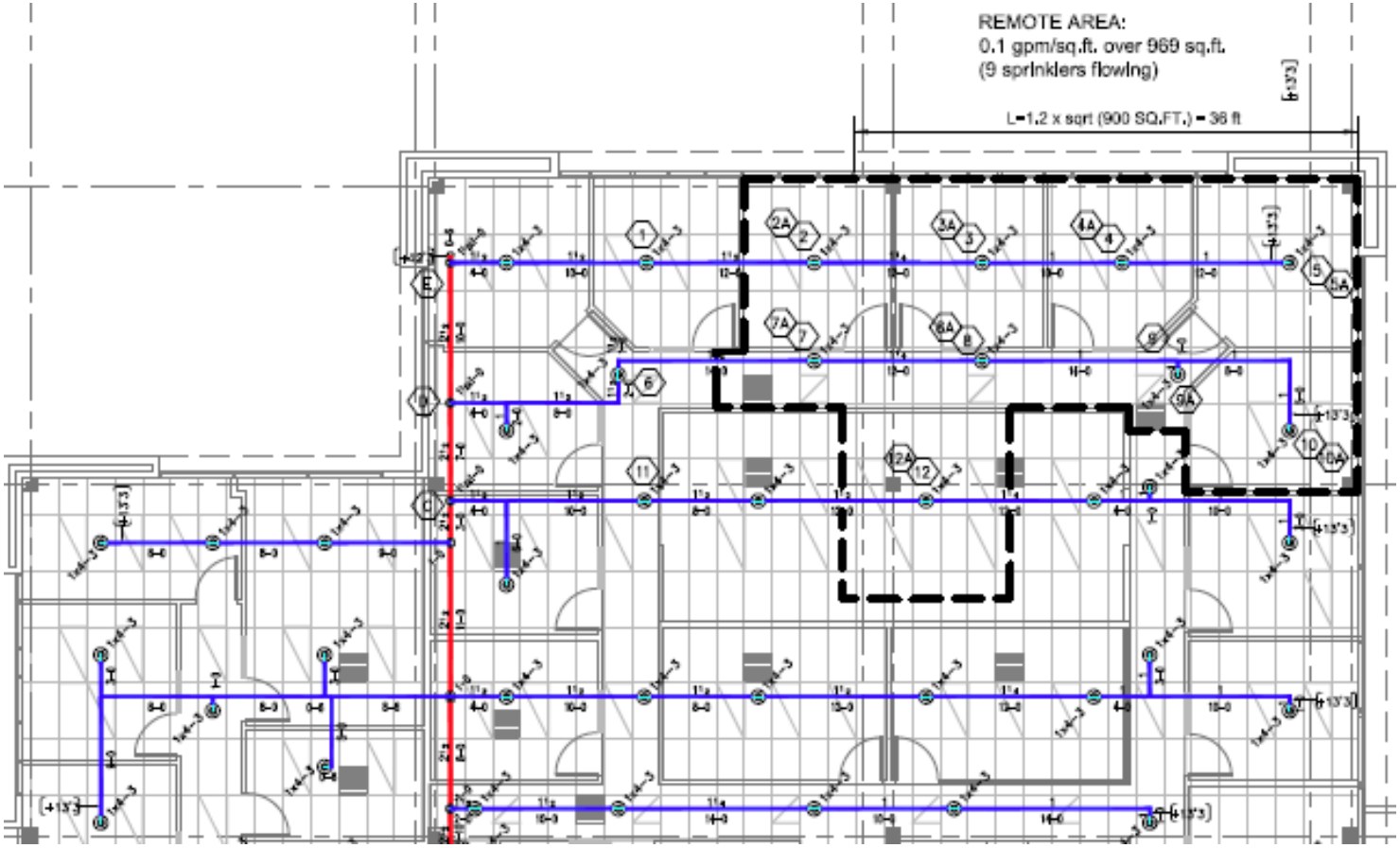
Hydraulic Calculation – 2nd Floor Addition

0.1 gpm / 969 ft² with 100 gpm Hose Demand



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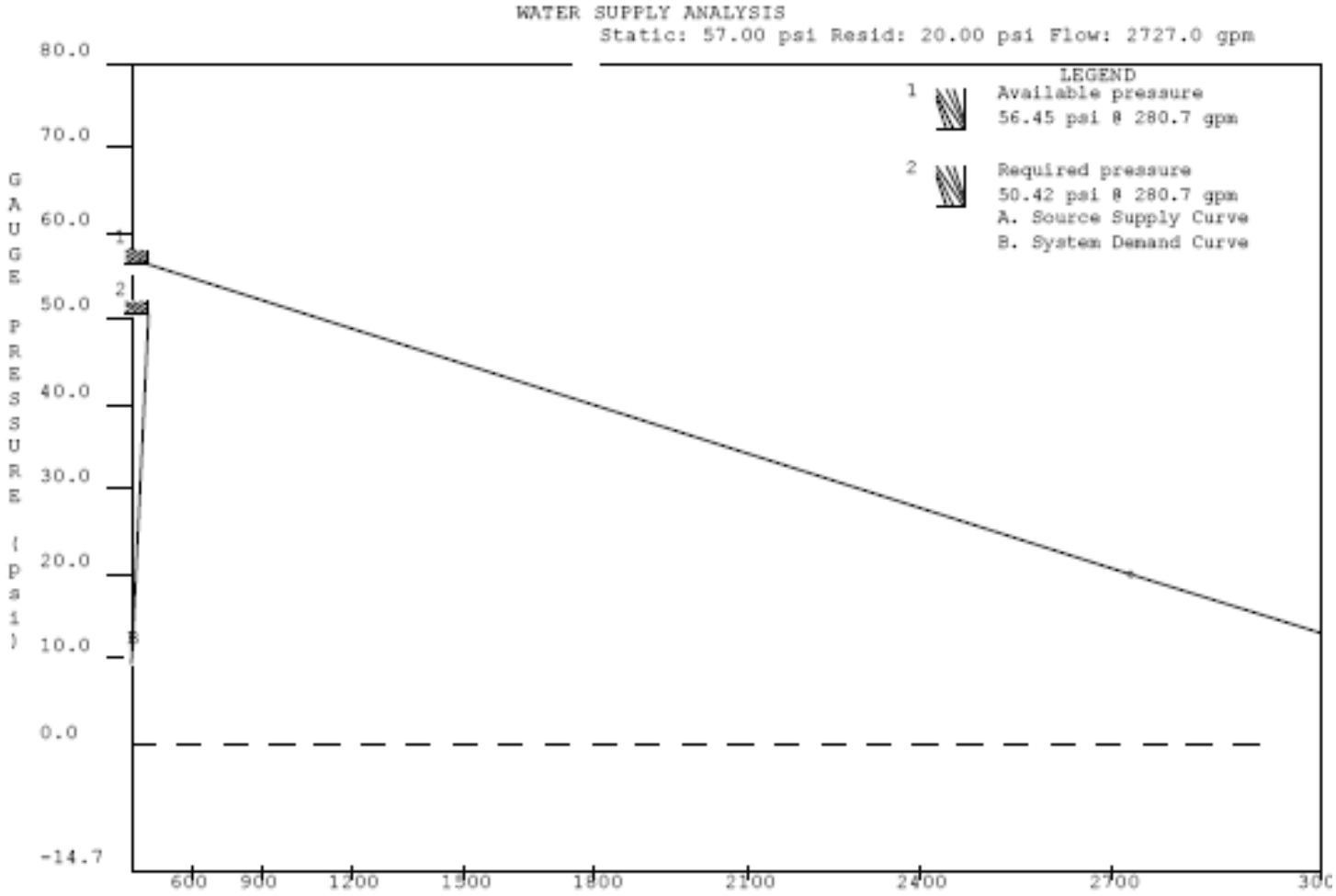
Hydraulic Calculation Analysis



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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

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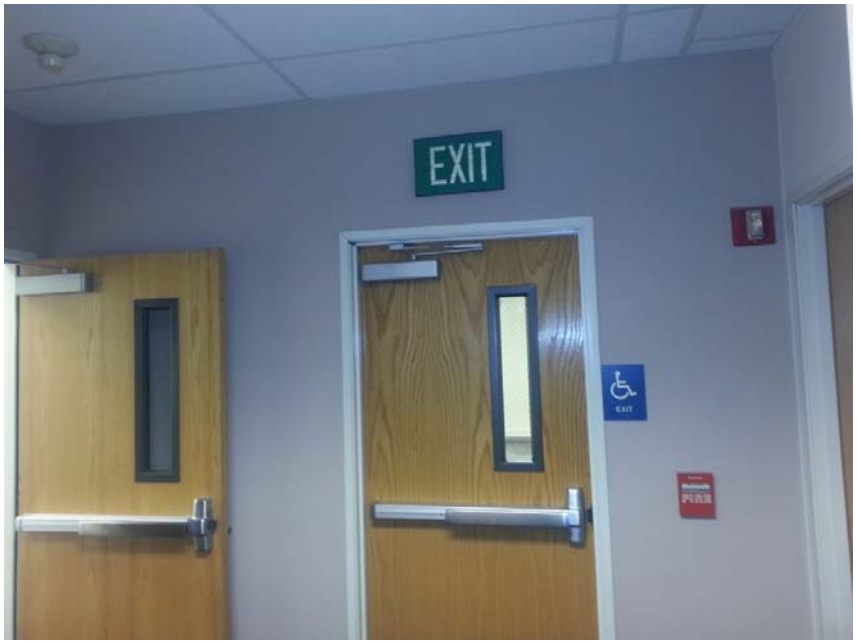
- **Smoke Detectors**

