FIRE PROTECTION ANALYSIS OF WARREN J. BAKER CENTER FOR SCIENCE

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Master of Science in Fire Protection Engineering

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Aric Edgar Carracino
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Statement of Disclaimer

COMMITTEE MEMBERSHIP

TITLE: Fire Protection Analysis of Warren J. Baker Center for Science

AUTHOR: Aric Edgar Carracino

DATE SUBMITTED: June 2015

COMMITTEE MEMBER: Frederick Mowrer, PhD
Fire Protection Engineering, Director

COMMITTEE MEMBER: Christopher Pascual, PhD
Fire Protection Engineering, Graduate Coordinator

ABSTRACT

Fire Protection Analysis of Warren J. Baker Center for Science

Aric Edgar Carracino

A prescriptive and performance based analysis was performed on the Warren J Baker Center for Science on the California Polytechnic San Luis Obispo campus. The code based analysis included reviewing the building's egress components, structural fire protection, fire sprinkler system, and fire alarm system. This included the requirements of the California Building Code, as well as applicable NFPA codes. Analysis of the egress components of the building revealed several dead end corridors within the building that exceed the maximum allowed length of 50 feet. In addition, the student workspace areas on Level 3 require two exits, but are only provided with one. The structural fire protection requirements were found to meet the requirements of the California Building Code, including the required height, area and occupancy separation. The provided fire suppression system and fire alarm system were found to be compliant with the requirements of NFPA 13 and NFPA 72, respectively. A performance based analysis was conducted on the natural ventilation smoke control system within the atrium of the building. This was done by comparing the results of Pathfinder and Fire Dynamics Simulator models to determine if the available safe egress time is greater than the required safe egress time. It was found that the existing smoke control system failed performance requirements in two separate design fire scenarios. A new natural ventilation smoke control system design with 150% greater ventilation was proposed and tested using the most severe fire scenario and was found to provide an available safe egress time greater than the required safe egress time.

Keywords: Life Safety Analysis, California Building Code, Performance Based Design, Fire Dynamics Simulator, Natural Ventilation Smoke Control

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1.0 PROJECT INTRODUCTION

1.1 Purpose

The purpose of this report was to analyze the Warren J. Baker Center for Science (CSM) in every aspect of fire protection, including a prescriptive analysis and a performance based analysis. The prescriptive analysis included the analysis of the building's egress components, structural fire protection, the fire suppression system, and the fire alarm system. This analysis was conducted using the California Building Code (CBC) and applicable NFPA codes to determine if the current systems and construction within the building meet the requirements of the codes. Throughout this report, if discrepancies are found between existing components of the building and the requirements of the codes, recommendations will be made to show how the building could comply with the code.

In addition to the prescriptive analysis of this report, a performance based analysis was performed on the natural ventilation smoke control system within the atrium of the building. The purpose of this analysis was to determine if the smoke control system was adequate to maintain safe conditions within the atrium for a time greater than it takes the occupants to exit the space. This was determined by using the computer programs Pathfinder and Fire Dynamics Simulator (FDS) to find the required safe egress time (RSET) of the occupants and the available safe egress time (ASET). Through the performance based analysis as well as the prescriptive requirements of the applicable codes, it can be determined if the building is considered safe for occupancy.

1.2 Building Description

The Warren J. Baker Center for Science and Mathematics (CSM) is the newest building on the Cal Poly San Luis Obispo Campus. Construction was completed in 2013 and the first classes were held in the building in Fall of 2013. The building is 6 stories and 108 feet in height, but is not classified as a high-rise, and has a total area of 188,372 square feet. The CSM is classified as a separated occupancy and is Type 1B construction. The building is fully sprinklered and contains a fire pump and standpipe system. The building contains a fire alarm system that include an in-building emergency voice alarm communication system (EVACS). From Level 2 to Level 6, there is a five story atrium that separates the east and west wings of the building and is protected with a natural ventilation smoke control system. The building is primarily a Group B occupancy since it contains mainly offices, classrooms and labs, but it also contains large lecture halls, storage spaces, and hazardous storage.

1.2.1 Fire Department Access

The building has fire department access on Level 1, Level 2, and Level 3 as shown in Figure 1. On the west side of the building, there is a public way that provides fire department access to Level 1. On the north side, North Poly View Drive provides fire department access to Level 1, Level 2, and Level 3 since this road is on a steep slope.

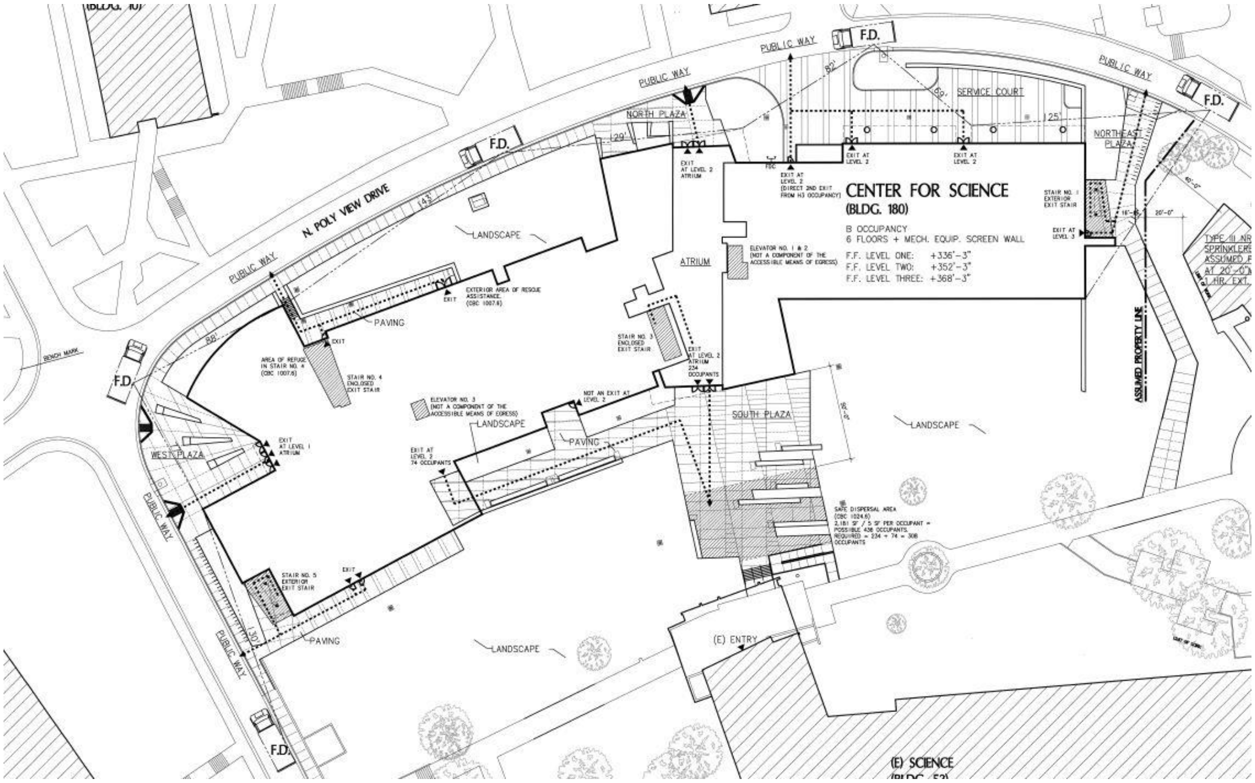


Figure 1 – Fire department access for the building [1].

1.2.2 Non High-Rise Classification

The California Building Code (CBC) defines a high-rise structure as a building of any type of construction or occupancy having floors used for human occupancy located more than 75 feet above the lowest floor level having building access [2]. Since the building is 108 feet tall, it would normally be classified as a high-rise structure. CBC Section 403.1 states, "When a building is located on sloping terrain and there is building access on more than one level, the enforcing agency may select the level that provides the most logical and adequate fire department access." [2] Since the building is on a steep grade and has adequate fire department access on Level 2, the building height can be measured from Level 2. As shown in Figure 2, the overall building height from Level 1 to the Upper Roof is 108 feet, while the height from the fire department access on Level 2 to the highest occupied floor, Level 6, is 64 feet. Since this is less than 75 feet, the building is not classified as a high-rise structure.

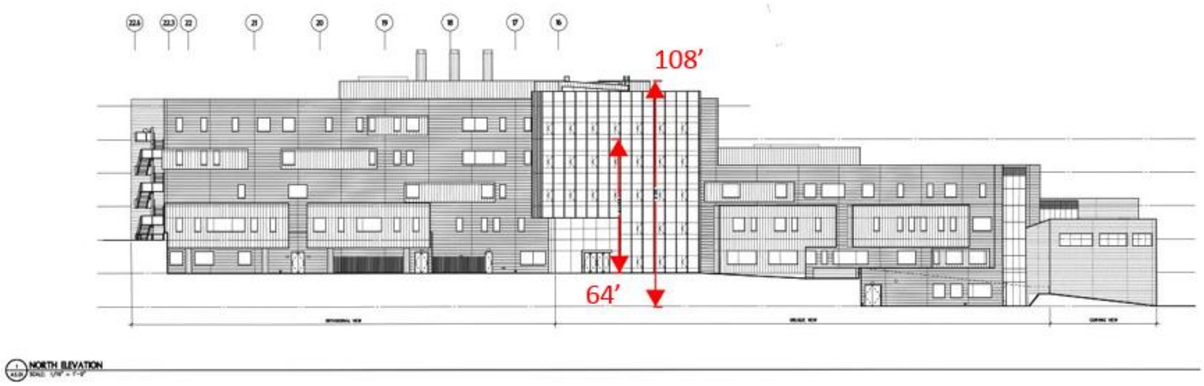


Figure 2 – Building elevation showing total height of 108 feet and defined height of 64 feet [1].

1.3 Applicable Codes and Standards

California Building Code (CBC), 2013 Edition

California Fire Code (CFC), 2013 Edition

NFPA 13 Automatic Sprinkler System Handbook, 2013 Edition

NFPA 14 Standard for the Installation of Standpipe and Hose Systems, 2013 Edition

NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2014 Edition

NFPA 72 National Fire Alarm and Signaling Code, 2013 Edition

NFPA 92 Standard for Smoke Control Systems, 2015 Edition

2.0 EGRESS ANALYSIS

2.1 Occupancy Classification

The occupancy of each space of the building is classified according to Chapter 3 of the CBC. The following rooms and areas have the occupancies as indicated (Table 1).

Table 1 - Occupancy Classifications Present in Building

Room Description	Occupancy	CBC Reference [2]
Lecture Hall, Conference Room	A-3	303.4
Classroom, Lab, Office, Conference Room <50 occupants, Restroom, Atrium, Corridors	B	304
Mechanical , Electrical, Telecomm, Server, Fire Pump Room	S-1	311.2
Storage, Janitorial	S-2	311.3
Chemical Storage, Hazardous Waste	H-3	307.5

Appendix A shows the floor plans for each level of the building indicating the location of each occupancy, as well as the exits, shafts, and corridors within the building. The occupancy classifications are used to determine requirements for the egress system, and since the building has multiple occupancies, the most restrictive of these requirements must be followed (CBC 1004.6).

2.2 Occupant Load

In order to calculate the occupant load of the building, each space or room must be classified by its use, which can differ from its occupancy classification. The occupant load for each floor was calculated according to the appropriate use of the space and corresponding occupant load factor (Table 2).

Table 2 - Occupant Load Factors for Uses Present in Building

Occupant Load (CBC Table 1004.1.2) [2]	
Use	**Occupant Load Factor (ft^2 per person)**
Accessory Storage/ Mechanical Equipment Room	300
Assembly without Fixed Seating, unconcentrated	15
Business	100
Educational, Classroom	20
Educational, Lab	50

For some uses, such as educational for classrooms and labs, the use is different from the occupancy classification. The classrooms and labs in this building are considered Group B because they are intended for university classes rather than K-12 classes, but still use the occupant load factor for the educational use. Use and occupancy also differ for conference rooms with less than 50 occupants. For these rooms, the occupant load factor for assembly use is used to calculate the occupant load, but since the occupancy is less than 50 it is considered a Group B occupancy rather than a Group A-3.

The calculated occupant load per story are shown in Table 3. The occupant loads for classrooms, labs, and assembly spaces were calculated using the net area of each room. The remaining area of each floor was considered business use, since the building is predominantly a business occupancy. The entire area within the perimeter walls was used to calculate the occupant load of the business use since it is dependent on gross area.

Table 3 - Calculated Occupant Load per Level

Level	Occupant Load
1	659
2	650
3	770
4	525
5	339
6	289

2.3 Means of egress

2.3.1 Number of Exits

The requirements for number of exits for floors depending on occupant load according to CBC Table 1021.1 are shown in Table 4.

Table 4- Exit Requirements Depending on Occupant Load [2]

Occupant Load Per Story	Minimum Number of Exits from Story
1-500	2
501-1000	3

The occupant load of each story does not exceed 1000 occupants, so no story requires more than 3 exits. The required number of exits for each floor is shown in Table 5 using the above requirements and the calculated occupant loads.

Table 5- Number of Exit Requirement based on Occupant Load of Building

Floor	Occupant Load	Required	Provided
1	659	3	3
2	650	3	6
3	770	3	4
4	525	2	3
5	339	2	2
6	289	2	2

All floors are compliant with the requirements of the CBC because they all have the required number of exits based on their occupant load. The open stairway within the atrium does not count as an exit because it is not protected according to the requirements of the CBC. This stairway is not included in the number of exits or in exit capacity calculations.

2.3.2 Exit Capacity

The means of egress capacity was calculated using the factors shown in Table 6. Since the building is equipped throughout with an automatic sprinkler system and an emergency voice/alarm communication system, the factors can be reduced as shown in Table 6.

Table 6 - Means of Egress Capacity Factors

Means of Egress Capacity		
Egress Component	**Capacity Factor (inches/person)**	**CBC Reference [2]**
Stairways	0.2	CBC 1005.3.1, Exception 1
Other Egress Components	0.15	CBC 1005.3.2, Exception 1

The egress capacity of each floor was calculated by multiplying the width of each egress component by the factors in Table 6. When two exit components that are used in series had different exit capacities, the lesser of the two was used as the limiting capacity in order to determine the overall exit capacity of each floor (Table 7).

Table 7- Exit Capacity Calculation from Each Floor

Description	Component	Width (in)	Capacity Factor (in/person)	Capacity (people)	Limiting Capacity (people)
Floor 1					
Front Doors	Door	216	0.15	1440	1440
Access to N Exit	Door	72	0.15	480	480
N Exit	Door	96	0.15	640	
Stair #4	Door	36	0.15	240	240
				TOTAL	**2,160**
Floor 2					
West Wing Exit	Door	72	0.15	480	480
Atrium North	Door	144	0.15	960	960
Atrium South	Door	144	0.15	960	960
East Wing Exit	Door	72	0.15	480	480
Stair #4	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #5	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #3	Door	36	0.15	240	240
	Stair	48	0.2	240	
				TOTAL	**3,240**
Floor 3					
Stair #1	Door	36	0.15	240	240
Stair #3	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #4	Door	36	0.15	240	240
	Stair	48	0.2	240	

Stair #5	Door	36	0.15	240	240
	Stair	48	0.2	240	
				TOTAL	**960**
Floor 4					
Stair #1	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #3	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #4	Door	36	0.15	240	240
	Stair	48	0.2	240	
				TOTAL	**720**
Floor 5					
Stair #1	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #3	Door	36	0.15	240	240
	Stair	48	0.2	240	
				TOTAL	**480**
Floor 6					
Stair #1	Door	36	0.15	240	240
	Stair	48	0.2	240	
Stair #3	Door	36	0.15	240	240
	Stair	48	0.2	240	
				TOTAL	**480**

In order to be compliant with CBC 1005.3, the available exit capacity must be greater than the occupant load for each floor. The building is compliant with this requirement as shown in Table *8*.

Table 8 - Occupant Load vs. Egress Capacity for Each Floor

Floor	Occupant Load	Egress Capacity
1	659	2,160
2	650	3,480
3	770	960
4	525	720
5	339	480
6	289	480

2.3.3 Arrangement of Exits

According to CBC 1015.2.2 Exception 2, buildings protected throughout by an automatic sprinkler system must have a separation distance between two exits not less than one-third the maximum diagonal of the room or floor [2]. All levels and rooms with more than one exit are compliant with this requirement.

Since more than two exits are required for Levels 1 through 4, the requirements of CBC 1015.2.2 must be met. This section requires that when more than two exits are required, at least two of the exits must meet the separation requirements. All floors meet this requirement of the CBC.

2.3.4 Travel Distance

The CBC requirements for exit travel distance, common path of travel, and dead end length for the occupancies present in the building are summarized in Table 9.

Table 9- Travel Distance Limits Based on Occupancy [2]

Occupancy	Exit Travel Distance (CBC Table 1016.2)	Common Path of Travel (CBC Table 1014.3)	Dead Ends (CBC 1018.4, Exception 2)
A	250	75	50
S-1	250	100	
S-2	400	100	
B	300	100	
H-3	150	2	

On each floor, this requirement is met due to the number and arrangement of exits for the size of the building. However, on the north end of the second floor, there is a dead end corridor in excess of 50 feet as shown in Figure 3. This does not meet the 50 foot requirement for business occupancies. In order to reduce the length, the doors leading to the corridor could be offset farther back. There will still be a dead end corridor, but this would reduce its length.

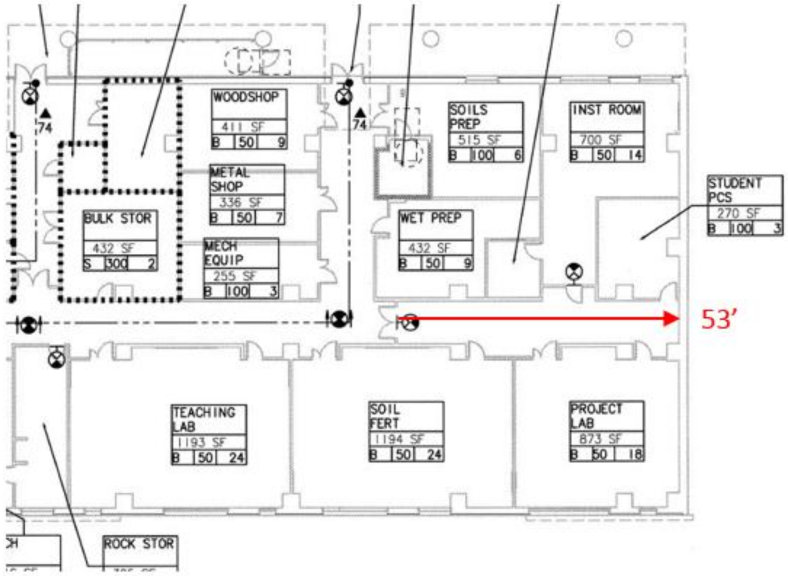


Figure 3 - North end of Level 2 showing dead end corridor greater than maximum 50 feet [1].

In addition to this dead end, on Levels 4-6 in the atrium a dead end greater than 50 feet occurs in the corridor leading to the faculty offices as shown in Figure 4.

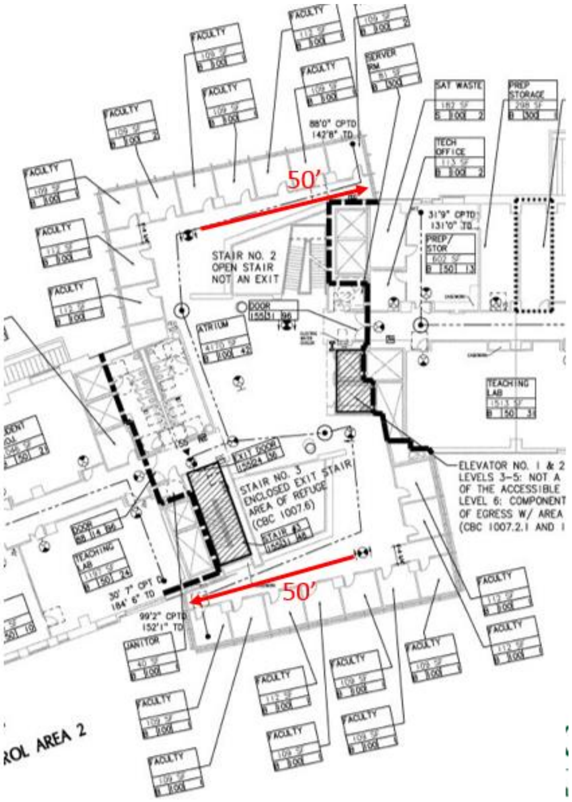


Figure 4 - Dead end exceeding 50 foot maximum on Levels 4-6 of the atrium [1].

2.3.5 Exit Signage

The locations of exit signs within the building are compliant with the requirements of CBC 1011.1. All exits from a floor or the building are marked with exit signs including any access to exits. Following the requirements of CBC 1011.1, all exit signs were placed so no point in exit access corridors is in excess of 100 feet [2].

2.4 Fire Resistance of Egress Components

Fire resistance of vertical openings, exit access corridors, and exit stairs are all shown on the plans in Appendix B.

2.4.1 Interior Exit Stairs

According to CBC 1022.2, exit stairs must be protected by 1 hour fire resistance rating for stairs serving three or fewer stories and 2 hour fire resistance rating for stairs serving four or more stories [2]. Since both interior exit stairs serve four or more floors, both must be protected by 2 hour fire resistance rating enclosures.

2.4.2 Exterior Exit Stairs

According to CBC 1026.6, outside stairs must be separated from the interior of the building by construction with the fire resistance rating required for enclosed stairs [2]. To meet this requirement, the south exterior stair requires 1 hour fire resistance rating since it is less than four stories, and the north exterior stair requires 2 hour fire resistance rating since it is greater than 4 stories.

2.4.3 Corridors

The requirements for corridor fire resistance rating for the present occupancies from CBC Table 1018.1 are shown in Table 10 – Corridor Fire Resistance Rating Requirements from CBC Table 1018.1Table 10.

Table 10 – Corridor Fire Resistance Rating Requirements from CBC Table 1018.1 [2]

Occupancy	Required Corridor Fire Resistance Rating (sprinklered)
H-3	1
A, B, S	0

The corridors within the building are not required to have a fire resistance rating, except where the Group H-3 occupancy is located. Since the Group H-3 is only in one location of the building that is separated from the rest of the building, only this area is required to have a 1 hour fire rated corridor, as shown in Figure 5.

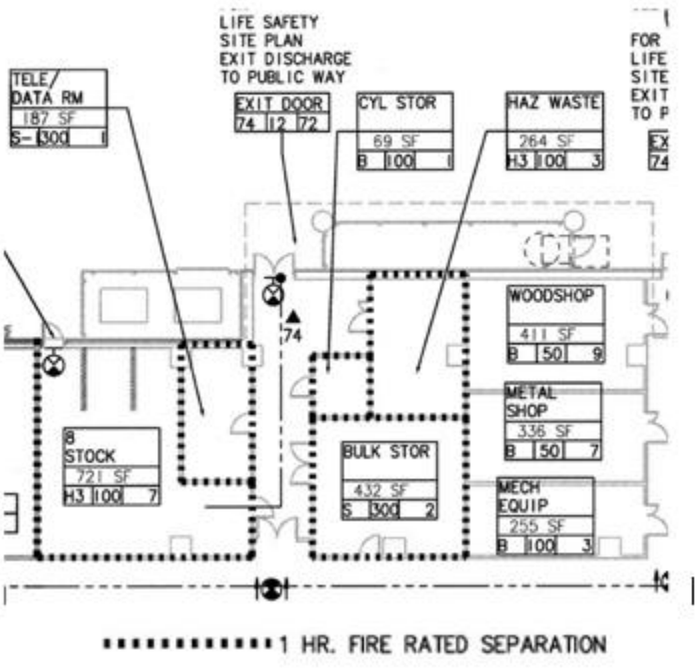


Figure 5 - Location of H-3 occupancy showing 1 hour fire rated corridor [1].

2.4.4 Vertical Openings

Vertical openings, including mechanical shafts and elevator shafts, covering four or more stories require a 2 hour fire resistance rating while shafts covering less than four stories require a 1 hour fire resistance rating according to CBC 713.4 [2].

2.4.5 Openings Protection

All openings and assemblies within fire rated construction require a fire resistance rating. The required fire resistance ratings for opening protectives in fire resistance rated assemblies are listed in Table 11.

Table 11 - Openings Fire Resistance Requirements in Rated Assemblies [2]

Component	Walls (hr)	Doors (hr)	Windows (hr)
Vertical Shafts (including stairways)	2	1 1/2	NP
	1	1	NP
Exit Access Corridors	1	1/3	3/4
Fire Barriers	2	1 1/2	NP
	1	1	1

*NP: Not Permitted

2.4.6 Interior Finish

The interior finish classification limitations for the occupancies that are present in the building are listed in Table 12 from the requirements of CBC Table 803.9 for wall and ceiling finish and CBC 804.4.2 for interior floor finish.

Table 12- Interior Finish Requirements in Components of Means of Egress [2]

Occupancy	Exits	Exit Access Corridors	Other Spaces
A-3	B I or II	B I or II	C I or II
B	B I or II	C I or II	C I or II
S	C I or II	C I or II	C I or II

3.0 STRUCTURAL FIRE PROTECTION ANALYSIS

3.1 Occupancy Classification

Since the building is primarily university classrooms, the main occupancy is Group B Business. The building also contains the occupancy classifications shown in Table 13 as determined by CBC Chapter 3.

Table 13 - Occupancy Classification [2]

Occupancy Classification	Area
A-3	Lobbies, Lecture Halls
B	Offices, Conference Rooms < 50, Laboratories
S-1	Electrical, Mechanical, Telecommunications
S-2	Storage, Janitorial
H-3	Chemical Storage

The occupancy classifications for the building are shown on the drawings in Appendix A.

3.2 Construction Type

The building is Type 1B construction. The fire resistance rating requirements for building elements are shown in Table 14 as determined by CBC Table 601.

Table 14 - Fire Resistance Rating for Building Elements [2]

Building Element	Type 1B
Primary Structural Frame	2
Exterior Bearing Walls	2
Interior Bearing Walls	2
Interior NonBearing Walls	0
Floor Construction	2
Roof Construction	1

The requirements for exterior walls are based on fire separations distance and occupancy, as well as construction type. The fire resistance rating for different fire separation distances for Group B occupancies and Type 1B construction are shown in Table 15, based on the requirements from CBC Table 602.

Table 15 - Fire Resistance Ratings for Fire Separation Distances [2]

Fire Separation Distance (feet)	Group B, Type 1B
X<5	1
5<X<10	1
10<X<30	1
X>30	0

Since there is a separation distance of at least 30 feet around the entire building, the exterior walls are not required to have a fire resistance rating.

3.3 Height and Area Analysis

Since the building contains multiple occupancies, it is classified as a mixed use building in accordance with CBC Section 508. The Group H-3 occupancy spaces are required to be separated from the remainder of the occupancies as required by CBC Section 508.4. For this reason, the building is classified as a separated occupancy building. The allowable building area per story is determined by increasing the tabular area from Table 503 by 200% for sprinkler protection (CBC Section 506.3) and by 75% when the frontage area exceeds 30 feet on all sides of the building (CBC Section 506.2) as shown in Table 16. Group H-3 occupancies are not permitted to have an area increase due to sprinkler protection per CBC Section 506.3 Exception 2 [2].

Table 16 – Allowable Area [2]

Construction Type 1B	Group B	Group A-3	Group S-1	Group S-2	Group H-3
Base Area (Table 503)	UL	UL	48,000	79,000	60,000
Sprinkler Increase (506.3)	UL	UL	96,000	158,000	0*
Frontage Increase (506.2)	UL	UL	36,000	59,250	45,000
Allowable Area Per Story	UL	UL	180,000	296,250	105,000

The actual building area per story is shown in Table 17 showing compliance with the requirements from Table 16.

Table 17 – Provided Area

Floor	Area (square Feet)
1	23,146
2	43,458
3	43,209
4	33,307
5	25,294
6	19,958
Total	188,372

Since the building is classified as a separated occupancy building, the required fire resistance rating between occupancies is determined by CBC Table 508.4. These requirements are summarized in Table 18 for the present occupancies within a sprinklered building and shown on the drawings in Appendix B.

Table 18 - Required Occupancy Separation [2]

Occupancy	**A**	**S-2**	**B, S-1**	**H-3**
A	N	N	1	2
S-2	N	N	1	2
B, S-1	1	1	N	1
H-3	2	2	1	1

The allowable building height is determined from the requirements of CBC Table 503 along with the allowed increase from Section 504.2 for the presence of an automatic sprinkler system. Since the building contains Group H-3 occupancy, the building height is not permitted to be increased in accordance with CBC Section 504.2 Exception 2. The determination of the allowable building height is shown in Table 19.

Table 19 - Allowable Height and Provided Height [2]

Construction Type 1B	**Group B**	**Group A-3**	**Group S-1**	**Group S-2**	**Group H-3**	**Provided**
Allowable Height (Table 503)	160					**108**
Allowable Stories (Table 503)	11	11	11	11	6	**6**

As seen in Table 19, the building is in compliance with the allowable height and stories as required by CBC Table 503.

3.4 Atrium Fire Separation

Since the building contains a five story atrium from Levels 2 to 6, it is required that the atrium space is separated from adjacent spaces by a 1 hour fire barrier in accordance with CBC 404.6 [2]. The 1 hour fire rated separation is shown in Figure 6 on Level 3 of the atrium, which is typical on each level. Within the 1 hour fire separation between the atrium and the east and west wings of the building there are magnetically held open doors. Upon activation of the fire alarm system, the doors close to maintain the 1 hour rated separation.

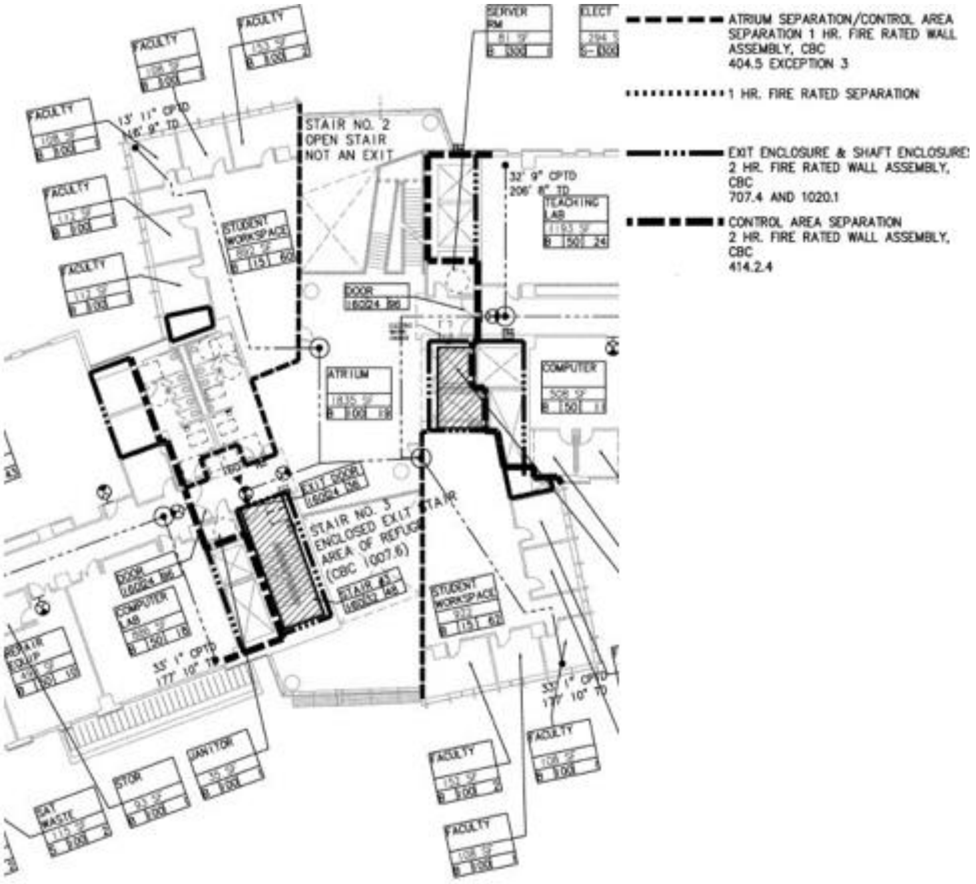


Figure 6 – Level 3 showing 1 hour rated fire barrier separating atrium from remainder of building [1].

3.5 Required Fire Resistance

Along with the fire resistance requirements of the elements in Table 14 of this report, additional fire protection of building components are listed in the CBC Table 721.1(1), (2), and (3). CBC Table 721.1(1) states the minimum protection for structural components, Table 721.1(2) states the required fire resistance rating for walls and partitions, and Table 721.1(3) states the minimum protection requirements for floor and roof systems [2].

3.6 Provided Construction Materials

The construction materials used within the building for interior rated partitions, floor assemblies, roof assemblies, and penetrations are shown in Appendix C.

4.0 FIRE SUPPRESSION SYSTEM

All information from the current system is from the plans provided by Aero Automatic Sprinkler Company and is provided in Appendix D.

4.1 Water Supply

The water supply was determined by a hydrant test conducted by the Fluid Resource Management on August 19, 2011. The water supply as determined by the flow test is shown in Table 20 including a 10% safety margin.

Table 20- Water Supply Information [3]

	Flow Test Information	10% Reduction
Static	60 psi	54 psi
Residual	55 psi	49 psi
Flow	914 gpm	914 gpm

The point of connection to the water supply system is separated from the building by 8” underground PVC pipe and an 8” Wilkins model 350ADA double check assembly [4]. The manufacturer specification sheet is shown in Appendix E.

4.2 Hazard Classification

Since the building mainly consists of classrooms, laboratories, offices and storage, the occupancy classifications present are Light Hazard and Ordinary Hazard Group 1 (Table 21).

Table 21- Hazard Classifications for Current System

Description	Hazard Classification	NFPA 13 Reference [5]
Classrooms, auditoriums, corridors, offices, conference rooms	Light Hazard	5.2
Laboratories, storage, mechanical, electrical	Ordinary Hazard Group 1	5.3.1

4.3 Design Criteria

4.3.1 Sprinkler System

Design densities and areas of operation for different hazards are determined from NFPA 13 Exhibit 5.5 (Figure 7). The points used for Light Hazard and Ordinary Hazard Group 1 are identified in Figure 7.

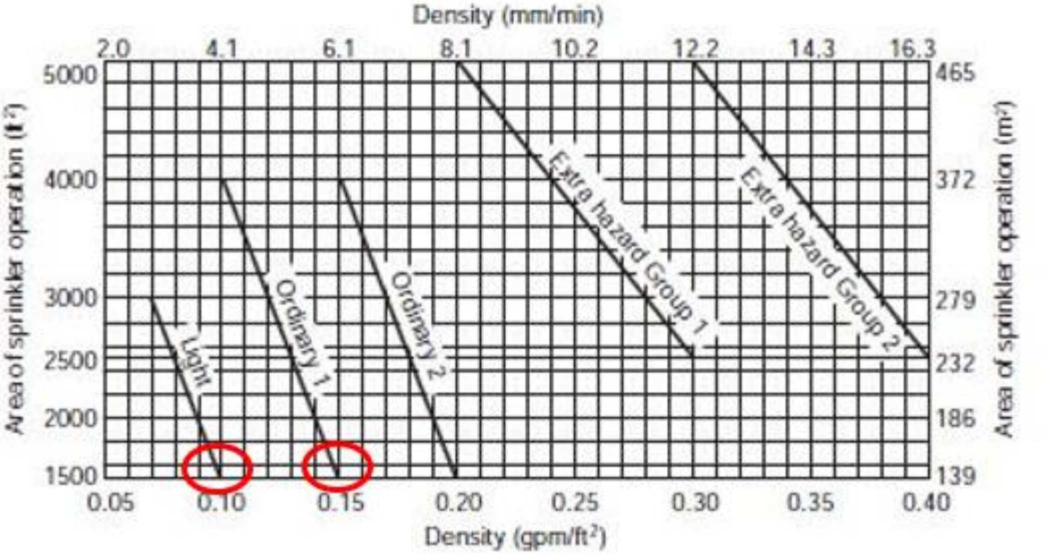


Figure 7- Density and area of operation curves [5].

Maximum spacing areas for different hazards are determined from NFPA 13 Table 8.6.2.2.1. Hose stream allowances (HSA) are determined from NFPA 13 Table 11.2.3.1.2. A summary of the design criteria for the present occupancy hazards is shown in Table 22.