(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

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- **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

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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

Total = 641 + 373 = 1014

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2nd Floor Exit Capacity (IBC 1005.1)

Stair	Stair Width (inches)	Stair Capacity (inches/0.3)	Door Width (inches)	Door Capacity (inches/0.2)
#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) ✔

CAL POLY

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

Exit	Total Door Width (inches)	Door Capacity (inches/0.2)
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) ✔

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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 ✔

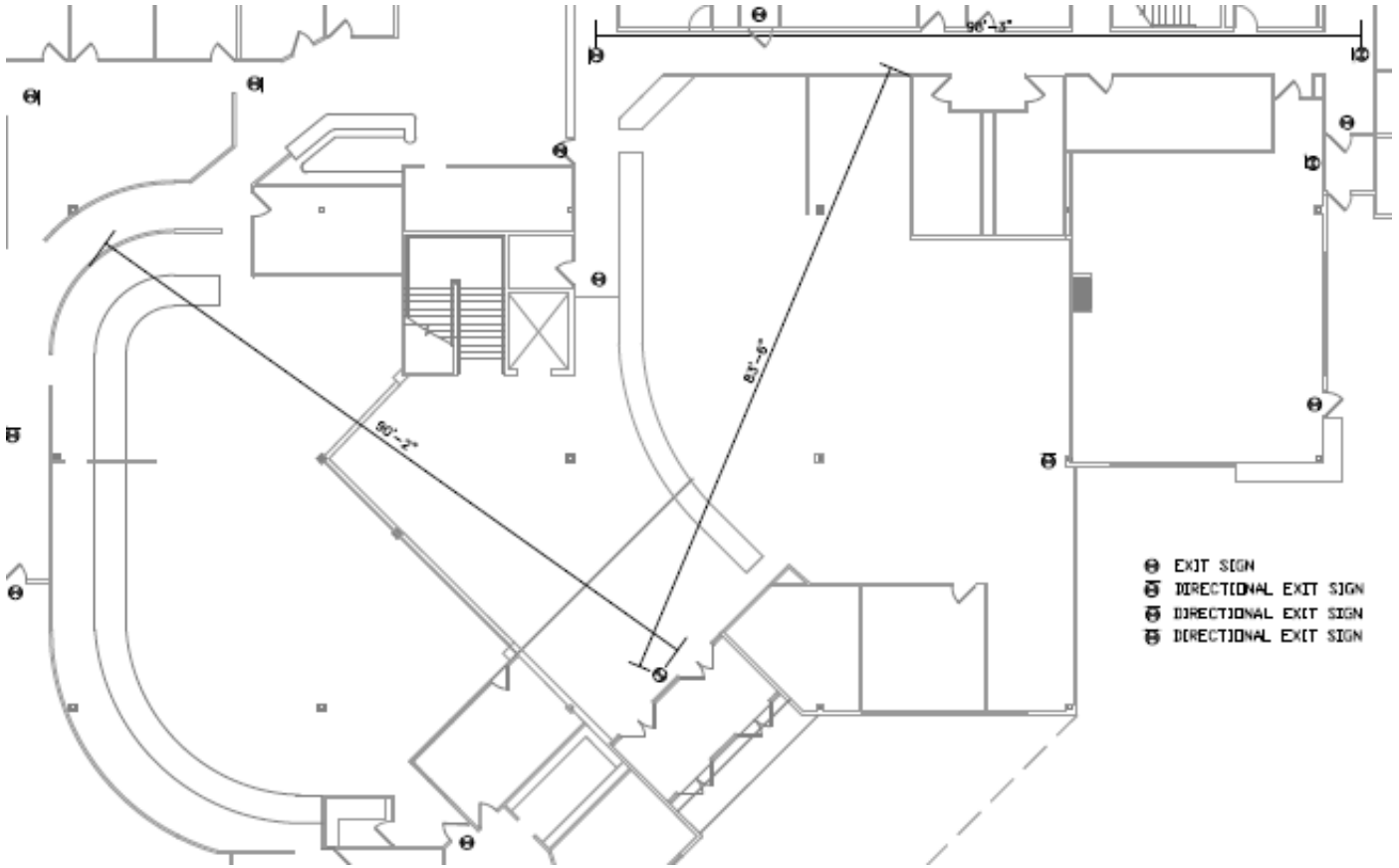
Corridor Dead Ends (IBC 1018.4)

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

CAL POLY

Exit Signs (IBC 1011.1)

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



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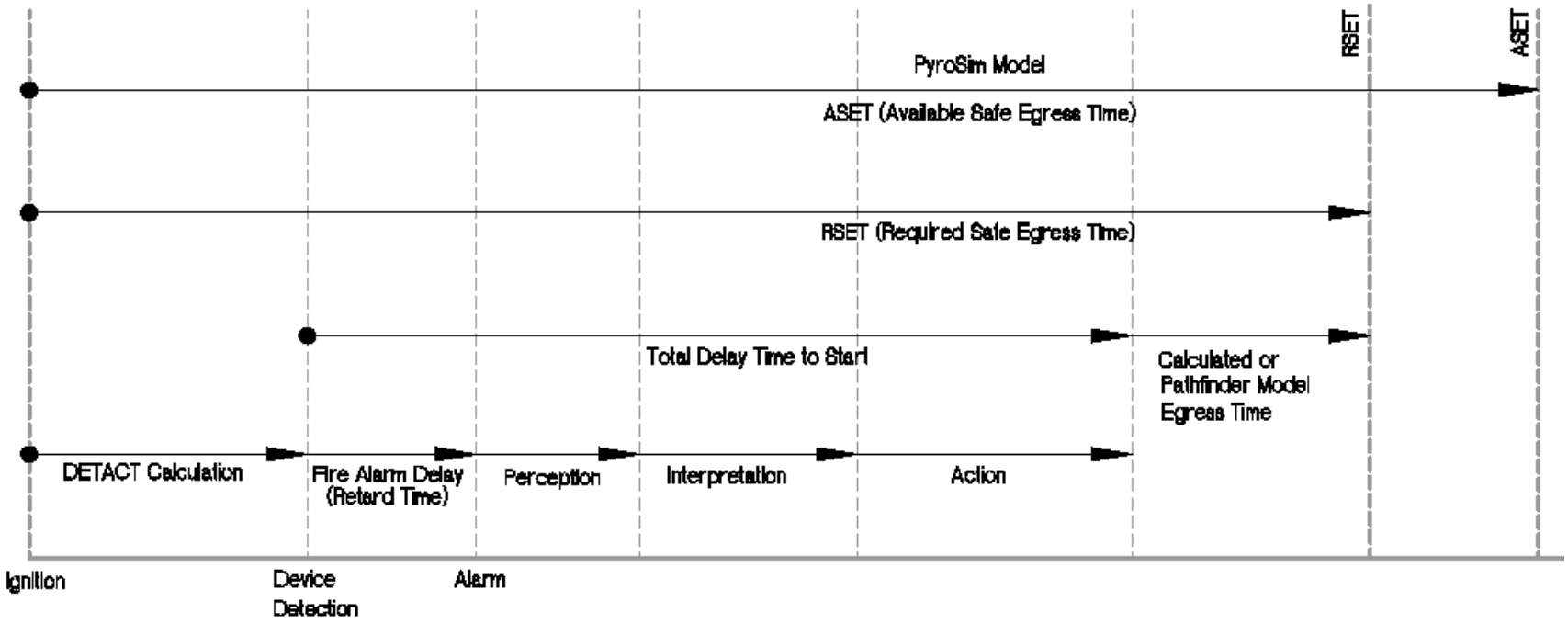
RSET < ASET



Fire Alarm Delay = 25 seconds[1] ✔

Delay Time to Start Evacuation = 66 seconds[2] ✔

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

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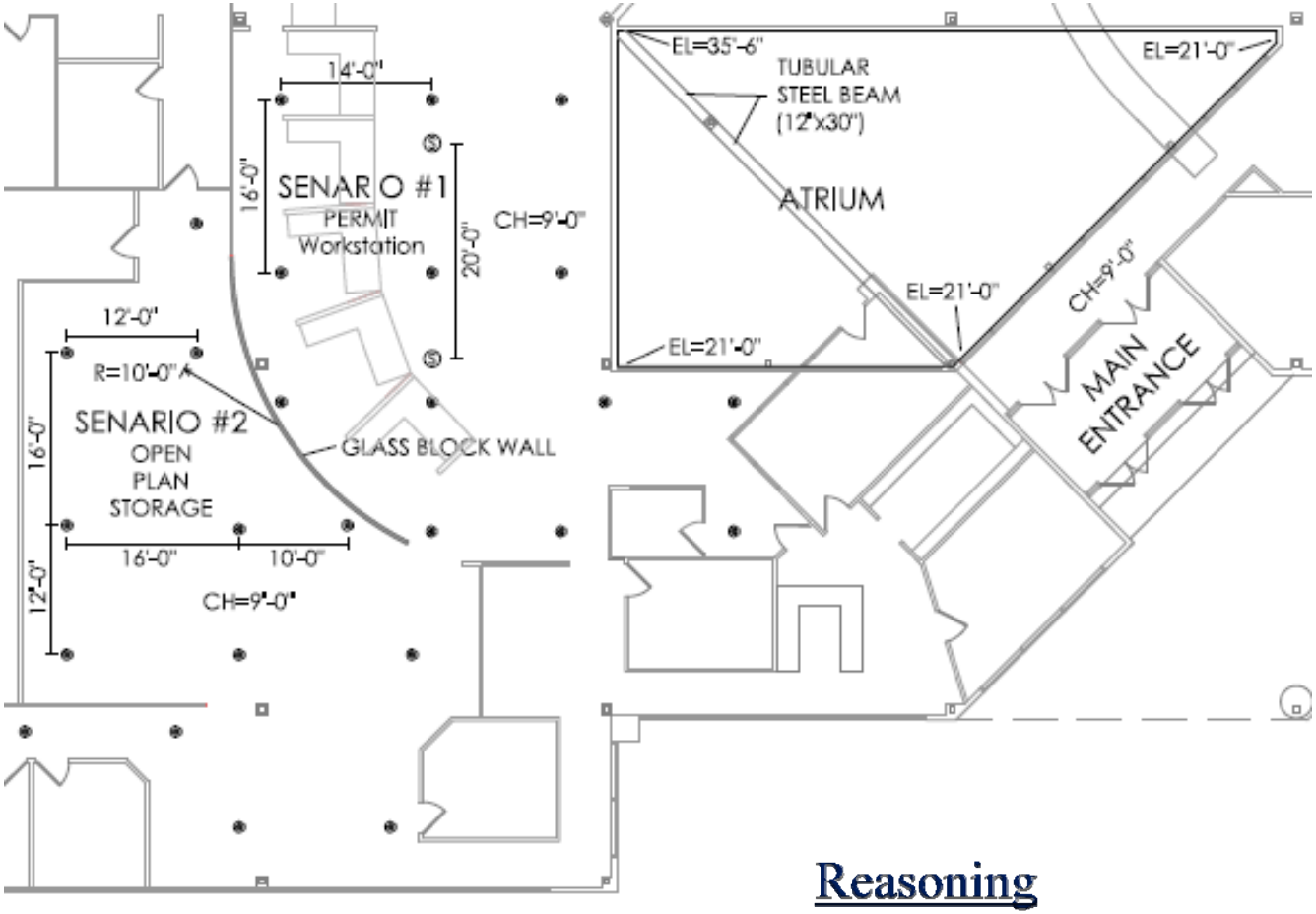
Influencing Factors of Egress

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

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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

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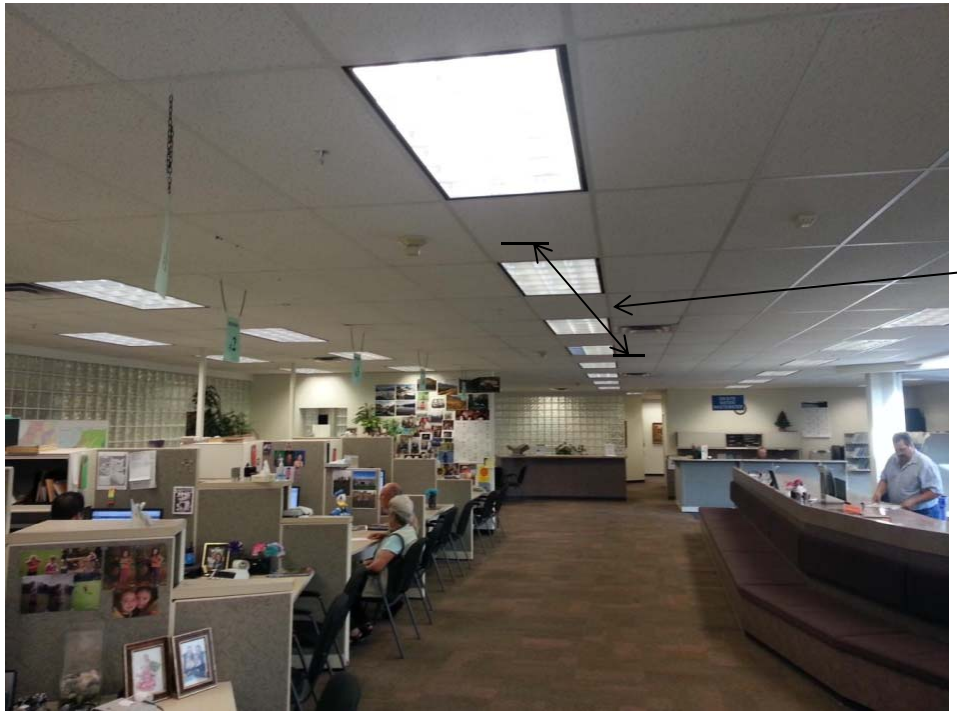
Fire Scenario #1:



Permitting Work Station Area

Smoke detectors 20’ o.c. above work stations

<u>Central ESLO ECOH Sprinklers</u>

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

CAL POLY

Open Plan Storage Area

Fire Scenario #2:

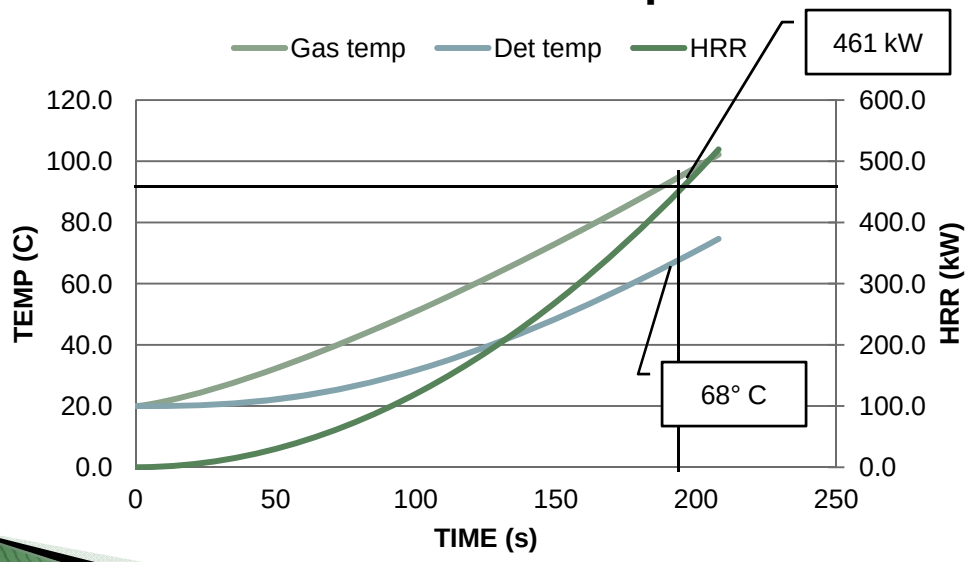
- Open Storage
- Wood / Paper combustibles
- 16'x16" ECOH Sprinklers
- No Smoke Detectors
- Plastic trash containers
- Ceiling Height = 9'-0"
- Glass block wall
- Fast t^2 fire

CAL POLY

DETACT 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

DETACT Scenario 1 Sprinkler



Fire Scenario #1

(Sprinkler Activation)