Table 22- Design Criteria for Current Sprinkler System [5]

Hazard	Max Area (ft^2)	Density (gpm/ft^2)	Operation Area (ft^2)	Inside HSA (gpm)	Combined HSA (gpm)	Duration (min)
Light	225	0.1	1500 (912)	0	100	30
OH Group 1	130	0.15	1500 (912)	100	250	60-90

Since the sprinklers used are quick response, the area of operation is reduced without revising the density in accordance with NFPA 13 Section 11.2.3.2.3. The area is reduced using the following equation from Figure 8.

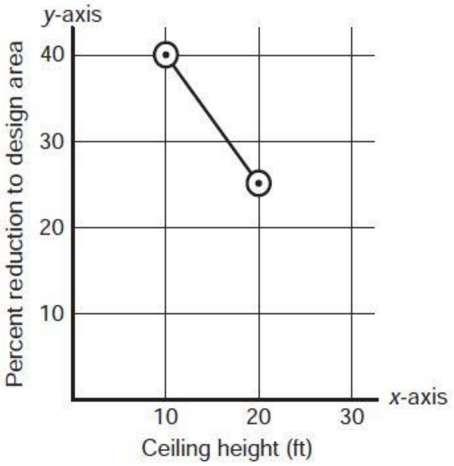


Figure 8 - Allowable reduction of operation area for quick response sprinklers [5].

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

Where: x= ceiling height

y= % reduction

For a ceiling height of 10’-6”, the area of operation is reduced by 39.25%. This makes the minimum area of operation 912 square feet.

4.3.2 Standpipe System

All requirements for the standpipe system are from NFPA 14 for a Class I standpipe system. Section 7.8.1 requires a minimum pressure of 100 psi and Section 7.10.1.1.1 requires a minimum flow rate of 500 gpm at the hydraulically most remote 2 ½ inch connection. For additional standpipes, Section 7.10.1.1.3 requires an additional 250 gpm per standpipe. Since there are four total standpipes, the flow would be increased to 1250 gpm, but Section 7.10.1.1.5 states that if a building is fully sprinklered, the max flow rate is 1000 gpm. Section 9.2 requires a duration of 30 minutes for standpipe flow [7]. These results are summarized in Table 23.

Table 23- Design Criteria for Standpipe System

		NFPA 14 Reference [7]
Pressure at most remote outlet	100 psi	7.8.1
Flow at most remote outlet	500 gpm	7.10.1.1.1
Flow for each additional SP	250 gpm	7.10.1.1.3
Max Flow	1000 gpm	7.10.1.1.5
Duration	30 minutes	9.2

4.4 System Components

4.4.1 Fire Pump

The building contains an electric in-line fire pump located in the fire pump room on the first floor. The pump is a model number 6PVF10 manufactured by Peerless Pumps. The pump has an 8.24 inch impeller and an operating speed of 3550 RPM. The performance points of the fire pump are listed in Table 24. All information for the pump, including the pump curve, is in Appendix F.

Table 24- Fire Pump Performance Points [6]

	Pressure (psi)	**Flow (gpm)**
Churn	125	0
Design	113	750
150%	86	1125

4.4.2 Standpipe

The building contains a standpipe system with a standpipe in each of the four stairways, including the two exterior stairs and the two protected interior stairs. The standpipe system is Class I in accordance with the requirements of NFPA 14 Section 7.3.2. Since the building is fully sprinklered, the standpipes are allowed a 4 inch diameter, rather than 6 inch, in accordance with NFPA 14 Section 7.6.3 [7]. Standpipe #4 and #5 have a 4 inch diameter while standpipe #1 and #3 have a 6 inch diameter (Appendix D plans for reference). The standpipes have an outlet on each floor within the stairways that has a 2 ½ inch hose connection with a reducer to a 1 ½ inch connection (Figure 9).

Figure 9- Standpipe hose connection with 2 1/2" and 1 1/2" connections.

4.4.3 Risers

The building contains six risers, each serving the sprinkler system on a single floor. The riser to the first floor is located in the fire pump room and has a 3 inch diameter. The risers for the second through sixth floor are located in the central interior stairway. These risers come off of the standpipe in this stairway (Standpipe #3) and are all 2 ½ inch in diameter.

4.4.4 Cross Mains, Branch Lines

Locations of cross mains and branch lines as installed in the building are shown in the plans in Appendix D. All cross mains are 2 ½ inches in diameter, except for a 3 inch main on the first floor. Branch lines are mainly 1 inch in diameter, but some have a 1 ¼ inch diameter where there is higher flow. All piping in the building is schedule 40 black steel.

4.4.5 Sprinklers

All sprinklers in the building are quick response with a k factor of 5.6 and a temperature rating of 155°F. In the majority of the building where there is finished ceiling, there are pendent sprinklers while in areas such as storage and mechanical rooms there are upright sprinklers.

4.5 Hydraulic Calculations

4.5.1 Computer Based Calculations

The calculations for the current sprinkler system were performed by Aero Automatic Sprinkler Company using Hydratec software. The calculations include eight remote areas: two on the first floor, two on the third floor, and four on the sixth floor. A summary of the hydraulic calculations of these remote areas is shown in Table 25.

Table 25- Summary of Computer Based Hydraulic Calculations for Current System [6]

First Floor	
Area	1-1
Occupancy	Lecture
Hazard	Light Hazard
Density	0.10 GPM/Sq Ft
Area of Operation	1520 Sq Ft
Area Per Head	168 Sq Ft
Hose Stream Allowance	100 GPM inside
PSI Req. at BOR	126.6
GPM Req. at BOR	250.6
PSI Req. at Source	7.27
GPM Req. at Source	350.6
PSI Available at Source	53.15
PSI Safety Factor	45.88
Area	1-2
Occupancy	Lecture
Hazard	Light Hazard

Density	0.10 GPM/ Sq Ft
Area of Operation	1575 Sq Ft
Area Per Head	163 Sq Ft
Hose Stream Allowance	100 GPM inside
PSI Req. at BOR	162.2
GPM Req. at BOR	328.4
PSI Req. at Source	45.59
GPM Req. at Source	428.4
PSI Available at Source	52.76
PSI Safety Factor	7.17
Third Floor	
Area	3-1
Occupancy	Lab
Hazard	Ordinary Hazard Group 1
Density	0.15 GPM/Sq Ft
Area of Operation	967 Sq Ft
Area Per Head	130 Sq Ft
Hose Stream Allowance	100 GPM inside, 150 GPM outside
PSI Req. at BOR	102.61
GPM Req. at BOR	252.75
PSI Req. at Source	-0.88
GPM Req. at Source	502.75
PSI Available at Source	52.35
PSI Safety Factor	53.23
Area	3-2
Occupancy	Lab
Hazard	Ordinary Hazard Group 1
Density	0.15 GPM/Sq Ft
Area of Operation	1135 Sq Ft
Area Per Head	130 Sq Ft
Hose Stream Allowance	100 GPM inside, 150 GPM outside
PSI Req. at BOR	107.33
GPM Req. at BOR	233.54
PSI Req. at Source	3.22
GPM Req. at Source	483.54
PSI Available at Source	52.45
PSI Safety Factor	49.23
Sixth Floor	
Area	6-1
Occupancy	Lab

Hazard	Ordinary Hazard Group 1
Density	0.15 GPM/Sq Ft
Area of Operation	940 Sq Ft
Area Per Head	130 Sq Ft
Hose Stream Allowance	100 GPM inside, 150 GPM outside
PSI Req. at BOR	95.47
GPM Req. at BOR	233.16
PSI Req. at Source	12.35
GPM Req. at Source	483.15
PSI Available at Source	54.35
PSI Safety Factor	40.1
Area	6-2
Occupancy	Corridor
Hazard	Light Hazard
Density	0.10 GPM/Sq Ft
Area of Operation	5 Heads
Area Per Head	225 Sq Ft
Hose Stream Allowance	100 GPM inside
PSI Req. at BOR	34.5
GPM Req. at BOR	113.1
PSI Req. at Source	-51.52
GPM Req. at Source	213.09
PSI Available at Source	53.58
PSI Safety Factor	105.1
Area	6-3
Occupancy	Lab
Hazard	Ordinary Hazard Group 1
Density	0.15 GPM/Sq Ft
Area of Operation	920 Sq Ft
Area Per Head	130 Sq Ft
Hose Stream Allowance	100 GPM inside, 150 GPM outside
PSI Req. at BOR	108.4
GPM Req. at BOR	273.4
PSI Req. at Source	26.71
GPM Req. at Source	523.4
PSI Available at Source	52.11
PSI Safety Factor	25.4
Area	6-4

Occupancy	Office/Lobby
Hazard	Light Hazard
Density	0.10 GPM/Sq Ft
Area of Operation	1567 Sq Ft
Area Per Head	210 Sq Ft
Hose Stream Allowance	100 GPM inside
PSI Req. at BOR	116.86
GPM Req. at BOR	347.3
PSI Req. at Source	39.09
GPM Req. at Source	447.3
PSI Available at Source	52.66
PSI Safety Factor	13.57

4.5.2 Hand Calculations

Hand calculations were performed in order to compare results with the computer based calculations. Due to the size of the building and number of calculations required, hand calculations were only performed on remote area 6-3 on the sixth floor. This remote area contains twelve sprinklers along three branchlines and is Ordinary Hazard Group 1. These calculations are shown in Appendix G.

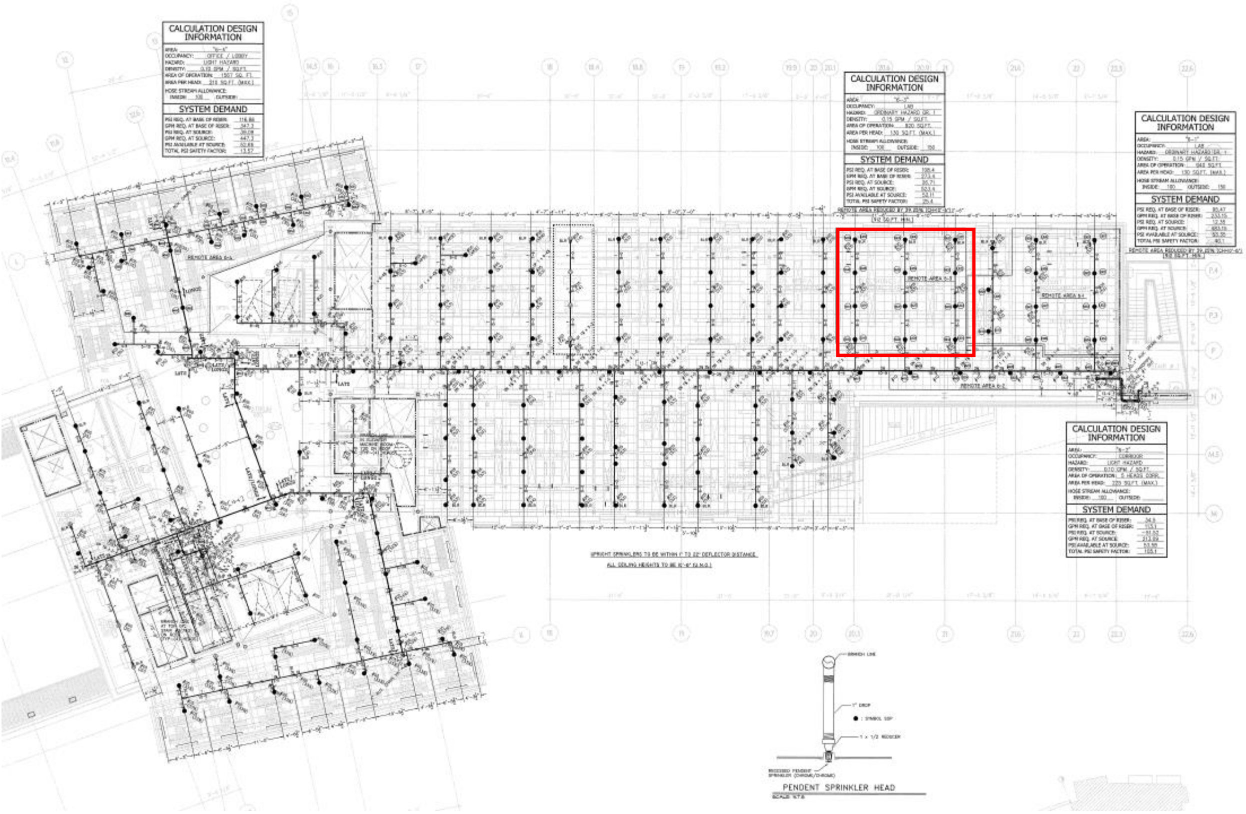


Figure 10 – Remote area location on Level 6 [3].

The calculations were performed starting at the most remote sprinkler, Node S631 (Appendix D). The flow at this sprinkler was determined to be 19.5 gpm based on the density of 0.15 gpm/ft^2 and area per sprinkler of 130 ft^2. The pressure was determined to be 12.125 psi at this sprinkler by using the k factor of 5.6 and the calculated flow. From this sprinkler, the hydraulic calculations were performed back to the base of the riser (BOR) and the source. All of the piping within the building is schedule 40 steel with a coefficient of 120 for the Hazen-Williams equation. The equivalent length of all fittings for schedule 40 steel pipe were used from NFPA 13 Table 23.4.3.11 [5]. The inside hose stream allowance of 100 gpm was added at the standpipe connection inside the building on the sixth floor and the outside allowance of 150 gpm was added at the source. Between the BOR and the source, the path of the water passes through the pump room. Based on the flow at the pump outlet, the head from the pump is subtracted during the calculations (Fire pump curve in Appendix F). There is also an 8" Wilkins model 350ADA double check assembly outside of the building before the source. This results in a fixed pressure loss based on the flow as determined by the manufacturer information in Appendix E. The summarized results of the hand calculations compared with the computer based calculations for the same remote area are compared in Table 26.

Table 26- Comparison of Hand Calculations and Computer Based Calculations

	Hand Calculation	Computer Based Calculation [6]
PSI Req. at BOR	98.4	108.4
GPM Req. at BOR	273.6	273.4
PSI Req. at Source	21.2	26.7
GPM Req. at Source	523.6	523.4
PSI Available at Source	52.1	52.1
PSI Safety Factor	30.9	25.4

The results of both calculations were similar with a 5.5 psi difference in demand and 0.2 GPM difference at the source. There were several discrepancies between the hand calculations and the computer calculations. First, the computer calculations used a different equivalent length for elbows than that listed in NFPA 13 Table 23.4.3.11. Also, for the 8" underground PVC pipe, the computer calculations used a C factor of 140 while for the hand calculations, a C factor of 150 was used based on NFPA 13 Table 23.4.4.7.1. This would create a difference in the amount of pressure loss in this pipe as well as the equivalent length of fittings for these pipes since a different C factor multiplier is used from NFPA 13 Table 23.4.3.2.1. The computer calculations also included the two elbows on either side of the backflow preventer and the pipe between them as 8" PVC pipe. This pipe and these fittings should have been calculated as 8" steel pipe and was done this way in the hand calculations.

Other than these differences, the calculations came out very close and the system has a large safety factor, mainly due to the presence of the fire pump. For this area, the system supply exceeds the demand, as seen in Figure 11, the pressure vs. flow curve for the computer based calculations.

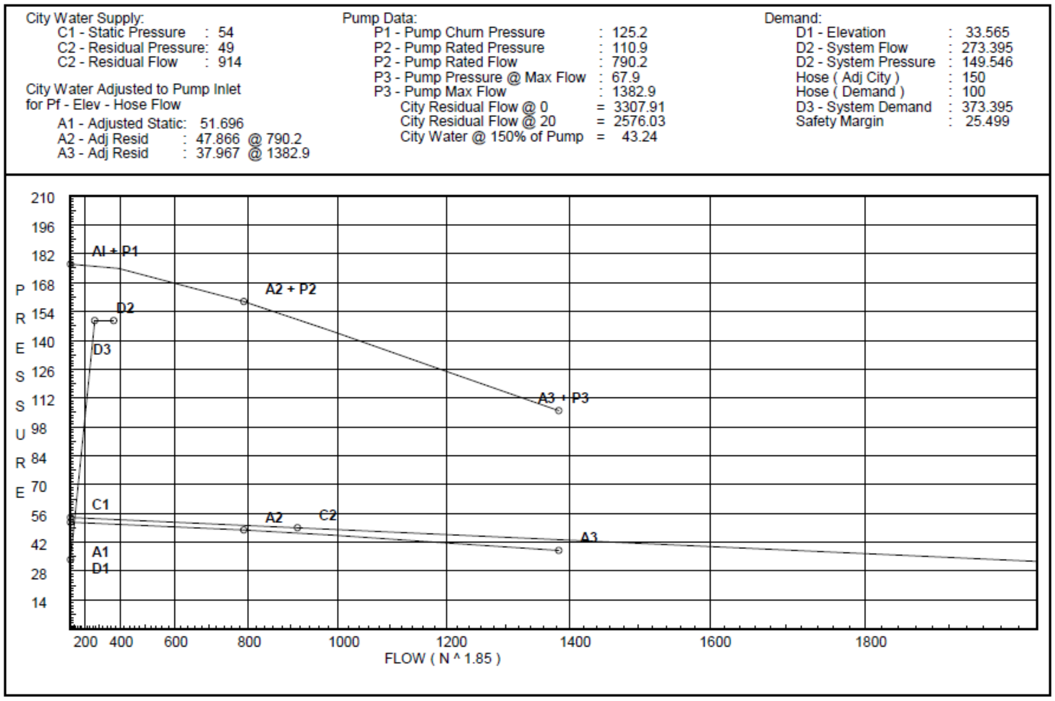


Figure 11 - Pressure vs. flow curve for remote area 6-3 showing supply and demand curves [6].

4.5.3 Standpipe Calculations

The standpipe system must also be hydraulically calculated following the requirements from Table 23. These calculations have been performed by Aero Automatic Sprinkler Company as shown in Table 27.

Table 27- Summary of Standpipe Calculations [6]

Standpipe #1	
Occupancy	Light/ OH
Flow at Top Outlet	500 GPM
Pressure at Top Outlet	100 psi
Flow for Additional SP	500 GPM
Total SP Flow	1000 GPM
PSI Required at Pump Discharge	144.08
GPM Required at Pump Discharge	1000
PSI Required at Source	47.18
GPM Required at Source	1000
PSI Available at Source	48.09
Total PSI Safety Factor	0.91
Standpipe #4	
Occupancy	Light/OH
Flow at Top Outlet	5000 GPM
Pressure at Top Outlet	100 psi
Flow for Additional SP	500 GPM

Total SP Flow	1000 GPM
PSI Required at Pump Discharge	144.08
GPM Required at Pump Discharge	1000
PSI Required at Source	45.85
GPM Required at Source	1000
PSI Available at Source	48.09
Total PSI Safety Factor	2.24
Standpipe #5	
Occupancy	Light/OH
Flow at Top Outlet	500 GPM
Pressure at Top Outlet	100 psi
Flow for Additional SP	500 GPM
Total SP Flow	1000 GPM
PSI Required at Pump Discharge	143.7
GPM Required at Pump Discharge	1000
PSI Required at Source	46.8
GPM Required at Source	1000
PSI Available at Source	48.08
Total PSI Safety Factor	1.26

As can be seen from these results, the safety factor is much smaller than those from the sprinkler system hydraulic calculations. This shows that the standpipe system has a much higher demand and the fire pump is most likely sized to account for this, rather than the sprinkler system.

4.6 Inspection, Testing, and Maintenance

The inspection, testing, and maintenance requirements come from NFPA 25 Standards for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems. The type of procedure for each component, as well as the frequency it must be performed, are shown in Table 28.

Table 28- Inspection, Testing, and Maintenance Requirements and Frequency [8]

Component	**Inspection**	**Frequency**	**Testing**	**Frequency**	**Maintenance**
Sprinklers	Check for corrosion, loading, foreign materials, paint, physical damage, proper orientation, and obstructions. Replace any violations.	Annually	Sprinklers in service for 50 years shall be tested by a recognized testing lab. A sample of 1% but not less than 4 sprinklers shall be tested. If any fail, all sprinklers represented by sample must be replaced	10 years	Replacement sprinklers shall have the same characteristics as installed sprinklers and shall be new and listed
Spare Sprinklers	Proper number of sprinklers and a sprinkler wrench for each type of sprinkler	Annually			Cabinet must be located so not exposed to dust, corrosion, or 100F.

Pipe and Fittings	In good condition, free of mechanical damage, leakage, corrosion, misalignment, and external loading.	Annually			
Hangers and Braces	Not damaged or loose or else replaced or refastened	Annually			
Gauges	Ensure good condition and that normal supply pressure is being maintained	Monthly	Replaced or tested by comparison with a calibrated gauge. Must be within 3% of full scale or replaced.	5 years	
Alarm Devices	Free of physical damage	Quarterly	Done by opening inspector's test valve and recording time until alarm sounds	Quarterly	
Hydraulic Nameplate	Attached securely to sprinkler riser and is legible	Quarterly			
Hose Connections	Hose, hose couplings, and nozzles connected to the sprinkler system shall be inspected	Annually	Tested 5 years after installation following NFPA 1962. After service test, each shall be flow tested to ensure water discharge and operation of water flow alarm	3 years	Clean and dry all hoses connected to sprinkler system after use. If exposed to hazardous materials, dispose or decontaminate.
Control Valves	Ensure in normal open or closed position, sealed or locked, accessible, provided with appropriate wrenches, free from leaks, and has proper identification	Weekly	Operated through full range and returned to normal position. Post indicator valves shall be opened until torsion felt, then backed a quarter turn from open position	Annually	Operating stems shall be lubricated annually then completely closed and reopened.
Check Valves	Inspected internally to verify all components operate properly, move freely, and are in good condition	5 years			Internal components shall be cleaned, repaired or replaced as necessary
Fire Department Connections	Verify FDC is visible and accessible, no damage, caps and gaskets are in place, ID signs are in place, check valve no leaking and drain valve is operating	Quarterly			Components shall be repaired or replaced as necessary. Any obstructions present shall be removed

4.7 Alternate Fire Suppression System

An alternate design was done for the building using AutoSprink software. This design contained different hazard classifications and design criteria as described below.

4.7.1 Occupancy Classification

The hazard classifications for each type of room in the building are listed in Table 29.

Table 29- Occupancy Classifications for AutoSprink Designed System

Description	Hazard Classification	NFPA 13 Reference [5]
Classrooms, auditoriums, corridors, offices, conference rooms	Light Hazard	5.2
Laboratories, storage, mechanical, electrical	Ordinary Hazard Group 2	5.3.2

This design classifies laboratories, storage space, mechanical and electrical rooms as Ordinary Hazard Group 2 as opposed to the current classification of Ordinary Hazard Group 1. This is more appropriate because these spaces more closely resemble the uses listed in NFPA 13 Section 5.3.2 Ordinary Hazard (Group 2) than those listed in NFPA 13 Section 5.3.1 Ordinary Hazard (Group 1). Occupancy classifications by floor are shown in the plans in Appendix H.

4.7.2 Design Criteria

The design criteria for the alternate design are shown in Table 30. The only difference between Table 30 and the design criteria for the current system is the higher density required for Ordinary Hazard Group 2.

Table 30- Design Criteria for AutoSprink Designed System [5]

Hazard	Max Area (ft^2)	Density (gpm/ft^2)	Operation Area (ft^2)	Inside HSA (gpm)	Combined HSA (gpm)	Duration (min)
Light	225	0.1	1500	0	100	30
OH Group 2	130	0.2	1500	100	250	60-90

4.7.3 Sprinkler System Design and Layout

Using AutoSprink software, a sprinkler system layout was designed for the building and is shown in Appendix I. The plans in Appendix I display sprinkler system layouts for each individual floor, but does not represent a complete design due to the following simplifications. All sprinklers were assumed to be pendent and at a height of 10’-6”. This would not be the case for areas without finished ceiling, but was done for simplicity. All piping was laid out assuming no obstructions, which would not be true due to air ducts, cable trays, and structural members. The standpipe system was not modeled using AutoSprink and can be assumed to follow the same layout as the current system. Also, the first floor does not show the fire pump room or the point of connection to the underground piping. In the plans in Appendix I, the sprinkler system on each floor terminates at the riser for that floor and the floors are not interconnected. This design can still be used for the layout of the sprinkler system and for performing hydraulic calculations on each floor.

The sprinkler system was designed in AutoSprink using the following criteria. System risers were placed in the same locations as the current design and were assumed to be 2 ½” inches. All cross mains, branch lines and sprinklers were at constant heights. In the model, cross mains range from 2 ½” to 3” and branch lines are 1 ¼”. The sprinklers were spaced with a maximum area of 225 square feet in Light Hazard areas and 130 feet in Ordinary Hazard Group 2 areas. All piping has a C factor of 120 and all sprinklers have a K factor of 5.6.

4.7.4 Hydraulic Calculations

Using the sprinkler system layout in AutoSprink, hydraulic calculations were performed in the software. A remote area on Level 3, Remote Area 3-2 on the as-built plans in Appendix D, was used for the hydraulic calculations. This remote area contains ten sprinklers in a lab area and is Ordinary Hazard Group 1 in the current design, but Ordinary Hazard Group 2 in the Autosprink design. The node analysis and hydraulic calculations are shown in Appendix J. This system had a different demand at the base of the riser than the currently installed system, as shown in Table 31.

Table 31- Comparison of Demand for AutoSprink System and Current System

	AutoSprink System	Current System
PSI Required at BOR	82.4	107.3
GPM Required at BOR	248.0	233.5

These differences are due mainly to the different elevations and diameters of the cross mains and branch lines as well as a different layout. The AutoSprink System has a greater flow demand because a density of 0.2 gpm/ft^2 was used for Ordinary Hazard Group 2 rather than 0.15 gpm/ft^2 for ordinary hazard group 1 that was used for the current system. The pressure demand is most likely lower for the AutoSprink system because the branchlines are all 1 ¼” while the current system has 1” – 1 ¼” branchlines. Assuming the same piping layout and pump is used in both systems between the base of the riser and the source, the demand of the AutoSprink designed system will meet the requirements of the supply.

5.0 FIRE ALARM SYSTEM

5.1 Type of Fire Alarm System

The fire alarm as-built plans can be seen in Appendix K. The building contains a Class B, addressable, manual fire alarm system. As defined by NFPA 72 Section 12.3.2, a Class B pathway performs as follows [9]:

1) Does not include a redundant path
2) Operational capability stops at a single open
3) Conditions that affect the intended operation of the path are annunciated as a trouble signal
4) Operational capabilities are maintained in the application of a single ground fault
5) A single ground condition shall result in the annunciation of a trouble signal

As defined by NFPA 72 Section 3.3.8, an addressable device is one with discrete identification that can have its status individually identified or that is used to individually control other functions [9]. With an addressable system, the name, location, and type of alarm are annunciated at the control panel in order to assist firefighters upon arrival to a fire situation, or for personnel fixing an issue with the system.

Because the building is completely sprinklered, complete automatic coverage by the fire alarm system is not required, so the installed system is a manual, partial area coverage system. This means that there is not complete coverage by smoke detection due to the presence of sprinklers as heat detectors, but the building does contain manual pull stations at each exit from the building.

Since the building contains an atrium between the second and sixth floors, there is a smoke control system installed in the building. The smoke control system contains beam smoke detectors installed throughout the atrium as well as a firefighter smoke control panel in the fire control room and vents to the exterior located at the ceiling of the atrium. The smoke control system will not be described in detail in this report, but will be addressed in a future report.

5.2 Fire Alarm Control Panel

The fire alarm control panel is located on the first floor of the building in the fire control room (Figure 12).

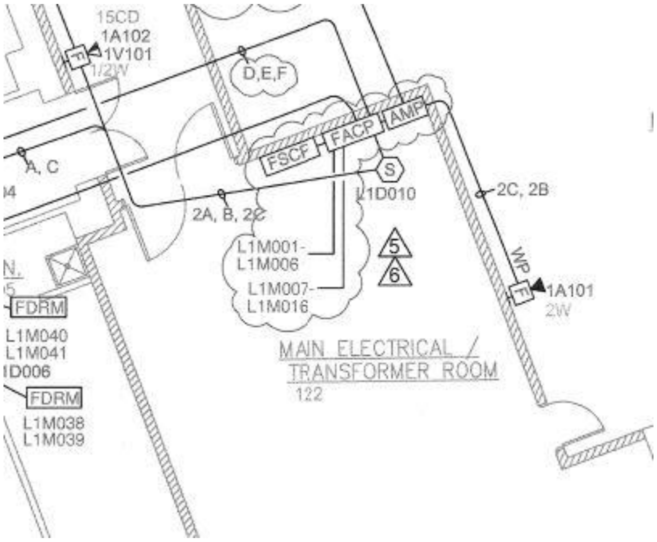


Figure 12 - Plan view of fire alarm control panel in fire control center on first floor of building [10].

The panel is manufactured by Honeywell Notifier and has a model number NFS-640 (Figure 13).

Figure 13 - Honeywell Notifier fire alarm control panel.

In the fire control room there is also a firefighter smoke control panel for control of the smoke control system in the atrium (Figure 14).

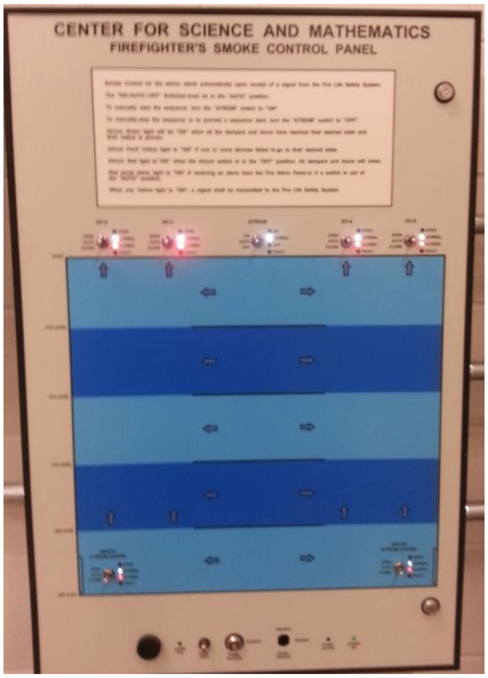


Figure 14 - Firefighter's smoke control panel located in fire control room.

5.3 Operating Characteristics

The operating characteristics of the fire alarm system are all determined from the sequence of operations matrix, which can be found in Appendix K. The following sections summarize some important operating characteristics of the fire alarm system including disposition of alarm, supervisory, and trouble signals. The sequence of operations matrix also indicates what events will result in air handling units being shut down, activation of smoke/fire dampers, release of magnetic door holders, and elevator recall. Other important information in the sequence of operations matrix includes the operation of the smoke control system, which will be discussed in a later report.

5.3.1 Alarm Signal

The following events will lead to an alarm signal and activation of the fire alarm system throughout the entire building:

- Manual pull station activation
- Spot smoke detector activation
- Duct smoke detector activation
- Sprinkler water flow activation
- Fire pump running
- Atrium smoke control system alarm
- Beam smoke detector activation

5.3.2 Supervisory Signal

The following events will result in a supervisory signal at the fire alarm control panel:

- Sprinkler tamper switch

- Fire pump loss of phase
- Fire pump phase reversal
- Shunt trip power supervision

5.3.3 Trouble Signal

The following events will result in a trouble signal at the fire alarm control panel:

- Panel trouble condition
- AC power failure
- Low battery
- Open circuit
- Ground fault

5.4 Initiating Devices

The following devices are present in the building and shown in the plans in Appendix K.

5.4.1 Manual Pull Stations

There are a total of 30 manual pull stations present throughout the building near all exit locations (Figure 15).

Figure 15 - Plan view symbol and photo of manual pull boxes within building.

According to NFPA 72 Section 17.14.8.4, manual fire alarm boxes shall be within 5 feet of each exit doorway on each floor. As seen on the plans in Appendix K, all exit doors to the exterior and to stairways are in compliance with this requirement.

5.4.2 Smoke Detectors

5.4.2.1 Spot-Type Smoke Detectors

The building does not contain complete automatic coverage of spot-type smoke detectors because it is completely sprinklered. However, there are 30 photoelectric smoke detectors in place in certain locations such as electrical rooms, elevator lobbies, and at magnetically held doors at the perimeter of the atrium. The spot smoke detectors are Notifier FSP-851(A) photoelectric smoke detectors as shown in the manufacturer specification sheet in Appendix L [11].

Figure 16 - Plan symbol of smoke detector.

Although not located throughout the building, the location and spacing of spot type smoke detectors must follow the requirements of NFPA 72 Section 17.7.3.2.3.1 (1) or (2) as follows.

1) The distance between smoke detectors shall not exceed a nominal spacing of 30 feet and there shall be detectors within a distance of one half the nominal spacing, measured at right angles from all walls or partitions extending upward to within the top 15 percent of the ceiling height.
2) All points on the ceiling shall have a detector within a distance equal to or less than 0.7 times the nominal 30 foot spacing.

Following these requirements, floor plans showing complete area coverage with spot type smoke detectors are shown in Appendix M.

5.4.2.2 Elevator Lobbies

As required by NFPA 72 Section 21.3.5, lobby smoke detectors are required to be installed within 21 feet of the centerline of each elevator door. The building contains an elevator between the first and second floor, as well as two elevators between the second and sixth floor located within the atrium. The building is in compliance with this requirement because all elevators contain a photoelectric smoke detector within the required distance (Figure 17).

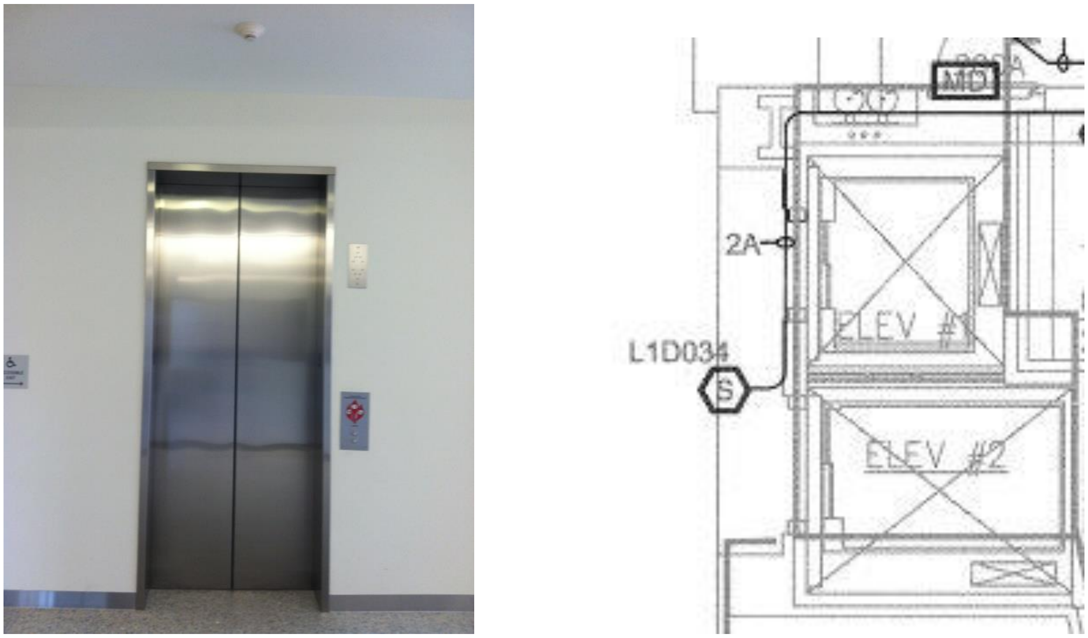


Figure 17 - Photo of elevator lobby smoke detector and plan view [10].

5.4.2.3 Magnetic Doors

At the east and west ends of the atrium on each floor, there are magnetically held open doors leading to the classroom corridors. Since the doors are in fire walls that surround the atrium, they must be fire rated and are required to be closed when a fire is detected. For this reason, at each door there is a photoelectric smoke detector that will release the magnetically held open door upon activation (Figure 18

Figure 18 - Photo of magnetic door smoke detector and plan view [10].

5.4.2.4 Duct Detectors

The building contains 62 photoelectric duct detectors as located in the plans in Appendix K. All duct detectors must be installed in accordance with the requirements of NFPA 72 Section 17.7.5.5 Locations and Installation of Detectors in Air Duct Systems. Activation of duct smoke detectors shut down the associated air handling unit and close associated fire/smoke dampers if located in a duct penetrating a fire wall as indicated by the sequence of operations of the fire alarm system.