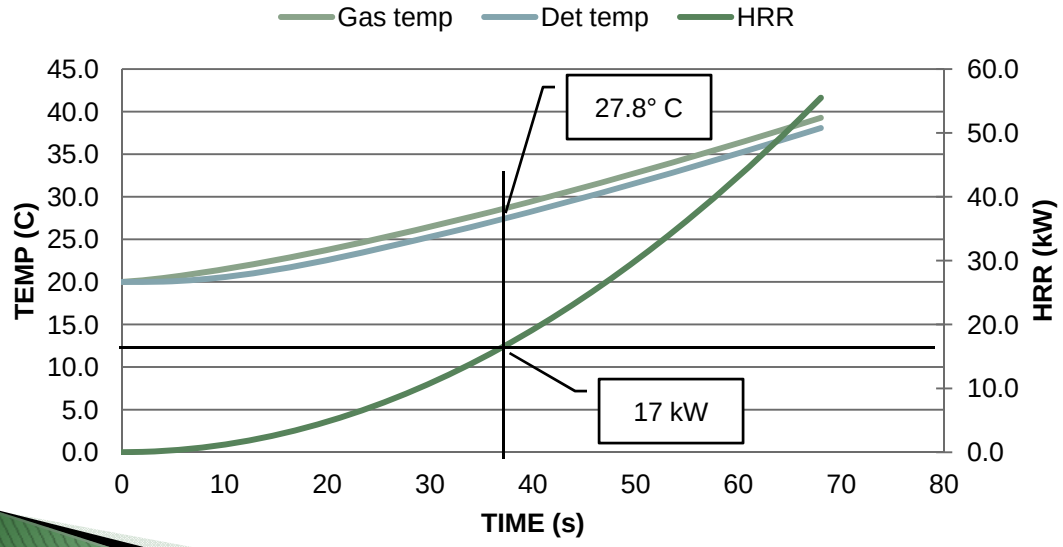
- Activates at 196 seconds
- HRR = 461 kW

CAL POLY

DETACT 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

DETACT Scenario 1 Smoke Detector



Fire Scenario #1

(Detector Activation)

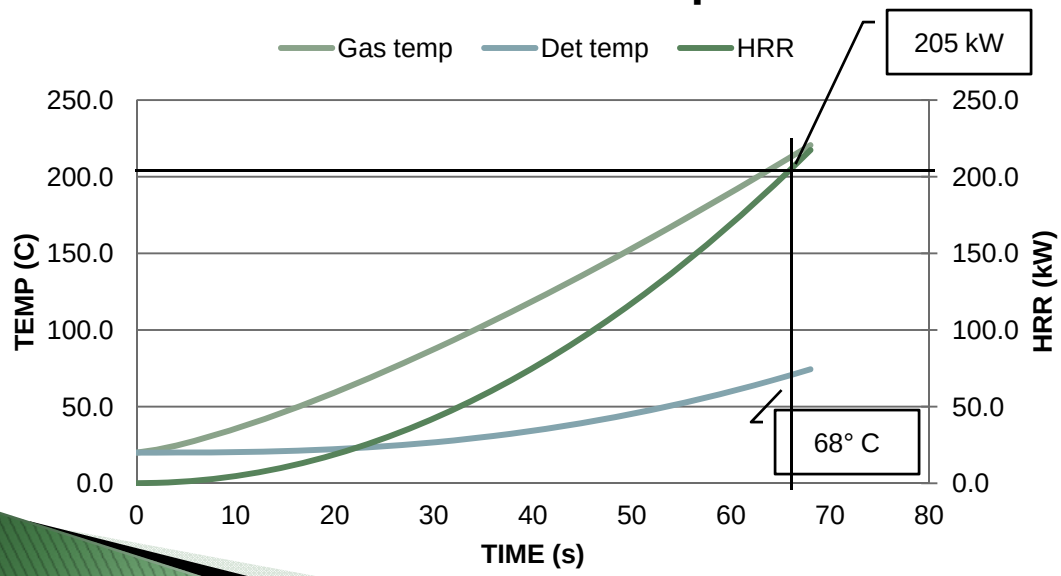
- Activates at 38 seconds
  - HRR = 17 kW

CAL POLY

DETACT 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

DETACT Scenario 2 Sprinkler



Fire Scenario #2

(Sprinkler Activation)

- Activates at 66 seconds
- HRR = 205 kW

CAL POLY

Total Building Egress Time

Egress Component	Width (inches)	Effective Width (We) (inches)	Effective Width (We) (feet)	Flow Capacity (persons per minute)
Main Entrance #1	2 (68)	2(68 – 12) = 112	9.33	24 x 9.33 = **224**
Secondary Entrance #2	68	68– 12 = 56	4.67	24 x4.67 = **112**
Exits #3 to #6	4(34)	4(34 – 12) = 88	7.33	24 x 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) ✔

CAL POLY

Calculated (DETACT) RSET

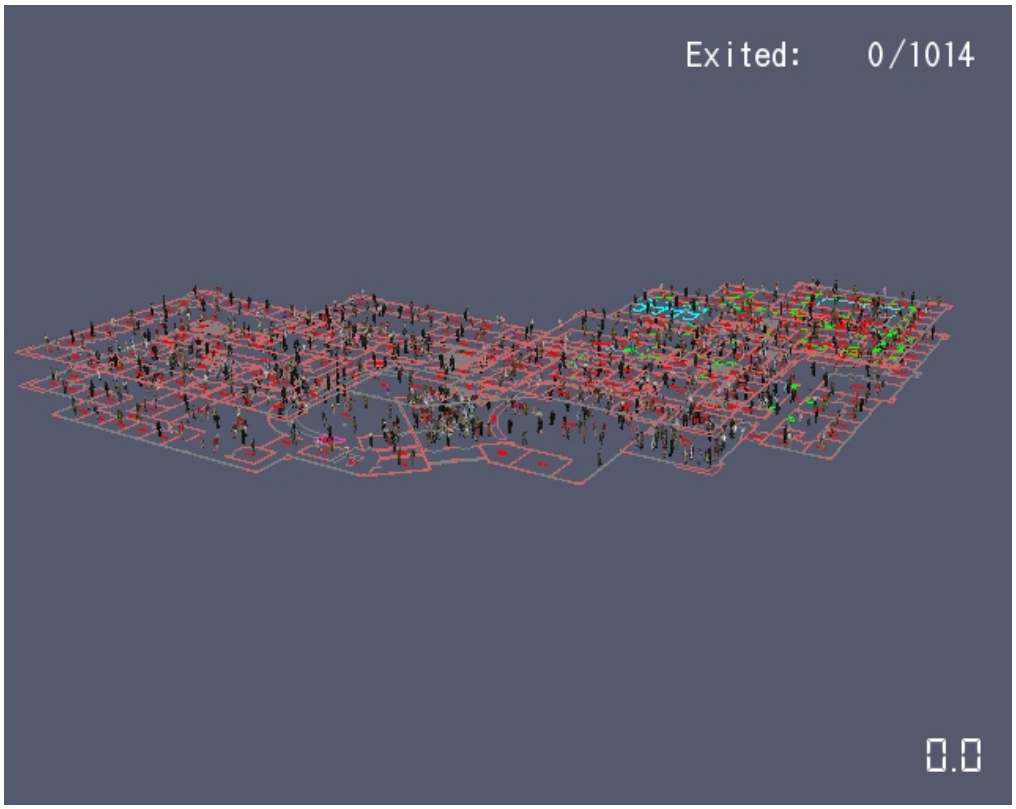
= Detection & Notification (Retard Time)
+ Pre-Movement + Total Evacuation

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 ✔

CAL POLY

Pathfinder Egress Simulation Model

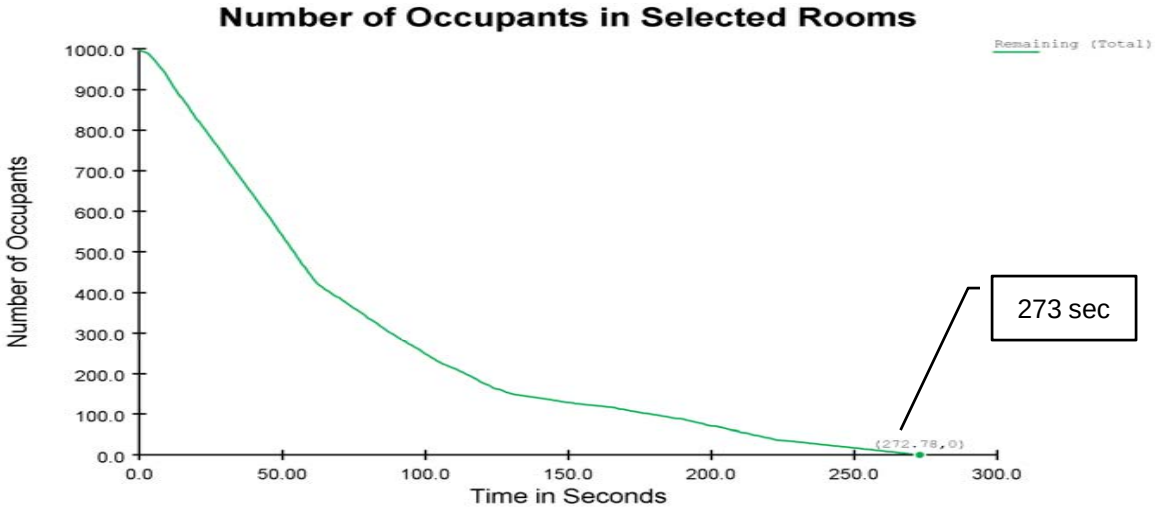


Model Based Upon

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

CAL POLY

(Pathfinder) RSET



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 ✔

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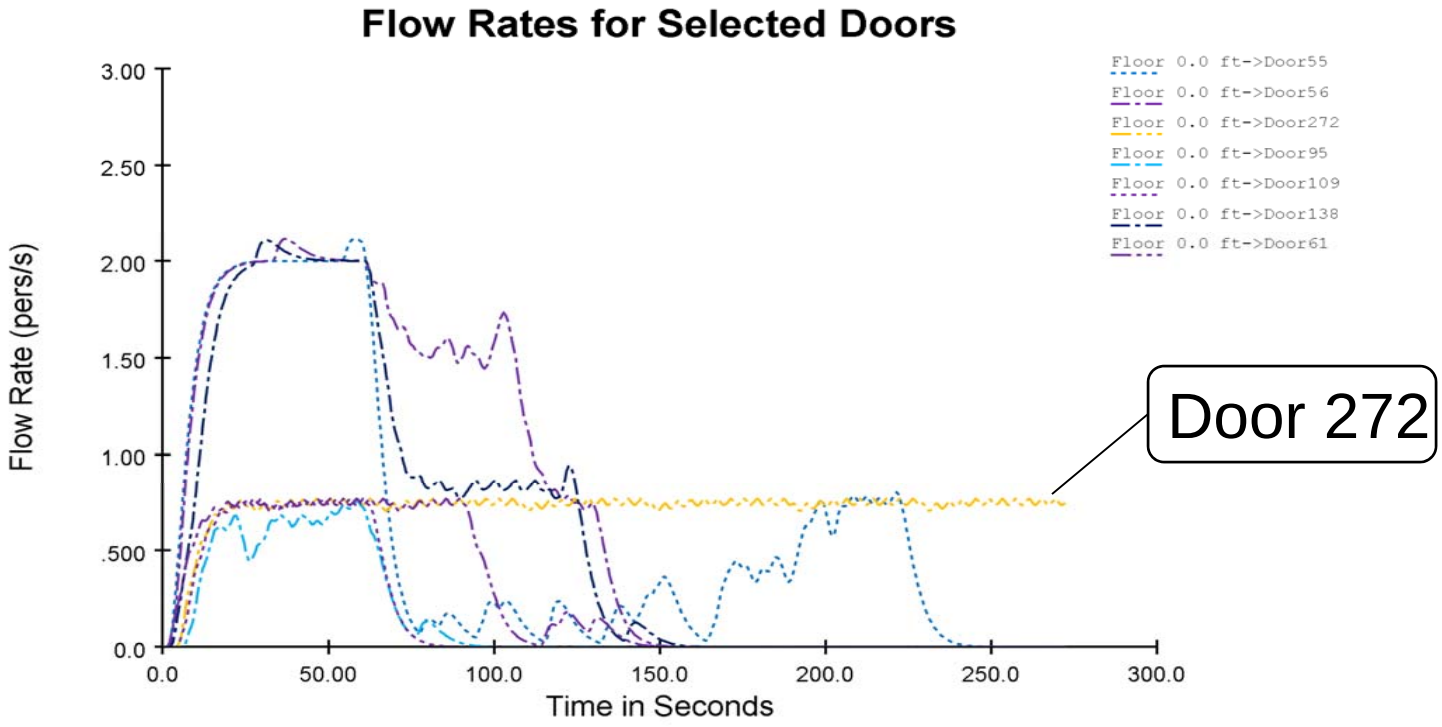
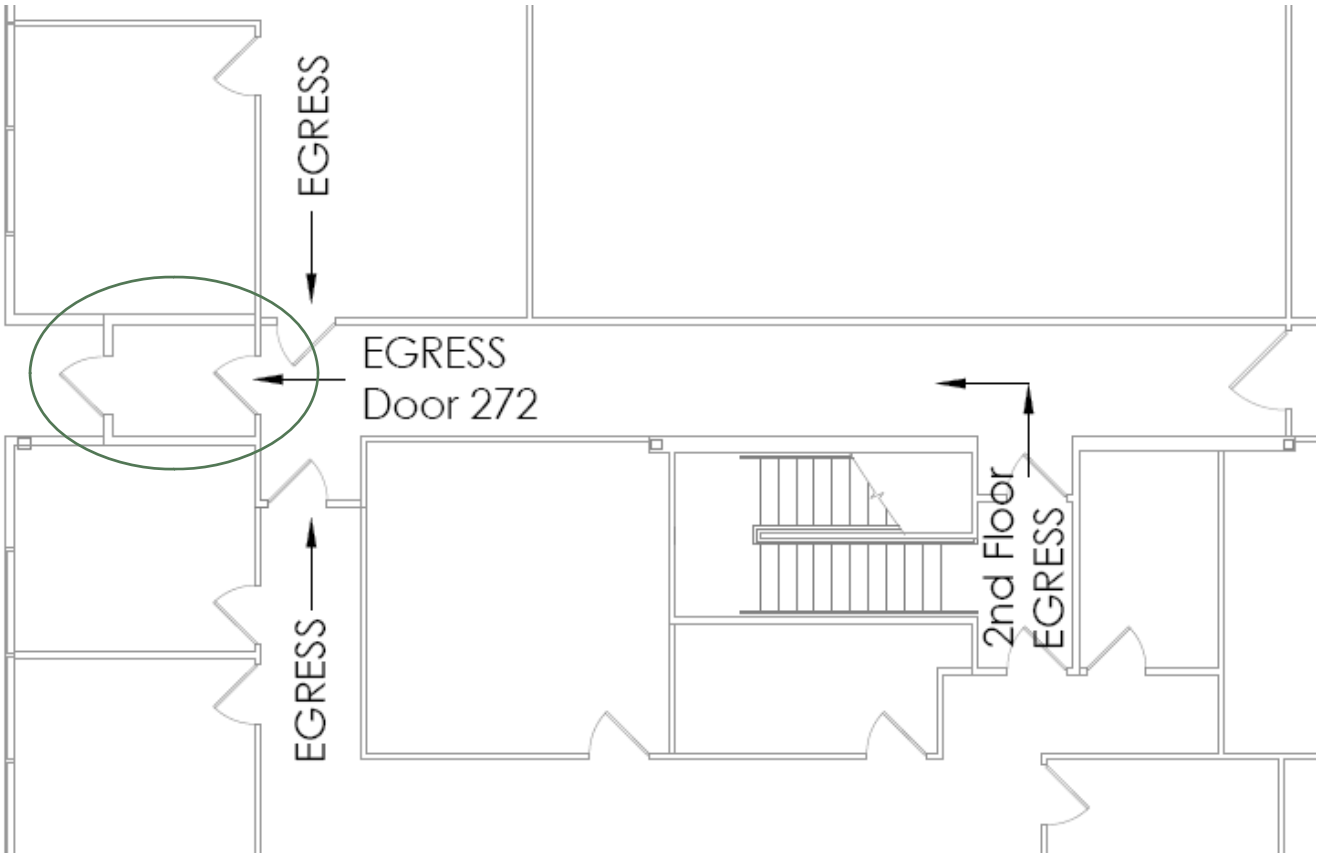
Pathfinder Results



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

CAL POLY

Pathfinder Results



- Door 272: South Exit Door

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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)