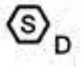


Figure 19 - Plan symbol of duct smoke detector.

5.4.2.5 Beam Detectors

There are eleven beam detector imagers and receivers located in the atrium of the building between the second and sixth floors. Beam detectors are located on each floor of the atrium from the second floor up to the fifth floor (Figure 20).

Figure 20 - Plan symbol of beam detector receiver, imager, and photo of beam detectors in atrium.

Beam detectors must be installed in accordance with NFPA 72 Section 17.7.3.7 Projected Beam-Type Smoke Detectors. The beam detectors are open-area smoke imaging detectors (OSID) manufactured by Xtralis as shown in the manufacturer specification sheet shown in Appendix N. The beam detectors are used to activate the smoke control system within the atrium, which will be discussed in more detail in the performance based analysis.

5.4.3 Sprinklers

The building is fully sprinklered, as discussed in detail in a previous report. All sprinklers within the building have an activation temperature of 155°F and are quick response. Activation of a sprinkler will activate the fire alarm system once water begins to flow and a sprinkler flow switch is triggered. For this reason sprinklers are considered initiating devices, although not necessarily being components of the fire alarm system.

5.5 Notification Devices

5.5.1 Visible Notification Devices

The visible notification devices present in the building are strobes and speaker/strobe combos (Figure 21).

Figure 21 - Plan symbol of speaker/strobe, strobe and photo of strobe from building.

Speaker/strobes are typically installed throughout the corridors and in all of the classrooms. Within the building, there are 66 visible only strobes that are typically located in small rooms, such as restrooms, and also in rooms containing speaker/strobes that do not meet the visible requirements.

5.5.1.1 Location and Spacing Requirements

All wall mounted devices must be not less than 80 inches and not greater than 96 inches above the finished floor in accordance with Section 18.5.5 of NFPA 72. Visible appliances must be spaced in rooms following the requirements of either Table 18.5.5.4.1(a) for wall mounted appliances or Table 18.5.5.4.1(b) for ceiling mounted devices. By inspection, the location and spacing of devices in rooms appears to meet the requirements of NFPA 72. For example, the following large classroom will be analyzed (Figure 22).

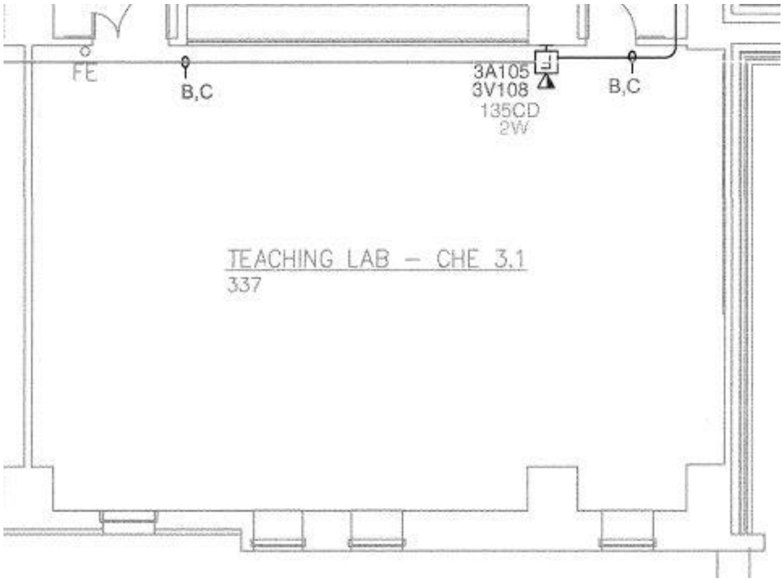


Figure 22 - Plan view of classroom showing adequate coverage for visible notification devices [10].

This room has dimensions of approximately 25 feet by 41 feet and contains one wall mounted speaker/strobe rated at 135 candella. From Table 18.5.5.4.1(a), for one 135 candella light in a room, the maximum room size can be 60 feet by 60 feet. Since the room is non-square, a square size of 60 feet by 60 feet allows the entire room to be encompassed, as required by NFPA 72 Section 18.5.5.4.5, so the room is in compliance with the code.

For spacing of visible notification devices in corridors, the requirements of NFPA 72 Section 18.5.5.5 must be met. This section states that for corridors 20 feet or less in width, visible notification appliances shall be located not more than 15 feet from the end of the corridor with a separation not greater than 100 feet between appliances. All corridors in the building meet this requirement, with an example seen in Figure 23.

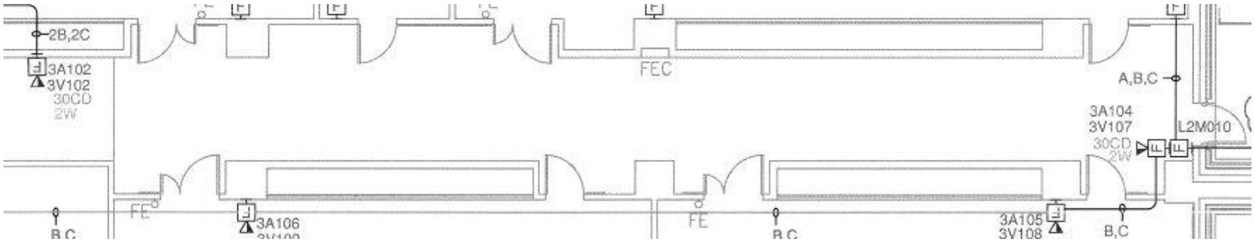


Figure 23 - Plan view of corridor showing adequate spacing of visible notification devices [10].

In this corridor, there is a device at the end of the corridor, with the next visible device separated approximately 85 feet from the first device. From this analysis, all visible notification devices within the building are spaced properly and meet the requirements of the code.

5.5.2 Audible Notification Devices

The audible notification devices present in the building are bells, speakers, and speaker/strobes (Figure 24).

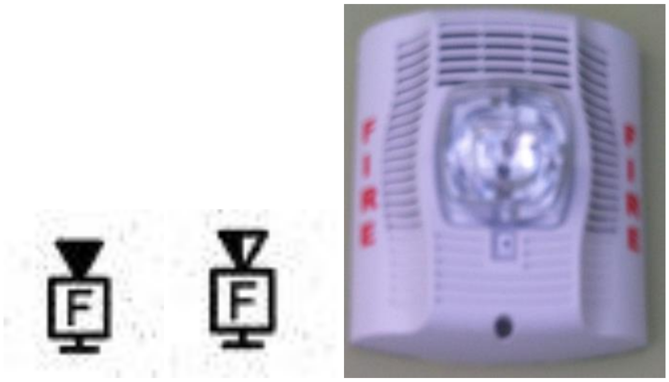


Figure 24 - Plan symbol of speaker, speaker/strobe, and photo of speaker/strobe from building.

Throughout the building there are a total of 172 speakers and 1 bell. The bell is located outside of the fire pump room on the exterior of the building (Figure 25).

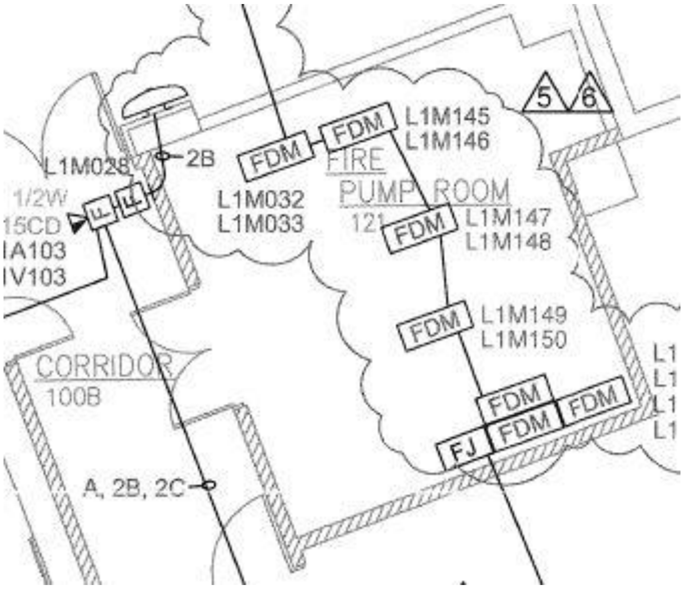


Figure 25 - Plan view of bell located outside fire pump room [10].

Combination speaker and strobe devices are installed in normally occupied spaces, such as corridors and classrooms. Audible only devices are installed in normally unoccupied areas, such as mechanical rooms as well as on the exterior of the building. The devices installed on the exterior of the building are weatherproof and are located on the terraces on the upper stories of the building as well as on the exterior of the building near exits (Figure 26).

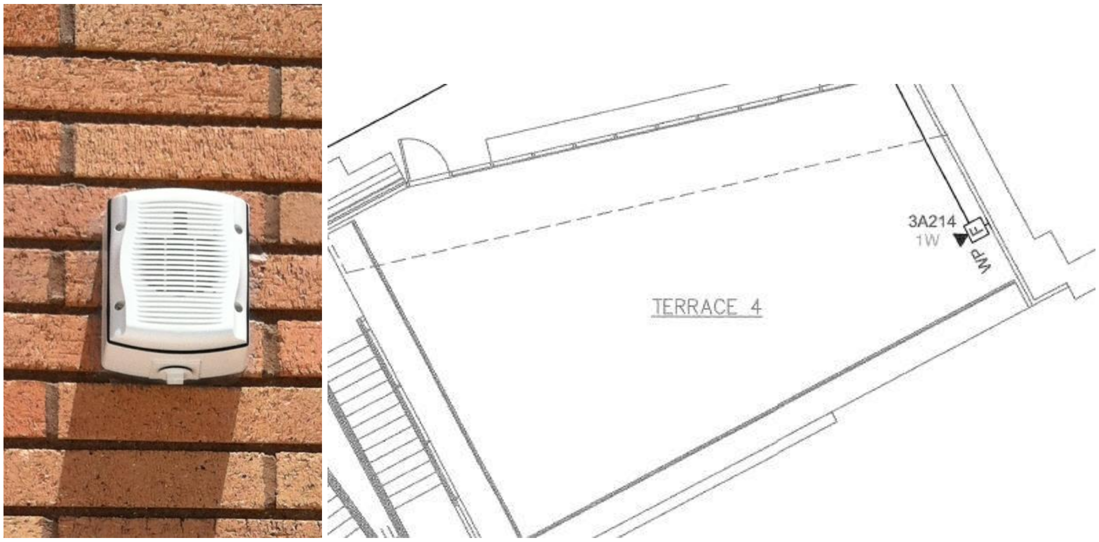


Figure 26 - Photo and plan view of weatherproof audible device on terrace [10].

5.5.2.1 Location and Spacing Requirements

Wall mounted audible devices must meet the same requirements of NFPA 72 Section 18.5.5 which states all wall mounted devices must be not less than 80 inches and not greater than 96 inches above the finished floor. Audible devices must be spaced in order to meet the requirements of NFPA 72 Section 18.4.3.1, which says for public mode signals the sound level should be at least 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured at 5 feet above the floor. According to Table A.18.4.3, the average ambient sound level for an educational occupancy is 45 dBA [9]. Since the building contains a large number of classrooms and classes typically start and end at the same time, there can be large numbers of people in the corridors at one time. For this reason, it would be more appropriate to measure a maximum sound level, since this would most likely be greater than 45 dBA and last more than 60 seconds at times in between classes.

5.6 Power Supply

The fire alarm system contains a secondary power supply at the fire alarm control panel consisting of batteries with a capacity of 55 amp-hours. In accordance with NFPA 72 Section 10.6.7.2.1 (2), the secondary power supply for an in building fire emergency voice/alarm communications service shall be capable of operating under standby for 24 hours and in alarm for 15 minutes at maximum load [9]. In order to show that the provided secondary power supply of 55 amp-hours is adequate, calculations were performed for all of the devices on the first floor connected to the fire alarm control panel (Table 32).

Table* 32*-Battery calculations for all devices connected to fire alarm control panel on first floor

Item	**Quantity**	**Standby Current (Amps)**	**Total Standby Current**	**Alarm Current (Amps)**	**Total Alarm Current**
Fire Alarm Control Unit	1	0.2850	0.2850	0.2850	0.2850
Universal Dialer	1	0.0400	0.0400	0.1000	0.1000
Remote Annunciator	2	0.0643	0.1286	0.0643	0.1286
Power Supply Amp	1	0.0000	0.0000	0.0250	0.0250
Beam Smoke Emitter	10	0.0035	0.0350	0.0035	0.0350
Beam Smoke Imager	10	0.0310	0.3100	0.0310	0.3100
Manual Pull	29	0.0004	0.0116	0.0004	0.0116
Relay Module	9	0.0017	0.0153	0.0022	0.0198
Smoke Detector	16	0.0003	0.0048	0.0003	0.0048
Dual Monitor Module	18	0.0008	0.0144	0.0064	0.1152
Speaker Only	3	0.0000	0.0000	0.0008	0.0024
Strobe Only 15CD	7	0.0000	0.0000	0.0660	0.4620
Strobe Only 30CD	6	0.0000	0.0000	0.0940	0.5640
Strobe Only 75CD	2	0.0000	0.0000	0.1580	0.3160
Fire Fighter Phone Jack	12	0.0075	0.0900	0.0075	0.0900
Six Relay Control Module	1	0.0015	0.0015	0.0320	0.0320
10-input Monitor Module	1	0.0035	0.0035	0.0550	0.0550
Speaker Strobe 15CD	3	0.0000	0.0000	0.0710	0.2130
Speaker Strobe 30CD	14	0.0000	0.0000	0.0960	1.3440
Speaker Strobe 75CD	14	0.0000	0.0000	0.1530	2.1420
Speaker Strobe 95CD	3	0.0000	0.0000	0.1760	0.5280
Speaker Strobe 115CD	16	0.0000	0.0000	0.2050	3.2800

Monitor Module	19	0.0037	0.0703	0.0037	0.0703
Dual Relay/Monitor Module	64	0.0013	0.0832	0.0240	1.5360
Duct Smoke Detector	64	0.0003	0.0192	0.0003	0.0192
		Total System Standby Current (Amps)	1.1124	**Total System Alarm Current (Amps)**	11.6889

From these calculations, the total system standby current was found to be 1.1124 amps and the total system alarm current was 11.6889 amps. Applying the time requirements of NFPA 72 Section 10.6.7.2.1(2), the total capacity required in amp-hours can be calculated (Table 33).

Table* 33*-Required standby and alarm capacity calculations [9]

Required Standby Time (Hours)	**Total System Standby Current (Amps)**	**Required Standby Capacity (Amp-Hours)**	**Required Alarm Time (Hours)**	**Total System Alarm Current (Amps)**	**Required Alarm Capacity (Amp-Hours)**
24	1.1124	26.6976	0.25	11.6889	2.9222

After applying the 20% safety margin as required by NFPA 72 Section 10.6.7.2.1(1), the total capacity required by the fire alarm system on the first floor of the building is found to be 35.5438 amp-hours, which is well below the provided capacity of 55 amp-hours (Table **34**).

Table* 34*-Battery calculations showing available spare capacity [9]

Required Standby Capacity (Amp-Hours)	26.6976
Required Alarm Capacity (Amp-Hours)	2.9222
Total Capacity (Amp-Hours)	29.6198
Capacity with 20% Safety Margin (Amp-Hours)	35.5438
Provided Capacity (Amp-Hours)	55
Available Spare Capacity (Amp-Hours)	19.4562

Since the provided capacity is much greater than the required capacity, the secondary power supply is adequate for this fire alarm system.

5.7 Mass Notification System

The building does not contain a mass notification system (MNS), but does contain an in-building fire emergency voice/alarm communication system (EVACS). As defined in NFPA 72, an in-building mass notification system is a system used to provide information and instructions to people in a building or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communication methods. An in-building fire emergency voice/alarm communication system is defined in NFPA 72 as dedicated manual or automatic equipment for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of the building [9]. The main difference between the two types of systems is that MNS can be used over the fire alarm system in order to issue different messages not related to fire emergencies. According to NFPA 72 Section 24.4.1, EVACS is used mainly in high rise buildings or large building where a total evacuation of the building would not be practical or desirable on every alarm. For this reason, the system can be used to tell certain occupants of the building to remain in place while other occupants are told to evacuate in order to limit the number of occupants in the means of egress. This allows occupants in direct threat of the fire to evacuate quicker while occupants in areas of the building not affected by the fire will not have to evacuate when there is an alarm.

5.8 Inspection, Testing, Maintenance Requirements

The requirements for inspection, testing, and maintenance for fire alarm systems and components are found in Section 14 of NFPA 72. Inspection and testing requirements relate to initial and reacceptance inspection and testing as well as periodic inspection and testing. According to NFPA Section 14.2.1, the purpose of initial inspection and testing is to ensure compliance with design documents and ensure proper installation and operation. The purpose of periodic inspection and testing is to identify obvious damage or changes to the system that will affect performance and assure operational reliability. According to Section 14.2.3, the property or building owner or the owner's designated representative shall be responsible for inspection, testing, and maintenance of the system as well as alterations or additions to the system [9].

5.8.1 Inspection

Inspection requirements and frequencies for the devices and components present in the building are listed in Table 35. All requirements are from NFPA 72 Table 14.3.1 [9].

5.8.2 Testing

According to NFPA 72 Section 14.4.1, all new systems must be inspected and tested. Changes to systems require reacceptance testing in accordance with NFPA 72 Section 14.4.2. The testing frequencies of devices and components of the fire alarm system that are present in the building are shown in Table 35. All requirements are form NFPA 72 Table 14.4.3.2, which also lists the methods for testing each component.

Table* 35-*Inspection and testing frequency requirements for fire alarm system components [9]

Component	Inspection Frequency	Testing Frequency
Primary power supply	Annually	Annually
Trouble signals	Semiannually	Annually
Digital alarm communicator transmitter	Annually	Annually
In-building emergency voice/alarm communication equipment	Semiannual	
Batteries	Monthly/Semiannual	Annually/Semiannually
Duct detectors	Semiannually	Annually
Electromechanical releasing devices	Semiannually	Annually
Manual fire alarm boxes	Semiannually	Annually
Smoke detectors	Semiannually	Annually

Beam smoke detectors	Semiannually	Annually
Supervisory signal devices	Quarterly	Annually
Waterflow devices	Quarterly	Semiannually
Audible notification appliances	Semiannually	Annually
Visible notification devices	Semiannually	Annually

5.8.3 Maintenance

Maintenance requirements for fire alarm systems and components are listed in NFPA 72 Section 14.5. This section states that fire alarm system equipment shall be maintained in accordance with the manufacturer’s published instructions at a frequency depending on the type of equipment and the local ambient conditions. A record of inspection, testing, and maintenance must be kept following the requirements of Section 7.8.2 of NFPA 72 [9].

6.0 PERFORMANCE BASED ANALYSIS

6.1 Introduction

The CSM contains a five story atrium on Levels 2 through 6 separating the east and west wings of the building (Figure 27). The openings between each level on the north and south side of the atrium are highlighted in Figure 27. Within the north opening, there is an unprotected staircase while the south opening is completely open from Level 2 to Level 6. Photographs of each opening from Level 2 are shown in Figure 28.

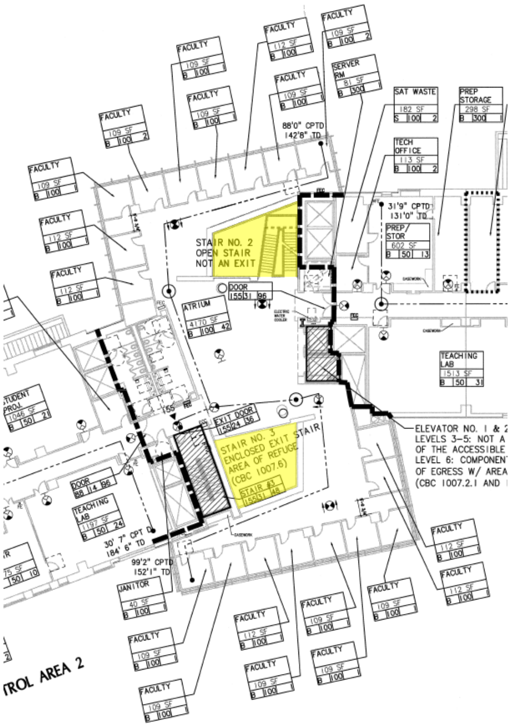


Figure 27 - Plan view of atrium with openings between floors highlighted [1].

Figure 28 - Photographs of the south (left) and north (right) openings of the atrium.

6.1.1 Existing Natural Ventilation Smoke Control System

The atrium contains a natural ventilation smoke control system that consists of exhaust and makeup vents as well as controls from the notification devices of the fire alarm system.

6.1.1.1 Ventilation Components

At the ceiling above the north and south openings within the atrium, there are smoke reservoirs as shown in Figure 29.

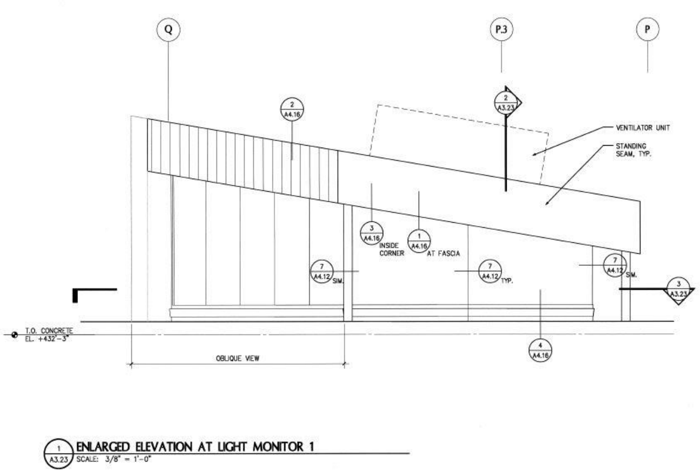


Figure 29 - Elevation view of smoke reservoirs with exhaust vents at the top of the atrium [1].

In each reservoir, there are two 50 square foot exhaust vents for a total of four 50 square foot exhaust vents. The plan view of the vents in the smoke reservoirs is shown in Figure 30.

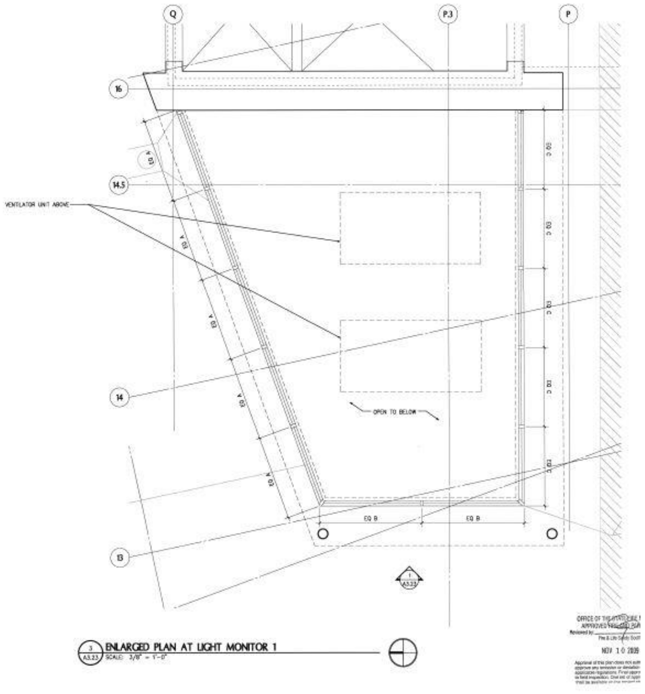


Figure 30 - Plan view of two 50 square foot exhaust vents at the top of the atrium [1].

In addition to the exhaust vents, the smoke control system also provides makeup air from the north and south doors to the exterior on Level 2. These doors open when the smoke control system is activated to provide fresh air from the exterior of the building as makeup air. The doors are 133.5 square feet each and located as shown in Figure 31.

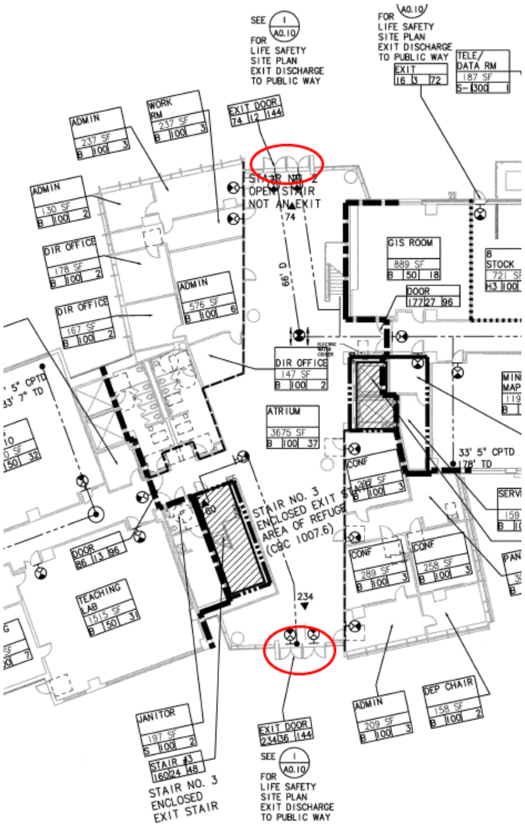


Figure 31 - Location of makeup air vents on Level 2 of the atrium [1].

6.1.1..2 Initiating Devices

Within the atrium, there are beam detectors, spot smoke detectors, sprinklers, and manual pull stations that can all activate the fire alarm system and the smoke control system. Any fire in one of the open areas of the atrium will most likely be detected by the beam detectors first. The typical locations of the beam transmitters and receivers on each level of the atrium are shown in Figure 32.

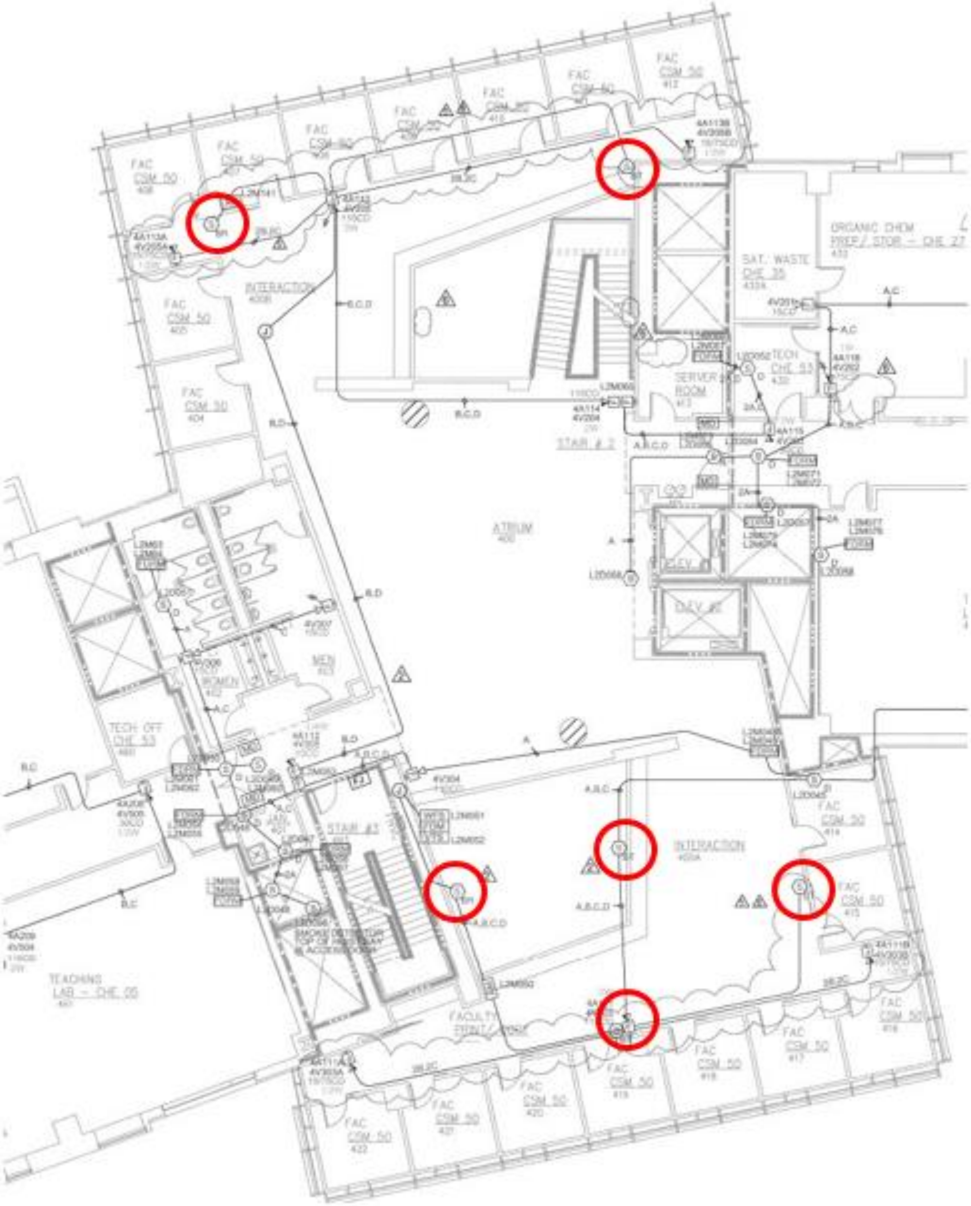


Figure 32 - Location of beam detectors on Level 4 of the atrium [10].

In addition to the beam detectors, there are also spot smoke detectors located at the magnetic doors within the 1 hour fire rated atrium separation and at the elevators within the atrium, as shown in Figure 33.

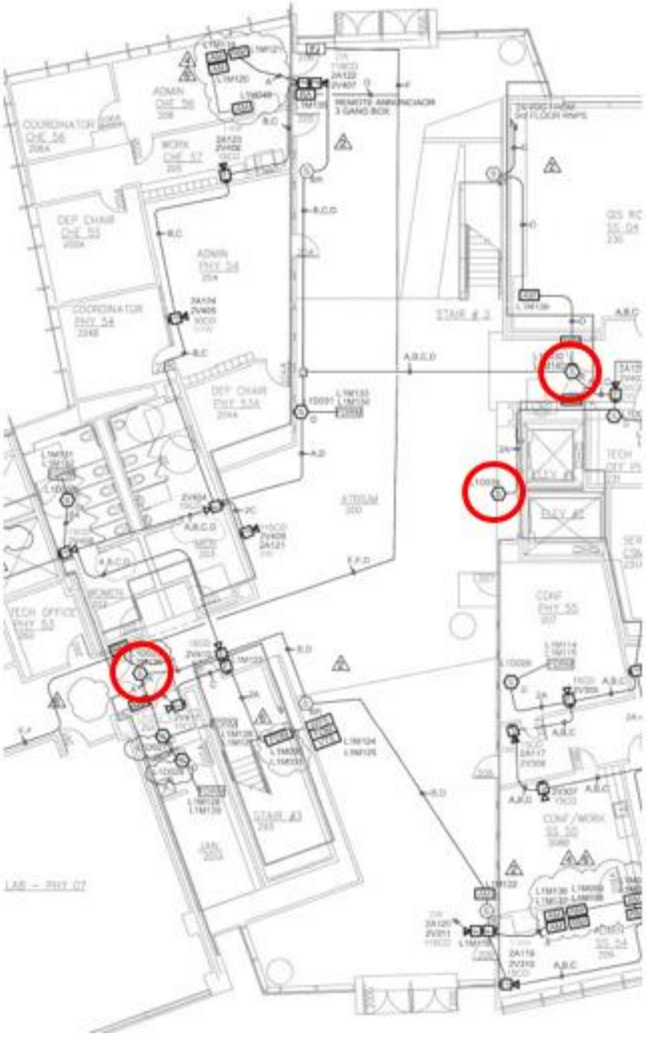
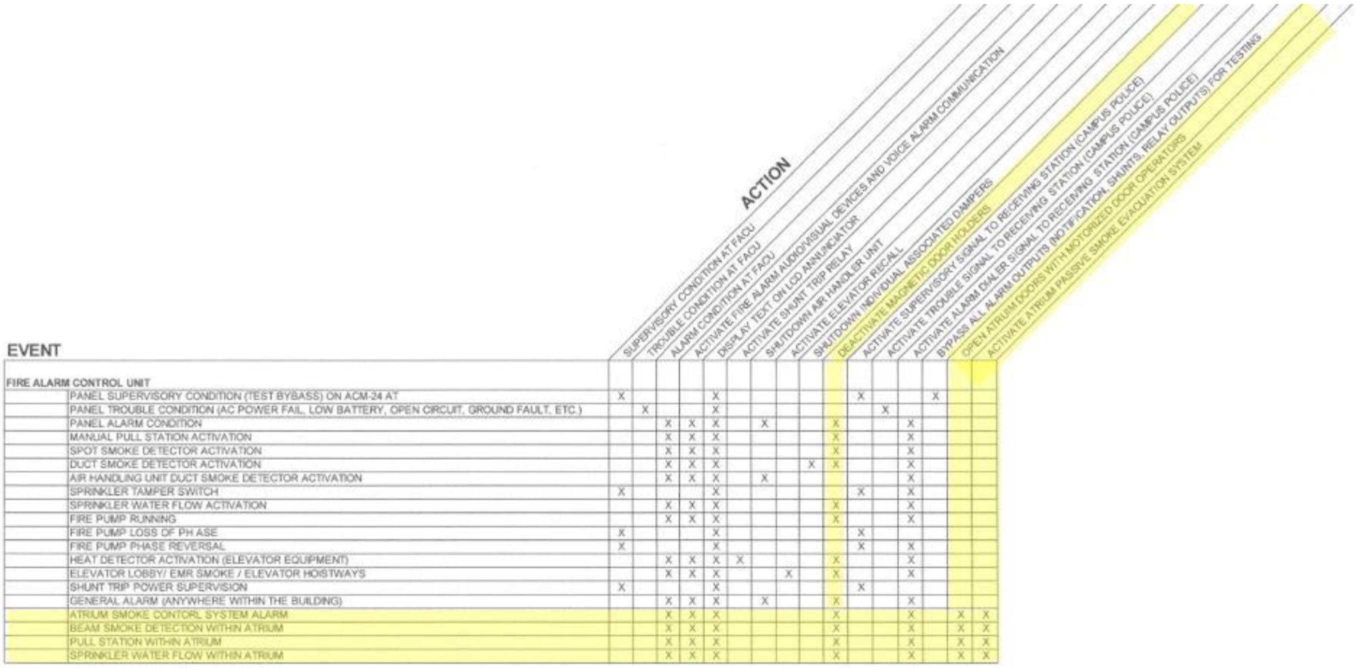


Figure 33 - Location of spot smoke detectors in the atrium [10].

Activation of any spot smoke detector, beam detector, pull station or fire sprinkler within the atrium will activate the sequences of the smoke control system highlighted in the sequence of operations shown in Figure 34. Once the fire is detected by one of these devices, the makeup air vents on Level 2 of the atrium open, the magnetic doors within the 1 hour rated atrium fire separation close, and the vents located at the top of the atrium open to exhaust smoke from the atrium.