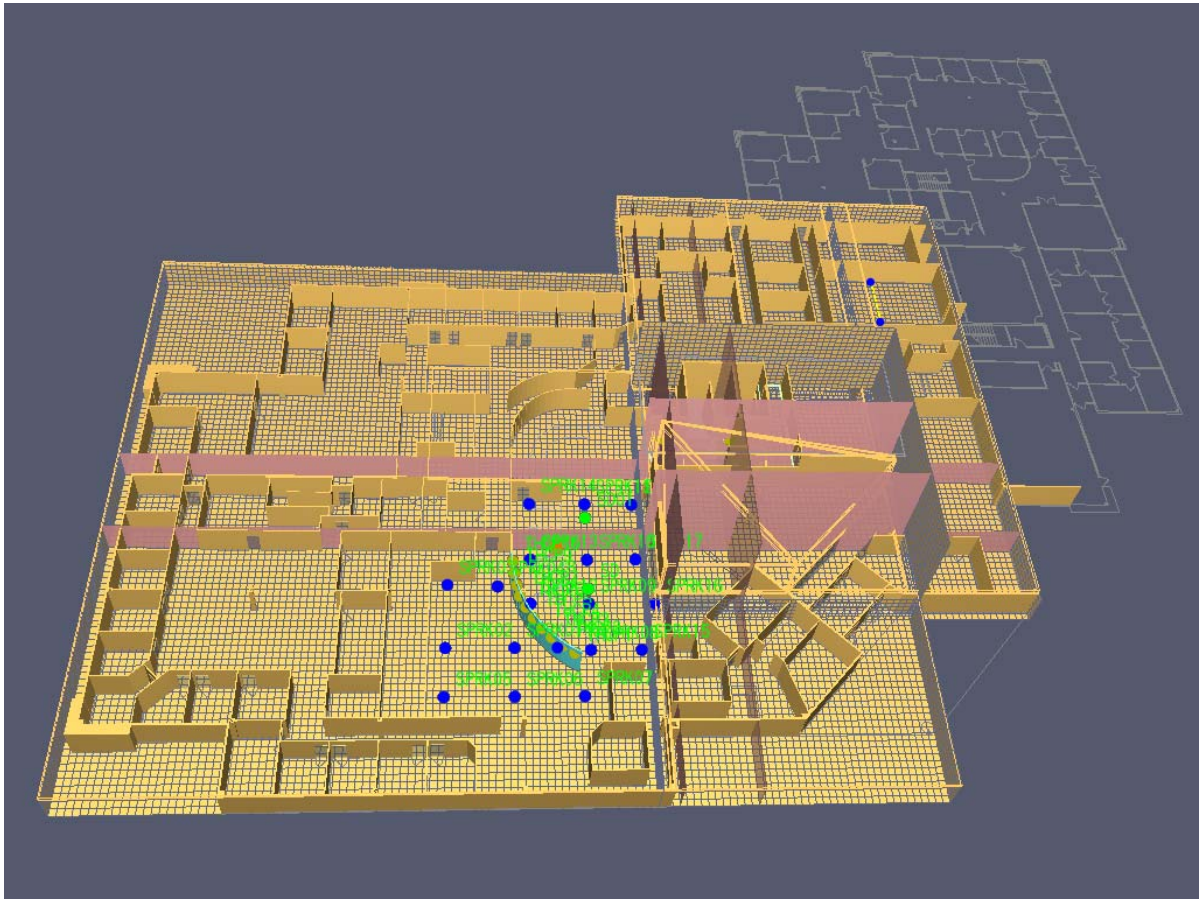
- Maintain 6 ft (2 m) tenable conditions on 2nd floor lobby.

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.

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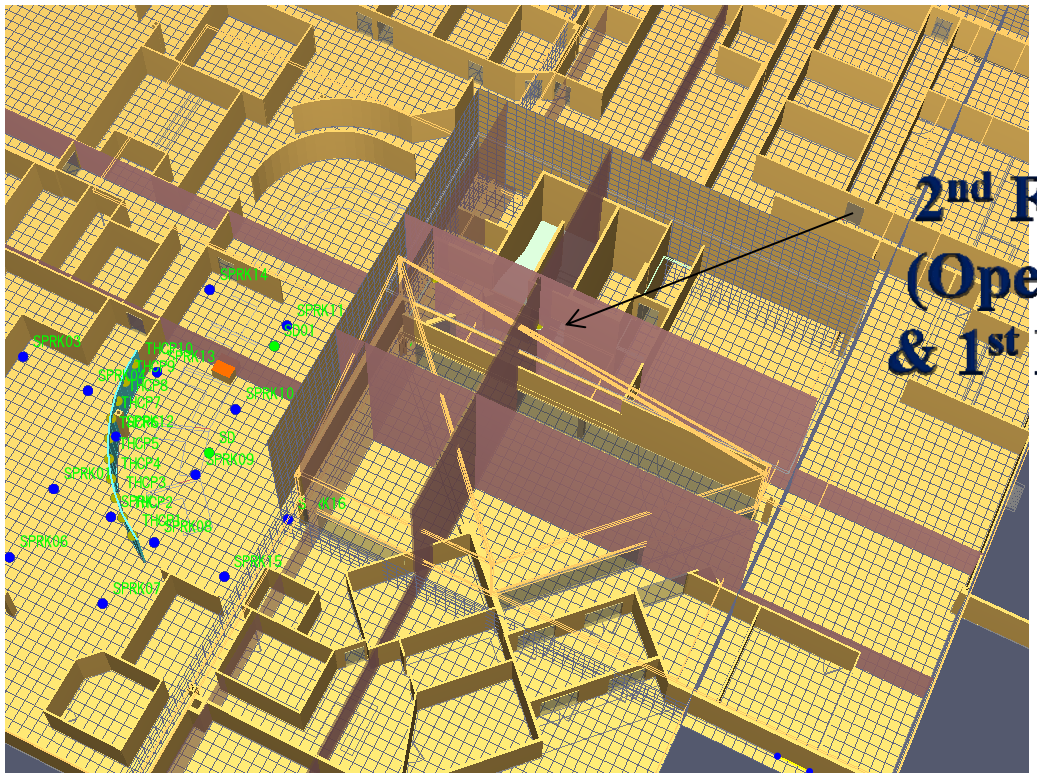
Close-up of Model



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

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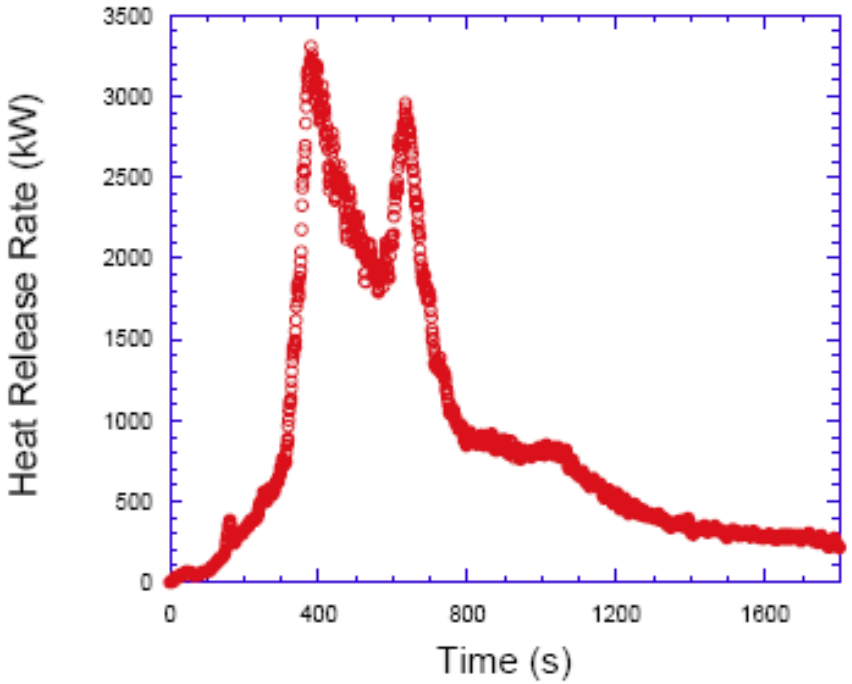
Scenario #1 Workstation HRR

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



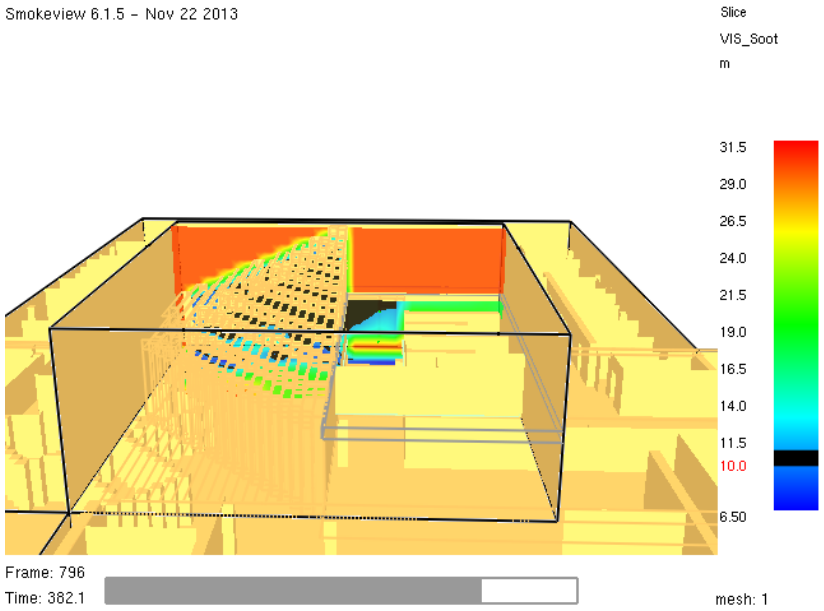
Model HRR = 3.3 MW at 360 seconds

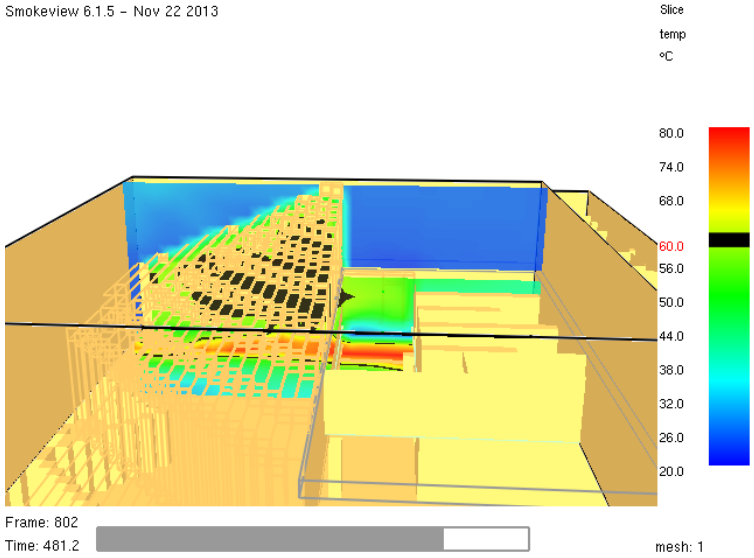
NIST Special Publication SP-1021
Cook County Administration Building Fire

CAL POLY

Scenario #1 Results

(*without* sprinkler activation)





Visibility > 10 m

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

Temperature < 60° C

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

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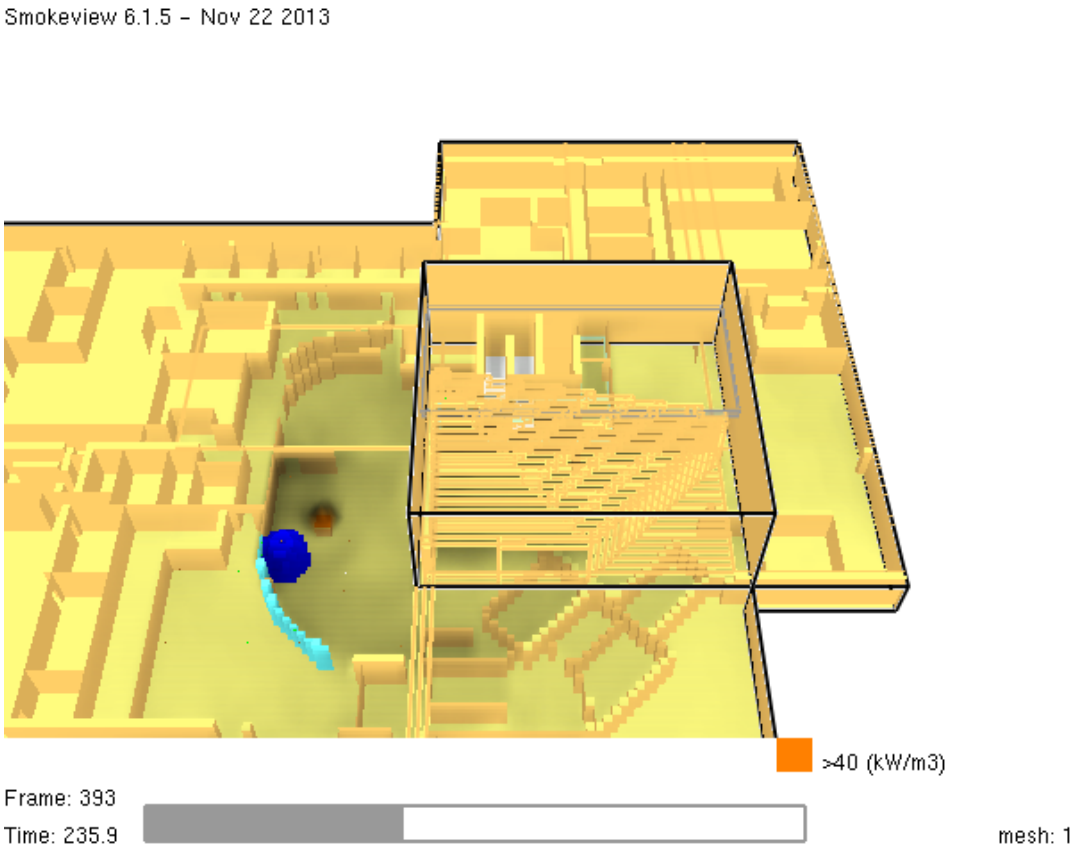
Scenario #1
(*with* sprinkler activation)



Sprinkler Activates

- 235 seconds
- HRR at activation = 1.3 MW

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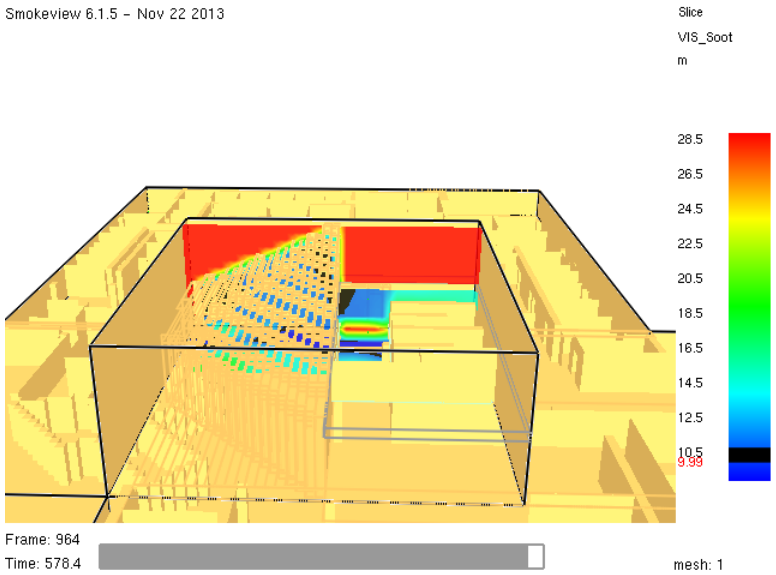
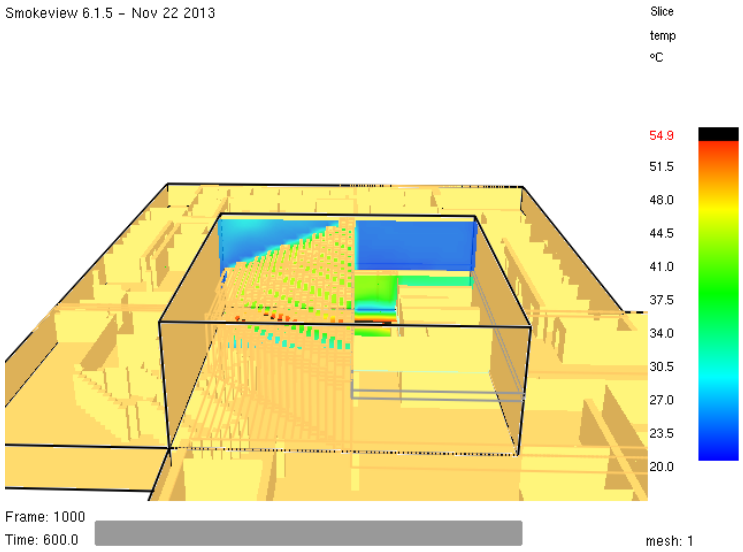
Scenario #1 Results
(*with* sprinkler activation)





Visibility > 10 m

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

Temperature < 60° C

- < 55° C at 600 seconds

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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! ✘

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Scenario #2 Plan Storage HRR

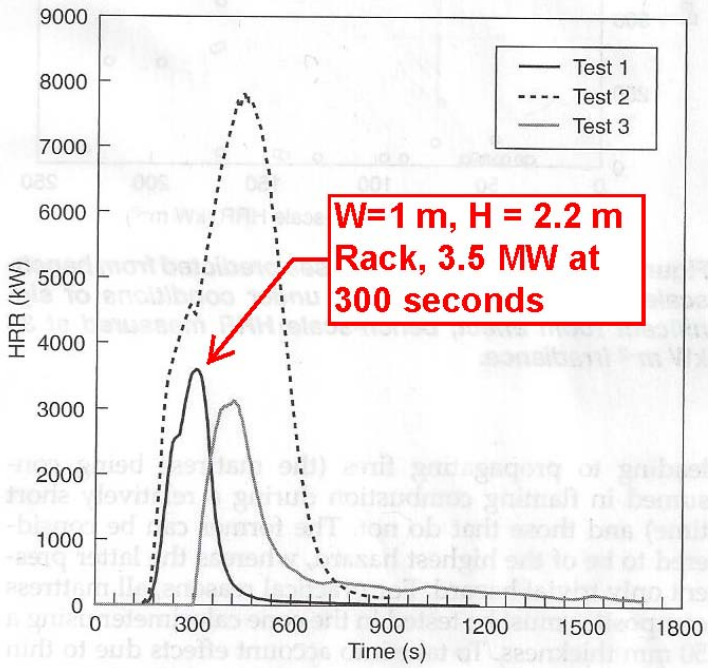

Figure 3-1.56. *HRR of magazine racks loaded with magazines, newspapers, and books.*