EVENT	ACTION															
	SUPERVISORY CONDITION AT FACU	TROUBLE CONDITION AT FACU	ALARM CONDITION AT FACU	ACTIVATE FIRE ALARM AUDIO/VISUAL DEVICES AND VOICE ALARM COMMUNICATION	DISPLAY TEXT ON LCD ANNUNCIATOR	ACTIVATE SHUNT TRIP RELAY	SHUTDOWN AIR HANDLER UNIT	ACTIVATE ELEVATOR RECALL	SHUTDOWN INDIVIDUAL ASSOCIATED DAMPERS	DEACTIVATE MAGNETIC DOOR HOLDERS	ACTIVATE SUPERVISORY SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE TROUBLE SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE ALARM DIALER SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	BYPASS ALL ALARM OUTPUTS (NOTIFICATION, SHUNTS, RELAY OUTPUTS) FOR TESTING	OPEN ATRUIM DOORS WITH MOTORIZED DOOR OPERATORS	ACTIVATE ATRIUM PASSIVE SMOKE EVACUATION SYSTEM
FIRE ALARM CONTROL UNIT																
PANEL SUPERVISORY CONDITION (TEST BYBASS) ON ACM-24 AT	X				X						X			X		
PANEL TROUBLE CONDITION (AC POWER FAIL, LOW BATTERY, OPEN CIRCUIT, GROUND FAULT, ETC.)		X			X							X				
PANEL ALARM CONDITION			X	X	X		X			X			X			
MANUAL PULL STATION ACTIVATION			X	X	X					X			X			
SPOT SMOKE DETECTOR ACTIVATION			X	X	X					X			X			
DUCT SMOKE DETECTOR ACTIVATION			X	X	X				X	X			X			
AIR HANDLING UNIT DUCT SMOKE DETECTOR ACTIVATION			X	X	X		X						X			
SPRINKLER TAMPER SWITCH	X				X						X		X			
SPRINKLER WATER FLOW ACTIVATION			X	X	X					X			X			
FIRE PUMP RUNNING			X	X	X					X			X			
FIRE PUMP LOSS OF PH ASE	X				X						X					
FIRE PUMP PHASE REVERSAL	X				X						X		X			
HEAT DETECTOR ACTIVATION (ELEVATOR EQUIPMENT)			X	X	X	X				X			X			
ELEVATOR LOBBY/ EMR SMOKE / ELEVATOR HOISTWAYS			X	X	X			X		X			X			
SHUNT TRIP POWER SUPERVISION	X				X						X					
GENERAL ALARM (ANYWHERE WITHIN THE BUILDING)			X	X	X		X			X			X			
ATRIUM SMOKE CONTORL SYSTEM ALARM			X	X	X					X			X		X	X
BEAM SMOKE DETECTION WITHIN ATRIUM			X	X	X					X			X		X	X
PULL STATION WITHIN ATRIUM			X	X	X					X			X		X	X
SPRINKLER WATER FLOW WITHIN ATRIUM			X	X	X					X			X		X	X

Figure 34 - Sequence of operations highlighting the atrium specific events and actions [10].

6.2 Code Requirements

The applicable codes and standards relating to the smoke control system within the atrium are listed below:

2013 California Building Code (CBC)

NFPA 92, Standard for Smoke Control System, 2015 Edition

6.2.1 CBC Requirements

6.2.1.1 404 Atriums

Since the atrium exceeds 2 stories, it is required to have a smoke control system installed in accordance with Section 909 (Section 404.5) [2]. Since atriums are large volume spaces interconnecting multiple stories, smoke and other products of combustion can spread from the point of origin of the fire to other stories within the atrium. Smoke and carbon monoxide are known to cause many deaths in fires to occupants not intimate with the fire origin, so exhausting the smoke from the atrium can maintain tenability within the atrium allowing the occupants to egress.

6.2.1.2 909 Smoke Control Systems

The smoke control system must follow the requirements of Section 909 and specifically Section 909.8 since the exhaust method will be utilized. The purpose of a smoke control system is solely to maintain a tenable environment for the duration of the evacuation of occupants (Section 909.1) [2].

6.2.1.3 909.4 Analysis

A rational analysis must be performed to justify that a smoke control system using the exhaust method will be appropriate and address the effects of the stack effect, temperature effect of the fire, wind, HVAC systems, and climate (Section 909.4.1-909.4.5) [2]. All of these items can alter the movement of smoke within the atrium, so they must be considered within the design of the smoke control system in order to ensure that the system will be able to perform as intended. The smoke control system will need to operate for either a duration of 20 minutes or 1.5 times the calculated egress time, whichever is less (Section 909.4.6) [2]. This is to ensure a safety factor is included in the egress time and that all components of the smoke control system will be able to operate long enough for all occupants to evacuate.

6.2.1.4 909.9 Design Fire

The rational analysis must also include a design fire that has been approved by the authority having jurisdiction. In addition to the items considered in Section 909.4, the design fire must include a consideration of the fuel load, fuel configuration, heat release rate, and effectiveness of sprinklers (Section 909.9.1-909.9.4) [2]. The rational analysis must address all of these considerations to ensure that the selection of a design fire best represents the fire risk of the specific situation.

6.2.1.5 909.8 Exhaust Method

The objective of the exhaust method is to maintain the height of the smoke layer at least 6 feet above any walking surface that is used as part of a means of egress within the smoke zone (Section 909.8.1) [2]. Maintaining the smoke layer at this height will limit the exposure of occupants to the toxic products of combustion and heat. Smoke control systems using the exhaust method must be designed in accordance with NFPA 92.

6.2.2 NFPA 92 Requirements

NFPA 92 states the design objectives and requirements for smoke control systems, as well as the procedures for smoke management calculations and heat release rate data to be considered for design fires.

6.2.2.1 Chapter 4

There are four specific objectives to be achieved from a smoke control system as listed in Section 4.1.2. Since the atrium will contain an exhaust smoke control system, the design objective is to maintain the smoke layer interface at a certain elevation within the large volume space of the atrium (Section 4.1.2 (4)). Since the exhaust method will be used for the smoke control system, makeup air will need to be provided below the smoke layer interface (Section 4.4.4.1-4.4.4.2). Makeup air velocity cannot exceed 200 feet per minute where it may contact the plume, unless an engineering analysis from the use of a fire model can prove a greater velocity will not disrupt the plume (Section 4.4.4.1.4). Since the smoke control system is intended to maintain the smoke layer at a height which would allow occupants enough time to egress, an egress analysis must be performed including tenability requirements in order to determine the required operating time of the smoke control system (Section 4.5.1.2) [12].

6.2.2.2 Chapter 5

Chapter 5 discusses algebraic methods that can be used to calculate the heat release rate of the design fire as well as equations to calculate smoke layer temperature and height. A smoke control system can be designed using these algebraic equations as well as a computational fluid dynamics (CFD) model (Section 5.1.3) [12]. Fire Dynamics Simulator (FDS), a CFD model designed for thermally driven flows present in fire situations will be used to design the system to ensure the smoke exhaust capacity is adequate to maintain the smoke layer for the required time.

6.3 Tenability Requirements

The available safe egress time (ASET) is defined as the time from ignition of a fire to the time an occupant encounters an incapacitating or lethal exposure to the products of combustion and heat from the fire [13]. The results of a fire that have the largest impact on occupant tenability are the visibility resulting from the density of smoke, toxic products of combustion such as carbon monoxide, and the high temperatures and heat fluxes from the fire. These parameters will be evaluated using Fire Dynamics Simulator (FDS) in order to determine when the tenable limits for occupants are exceeded in areas remote from the fire plume.

6.3.1 Visibility

Visibility in a fire situation is an important criterion of tenability because loss of visibility can prevent an egressing occupant from being able to locate an exit. If an occupant is attempting to find an exit and the smoke becomes thick enough to prevent them from continuing forward, they will be forced to turn around or stop their egress altogether which can result in incapacitation or death. An important factor in determining the minimum visibility limit is if the occupants are assumed to be familiar or unfamiliar with the building. If an occupant is familiar with the building and knows where the exits are located, they can be assumed to travel through dense smoke with less visibility to exit the building while unfamiliar occupants will not travel through the denser smoke since they don't know if they are nearing an exit. Table 2-6.11 of the SFPE Handbook of Fire Protection Engineering suggests a tenability limit of 10 meters of visibility for buildings with large enclosures and travel distances [14]. In the SFPE Handbook, Rasbash also suggests a visibility limit of 10 meters for occupants that are not familiar with an exit route within the building [14]. For this building, since the atrium is a large volume space and occupants are assumed to be unfamiliar with the building, the tenability limit for visibility will be 10 meters.

Visibility can be evaluated within FDS and is dependent on the soot yield that is prescribed to the reaction of the fire that is taking place. The soot yield in FDS is defined as the fraction of fuel mass converted into smoke particulate [15]. In order to determine visibility, FDS uses the following equation:

$$S = {}^{C}/_{K}$$

In this equation, C is a non-dimensional constant determined by the type of object being viewed through the smoke and K is the light extinction coefficient. For a light-emitting sign, C=8, and for a light-reflecting sign, C=3, which is the FDS default [15]. The light extinction coefficient, K, is determined by the following equation [15]:

$$K = K_m \rho Y_s$$

In this equation, K_m is the mass specific extinction coefficient (FDS default 8700 m^2/kg) and ρY_s is the density of smoke particulate, dependent on the soot yield, Y_s [15]. As shown in these equations, the visibility is strongly dependent on the soot yield that is prescribed by the user in FDS. For this reason, a sensitivity analysis will be performed to determine the effect of varying soot yield on the visibility within the atrium.

6.3.2 Toxic Gas Exposure

Since smoke inhalation results in more fire related deaths than direct exposure to flames, it is important to analyze the exposure of occupants to the toxic products of combustion. The burning of different materials can produce different toxic gases and irritants, but carbon monoxide is the most prevalent toxic gas. According to the NFPA Fire Protection Handbook Section 6-Chapter 2, a fractional effective dose of one is reached with a dose of 35,000 ppm CO * min resulting in incapacitation [16]. This dose over a 30 minute exposure time is equivalent to a CO concentration of 1167 ppm. This is a conservative tenability limit because this CO concentration can be tolerated by humans for 30 minutes, but for this performance based analysis it is assumed that an instantaneous concentration of 1167 ppm is the tenability limit. A CO yield will be prescribed in FDS for the most likely combustibles that will be burning in the fire and the concentration of CO throughout the atrium will be evaluated to ensure the tenable limit is not exceeded.

6.3.3 Exposure to Heat

Tenability criteria for heat exposure from a fire can be defined by the temperature that is reached or the heat flux that is tolerable for an occupant. According to the NFPA Fire Protection Handbook Section 6-Chapter 2, the tenability limit for radiant heat flux is 2.5 kW/m^2. At this heat flux, exposure can be tolerated for 30 minutes, but above this heat flux skin can burn rapidly. For this reason, the tenability limit in this rational analysis for heat flux will be defined as 2.5 kW/m^2. In Los Angeles, the tenability limit for temperature was selected as 66°C in the situation of a teacher or student entering a corridor from a room [16]. This temperature assumes dry air and a brief exposure time. For this reason, a conservative tenability limit for temperature of 60°C will be used for this rational analysis. The temperatures within the atrium will be evaluated with the use of FDS to ensure that occupants are not exposed to temperatures exceeding 60°C.

6.3.4 Summary

The tenability limits for visibility, carbon monoxide and heat are listed in Table 36.

Table 36 – Summary of Tenability Limits

Tenability Criteria	
Visibility	10 meters
Carbon Monoxide	1667 ppm
Heat	60°C, 2.5 kW/m^2

6.4 Purpose

The purpose of the performance based design is to ensure that the space remains tenable for a greater time than it takes for all of the occupants to exit the area. This performance based design will include an analysis of the required safe egress time (RSET) and the available safe egress time (ASET) using computer based models. RSET will be determined using the software Pathfinder while ASET will be determined using Fire Dynamics Simulator (FDS). The current smoke control system was analyzed to determine if tenability is maintained on each level of the atrium at a height of 6 feet above each walking surface as well as an alternate design.

6.5 Required Safe Egress Time (RSET)

The required safe egress time (RSET) is defined as the time from ignition of a fire and the time at which all occupants can reach an area of safety or exit [13]. In order for a building or area of a building to meet life safety requirements, the available safe egress time must be greater than the required safe egress time. This means that the area must remain tenable for a time greater than it take for all of the occupants to safely exit. An acceptable and unacceptable ASET/RSET comparison is shown in Figure 35.

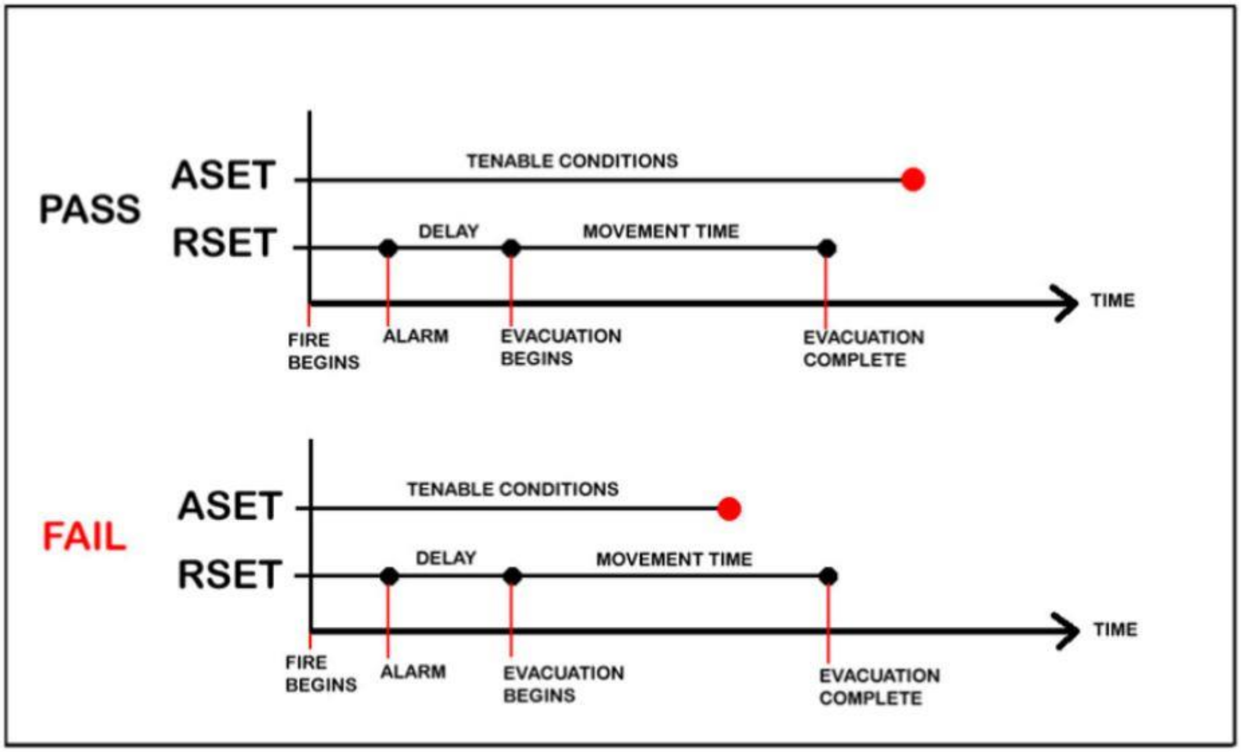


Figure 35 - ASET and RSET comparison showing a passing example and failing example.

The available safe egress time was found from the FDS simulations by determining when the tenability limits were reached on each level. The required safe egress time consists of three separate parts, as shown in Figure 35 and the following equation.

$$RSET = t_{detection} + t_{pre-movement} + t_{movement}$$

$$t_{detection} = Time\ from\ ignition\ to\ detection\ and\ notification$$

$$t_{pre-movement} = Time\ from\ notification\ to\ start\ of\ egress$$

$$t_{movement} = Time\ to\ completely\ evacuate$$

From this equation, the detection time was determined by the first activating smoke detector, beam detector, or heat detector device in the FDS simulation. The pre-movement time was an assumed constant value of 36 seconds from Table 4.2.1 of the NFPA Fire Protection Handbook for a mid-rise office building [17]. During this time after notification of the fire, it is assumed that occupants will not immediately begin exiting the building. Since the majority of occupants are professors and students, it is likely that they will gather their belongings, such as backpacks and laptops, before beginning to exit the building. A pre-movement time of 36 seconds represents these occupants well since they will most likely not ignore the fire alarm, but will still spend some time reacting to the situation and gathering belongings before egressing. Finally, the movement time was found from a Pathfinder model of the atrium.

6.5.1 Pathfinder Model

In order to determine the time for all of the occupants to completely exit the atrium, a model was made in Pathfinder (Figure 36). The model contains the protected stair within the atrium, but not the open stairway within the north opening of the atrium since it is not an approved means of egress.

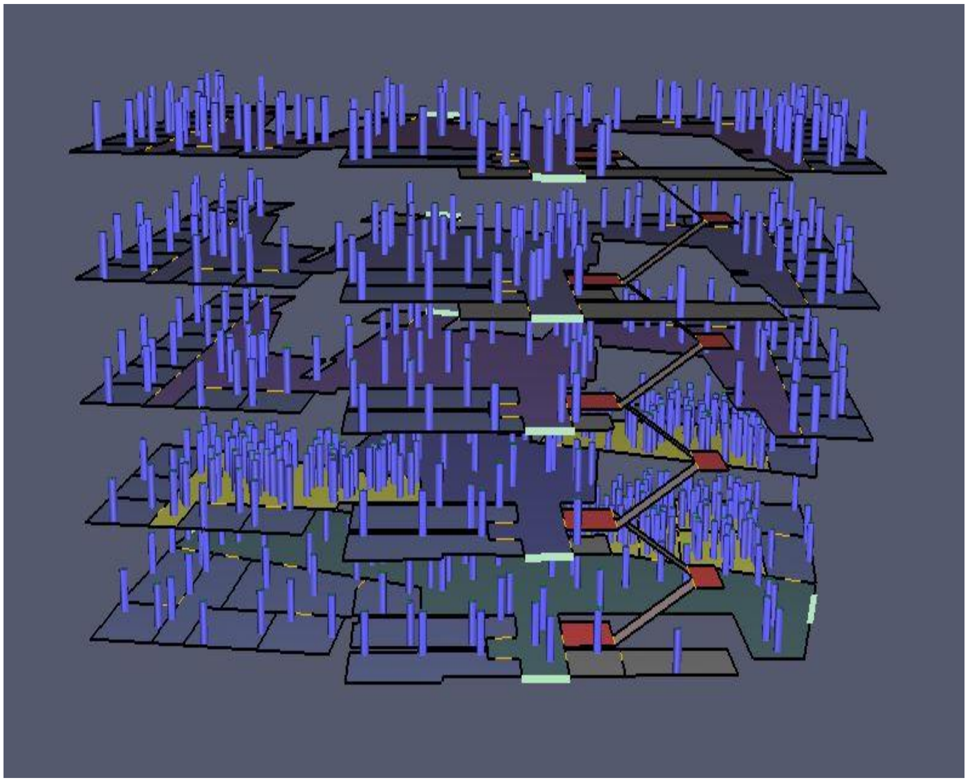


Figure 36 - Pathfinder model of the atrium of the building.

6.5.1.1 Pathfinder Model - Exits

Similar to the Pyrosim and FDS model, the Pathfinder model consisted of only the atrium. Since the atrium contains horizontal exits to the east and west wings of the building, as well as exits to the exterior on Level 2, the egress time was found when all of the occupants exit the atrium through these exits, rather than the entire building. Since the horizontal exits are in the 1 hour barrier separating the atrium from the remainder of the building, it is considered that occupants have exited the building when using a horizontal exit. A summary of the exits present in the Pathfinder atrium model is shown in Table 37.

Table 37 – Summary of Exits within Pathfinder Model

Egress Component	Width (inches)
Level 2	
North/South Exterior Exit	144” each
East/West Horizontal Exits	96” each
Level 3-4	
East/West Horizontal Exits	96” each
Stair	36” Door 48” Stair
Level 5-6	
East Horizontal Exit	96”
Stair	36” Door 48” Stair

6.5.1.2 Pathfinder Model – Occupant Load

Each area of the model contained occupants according to the appropriate occupant load for the use of the space. The majority of the atrium was considered business use since it is mainly offices and the atrium space, so the occupant load factor was 100 square feet per person. On Level 2 and Level 3, there are assembly spaces that used an occupant load of 15 square feet per person. These spaces are shown in yellow in Figure 36. A summary of the occupant load per floor is shown in Table 38.

Table 38 – Occupant Load on Each Level of Pathfinder Model

Floor	Occupants
2	155
3	170
4	88
5	91
6	91
TOTAL	**595**

6.5.1.3 Pathfinder Model – Results

In Pathfinder, there are two different methods to predict occupant movement: steering method and SFPE method. For the steering method, occupants use the steering system to maintain a reasonable separation distance from others and doors do not act to limit the flow of occupants [18]. In the SFPE method, occupants do not avoid one another and the egress time is determined by the flow limit and velocity through doors [18]. For this simulation, the steering method was used since it is believed to most accurately represent real life situations. The exit times from each floor are shown in Table 39.

Table 39 – Exit Time for Each Floor from Pathfinder Model

Floor	Exit Time
Level 2	53 seconds
Level 3	95 seconds
Level 4	37 seconds
Level 5	37 seconds
Level 6	44 seconds

6.6 Available Safe Egress Time (ASET)

The available safe egress time (ASET) is defined as the time from ignition to the time that untenable conditions occur [13]. In order to determine the ASET, a model of the atrium space was created in Pyrosim and simulations were performed using Fire Dynamics Simulator (FDS).

6.6.1 Limitations of FDS

FDS is a CFD model developed by NIST that solves a form of the Navier-Stokes equations for low Mach number thermally-driven flows. FDS uses Large Eddy Simulation to model turbulent fluid flows that are present in fire scenarios [15]. In order to increase calculation times, FDS uses a rectangular grid. All solid obstruction of the geometry must conform to the grid spacing, so geometry is restricted to the size of the mesh cells and must be rectilinear. This can make complex geometry difficult to create, and requires stair-stepping geometry in order to best represent the geometry and volume of the space. The FDS calculation is highly dependent on the size of the mesh cells, decreasing the size of the cells greatly increases calculation time. For this reason, a balance must be found between the calculation time and number and size of mesh cells to ensure accuracy of the results while maintaining realistic simulation times.

6.6.2 Model Overview

In order to assess the performance of the natural ventilation smoke control system, the atrium from Level 2 through Level 6 was modeled using Pyrosim. The model only contained the atrium space, not including the east and west wings of the building, or the offices and rooms adjacent to the atrium. Since the purpose of the smoke control system is to limit the amount of smoke and products of combustion that travel from the location of the fire to other floors and spaces of the atrium, only the open volume of the atrium was modeled. This would reduce the size of the model which would reduce the required time to perform each simulation. The model of the atrium in Smokeview with the exterior walls hidden is shown in Figure 37.

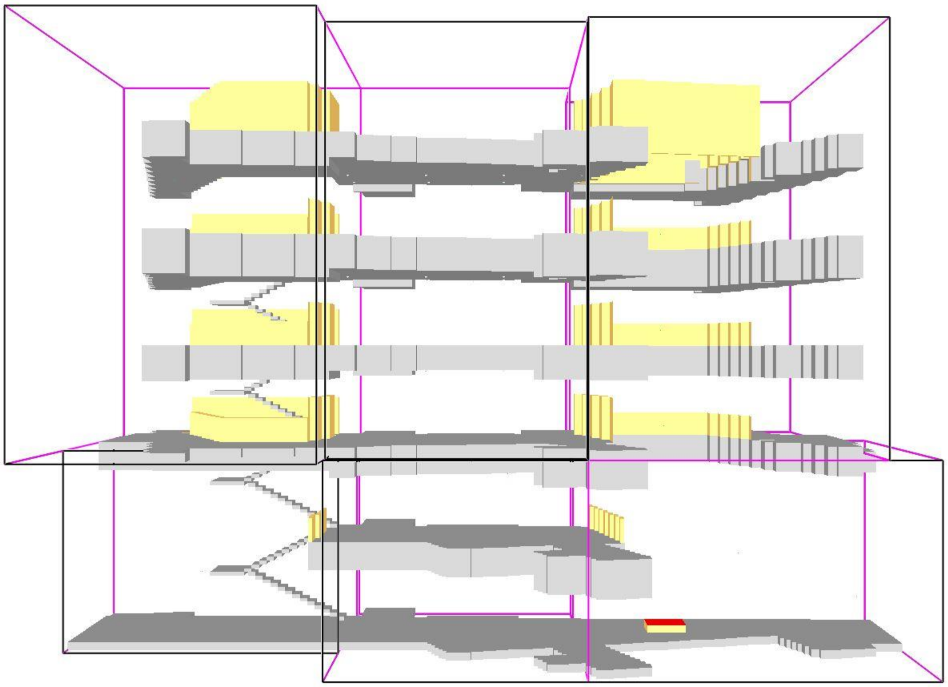


Figure 37 - Smokeview rendering of the FDS model of the atrium.

6.6.2.1 Devices

The model consists of different devices including spot smoke detectors, beam detectors and heat detectors. In addition to the devices, the exhaust vents and makeup air vents are included in the model initially closed. The vents were set to open once the first device was initiated. Spot smoke detectors were located per the fire alarm plans at the elevator on each level and at the magnetically held open doors to the east and west wing. Since the spot smoke detectors are photoelectric smoke detectors, the suggested values for Cleary Photoelectric P1 detectors from Table 15.1 of the FDS User's Guide were used [15]. These properties are summarized in Table 40.

Table 40 – Smoke Detector Properties for FDS Model [15]

Detector	**α_e**	**B_e**	**α_c. L**	**B_c**
Cleary Photoelectric P1	1.8	-1.0	1.0	-0.8

Beam detectors were located within the FDS model per the fire alarm plans. This included in the south opening of the atrium as well as above the corridor leading to the faculty offices on the north side of the atrium. The activation point for the beam detectors in the FDS model were set to 35%, which is the medium sensitivity of the OSID Xtralis beam detectors that are installed within the atrium as shown on the manufacturer specification sheet in Appendix N.

In addition to the spot smoke detectors and beam detectors, the sprinklers within the atrium were input into the model as heat detectors. The sprinklers were modeled as heat detectors so the model would not be interrupted by sprinkler activation, but it could be determined when the sprinklers would activate for each fire scenario. The heat detectors were modeled with an activation temperature of

68.33°C and RTI of $(50\text{ m-s})^{1/2}$ to represent the quick response sprinklers within the atrium. The activation time of the first device in the FDS model was used as the detection time in the calculation of RSET.

6.6.2.2 Slice Files

In order to visually analyze the results from the FDS simulations, slice files were input into the model to be viewed in Smokeview. Velocity slice files were placed through the makeup air vents as well as through the center of the atrium in order to determine the velocity of the makeup air to make sure the requirements of NFPA 92 were met. Vertically through the center of the atrium and horizontally on each level at 6 feet above the walking surface, slice files were placed for temperature, visibility, and carbon monoxide concentration in order to determine when the tenable limits were reached. While viewing each slice file, a limit can be marked to appear in black to determine where the limit is reached within the model. This was done for each slice file, setting the determined tenability limits to black to show the location and time when untenable conditions were reached. Since CBC 909.8 requires tenable conditions to be maintained at a height of 6 feet above all means of egress, the available safe egress time was determined by observing the slice files over the duration of the simulation to find when the tenable limit was reached. The available safe egress time was determined when the tenable limit was reached to the point where an egress path was completely blocked by the tenable limit marked in black on the slice file. If the tenable limit was reached in a spot for only a brief time or where it did not completely cover an egress path, it was not determined to be the available safe egress time.

6.6.2.3 Mesh

The model consists of six separate computational meshes that each are made up of a uniform grid of 0.2m x 0.2m x 0.2m cells which resulted in a total of 3,385,600 cells. This mesh resolution was determined to be adequate by performing a mesh sensitivity analysis that will be discussed later, as well as the following calculation from the FDS User's Guide. Equation 6.1 from the FDS User's Guide is shown below [15].

$$\frac{D^*}{\delta x} = \frac{\left(\frac{\dot{Q}}{\rho_\infty c_p T_\infty \sqrt{G}}\right)^{\frac{2}{5}}}{\delta x}$$

$where:\qquad \dot{Q} = the\ total\ heat\ releae\ rate\ of\ the\ fire\ (kW)$

$$\rho_\infty = ambient\ density\ of\ air\ \left(\frac{kg}{m^3}\right)$$

$$c_p = Specific\ heat\ of\ air\ \left(\frac{kJ}{kg} * K\right)$$

$$T_\infty = Ambient\ temperature\ of\ air\ (K)$$

$$g = gravitational\ acceleration\ \left(\frac{m^2}{s}\right)$$

$$\delta_x = mesh\ cell\ size\ (m)$$

The quantity $D^*/\delta x$ is a non-dimensional expression that can be used to characterize how well the flow field is resolved for buoyant plumes [15]. According to NUREG 1824, values between 4 and 16 can be used to accurately resolve fires in various scenarios [19].

6.6.2.4 Reaction Input Properties

There are multiple user-specified properties that affect the results from the FDS simulations: soot yield, CO yield, and heat of combustion. As defined in the FDS User's Guide, the soot yield is the fraction of fuel mass converted into smoke particulate during combustion while the CO yield is the fraction of fuel mass converted into carbon monoxide [15]. An increased soot yield will cause the visibility tenable limit to be reached at a quicker time while an increased CO yield will cause the tenable limit for carbon monoxide concentration to be reached sooner. The heat of combustion is defined as the amount of heat released per unit mass of fuel during combustion. Since the heat release rate was specified in the FDS models, the mass loss rate is determined by dividing the specified heat release rate by the heat of combustion. The heat of combustion affects the mass loss rate during combustion which will determine the mass of products, including soot and CO.

Since the primary fuels of the couch being considered as the design fire are polyurethane foam and wood, properties for these materials will be considered. Table 3-4.16 from the SFPE Handbook lists values for soot yield, CO yield and heat of combustion for various fuels. For flexible polyurethane foams, the average value for heat of combustion is approximately 25,000 kJ/kg while for wood it is approximately 17,500 kJ/kg. A value of 25,000 kJ/kg was selected as the heat of combustion for the FDS model since the primary fuel is the polyurethane foam. For this same reason, a CO yield of 0.04 was selected from Table 3-4.16. In order to best represent the soot yield, an effective value was determined to best represent the combination of polyurethane foam and wood. Table 3-4.16 lists soot yield values of wood of 0.015 while for polyurethane foam the range is from 0.131 to 0.227. Since the majority of the mass of a couch is wood, an effective soot yield of 0.05 was selected. A summary of the reaction parameters are shown in Table 41. In order to determine the impact of these parameters on the tenability in the FDS simulations, a sensitivity analysis will be performed.

Table 41 – FDS Reaction Properties [20]

Property	Value	Units
Heat of Combustion	25,000	kJ/kg
Soot Yield	0.05	kg/kg
CO yield	0.04	kg/kg

6.6.2 Design Fire #1 – Axisymmetric Plume

6.6.2.1 Overview/Location

Design fire #1 is an axisymmetric plume located on Level 2, the base level of the atrium as shown in the Smokeview model in Figure 38 and the plan view in Figure 39.

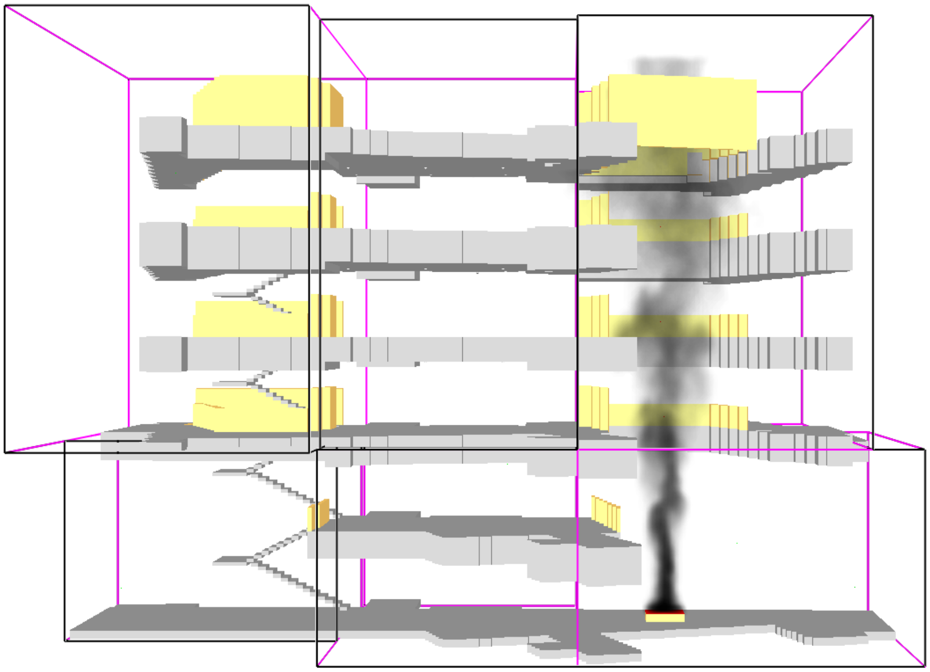


Figure 38 - Smokeview rendering showing the axisymmetric plume rising in the atrium.

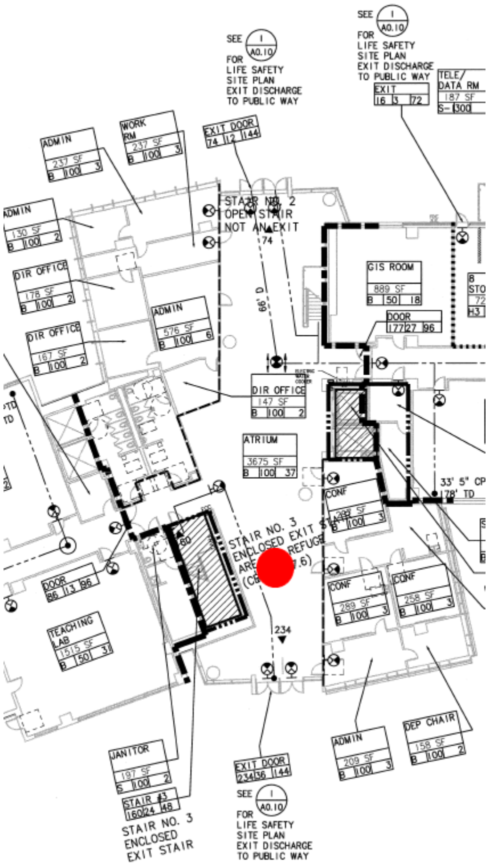


Figure 39 - Plan view of Level 2 of the atrium showing the location of Design Fire #1 [1].

As defined by NFPA 92 3.3.9.1, an axisymmetric plume is a plume that rises above a fire, does not come into contact with walls or other obstacles, and is not disrupted or deflected by airflow as shown in Figure 40 [12].

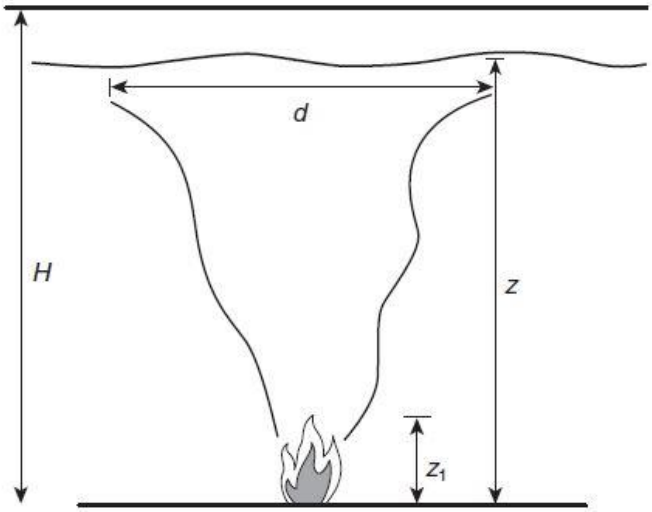


Figure 40 - Schematic of an axisymmetric fire plume [12].

In this location on Level 2 of the atrium, there is furniture that will serve as the fuel load. The actual furniture that is located within the atrium is shown in Figure 41.

Figure 41 - Photograph of furniture used for fuel load located within the atrium.

6.6.2.2 Heat Release Rate

The design fire for the axisymmetric plume for design fire #1 was selected as one of the couches shown in Figure 41. Heat release rate data for similar furniture is shown in Figure 42 from “Upholstered Furniture Heat Release Rates Measured with a Furniture Calorimeter” [21].