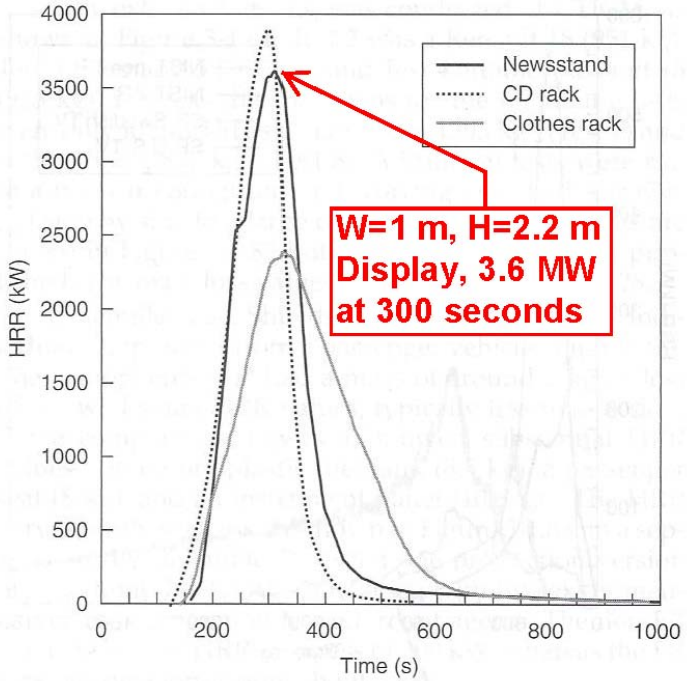

Figure 3-1.75. *HRR of various shop-display commodities tested by Chow.*[178]

Model HRR = 3.5 MW at 300 seconds

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

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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!

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Results & Recommendations

- Calculated RSET < ASET w/ sprinklers operating
- Pathfinder REST ≥ 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?

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Appendix F - Questions and Responses to Project Presentation on June 12, 2014.

Below are #4 questions asked by the review panel proceeding my project presentation on June 12th, 2014, along with a corresponding Code Analysis and statement of opinion.

Reviewer Question #1:

Question was raised as to IBC Section 1022 Exit Enclosures and whether a deficiency exists for the interior exit stairways which are open to both floors of the building.

> IBC Section 1022 states that *"Interior exit stairways and interior exit ramps shall be enclosed with fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 712, or both. Exit enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more and not less than 1 hour where connecting less than 4 stories.....Exit enclosures shall lead directly to the exterior of the building or shall be extended to the exterior of the building with an exit passageway conforming to the requirements of Section 1023. except as permitted in Section 1027.1. An exit enclosure shall not be used for any purpose other than means of egress."*
>
> *Exception #1 states that "In all occupancies, other than group H and I occupancies, a stairway is not required to be enclosed when the stairway serves an occupant load of less than 10 and the stairway complies with either Item 1.1 or 1.2. In all cases, the maximum number of connection open stories shall not exceed two."*
>
> *1.1. The stairway is open to not more than one story above its level of exit discharge; or*
> *1.2. The stairway is open to not more than one story below its level of exit discharge.*

Based upon IBC Section 1022, it appears that all of the ***interior*** 'exit' stairways from the 2nd floor to the first floor should be enclosed in a 1 hour enclosure. Note that one of the existing stairway is enclosed in a 1 hour enclosure, and that the remaining three are open to both the 1st and 2nd floors. The existing enclosed stairway was originally designed with an exit passageway which lead directly to the exterior. None of the remaining three stairways have 1 hour enclosures or exit passageways.

> IBC Section 708 Shaft Enclosure requires that "*openings through a floor/ceiling assembly shall be protected by a shaft enclosure complying with this section*." However, Exception 11 states that a "*shaft enclosure shall not be required for floor openings created by unenclosed stairs or ramps in accordance with Exception 3 or 4 in Section 1016.1*."
>
> IBC Section 1016 Exist Access Travel Distance provides the required exit access travel distance requirements for each occupancy type, "*measured from the most remote point within a story along the natural and unobstructed path of egress travel to an exterior egress door at the level of exit discharge, an entrance to a vertical exit enclosure, an exit passageway,.... shall not exceed the distances given in Table 1016.1.*" For a Group B Occupancy, with a sprinkler system, the exit access travel distance is 300 ft, at stated in the project report.

Exception 3 states that "in other than occupancy Group H and I, the exit access travel distance to a maximum of 50 % of the exits is permitted to be measured from the most remote point within the building to an exit using unenclosed exit access stairways or ramps when connecting a maximum of two stories. The two connected stories shall be provided with at least two means of egress. Such interconnected stories shall not be open to other stories."

Exception 4 states that "in other than occupancy Group H and I, the exit access travel distance is permitted to be measured from the most remote point within a building to an exit using unenclosed exit access stairways or ramps in the first and second stories above grade plane in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. The first and second stories above grade shall be provided with at least two means of egress. Such interconnected stories shall not be open to other stories."

When reading both Exception 3 and 4 in IBC Section 1016.1, my interpretation is that it states that it is acceptable to have unenclosed exit access stairways for building connecting two stories above grade and which is equipped throughout with an automatic sprinkler system. Since Section 1016.1 states that unenclosed exit access stairways is acceptable, it must override the requirement found in Section 1022. Since the public works building meet the requirements of Exception 4, the three unenclosed open stairways appears acceptable.

Reviewer Question #2:

Question was raised as to the potential deficiency of the atrium being open to adjacent spaces when referring to Section 404.6 Enclosures of Atriums.

IBC Section 404.6 Enclosures of Atriums states that "Atriums spaces shall be separated from adjacent spaces by a 1-hour fire barrier constructed in accordance with Section 707 or a horizontal assembly constructed in accordance with Section 712, or both."

Exception 3 states that "The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium where such spaces are accounted for in the design of the smoke control system."

However, when reading Exception 3, it specifies any three floors, which the MOA Public Works Building only has two. The exception stated in IBC Section 404.5 states that "a smoke control system is not required for atriums that connect two stores." It almost seems to be a conflict of requirements, but the only way I can interpret this is as follows. Since the MOA Public Works Building is only a two story building, and per the exception in Section 404.5, a smoke control system is not required. Exception 3 of Section 404.6 applies specifically to an atrium connecting any *three* floors. Since the MOA Public Works Building is only two stories (ie. less than the three stated by Exception 3 in Section 404.6), it appears that a 1 hour rated fire enclosure for the atrium is not required to separate it from adjacent areas, and that a smoke control system is not required either.

Reviewer Question #3:

Question was raised as to whether or not accessory occupancies exceed more than 10% of the building area of the story in which they are located, as stated in IBC Section 508.2.1 Area Limitations.

> *IBC Section 508.2.1 Area Limitations states that "Aggregate accessory occupancies shall not occupy more than 10% of the building area of the story in which they are located and shall not exceed the tabular values in Table 503, without building area increases in accordance with Section 506 for such accessory occupancies."*

When I look back on my determination of occupancy type per area of the building, it may be that I misapplied the occupancy type to the small Library and Lobby area as an Assembly A-3, instead of just Business B. If this is the case, and assuming that the Storage Group S areas are calculated correctly, the revised total area for the incidental occupancies for the 1st floor is shown below.

1st Floor Calculation: $\% \, Accessory \; Occupancy = \frac{Accessory \; Area}{Total \; Area} = \frac{5709}{46585} = 0.12$

2nd Floor Calculation: $\% \, Accessory \; Occupancy = \frac{Accessory \; Area}{Total \; Area} = \frac{3296}{39396} = 0.08$

Based on these calculations, the 1st floor aggregate accessory areas exceed the 10% allowable, and for the 2nd floor is below the allowable 10% limit. I would recommend that an another analysis and verification of occupancy use for each room on each floor be conducted to verify the accuracy of this calculation. It may be that over time additional space was converted to storage use without confirmation of this requirement, or a miscalculation of accessory areas occurred.

Reviewer Question #4:

Where did the activation temperature of 28.7°C for smoke detectors as used in the DETACT calculation for Scenario #1 come from?

Appendix B of NFPA #72, Table B.4.7.5.3 Temperature Rise for Detector Response (see below) provides an average Ionization Temperature Rise of 7.8°C, based upon calculations by Heskestad and Delichatsios. Section B4.7.5.3 also states that during full scale fire tests based on flaming fires, 80% of ionization detectors operated at measured temperature rises less than or equal to 3°C. Based on this, the calculated DETACT Model results for the Ionization Smoke Detector activation time are most likely too long, which would lower the calculated RSET for Scenario #1.

TABLE B.4.7.5.3 Temperature Rise for Detector Response [18]

	Ionization Temperature Rise		*Scattering Temperature Rise*	
Material	***°C***	***°F***	***°C***	***°F***
Wood	13.9	25	41.7	75
Cotton	1.7	3	27.8	50
Polyurethane	7.2	13	7.2	13
PVC	7.2	13	7.2	13
Average	7.8	14	21.1	38