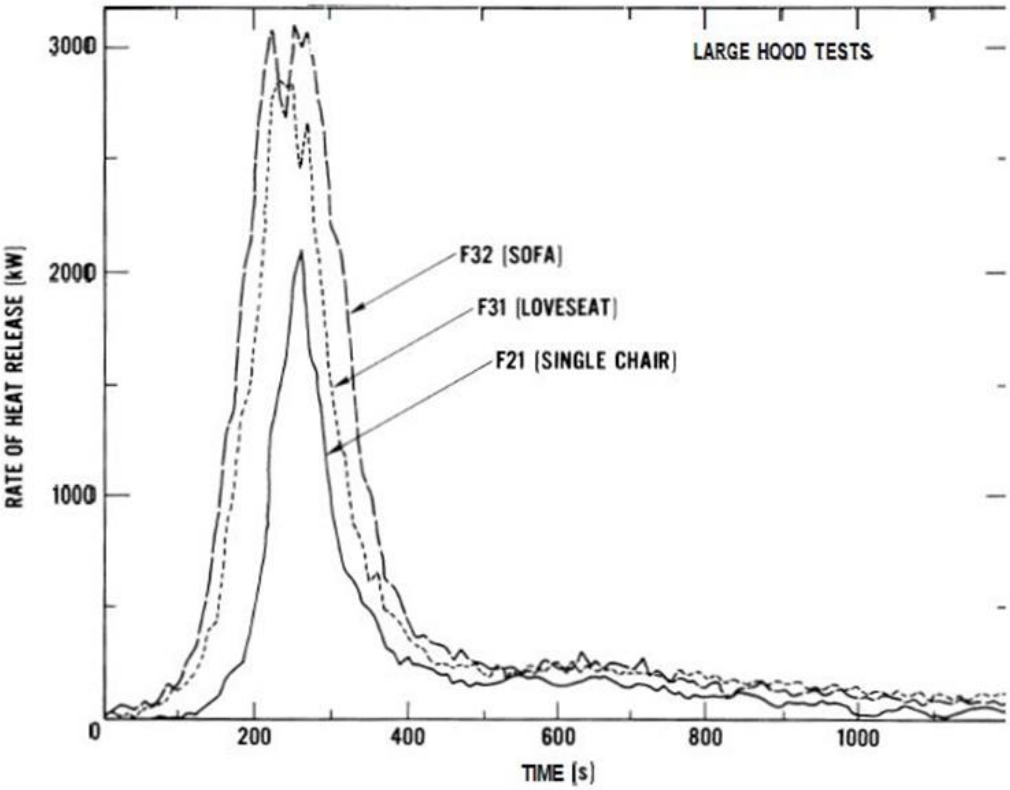


Figure 42 - Heat release rate for furniture similar to furniture found in the atrium [21].

Since the most similar piece of furniture from this test is the sofa, a peak heat release rate of 3MW was selected to be used in the FDS model. The fire was modeled as a fast t-squared fire since the heat release rate over time for the sofa most closely matches the fast curve shown in Figure 43.

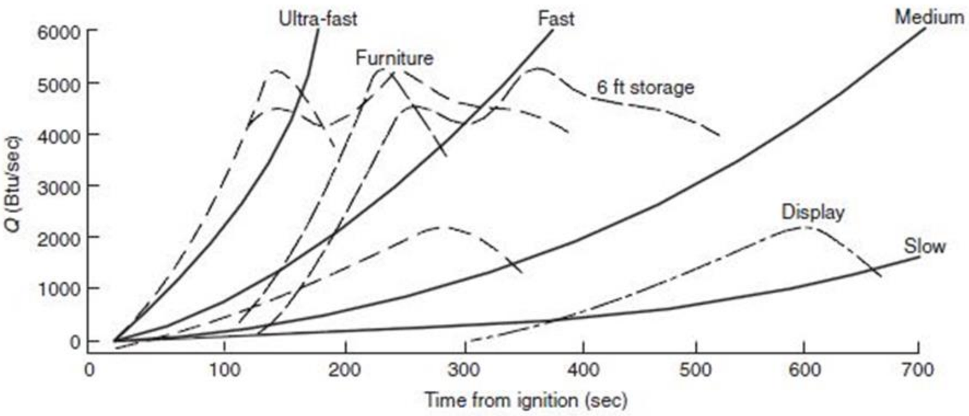


Figure 43 - Heat release rate curves for different t-squared fires [12].

Since this fire is located directly underneath one of the openings in the atrium, sprinklers will not have an effect on the fire, so the fire will be fuel-limited. In order to be conservative, it is assumed that the fire will grow as a fast t-squared fire until it reaches the peak heat release rate of 3 MW and then will remain constant at the peak heat release rate. This is conservative since a furniture fire would actually begin to decay once all of the fuel is consumed, as seen in Figure 42. The heat release rate over time output from the FDS simulation is shown in Figure 44.

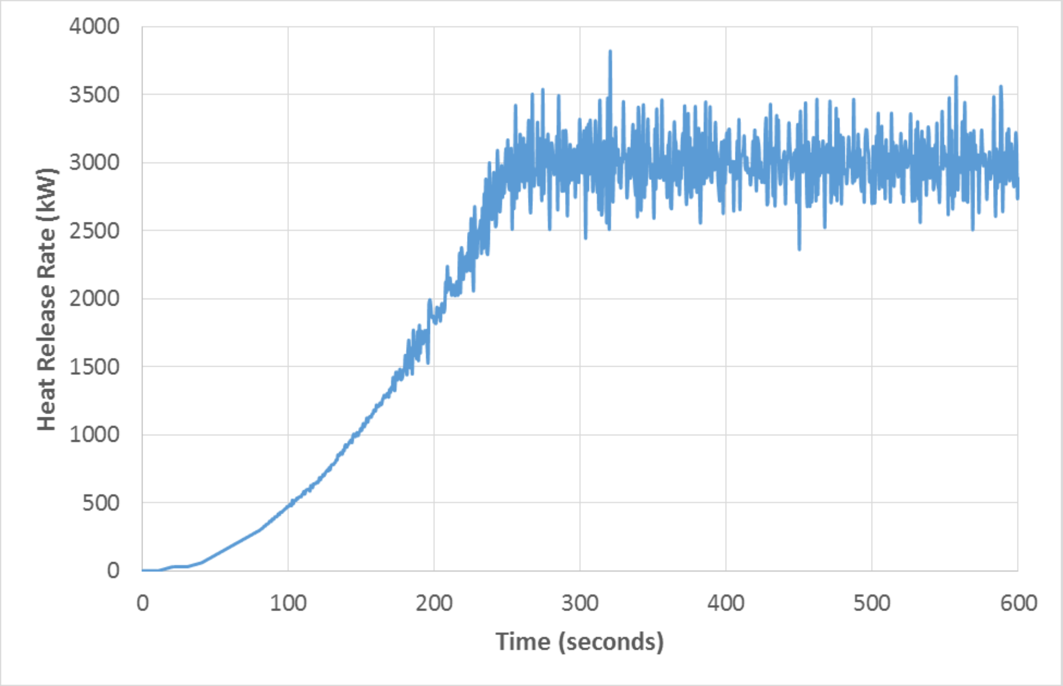


Figure 44 - FDS output of heat release rate over time.

6.6.2.3 Mesh

Using Equation 6.1 from the FDS User's Guide, the nondimensional parameter was calculated using a heat release rate of 3000 kW for design fire #1. Since this value is between 4 and 16, it is determined that the mesh spacing is adequate for this fire scenario.

$$\frac{\dot{Q}}{\delta x} = \frac{\left(\frac{(3000)}{(1.204)(1.005)(293)(\sqrt{9.81})}\right)^{\frac{2}{5}}}{0.2} = 7.44$$

6.6.2.4 Design Fire #1 ASET Results – Temperature

Figure 45 shows the temperature in the entire atrium at a time of 300s. The tenable limit of 60°C was not reached on any level within the atrium.

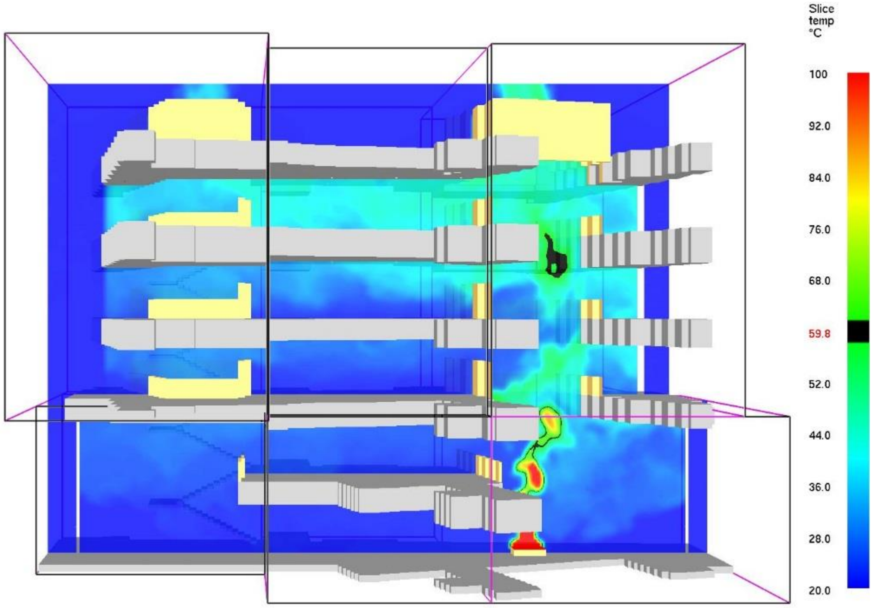


Figure 45 – Temperature slice file at a time of 300 seconds showing tenable limit not being reached.

6.6.2.5 Design Fire #1 ASET Results – Carbon Monoxide

Figure 46 shows the carbon monoxide concentration in the entire atrium where a maximum value of 500 ppm is reached. The tenable limit of 1,667 ppm was not reached, so the space remained tenable for the entire simulation.

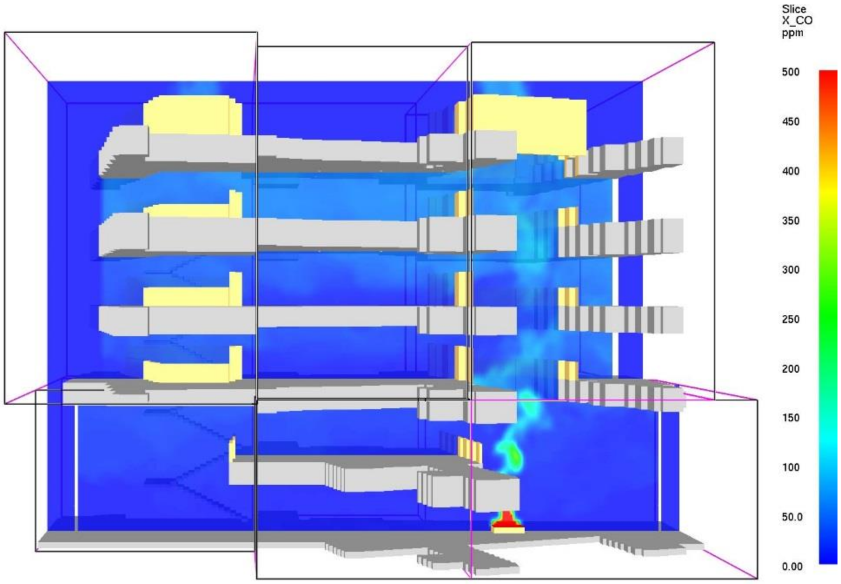


Figure 46 – Carbon monoxide slice file at 300 seconds showing tenable limit not being reached.

6.6.2.6 Design Fire #1 ASET Results – Visibility

Visibility slice files of Level 2 through Level 6 are shown in Figure 47 through Figure 51 showing the time when the tenable limit of 10 meters was reached. If the tenable limit was not reached on a level, the visibility slice file at 300 seconds is shown since this was the end of the simulation.

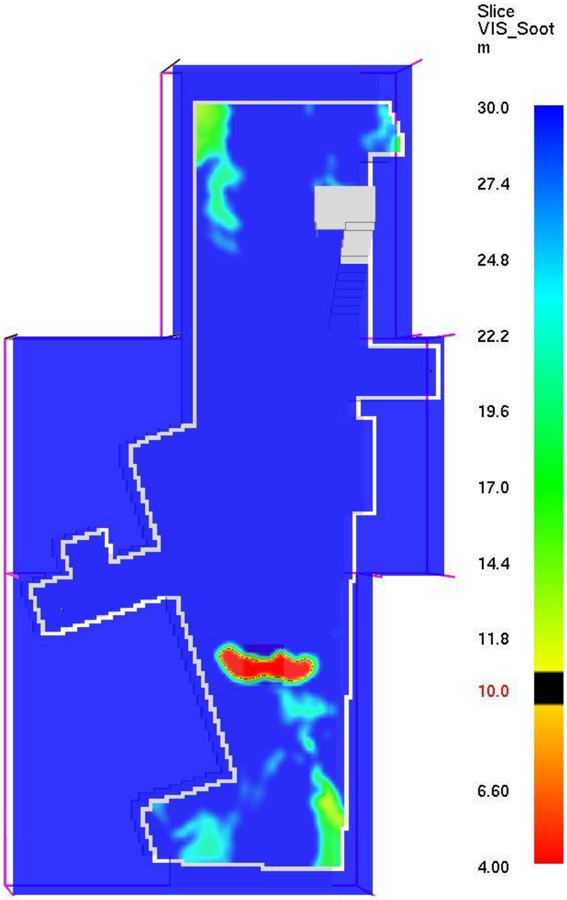


Figure 47 – Visibility slice file of Level 2 at 300 seconds showing tenable limit not being reached.

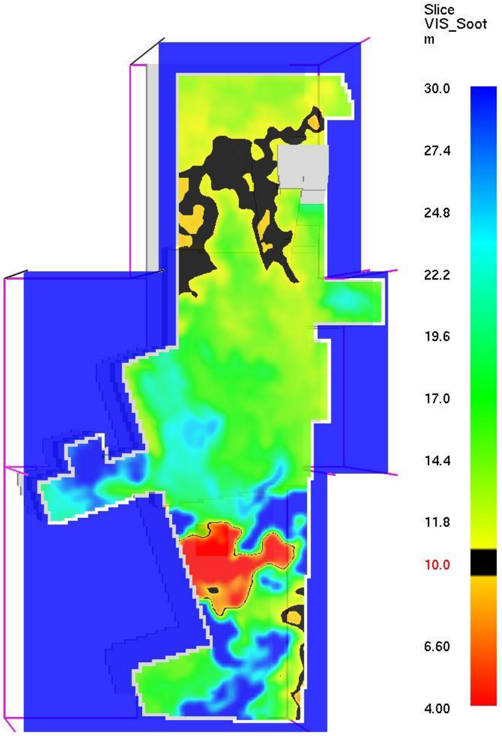


Figure 48 – Visibility slice file of Level 3 at 300 seconds showing tenable limit not being reached.

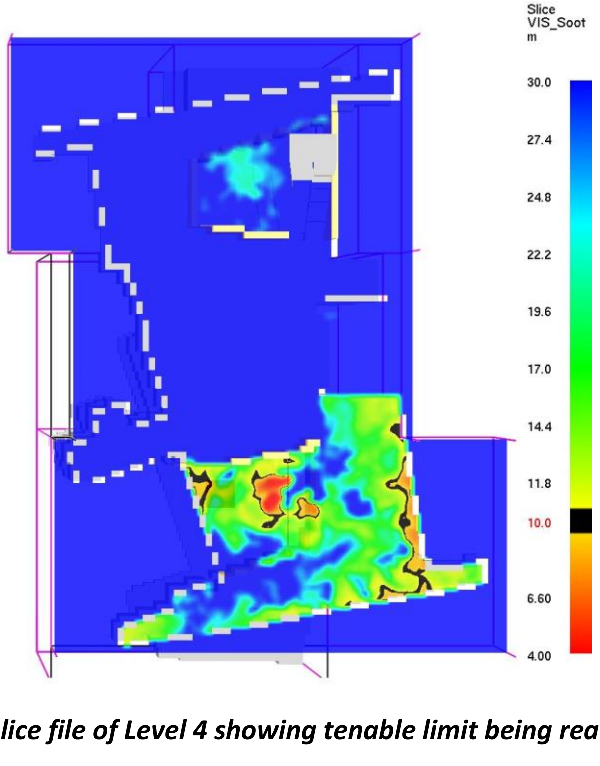


Figure 49 – Visibility slice file of Level 4 showing tenable limit being reached at 190 seconds.

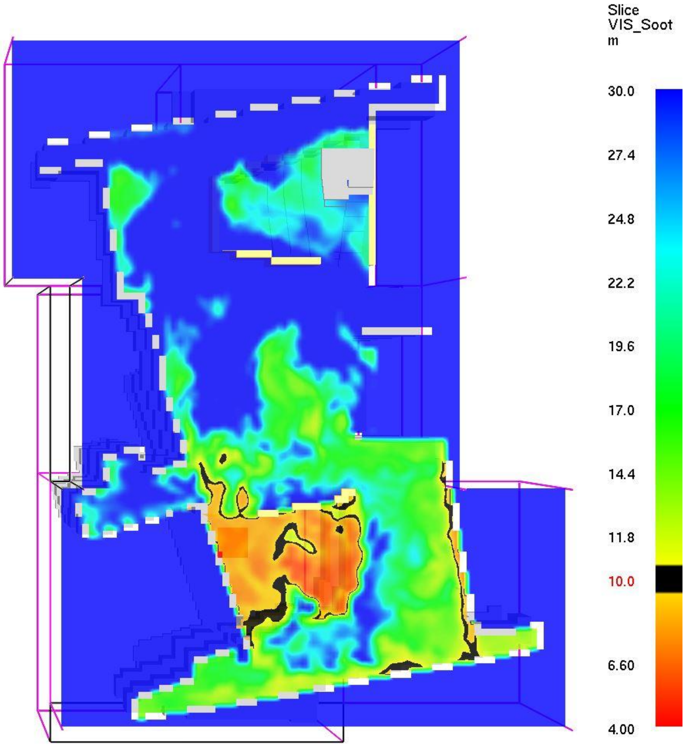


Figure 50 – Visibility slice file of Level 5 showing tenable limit being reached at 190 seconds.

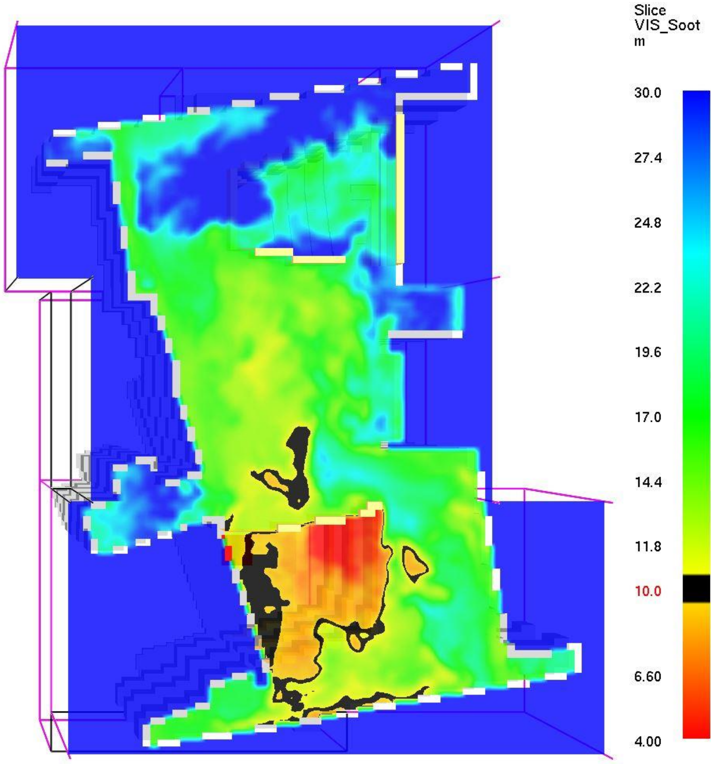


Figure 51 – Visibility slice of Level 6 showing tenable limit being reached at 174 seconds.

6.6.2.7 Design Fire #1 ASET/RSET Analysis

A summary of the ASET for design fire #1 is shown in Table 42.

Table 42 – Summary of ASET Results from Design Fire #1

	Temperature	**Carbon Monoxide**	**Visibility**
Level 2	Tenability maintained for 300 seconds	Tenability maintained for 300 seconds	> 300 s
Level 3			> 300 s
Level 4			190 s
Level 5			190 s
Level 6			174 s

Table 43 shows the calculation of RSET including a 50% safety factor compared with ASET for each level. Level 6 is the only level that fails since ASET is less than RSET. The detection time of 44 seconds was from the Level 3 beam detector directly above the fire.

Table 43 – ASET/RSET Comparison for Design Fire #1

Floor	**Detection Time**	**Pre-movement Time**	**Travel Time**	**Total RSET**	**RSET x 1.5**	**ASET**	**ASET>RSET?**
2	44	36	53	133	200	> 300 s	YES
3			95	175	263	> 300 s	YES
4			37	117	176	190	YES
5			37	117	176	190	YES
6			44	124	186	174	NO

6.6.2.8 Recommendations

Since the current smoke control system did not pass the ASET/RSET analysis on each floor, it is not adequate for the atrium in the building. In order to increase the ASET to a time greater than the RSET, two changes can be made to the current smoke control system. First, a mechanical ventilation smoke control system could be installed in order to increase the volume of smoke exhausted from the atrium. This would be a very costly alteration to the building since it would require the addition of exhaust fans to the roof where they may not be room for such fans. The other option is to redesign the natural ventilation smoke control system to have increased venting at the ceiling to increase the volume of smoke exhausted. Since the atrium has an existing natural ventilation system, this option would be the easiest and most cost effective solution. An alternate design to the current natural ventilation smoke control system was analyzed using FDS and will be discussed later in this report.

6.6.2.9 Mesh Sensitivity Analysis

Computational fluid dynamics simulations are highly dependent on the resolution of the computational mesh. The dilemma is that although decreasing the mesh cell size produces more accurate results, the increase in the number of cells greatly increases the duration of the calculation. For this reason, a balance must be found which produces sufficiently accurate results without creating unrealistically long calculation times. In order to determine an appropriate mesh cell size for the atrium FDS model, a mesh sensitivity analysis was performed. This would tell when the mesh cell size is adequately refined to achieve accurate results with a reasonable calculation time. Three different mesh configurations were tested with mesh cell sizes ranging from 0.2 meters to 0.4 meters using the model for design fire #1. As previously mentioned, the computational domain of the model consisted of six meshes, three across the base of the atrium extending to Level 4 and three covering Levels 4 through 6 at the top of the atrium. The different mesh configurations varied the mesh cell size between 0.2 meters and 0.4 meters across the bottom three meshes and the top three as summarized in Table 44.

Table 44 – Summary of Different Mesh Configurations for Mesh Sensitivity Analysis

Mesh Configuration	Description	Number of Cells
1	All cells 0.4m	423,200
2	Bottom three meshes 0.2m, top three meshes 0.4m	1,200,200
3	All cells 0.2m	3,385,600

As shown in Table 44, the number of cells in the computational domain increases rapidly as the cell size is decreased. As the number of cells increased, the calculation duration increased. The calculation time for mesh configuration 1 was approximately 4 hours while for mesh configuration 3 it was approximately 48 hours. In order to determine when the mesh was adequately refined, the total volume of smoke exhausted in each simulation was calculated using volume flux devices in the FDS models. The results from the three different mesh configurations are shown in Figure 52.

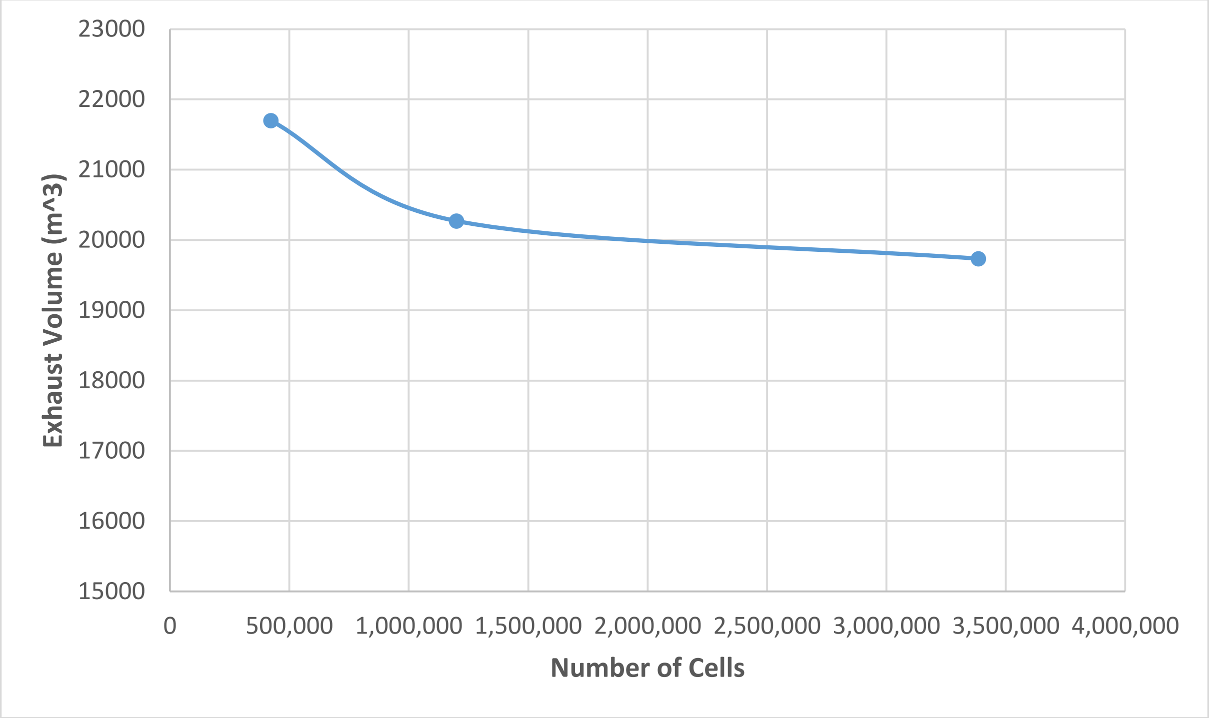


Figure 52 - Exhaust volume with increasing number of cells showing convergence.

As shown in Figure 52, as the number of cells increases the results appear to converge. A large difference can be seen between mesh configuration 1 and 2, but mesh configuration 2 and 3 only differ by 2.7%. For this reason, mesh configuration 3 is determined to be the best choice to provide the most accurate results while not taking excessively long to perform the calculation. A more refined mesh configuration was not tested due to the projected length of the calculation and the assumed minimal difference in results with mesh configuration 3 if the curve were to be extrapolated.

6.6.3 Design Fire #2 – Balcony Spill Plume

6.6.3.1 Overview/Location

Design fire #2 is a balcony spill plume located in the center of Level 2, the base level of the atrium as shown in the Smokeview model in Figure 53 and plan view in Figure 54.

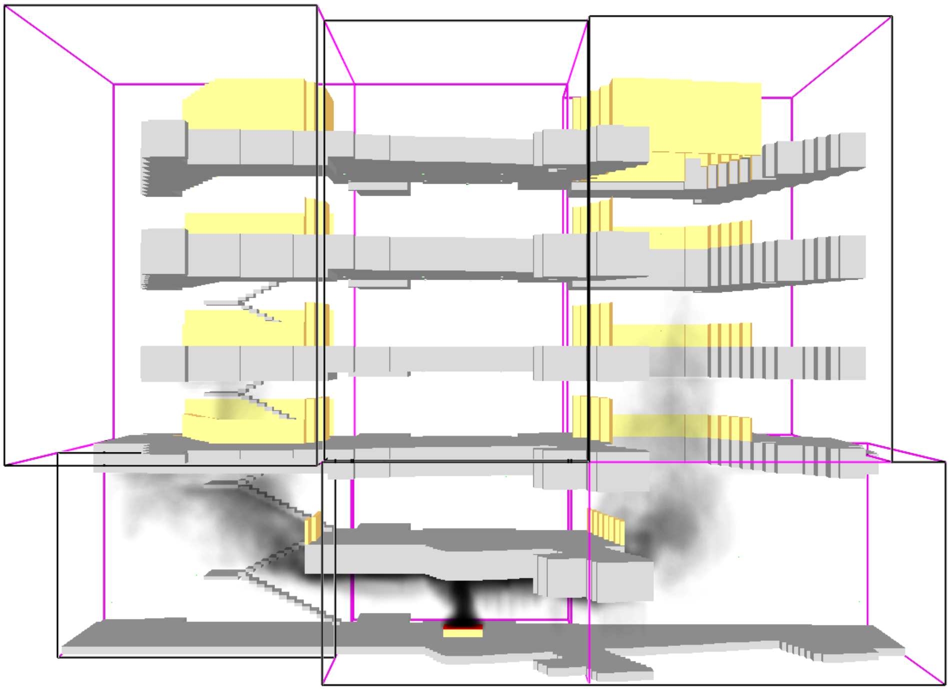


Figure 53 - Smokeview rendering showing the balcony spill plume.

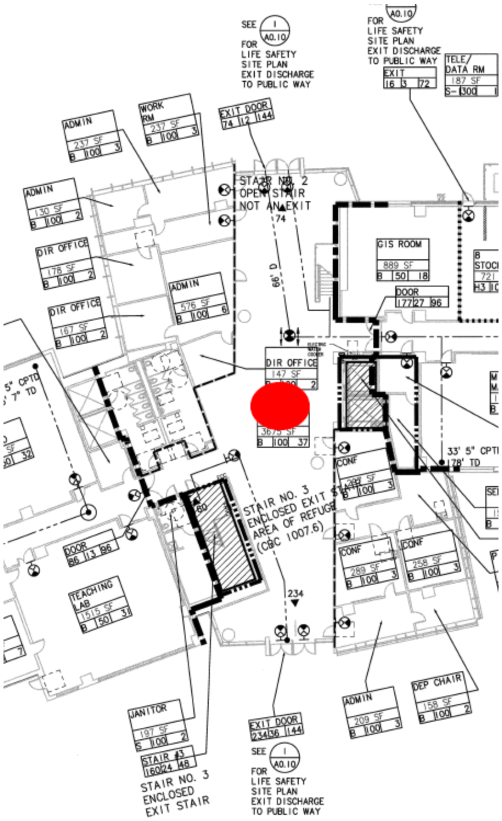


Figure 54 - Plan view showing location of Design Fire #2 [1].

As defined by NFPA 92 3.3.9.2, a balcony spill plume is a smoke plume that originates from a compartment fire, flows out the doorway, flows under a balcony, and flows upward after passing the balcony edge, as shown in Figure 55.

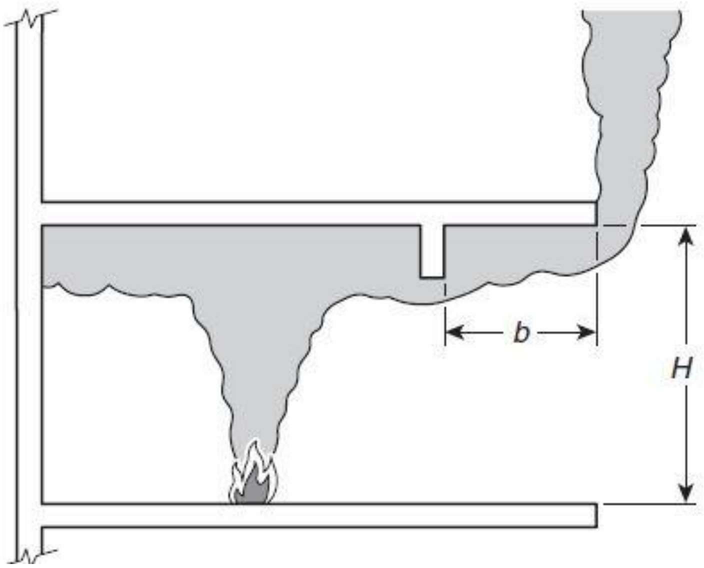


Figure 55 - Schematic showing a balcony spill plume fire [12].

The furniture shown in Figure 56 is found at this location of the atrium and will be the fuel load for design fire #2.

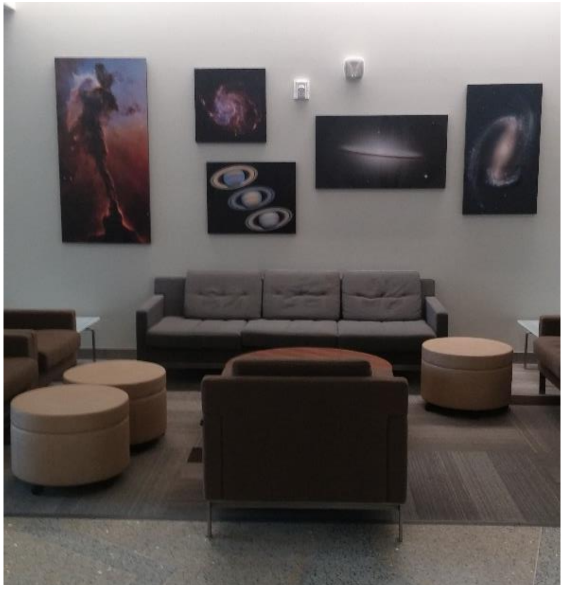


Figure 56 - Furniture found on Level 2 of the atrium.

6.6.3.2 Heat Release Rate

The same style couch that was used for design fire #1 will be used as the fuel load again for design fire #2. A fast growing t-squared fire with a peak heat release rate of 3 MW will be used for the heat release rate of the couch, but this fire will be sprinkler-controlled due to its location. The FDS model contains heat detector devices with an RTI of 50 (m-s)$^{1/2}$ and an activation temperature of 68.33°C that represent the quick response sprinklers located within this area of the atrium. An FDS simulation was run with the fast t-squared fire to determine when the sprinklers would reach the activation temperature. The results showing the sprinkler temperature and heat release rate is shown in Figure 57.

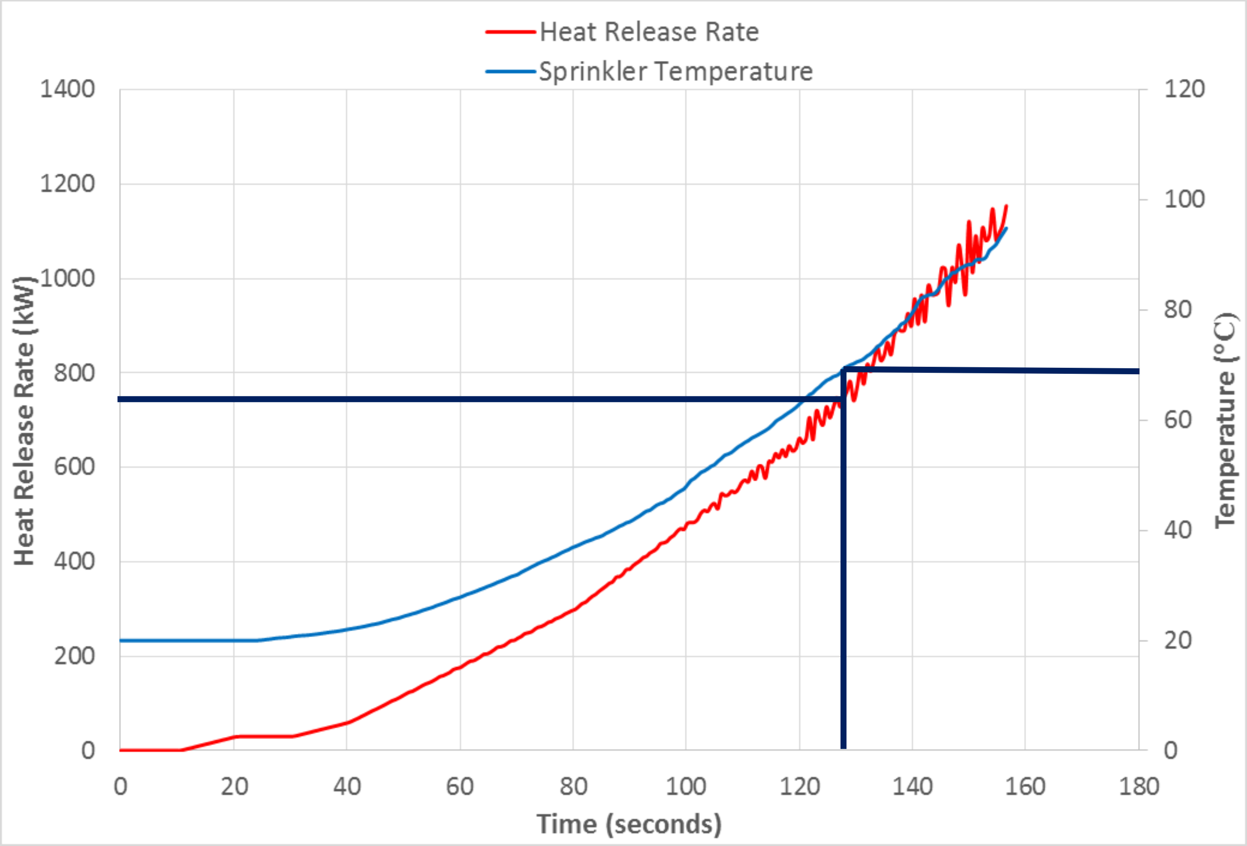


Figure 57 – FDS output showing heat release rate at time of sprinkler activation.

As shown in Figure 57, the sprinkler activation temperature is reached at a time of 127 seconds while the heat release rate is at a value of 750 kW. Since design fire #2 is a sprinkler-controlled fire, it will be modeled as a fast t-squared fire until it reaches a heat release rate of 750 kW at a time of 127 seconds. At this point, the heat release rate will remain constant at 750 kW for the remainder of the simulation, as shown in the heat release rate output from the FDS simulation in Figure 58.

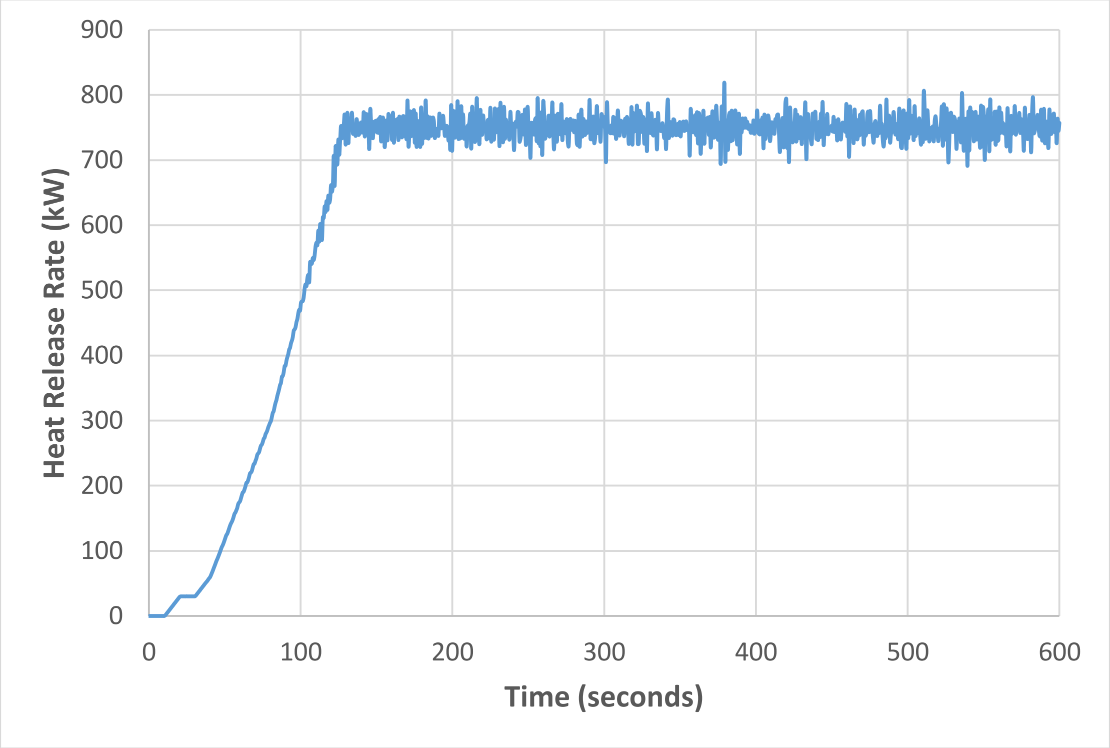


Figure 58 – Heat release rate over time from Design Fire #2 FDS simulation.

6.6.3.3 Mesh

The nondimensional parameter from Equation 6.1 of the FDS User’s Guide is calculated for design fire #2 using a heat release rate of 750 kW. Since the value is between 4 and 16, it is determined that the mesh resolution is adequate for this fire scenario.

$$\frac{\dot{Q}}{\delta x} = \frac{\left(\frac{(750)}{(1.204)(1.005)(293)(\sqrt{9.81})}\right)^{\frac{2}{5}}}{0.2} = 4.27$$

6.6.3.4 Design Fire #2 ASET Results – Temperature

Figure 59 shows a temperature slice file of the entire atrium showing the tenable limit of 60°C not being reached for the duration of the simulation.

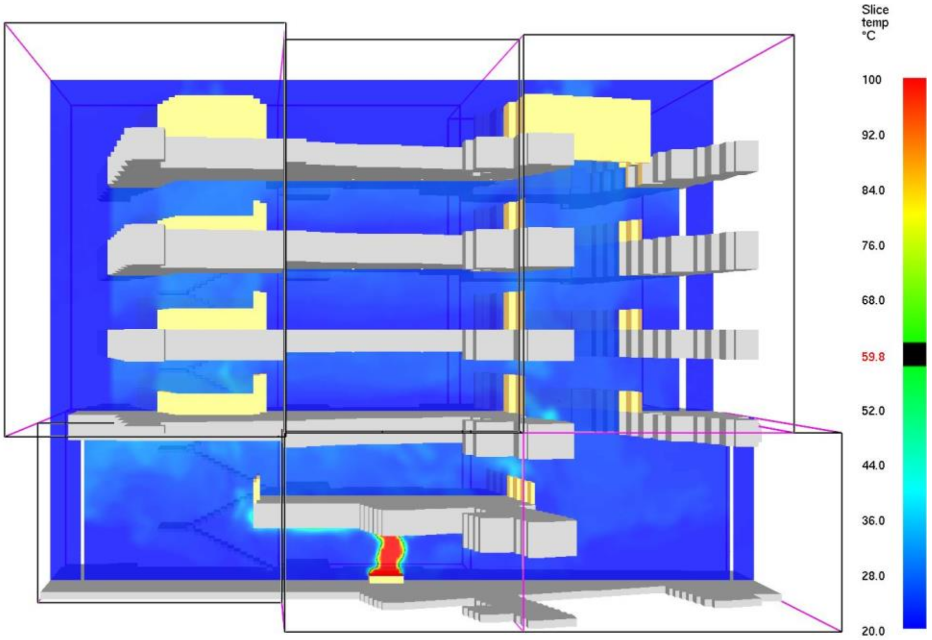


Figure 59 – Temperature slice file at 300 seconds showing tenable limit not being reached.

6.6.3.5 Design Fire #2 ASET Results – Carbon Monoxide

Figure 60 shows a slice file of the entire atrium showing the carbon monoxide concentration not reaching the tenable limit of 1,667 ppm.

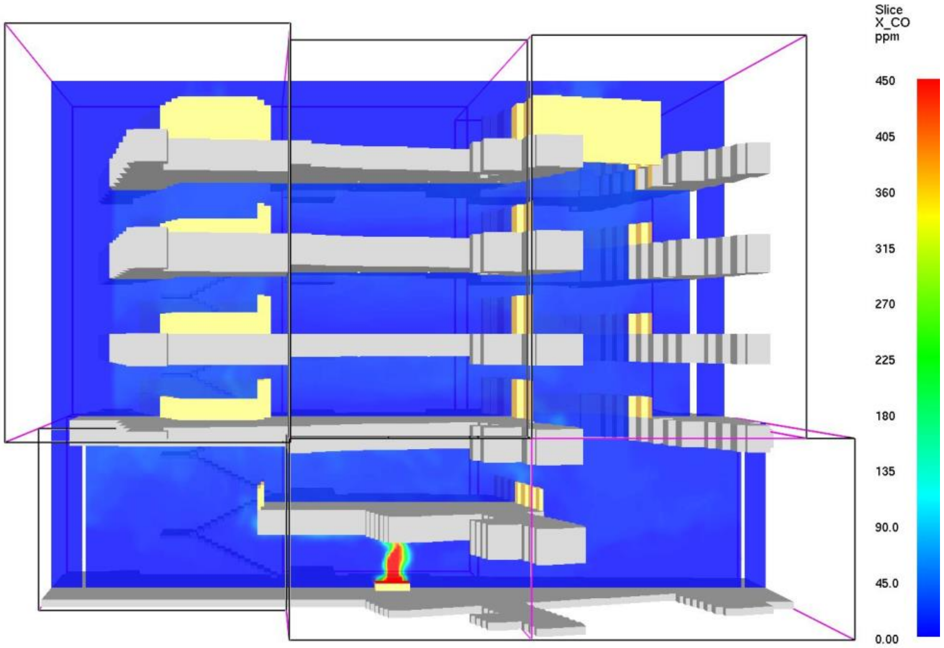


Figure 60 – Carbon monoxide slice file at 300 seconds showing tenable limit not being reached.

6.6.3.6 Design Fire #2 ASET Results – Visibility

Visibility slice files of Level 6 through Level 2 are shown in Figure 61 through Figure 65 showing the time that the tenable limit of 10 meters is reached on each level. If the tenable limit was not reached, the visibility slice file at 300 seconds is shown since this was the end of the simulation.

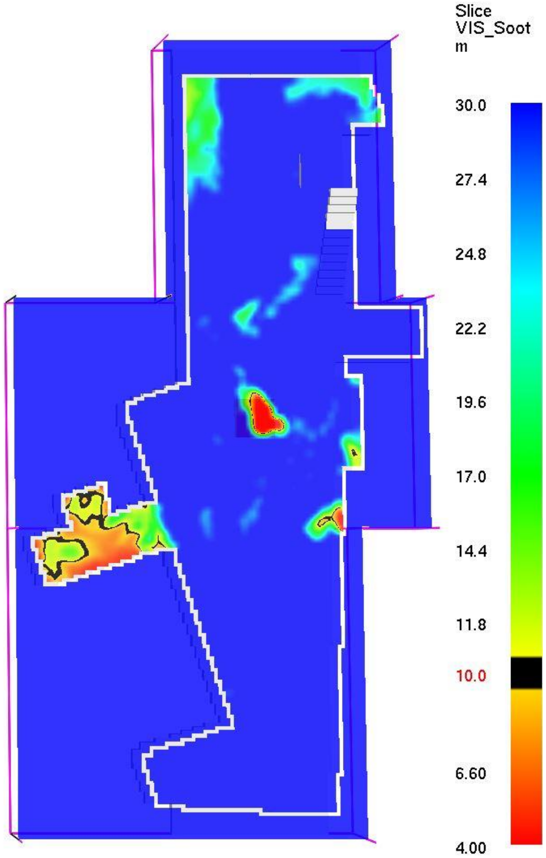


Figure 61 – Visibility slice file of Level 2 showing tenable limit being reached at 270 seconds.

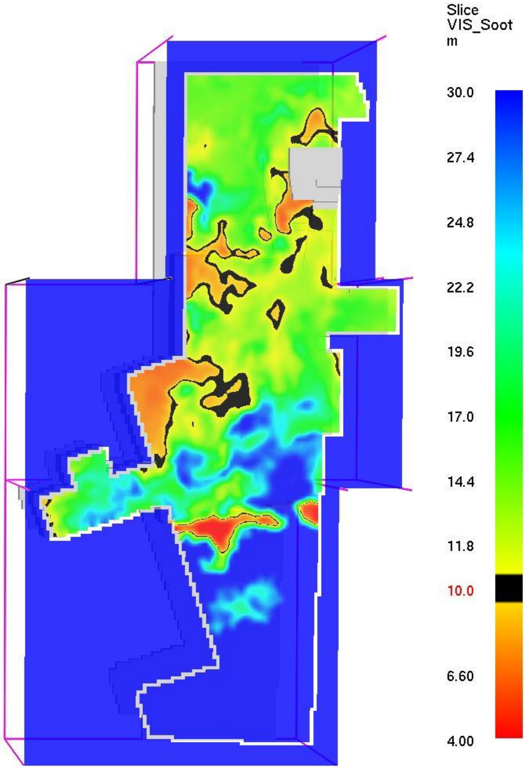


Figure 62 – Visibility slice file of Level 3 showing tenable limit being reached at 200 seconds.

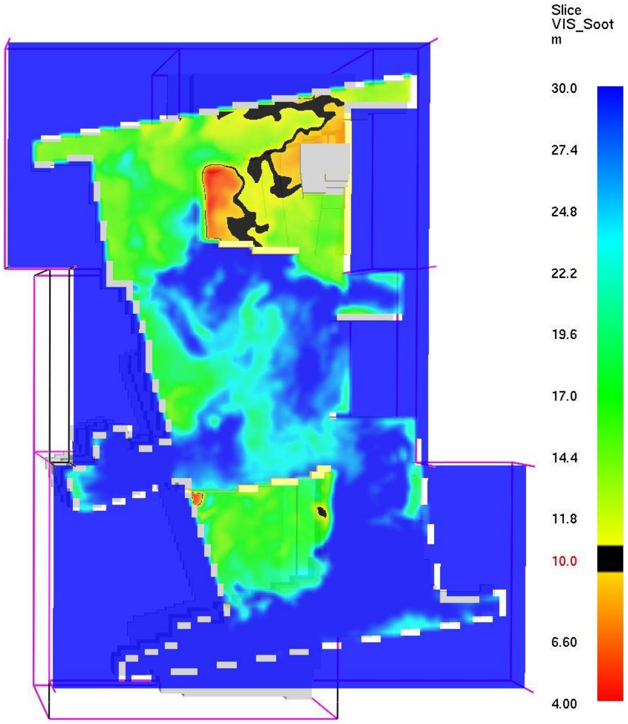


Figure 63 – Visibility slice file of Level 4 showing tenable limit being reached at 250 seconds.

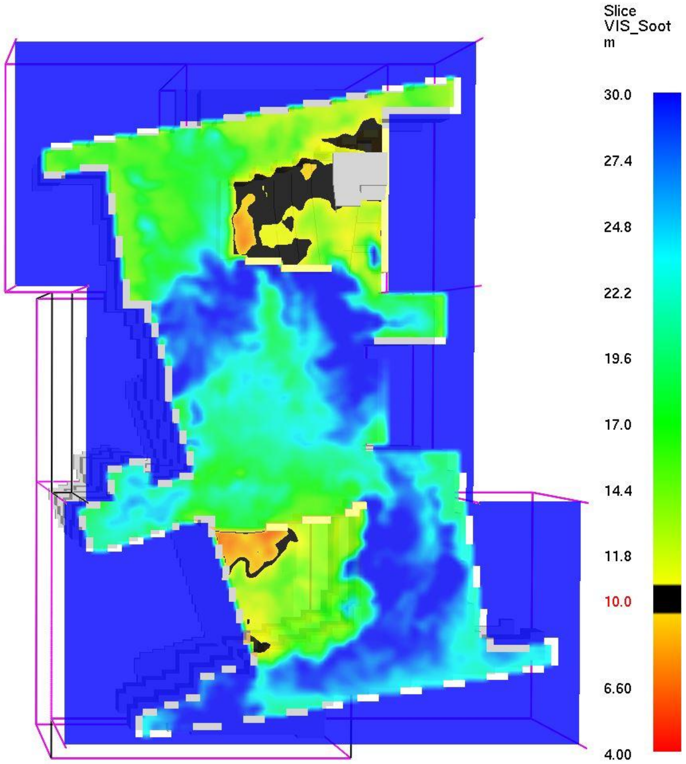


Figure 64 – Visibility slice file of Level 5 at 300 seconds showing tenable limit not being reached.

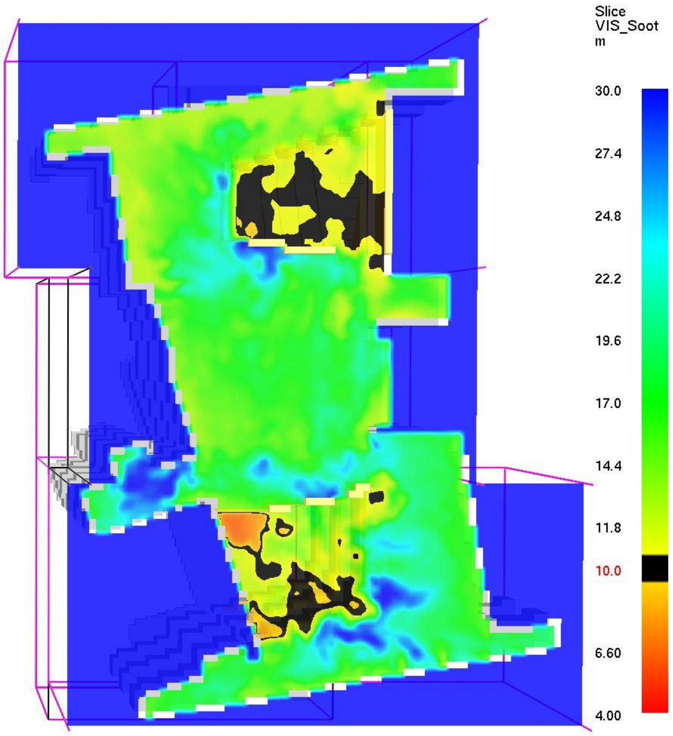


Figure 65 – Visibility slice file of Level 6 at 300 seconds showing tenable limit not being reached.

6.6.3.7 Design Fire #2 ASET/RSET Analysis

A summary of the ASET times for design fire #2 is shown in Table 45.

Table 45 – Summary of ASET Results for Design Fire #2

	Temperature	**Carbon Monoxide**	**Visibility**
Level 2	Tenability maintained for 300 seconds	Tenability maintained for 300 seconds	270 s
Level 3			200 s
Level 4			250 s
Level 5			> 300 s
Level 6			> 300 s

Table 46 shows the calculation of RSET including a 50% safety factor compared with ASET for each level. Level 3 is the only level that fails since ASET is less than RSET. The detection time of 31 seconds was from the elevator spot smoke detector on Level 2.

Table 46 – ASET/RSET Analysis for Design Fire #2

Floor	**Detection Time**	**Pre-movement Time**	**Travel Time**	**Total RSET**	**RSET x 1.5**	**ASET**	**ASET>RSET?**
2	31*	36**	53	120	180	270	YES
3			95	162	243	200	NO
4			37	104	156	250	YES
5			37	104	156	> 300 s	YES
6			44	111	167	> 300 s	YES

6.6.3.8 Recommendations

Since the only level that failed the ASET/RSET comparison was Level 3, directly above the fire, it is not likely that increasing the amount of ventilation or using mechanical ventilation would increase the ASET greater than the RSET. The other option is to reduce the RSET on Level 3. The RSET on Level 3 was significantly greater than on any other level due to the queuing at the single door from the student workspace assembly spaces as shown in Figure 66.

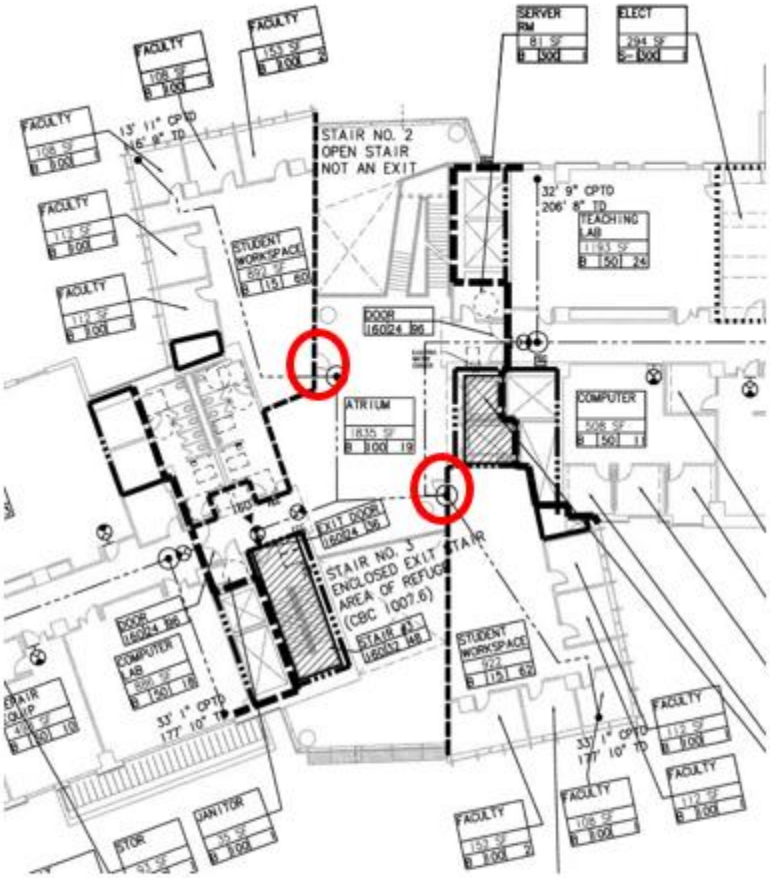


Figure 66 – Locations of queuing at Level 3 student workspace exits [1].

These spaces have an occupant load greater than 50, so there are two exits required, but only one provided as discussed previously in this report. This leads to the large number of occupants queuing at the single doors and increasing the RSET from Level 3. Although two exits are required from each of these spaces, there is not a practical way to fit a second exit from these spaces into the center of the atrium and the one-third diagonal separation rule would not be met. Two possible solutions are to change the use of the space so a business use occupant load factor of 100 can be used to decrease the occupant load, or to increase the width of the doors to reduce queuing times. Since it may not be practical to change the use of the space, increasing the width of the doors from 36 inches to 72 inches could decrease the queuing time, but would still not meet the requirement for two exits from the space. A Pathfinder model was performed with the wider 72 inch doors, which reduced the exit travel time from 95 seconds to 51 seconds. This resulted in a 1.5xRSET value of 177 seconds which is less than the ASET of 200 seconds, which passes the requirements of the performance based analysis. Although this satisfies the requirements of the performance based analysis, the prescriptive requirement for two exits from this space is still not met.

6.7 Proposed Natural Ventilation Smoke Control System

Since the current natural ventilation smoke control system did not pass the performance based analysis on each level for each design fire, the system is not adequate for the atrium. In order to create a passing design, where ASET is greater than RSET, an alternate natural ventilation smoke control system was created. This system included increased vent area at the ceiling as well as increased makeup air vent area. An alternate option would be a mechanical smoke control system, but this would be more costly than altering the already existing natural ventilation smoke control system, so this option will not be analyzed. Since the axisymmetric plume was the most severe fire scenario, the same fire size and location as design fire #1 was used to test the proposed natural ventilation smoke control system.

6.7.1 Exhaust Vents

In order to increase the available safe egress time, the size of the exhaust vents at the ceiling were increased in the new smoke control system design. In the existing design, there is a total of 100 square feet in each of the smoke reservoirs for a total of 200 square feet of exhaust area. In the new design, the exhaust area was increased to 250 square feet in each smoke reservoir, as shown in Figure 67, for a total of 500 square feet.

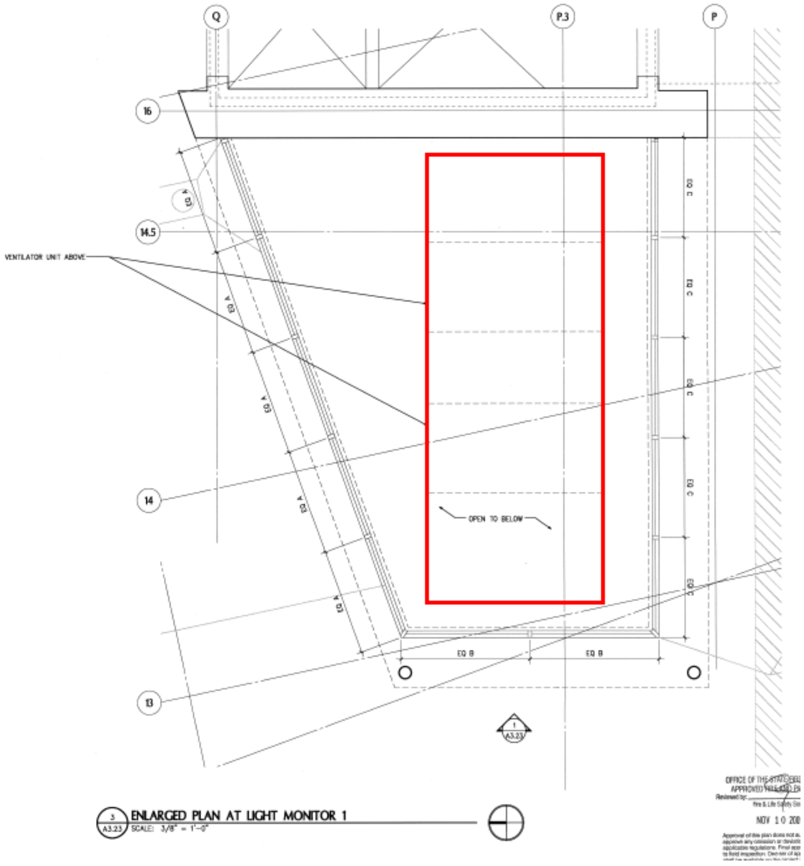


Figure 67 – Proposed 250 ft^2 exhaust vent in smoke reservoir at roof of atrium [1].

6.7.2 Makeup Air Vents

In the existing smoke control system, the makeup air vents are the Level 2 entrance doors at the north and south ends of the atrium. Since the area of the exhaust vents at the ceiling were increased, the area of the makeup air vents at Level 2 were increased as well. This would provide a greater amount of fresh air as makeup air since a greater volume of air is being exhausted from the atrium. Increasing the area of the makeup air vents will also decrease the velocity of the makeup air into the building so it will not disrupt the plume. The area of the makeup air vents were increased from 133.5 ft^2 to 341 ft^2 since this was as large as the vents could be made practically and was proportional to the increase in the exhaust vents.

6.7.3 New Smoke Control System ASET Results – Temperature

Figure 68 shows the temperature within the atrium at a time of 300 seconds. The tenable limit of 60°C was not reached on any level of the atrium.

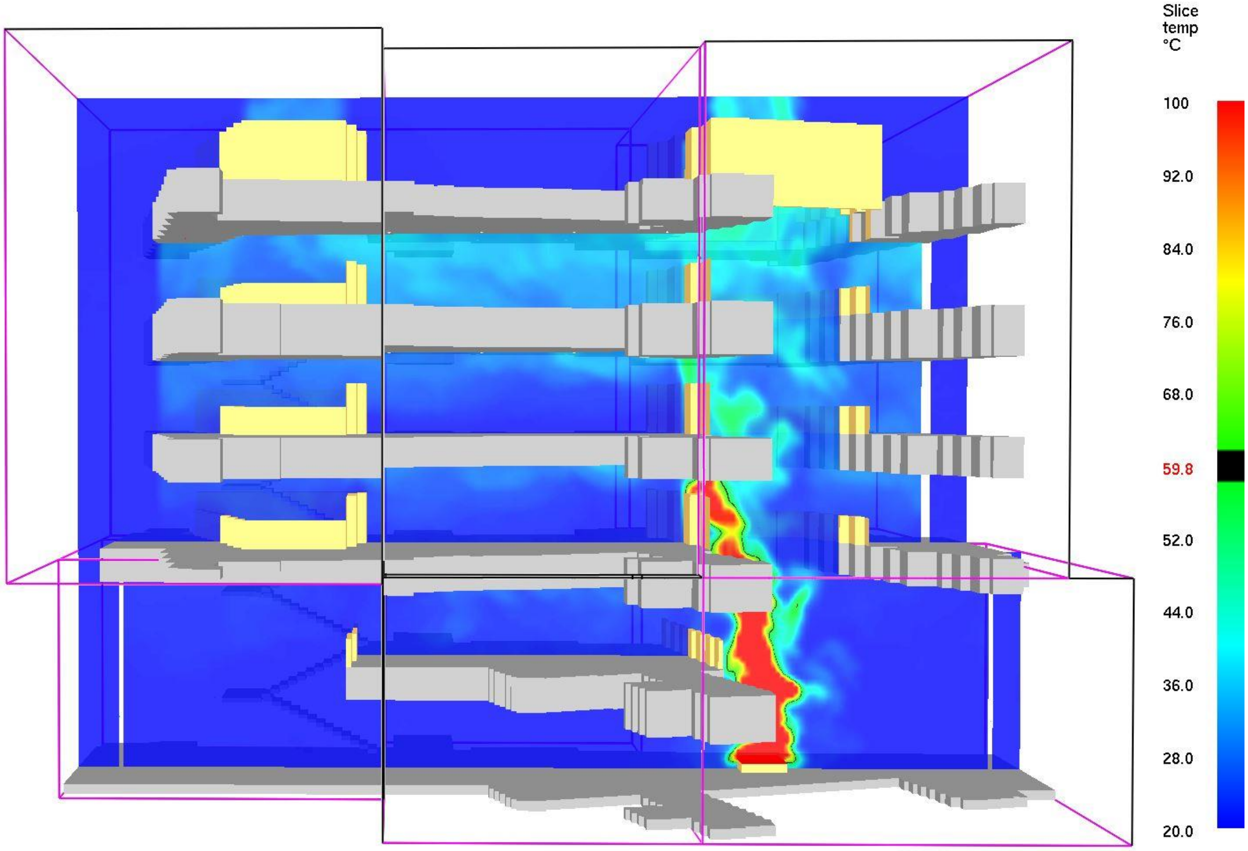


Figure 68 - Temperature slice file at a time of 300 seconds showing tenable limit not being reached.

6.7.4 New Smoke Control System ASET Results – Carbon Monoxide

Figure 69 shows the carbon monoxide concentration in the entire atrium where a maximum value of 350 ppm is reached. Since this is less than the tenable limit of 1,667 ppm, the atrium maintains tenability for the entire simulation.

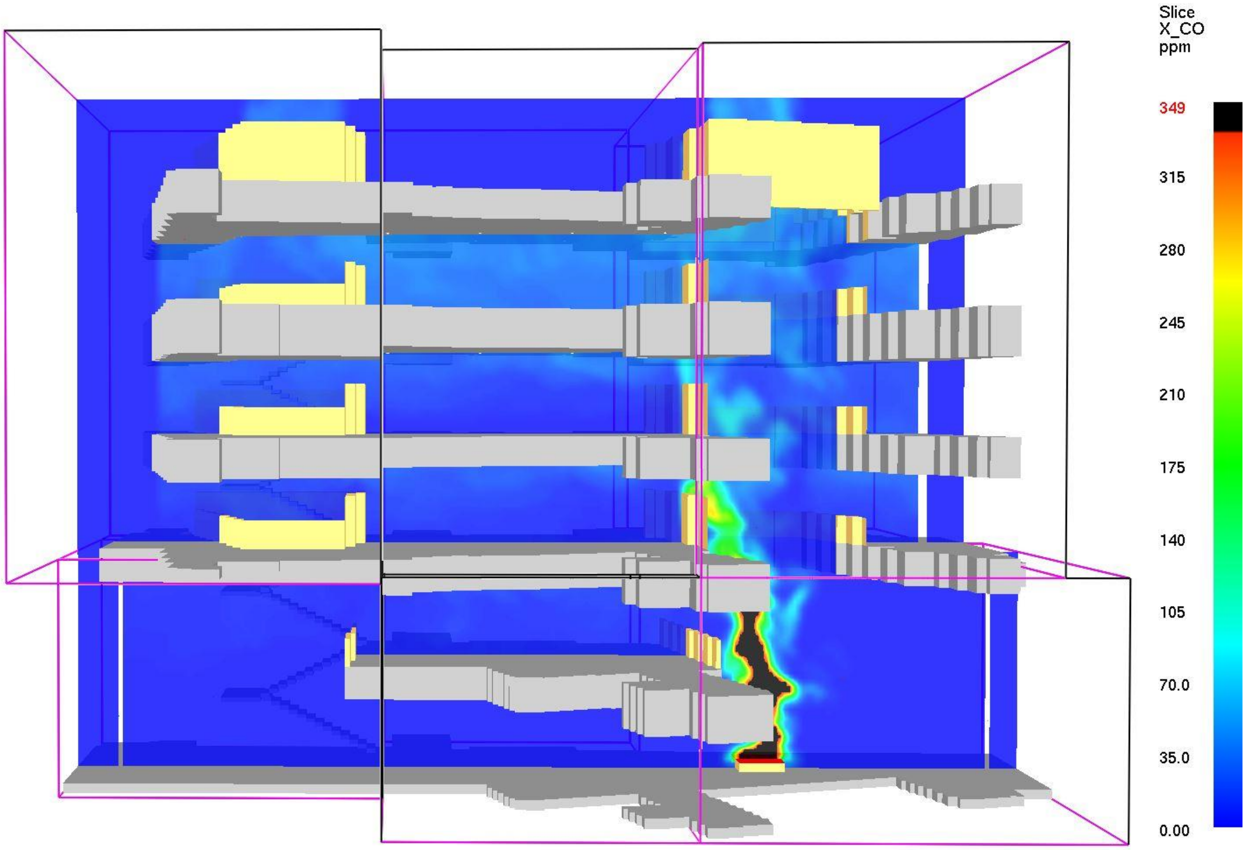


Figure 69 – CO Concentration slice file at 300 seconds showing the tenable limit not being reached.

6.7.5 New Smoke Control System ASET Results – Visibility

Figure 70 through Figure 74 show visibility slice files on Level 2 through Level 6 at the time the tenable limit of 10 meters was reached. If the tenable limit was not reached on a level, the slice file is shown at a time of 300 seconds, which was the end of the simulation.

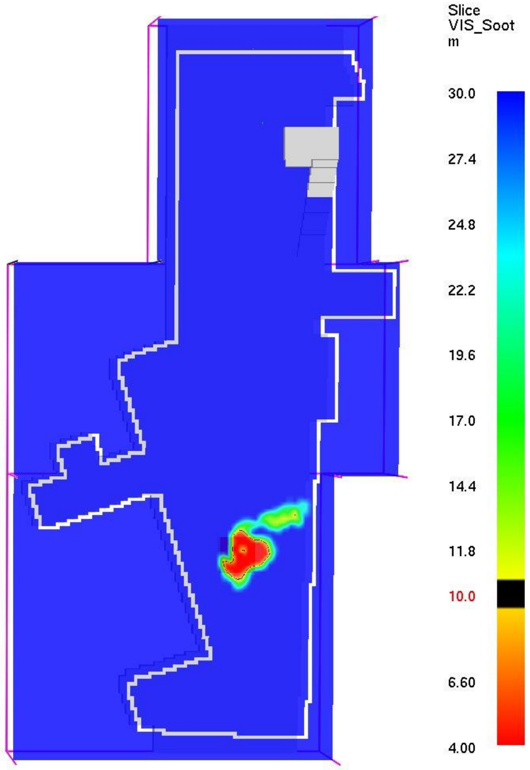


Figure 70 – Visibility slice file of Level 2 at 300 seconds showing tenable limit not being reached.

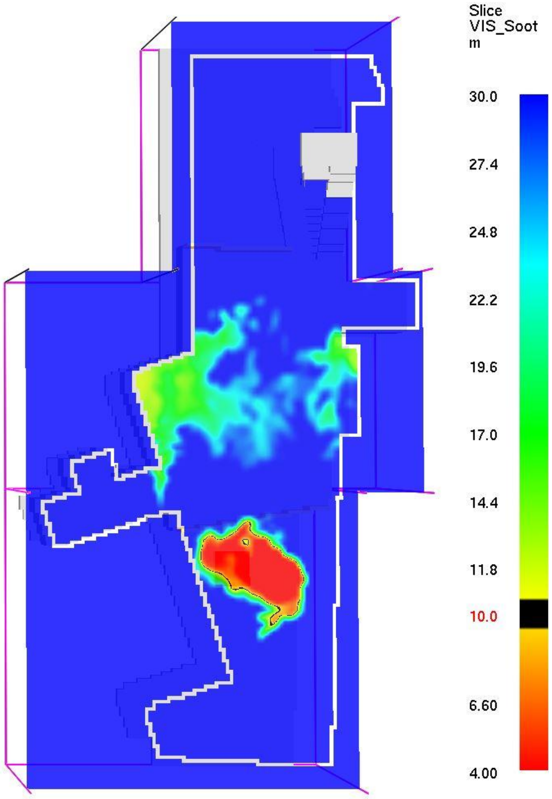


Figure 71 – Visibility slice file of Level 3 at 300 seconds showing tenable limit not being reached.

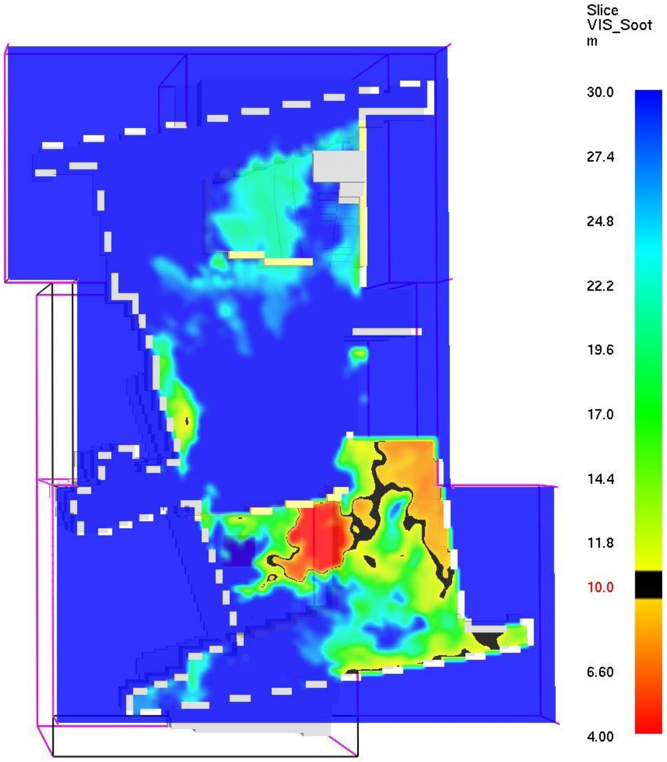


Figure 72 – Visibility slice file of Level 4 showing the tenable limit being reached at 264 seconds.

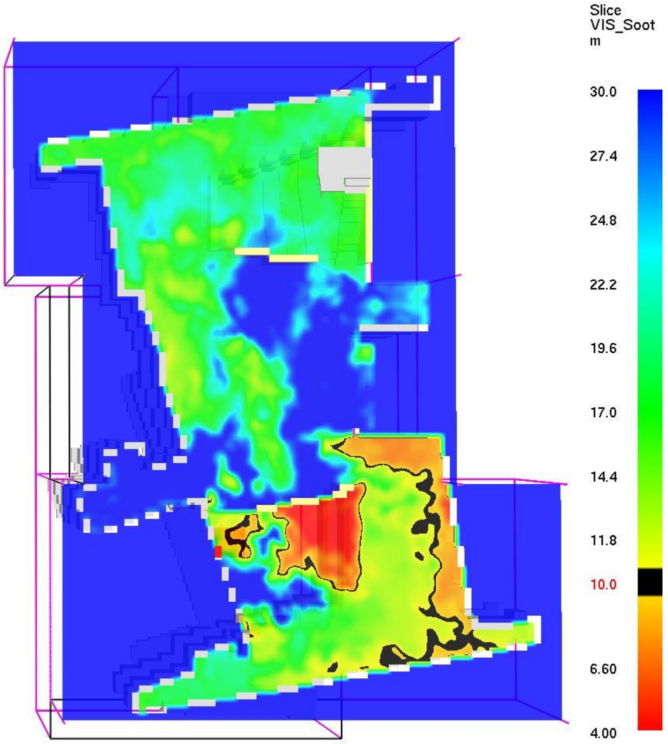


Figure 73 – Visibility slice file of Level 5 showing the tenable limit being reached at 265 seconds.

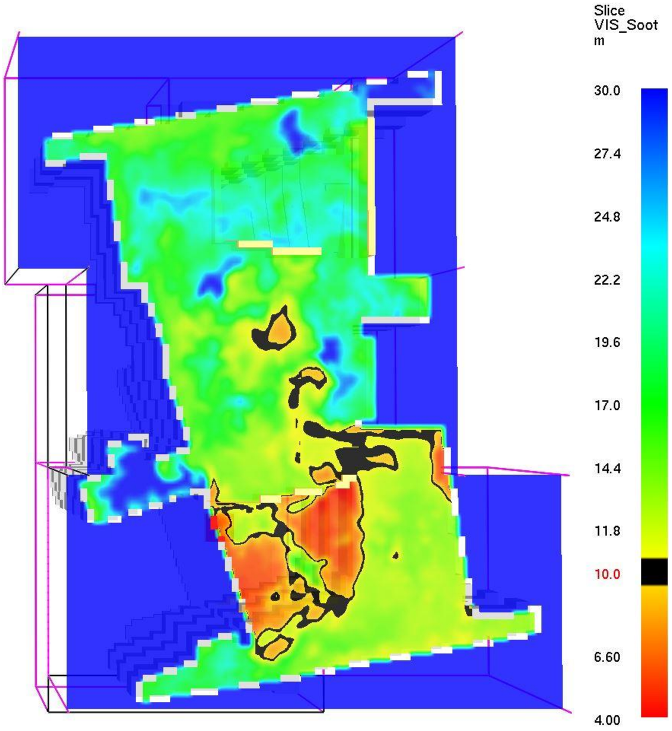


Figure 74 – Visibility slice file of Level 6 showing the tenable limit being reached at 222 seconds.

6.7.6 ASET/RSET Analysis

Table 47 shows a summary of the ASET results on each level for the new natural ventilation smoke control system

Table 47 – Summary of ASET Results for New Natural Smoke Control System Design

	Temperature	**Carbon Monoxide**	**Visibility**
Level 2	Tenability maintained for 300 seconds	Tenability maintained for 300 seconds	> 300 s
Level 3			> 300 s
Level 4			264 s
Level 5			265 s
Level 6			225 s

Table 48 shows the calculation of the RSET as well as a comparison of RSET with ASET showing a passing design since ASET is greater than RSET on each level of the atrium.

Table 48 – ASET/RSET Analysis for New Natural Smoke Control System Design

Floor	Detection Time	Pre-movement Time	Travel Time	Total RSET	RSET x 1.5	ASET	ASET>RSET?
2	44	36	53	133	200	> 300	YES
3			95	175	263	> 300	YES
4			37	117	176	264	YES
5			37	117	176	265	YES
6			44	124	186	225	YES

6.7.7 Ambient Temperature Effects

Differences in exterior ambient air temperature can cause differences in smoke movement within the building. When the exterior ambient temperature is colder than the interior air temperature this is called stack effect. Since the temperature of the air inside the building is warmer, it is less dense and will rise within building shafts due to the buoyant force. This results in an outward flow at the top of the building, due to the pressure difference between the interior and exterior, and an inward flow of air at the bottom of the building (Figure 75). When the temperature within the building is colder than the exterior ambient temperature, the opposite occurs, known as reverse stack effect as shown in Figure 75.

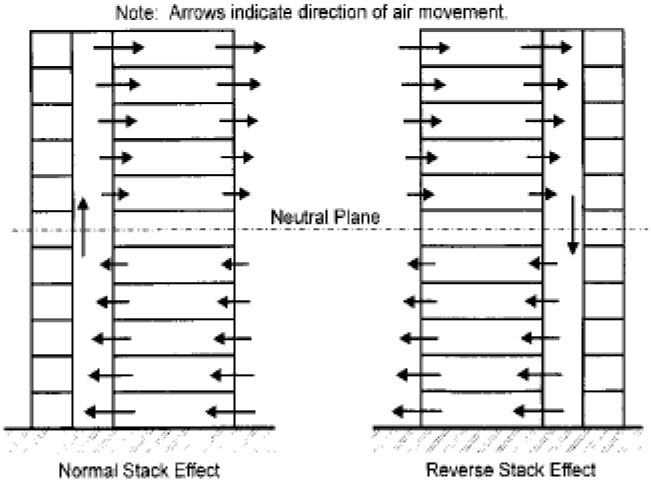


Figure 75 Air movement due to normal and reverse stack effect [22].

In order to analyze the effects of exterior ambient air temperature on the natural ventilation smoke control system, the most extreme hot and cold temperatures were analyzed in the FDS model to determine if the design passed the tenability criteria. According to Intellicast.com, the lowest recorded temperature was 12°F (-11.11°C) in December 1987 and the highest recorded temperature in San Luis Obispo was 112°F (44.44°C) in September 1971 [23]. By using these two extremes, it could be determined if the smoke control system is adequate for all of the conditions that can occur in the environment. The ambient temperature in the FDS models was set to these values, while the interior temperature of the building was initially set at 20°C to analyze stack effect and reverse stack effect within the atrium.

6.7.7.1 Stack Effect, 12°F Ambient Temperature

Table 49 shows the ASET compared to the RSET with a 50% safety factor for the new natural ventilation smoke control system with an ambient temperature of 12°F. The ASET was determined on each level by when the visibility limit was reached, similar to determining the ASET for Design Fire #1 and #2 with the existing natural ventilation smoke control system. Tenability was maintained on each level for a time greater than the RSET including the safety factor as shown in Table 49. With stack effect, the natural ventilation smoke control system performs as well, or even better than the case without stack effect. This is due to the natural upward air movement induced by stack effect that leads to a greater volume of smoke being exhausted by the vents at the ceiling.

Table 49 – ASET/RSET Analysis for Stack Effect Case

Floor	Detection Time	Pre-movement Time	Travel Time	Total RSET	RSET x 1.5	ASET	ASET>RSET?
2	54	36	53	143	215	> 300	YES
3			95	185	278	> 300	YES
4			37	127	191	> 300	YES
5			37	127	191	256	YES
6			44	134	201	209	YES

6.7.7.2 Reverse Stack Effect, 112°F Ambient Temperature

Table 50 shows the ASET compared to the RSET with a 50% safety factor for the new natural ventilation smoke control system with an ambient temperature of 112°F. Similar to the previous case, the ASET was determined when the visibility limit was reached on each level since the temperature and CO concentration limit were not reached in the atrium. The ASET is greater than the RSET on every level except Level 6. This is due to the downward movement of air due to the reverse stack effect. This does not allow smoke to be exhausted from the exhaust vents, so Level 6 reaches the tenable limit very quickly. This may suggest that this proposed natural ventilation smoke control system design is not adequate for the atrium, but since this is the most severe temperature situation, the design may still be approved by the AHJ since the other levels maintain tenability.

Table 50 – ASET/RSET Analysis for Reverse Stack Effect Case

Floor	Detection Time	Pre-movement Time	Travel Time	Total RSET	RSET x 1.5	ASET	ASET>RSET?
2	39	36	53	128	192	> 300	YES
3			95	170	255	> 300	YES
4			37	112	168	> 300	YES
5			37	112	168	282	YES
6			44	119	179	168	NO

6.7.8 Sensitivity Analysis

Since the FDS simulations are dependent on user inputs, such as soot yield and CO yield, a sensitivity analysis was performed in order to determine the effects of varying these inputs on the results. Since these input values were determined from tabular data for free burning tests of single materials, these properties do not best represent the fire situation. For this reason, it is important to perform a sensitivity analysis to determine if changing these properties can alter the results of the simulation and if the selected properties can be considered appropriate. Different percentages of these input variables were used to analyze this. If a small change in the input variables produced an ASET less than RSET, it was determined that the selected input value needed to be re-analyzed.

6.7.8.1 Soot Yield

Since the ASET was determined by the tenable limit for visibility in every case, the soot yield is a very important parameter since it determines the amount of smoke produced by the fire. Increasing the soot yield increases the quantity of the smoke produced, so the visibility limit will be reached sooner. In addition to the value of 0.05 used in the previous analysis of the smoke control system, three more values were used as indicated in Table 51.

Table 51 – Different Soot Yield Inputs Used in Simulations

Soot Yield	% of Simulation Value
0.025	50
0.05	100
0.075	150
0.1	200

An FDS simulation was performed with each of these soot yield values and the ASET was compared to the calculated RSET. The ASET values on each level for each simulation are summarized in Table 52.

Table 52 – ASET Results for Different Soot Yield Values

Floor	50%	100%	150%	200%
2	> 300 s	> 300 s	> 300 s	> 300 s
3	> 300 s	> 300 s	> 300 s	> 300 s
4	> 300 s	264 s	202 s	168 s
5	> 300 s	265 s	204 s	175 s
6	> 300 s	225 s	168 s	163 s

As shown in Table 52, higher values of soot yield decrease the ASET since the visible limit of 10 meters is reached sooner when there is more smoke. For each case, the design passes the performance based analysis because the ASET is greater than the calculated RSET with the 50% safety factor. Although the ASET is reduced for the 150% and 200% cases, the calculated RSET is also reduced because the detection time is sooner when the soot yield is higher. This is because the smoke is first detected by the beam detectors that are measuring the percent obscuration. With more smoke, the beam detectors will activate sooner, which decreases the RSET. The calculation of RSET and the ASET for the most severe case of a soot yield of 0.1 is shown in Table 53.

Table 53 – ASET/RSET Analysis for Simulation with Soot Yield of 0.1

Floor	Detection Time	Pre-movement Time	Travel Time	Total RSET	RSET x 1.5	ASET	ASET>RSET?
2	28	36	53	117	176	> 300	YES
3			95	159	239	> 300	YES
4			37	101	152	168	YES
5			37	101	152	175	YES
6			44	108	162	163	YES

6.7.8.2 CO Yield

Although the ASET was always determined by the visibility limit and not the CO concentration limit, a sensitivity analysis was performed on the CO yield to determine if different input values would have different results. The different values for the CO yield that were used are summarized in

Table 54. The tenable limit for CO concentration was never reached in any of the cases. The greatest CO concentration reached in the case with a CO yield of 0.12 was 1,000 ppm, far less than the tenable limit of 1,667 ppm.

Table 54 – Different CO Yields Used in the Sensitivity Analysis

CO Yield	% of Simulation Value
0.04	100
0.08	200
0.12	300

6.7.8.3 Sensitivity Analysis Conclusion

The sensitivity analysis of soot yield and CO yield showed that increasing the input values by 200% and 300% respectively did not have an effect on the ASET and RSET analysis. Since the changes in these parameters did not cause the new natural smoke control system design to fail the performance based analysis, it is safe to determine that the system is adequate for the atrium. The selected input properties are considered appropriate for the simulation since they were based on tabular data and more conservative values did not cause the smoke control system to fail.

6.8 Performance Based Analysis Conclusion

As shown in the previous analysis, the existing natural ventilation smoke control system is not adequate for the atrium since it cannot maintain tenable conditions for a time greater than it takes occupants to exit the atrium. In order to pass the performance based analysis, a new natural ventilation smoke control system has been proposed with additional venting. Using the most severe fire scenario, Design Fire #1, it was shown that this new smoke control system design is adequate for the atrium because it maintains tenability for a time greater than the egress time. Through a sensitivity analysis of input parameters and an analysis on the most severe temperature conditions for San Luis Obispo, the new smoke control system design was proven to pass the performance based analysis, except for on Level 6 for the case of reverse stack effect. Although this level did not pass, the suggested design is still more appropriate than the current design for the atrium and would be the most cost effective solution since it would only require increasing the size of the vents rather than installing a mechanical ventilation smoke control system.

7.0 CONCLUSION

Through a prescriptive and performance based analysis, several discrepancies were found in the Warren J. Baker Center for Science. For the egress components, dead end corridors have been identified that need to be reduced in length in order to be compliant with the CBC. Also, the student workspace on Level 3 requires a second exit, as previously discussed in the report. It was determined that the building meets the requirements for structural fire protection related to the height, area, and required fire resistance ratings and separations. The hydraulic calculations for the fire sprinkler system proved that the water supply exceeds the demand and is sufficient for the building. The fire alarm system contains adequate coverage of the building and is compliant with the requirements of NFPA 72 for spacing and placement of devices. The performance based analysis proved that the existing natural ventilation smoke control system is not adequate for the atrium and a new system has been proposed and tested in FDS to prove that it can provide a passing design. With the recommendations presented in this report, the Warren J. Baker Center for Science can be code compliant and safe for occupancy.

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<u>APPENDICES</u>

APPENDIX A – OCCUPANCY FLOOR PLANS

🟦 Group B

🟪 Group S-1, S-2

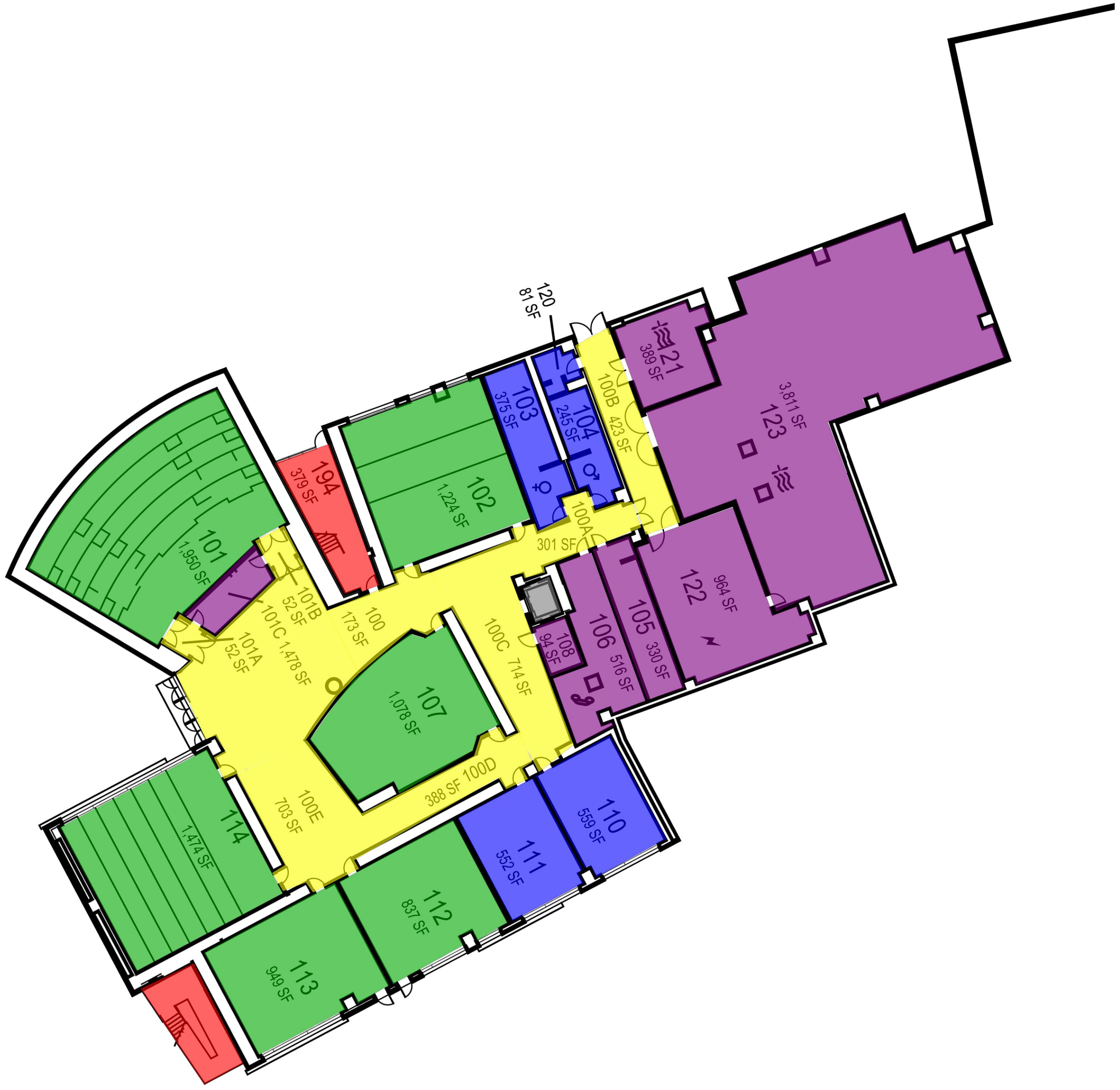
🟩 Group A-3

🟧 Group H-3

🟨 Corridors

▨ Vertical Openings

🟥 Exit Stairs



1 Level 1 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 1

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
1
OF 6 SHEETS

- 🟦 Group B
- 🟪 Group S-1, S-2
- 🟩 Group A-3
- 🟧 Group H-3
- 🟨 Corridors
- ▨ Vertical Openings
- 🟥 Exit Stairs

2 Level 2 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 2

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:
--

DRAWING NO.
2
OF 6 SHEETS

🟦 Group B

🟪 Group S-1, S-2

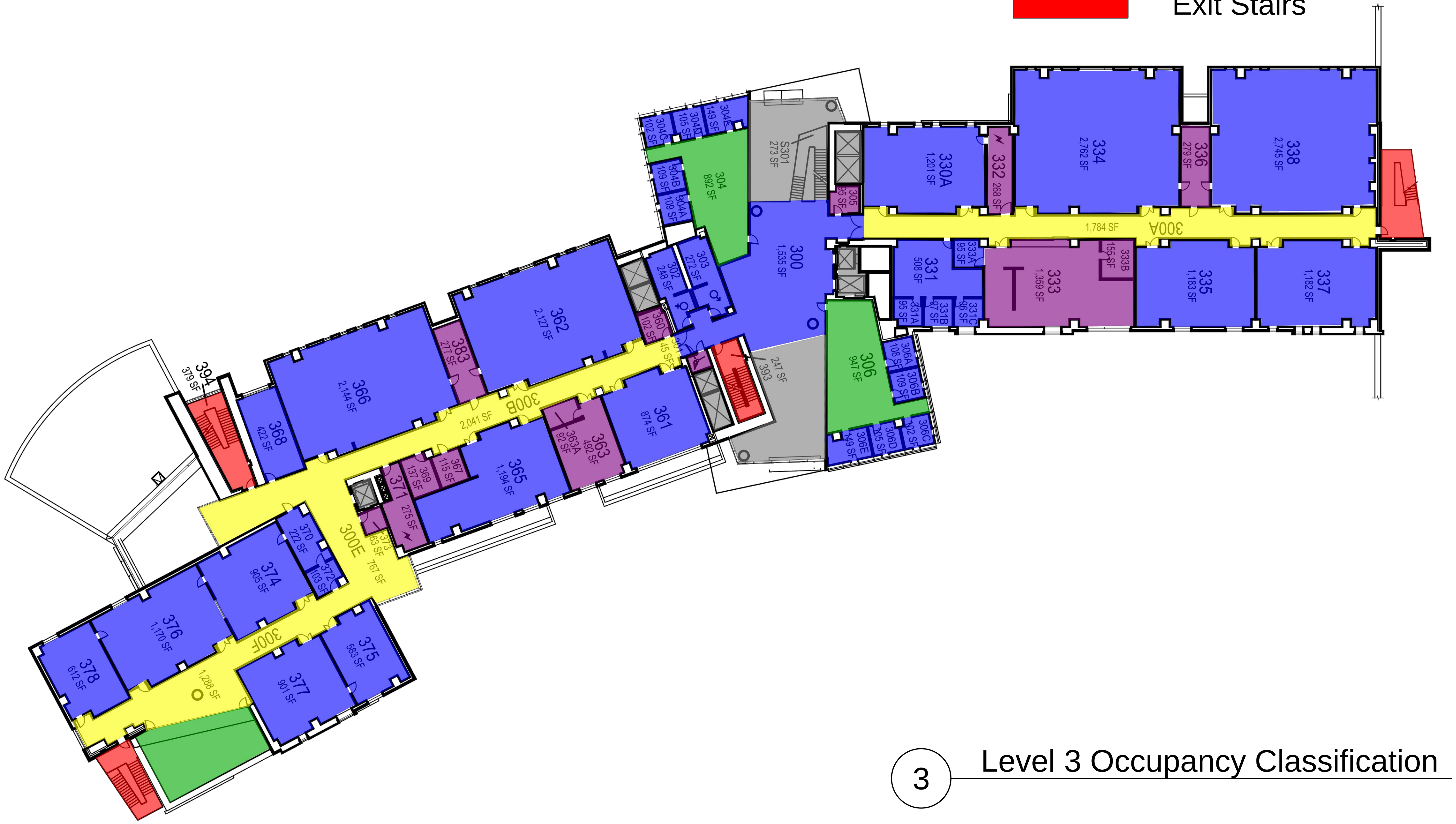
🟩 Group A-3

🟧 Group H-3

🟨 Corridors

▨ Vertical Openings

🟥 Exit Stairs



3 Level 3 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 3

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
3
OF 6 SHEETS

🟦 Group B
🟪 Group S-1, S-2
🟩 Group A-3
🟧 Group H-3
🟨 Corridors
◼ Vertical Openings
🟥 Exit Stairs

4

Level 4 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 4

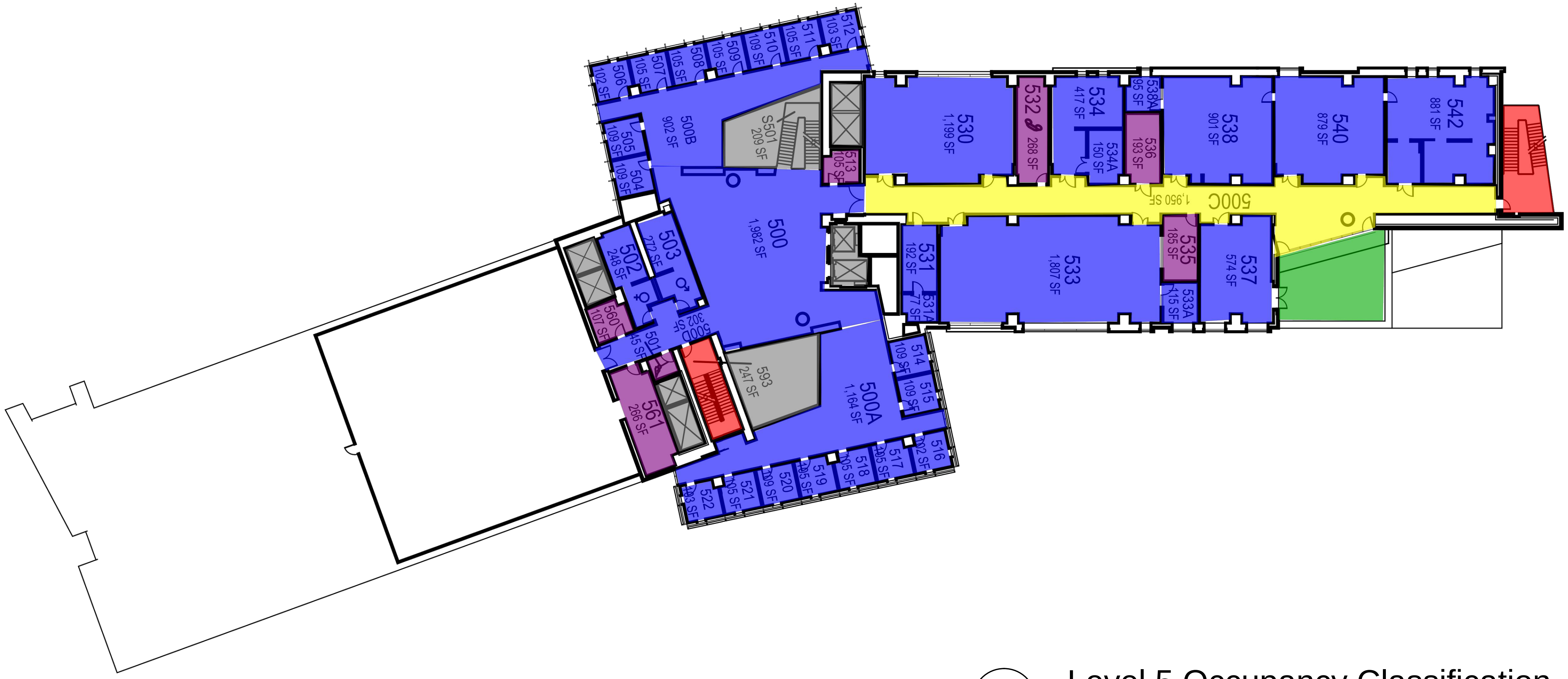
NAME:
Aric Carracino

DATE:
Spring 2015

SCALE:

DRAWING NO.
4
OF 6 SHEETS

🟦 Group B
🟪 Group S-1, S-2
🟩 Group A-3
🟧 Group H-3
🟨 Corridors
▨ Vertical Openings
🟥 Exit Stairs



5 Level 5 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 5

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:
--

DRAWING NO.
5
OF 6 SHEETS

🟦 Group B
🟪 Group S-1, S-2
🟩 Group A-3
🟧 Group H-3
🟨 Corridors
▨ Vertical Openings
🟥 Exit Stairs

6 Level 6 Occupancy Classification

CAL POLY

Buiding 180 CSM
Level 6

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

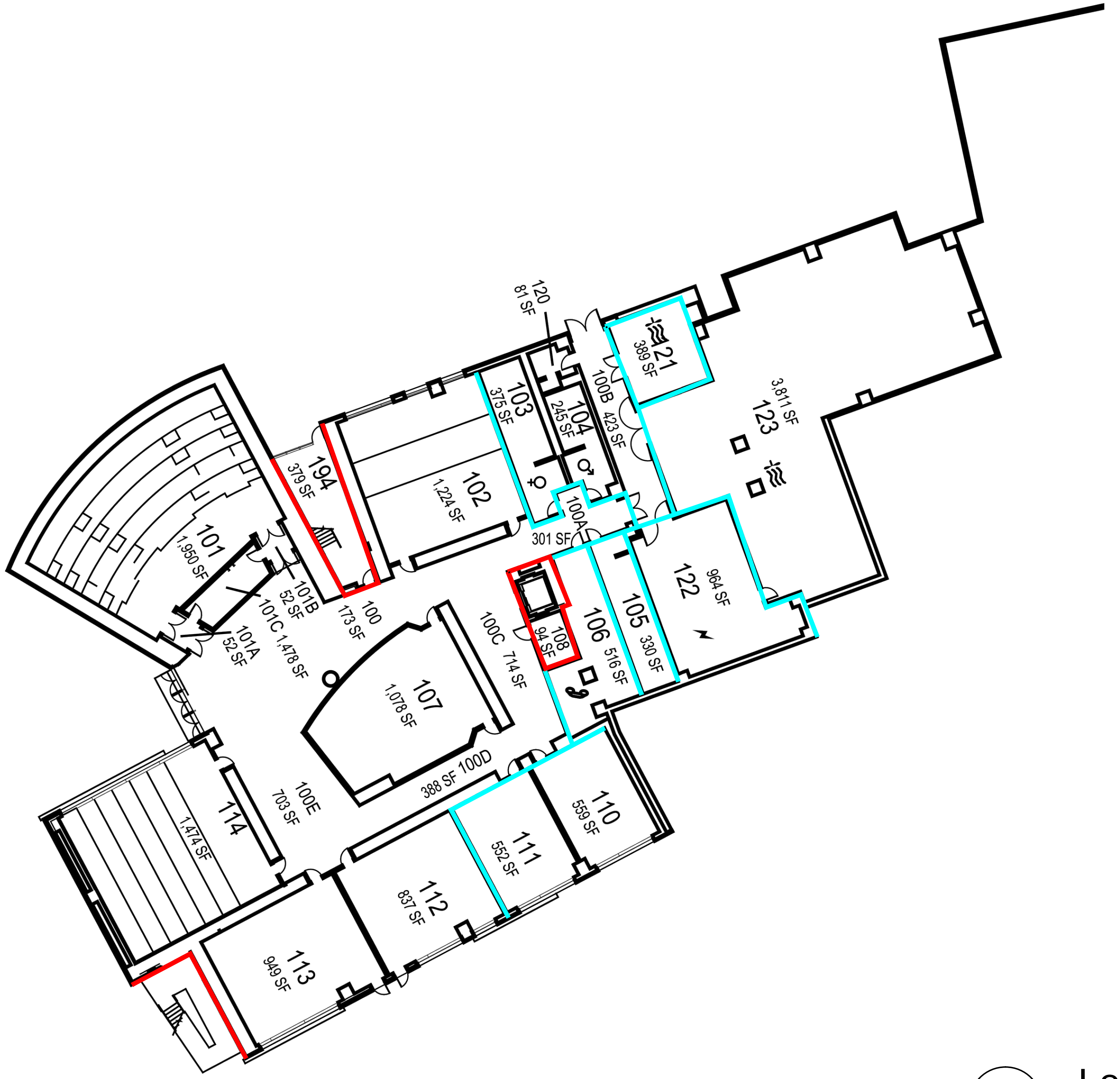
DRAWING NO.
6
OF 6 SHEETS

APPENDIX B – FIRE RATED CONSTRUCTION FLOOR PLANS

Legend:

🟦 1 Hour Rated Fire Barrier

🟥 2 Hour Rated Fire Barrier



1 Level 1 Fire Rated Construction

CALPOLY

Buiding 180 CSM
Level 1

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
1
OF 6 SHEETS

Legend:

🟦 1 Hour Rated Fire Barrier

🟥 2 Hour Rated Fire Barrier

2 Level 2 Fire Rated Construction

CAL POLY

Buiding 180 CSM
Level 2

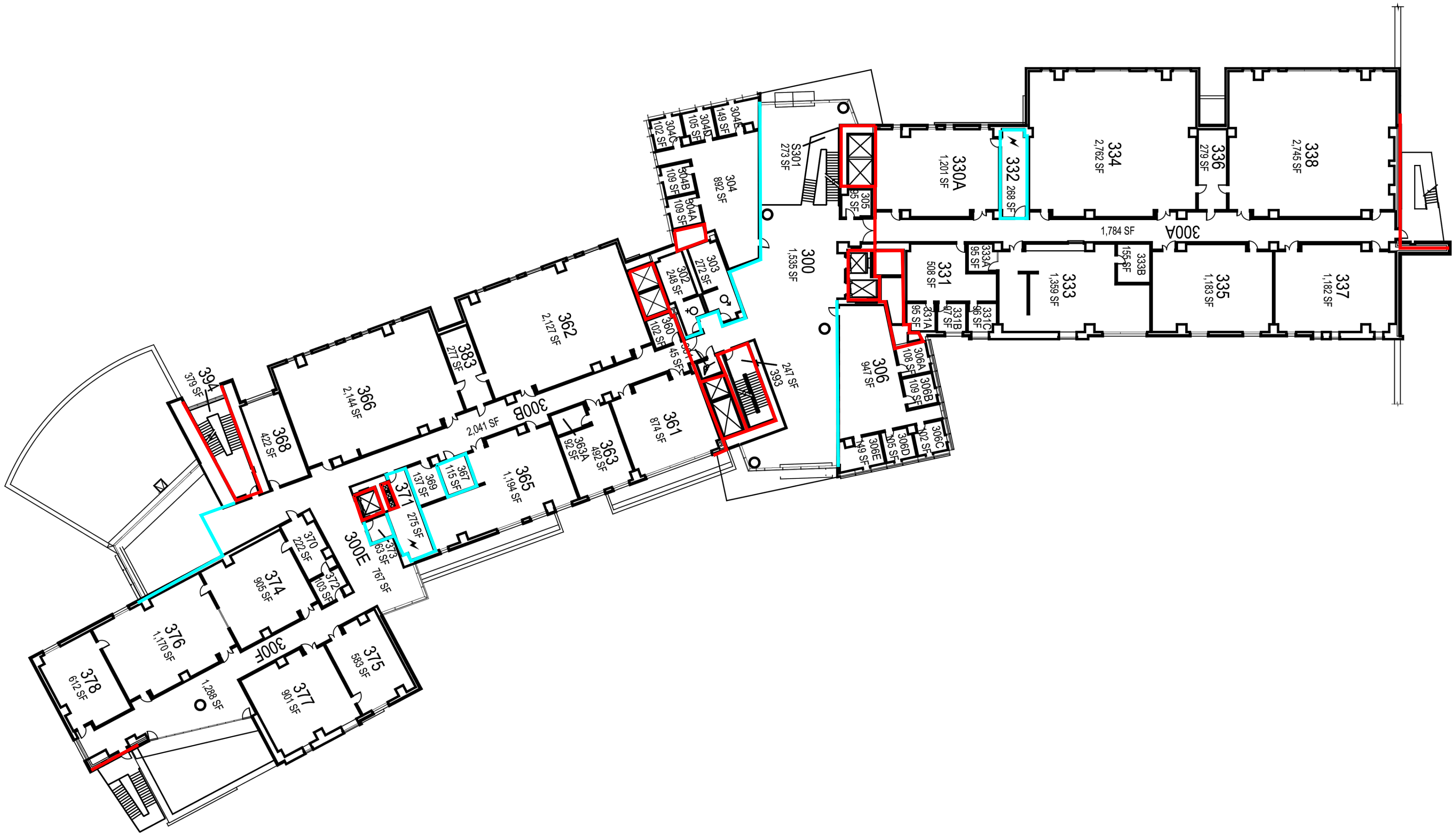
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
2
OF 6 SHEETS

Legend:

🟦 1 Hour Rated Fire Barrier

🟥 2 Hour Rated Fire Barrier



③ Level 3 Fire Rated Construction

CAL POLY

Buiding 180 CSM
Level 3

NAME:
Aric Carracino

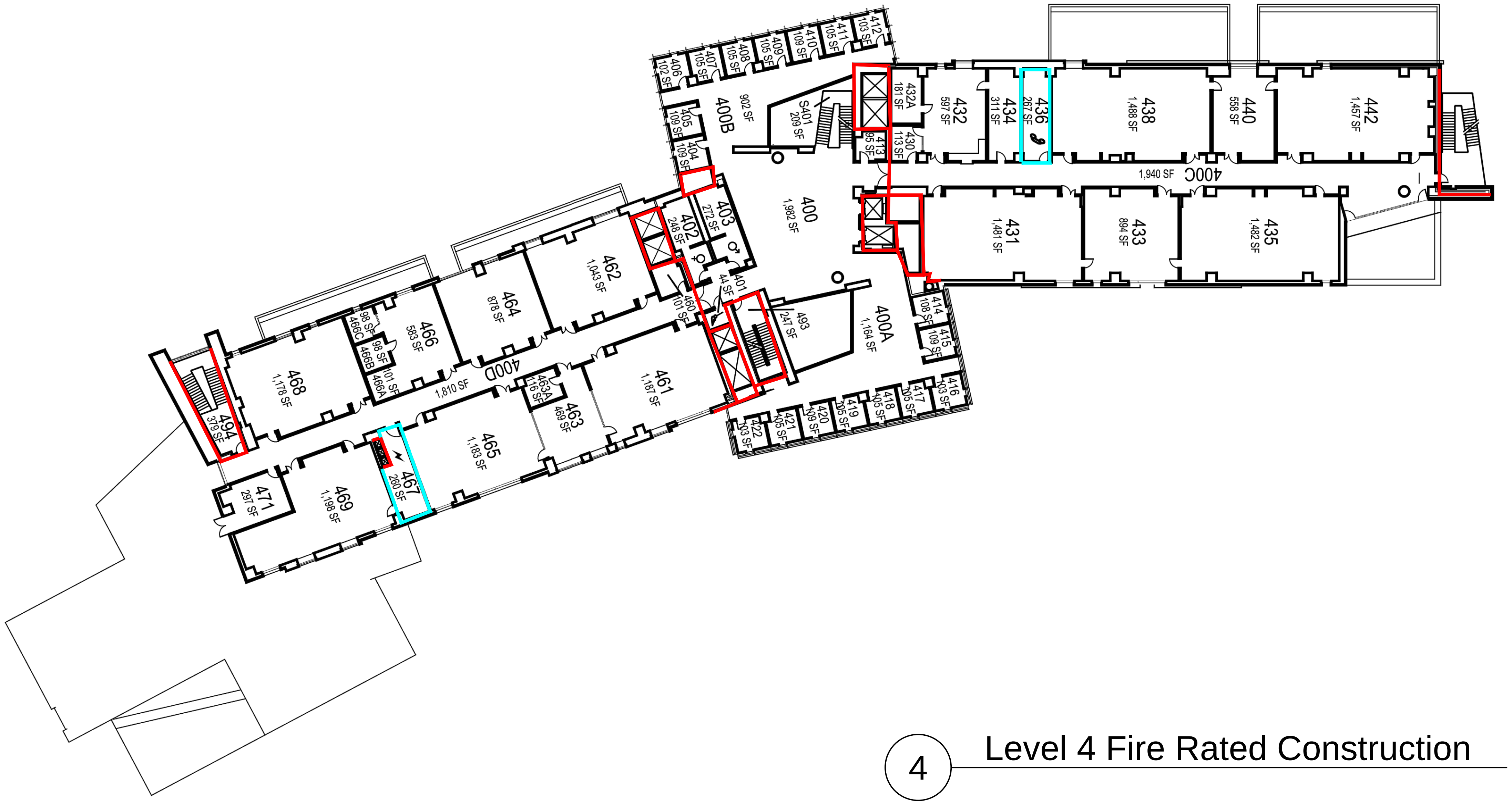
DATE:
Spring 2015

SCALE:
--

DRAWING NO.
3
OF 6 SHEETS

Legend:

🟦	1 Hour Rated Fire Barrier
🟥	2 Hour Rated Fire Barrier



4

Level 4 Fire Rated Construction

CAL POLY

Buiding 180 CSM
Level 4

NAME:
Aric Carracino

DATE:
Spring 2015

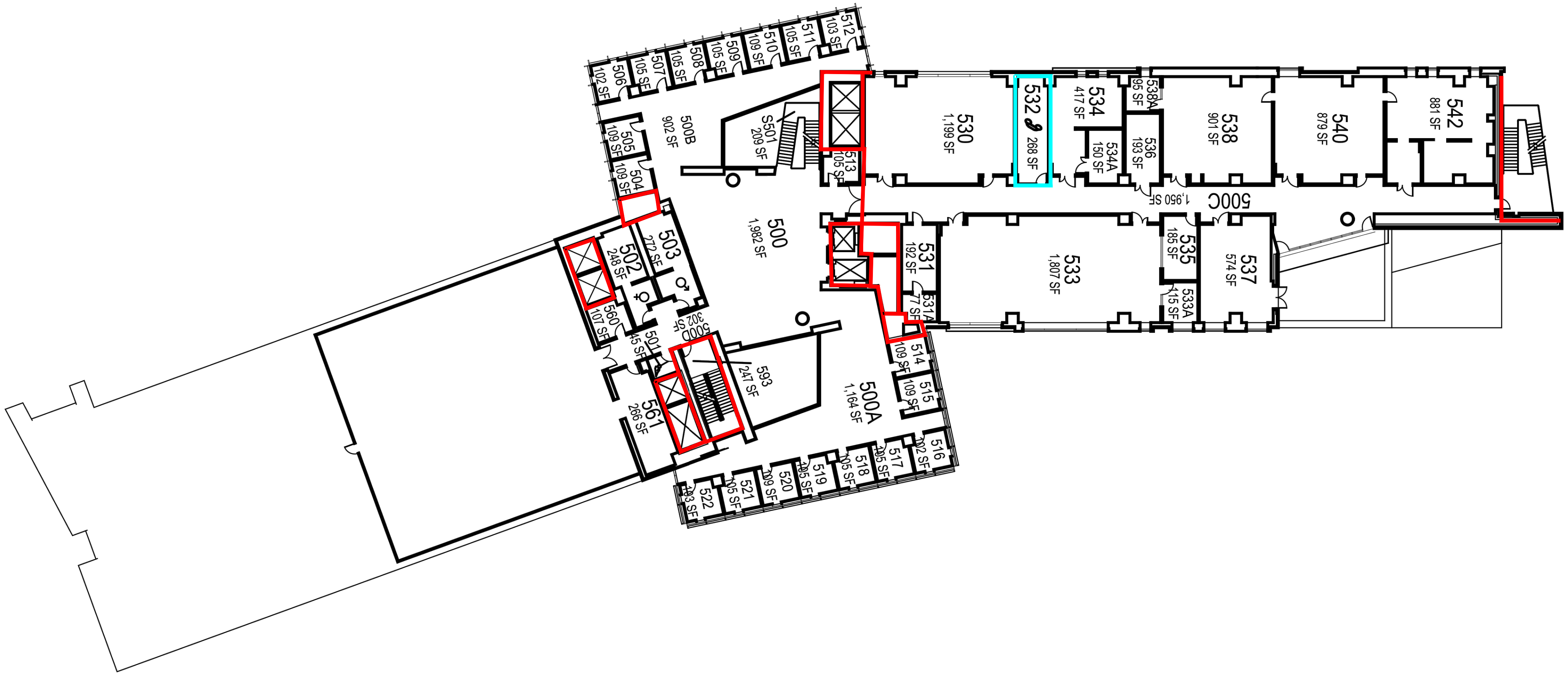
SCALE:
--

DRAWING NO.
4
OF 6 SHEETS

Legend:

🟦 1 Hour Rated Fire Barrier

🟥 2 Hour Rated Fire Barrier



5 Level 5 Fire Rated Construction

CAL POLY

Buiding 180 CSM
Level 5

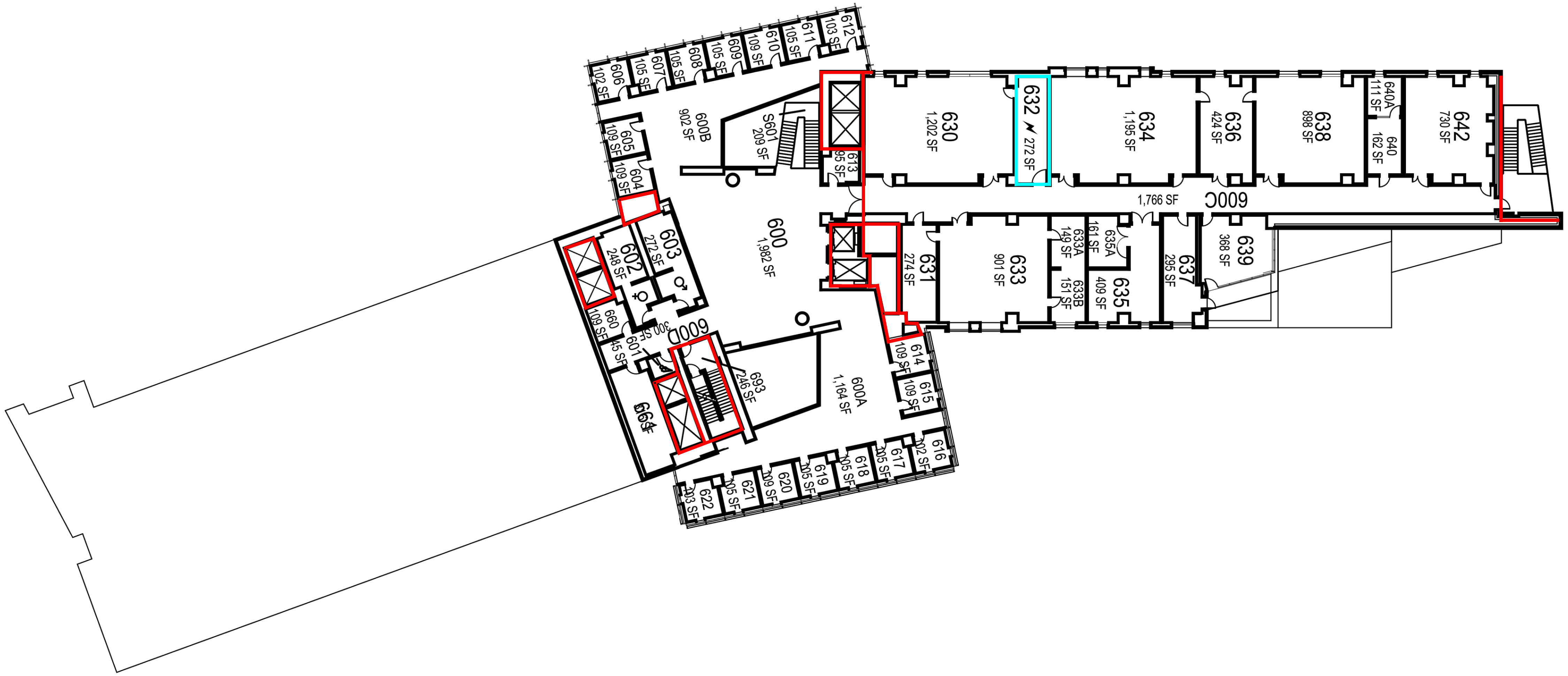
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:
--

DRAWING NO.
5
OF 6 SHEETS

Legend:

🟦 1 Hour Rated Fire Barrier

🟥 2 Hour Rated Fire Barrier



6 Level 6 Fire Rated Construction

CAL POLY

Buiding 180 CSM
Level 6

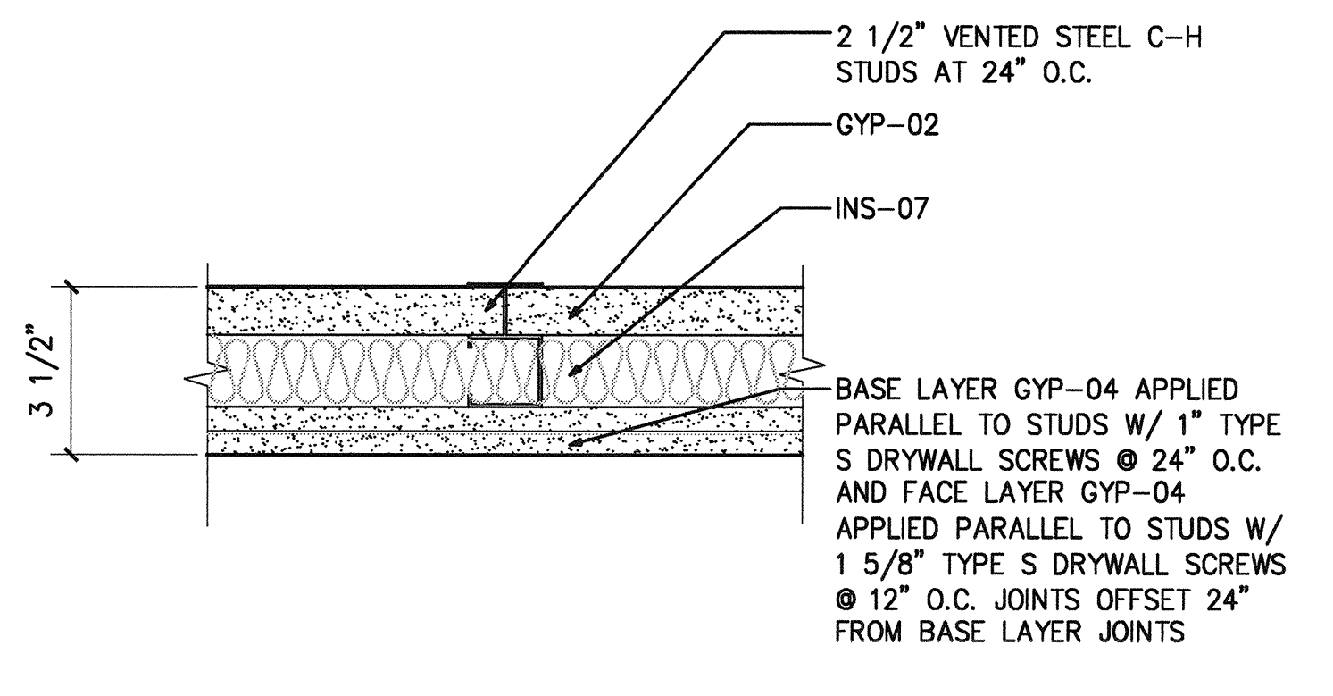
NAME:
Aric Carracino

DATE:
Spring 2015

SCALE:

DRAWING NO.
6
OF 6 SHEETS

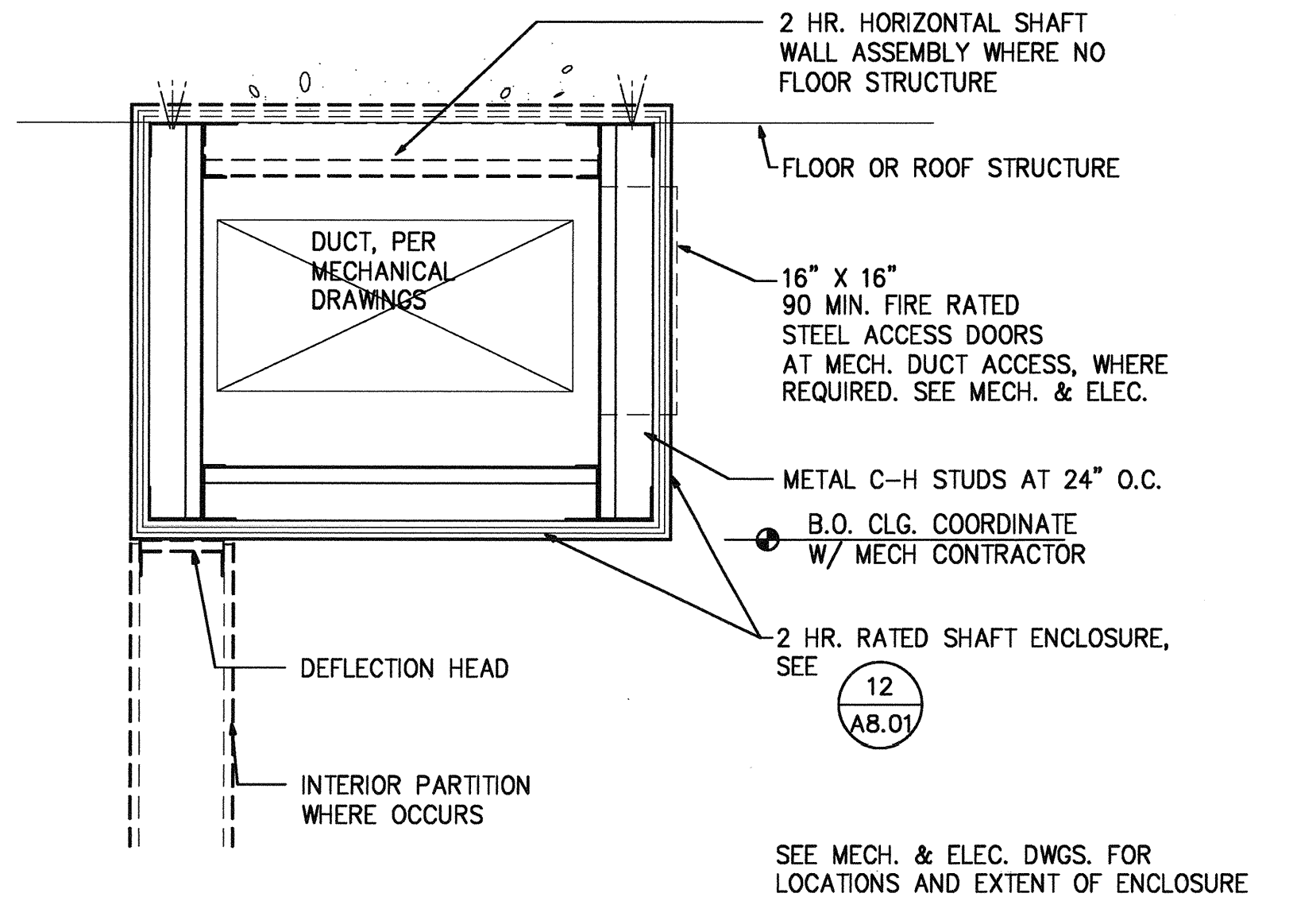
APPENDIX C – CONSTRUCTION MATERIALS



GA FILE NO. WP7095 FIRE RESISTANCE DESIGN MANUAL, 16TH EDITION BY GYPSUM ASSOCIATION. UL# U438, 2 HR. FIRE FSTC 45-49

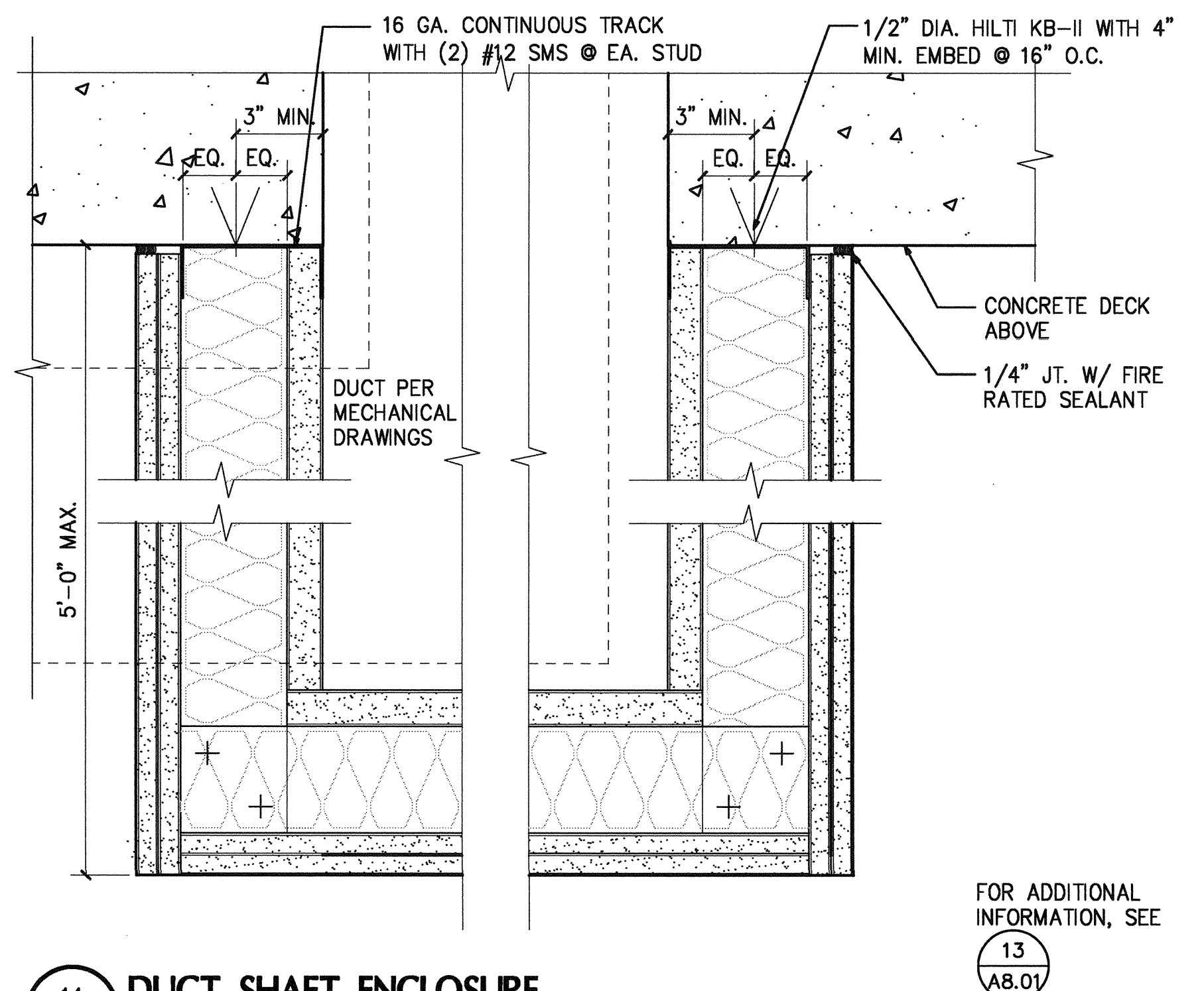
12 / A8.01 2 HOUR HORIZONTAL PARTITION/CEILING

SCALE: NTS



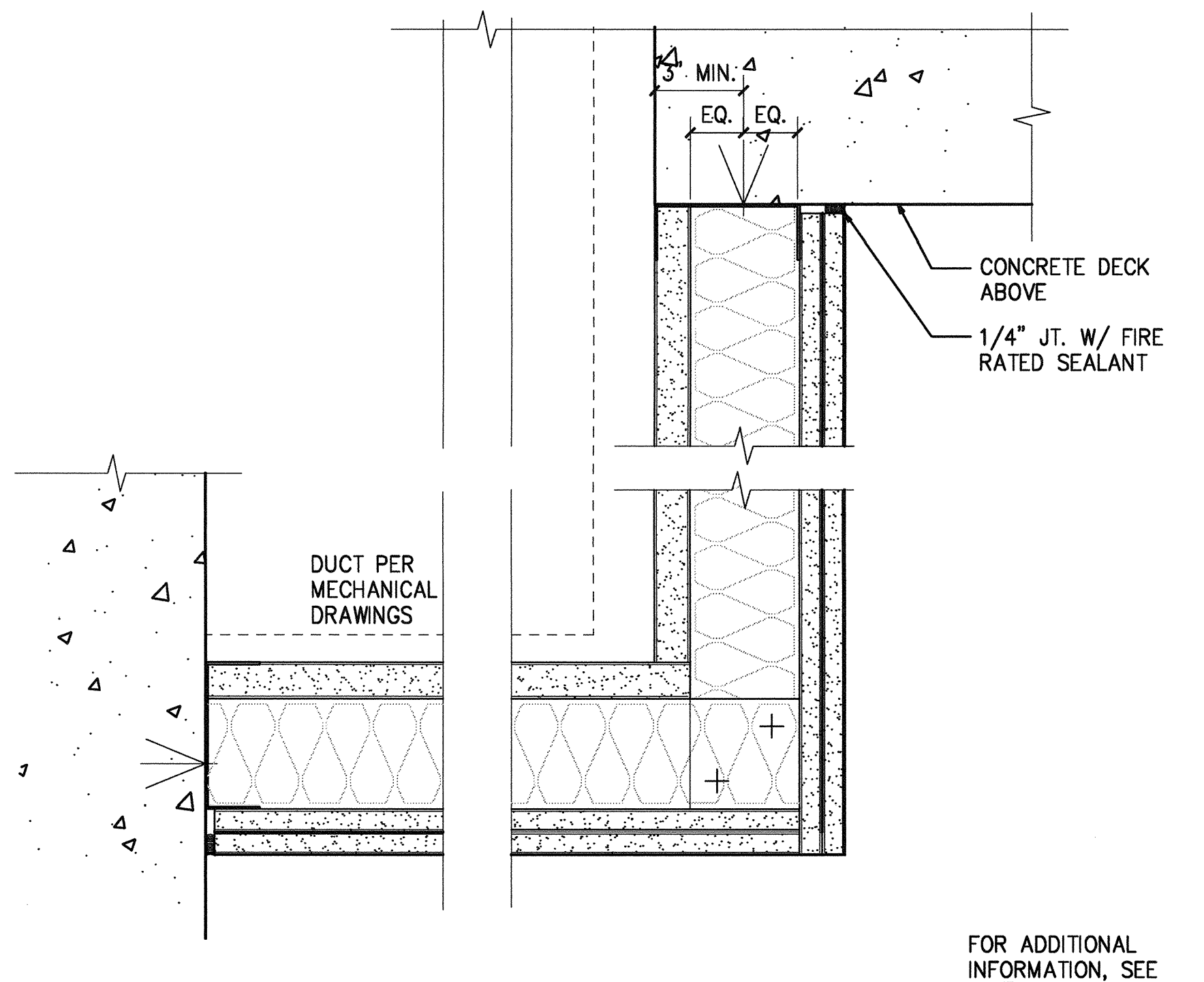
13 / A8.01 2 HOUR HORIZONTAL SHAFT/CEILING

SCALE: N.T.S.



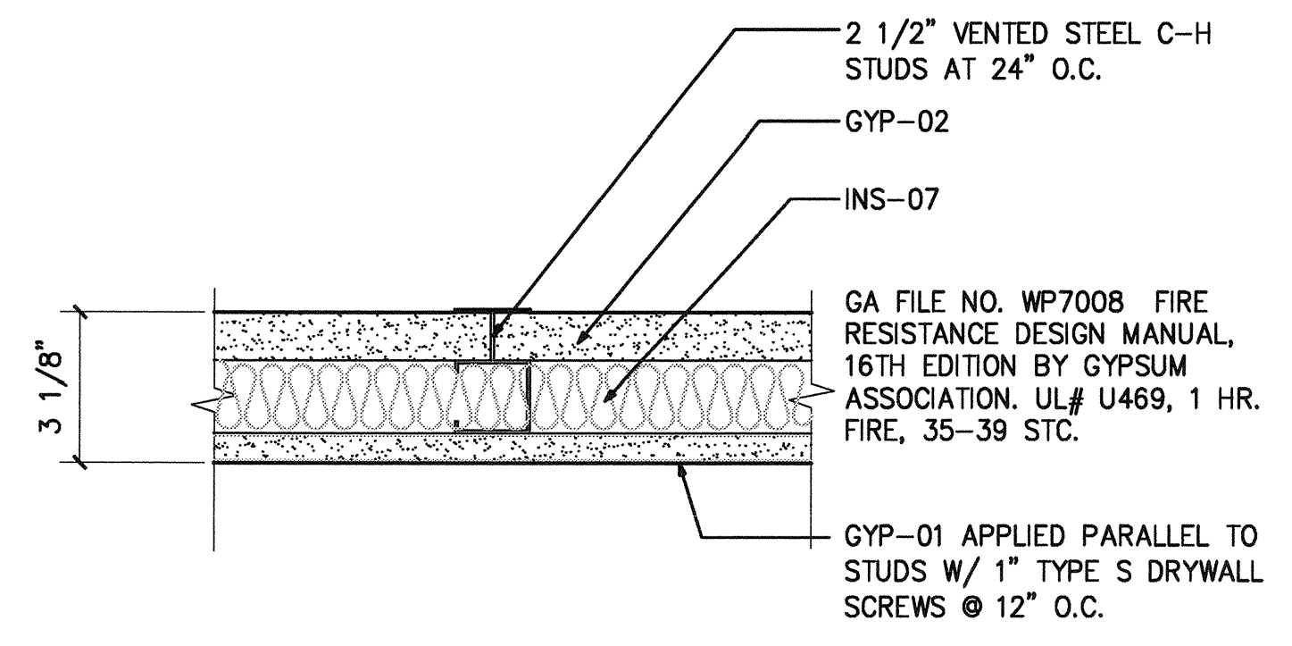
14 / A8.01 DUCT SHAFT ENCLOSURE

SCALE: 3" = 1'-0"



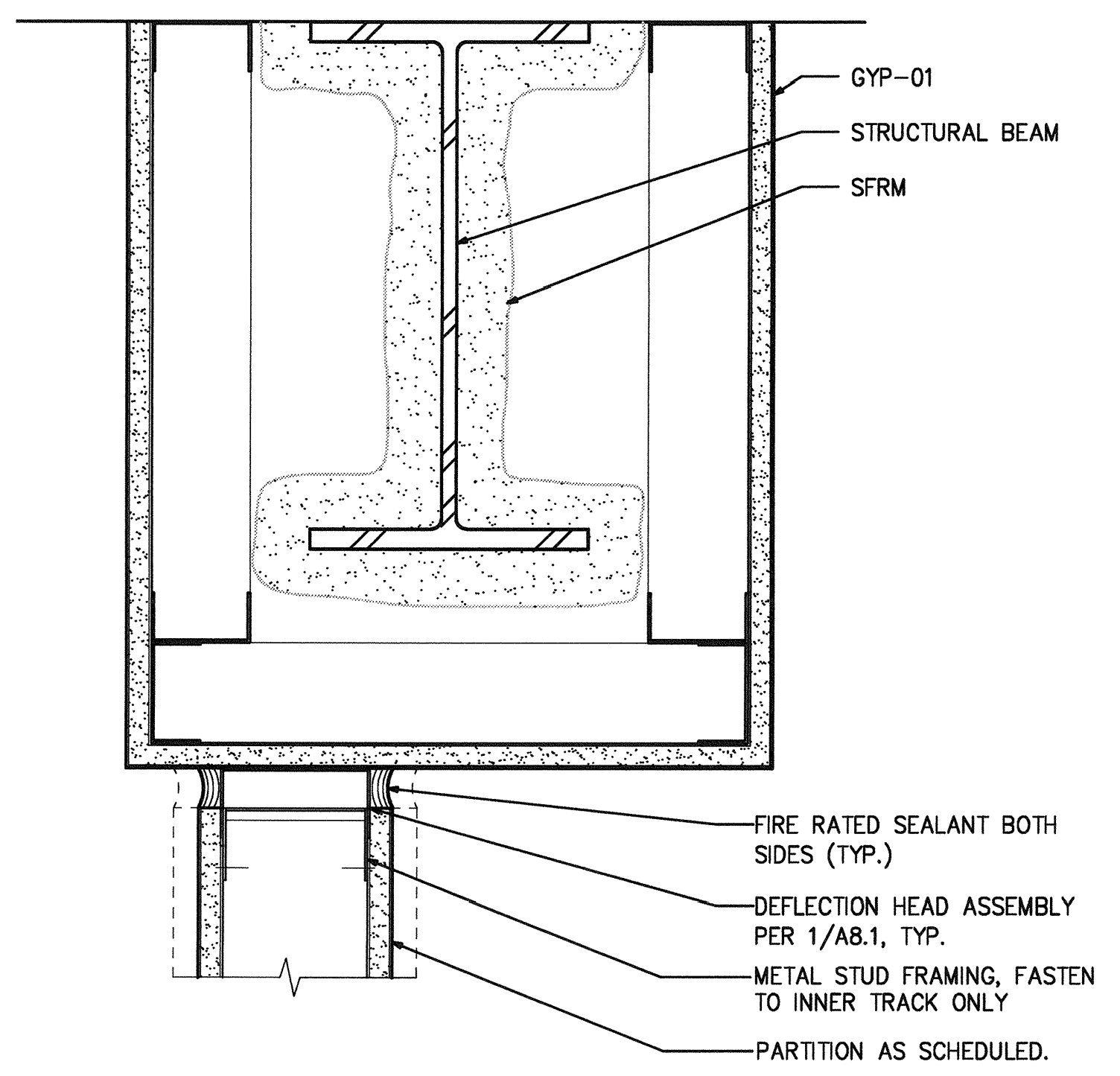
15 / A8.01 DUCT SHAFT ENCLOSURE

SCALE: 3" = 1'-0"



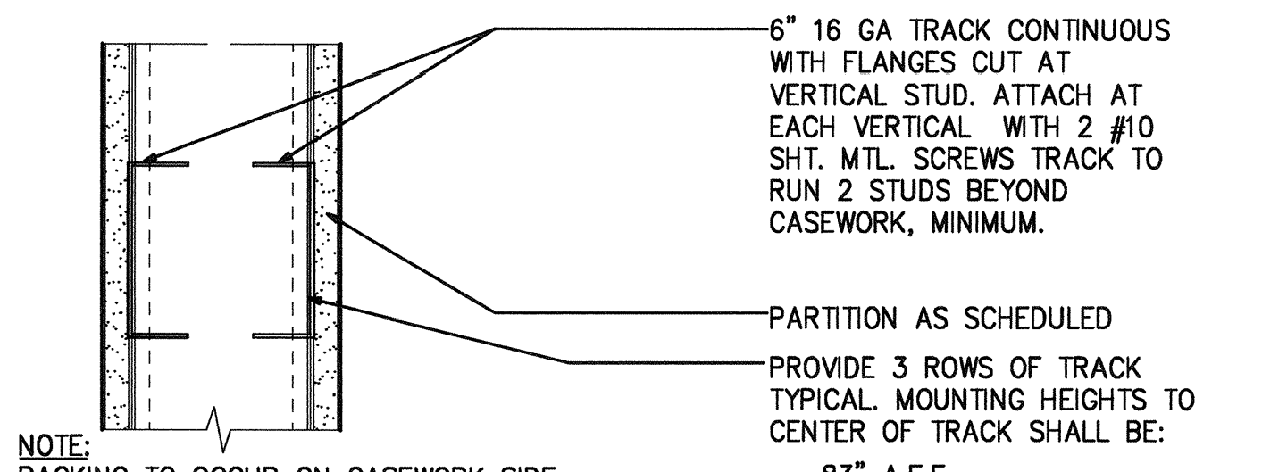
6 / A8.01 1 HOUR HORIZONTAL PARTITION/CEILING

SCALE: NTS



7 / A8.01 PARTITION AT BEAM

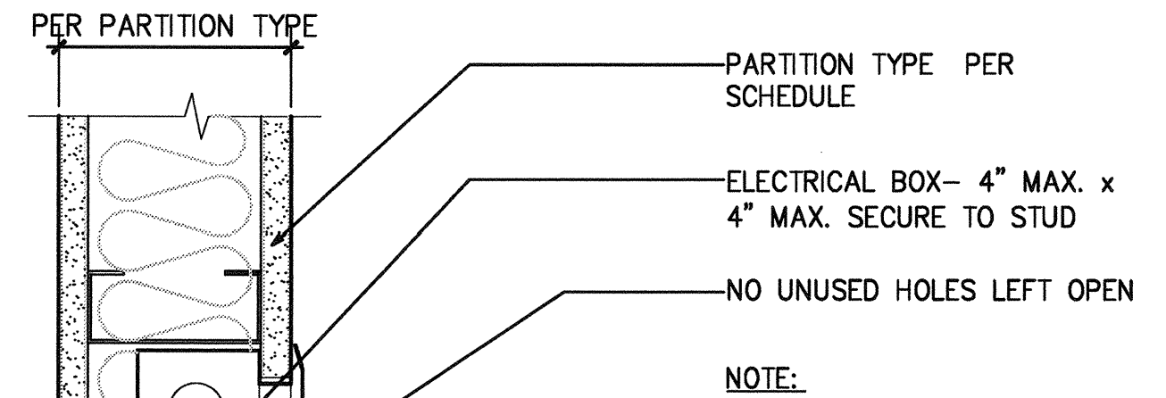
SCALE: NTS



NOTE:
BACKING TO OCCUR ON CASEWORK SIDE, TYP. SEE PLANS FOR CASEWORK LOCATIONS. (DWG. INDICATES CASEWORK ON BOTH SIDES)

8 / A8.01 CASEWORK BACKING AT PARTITION

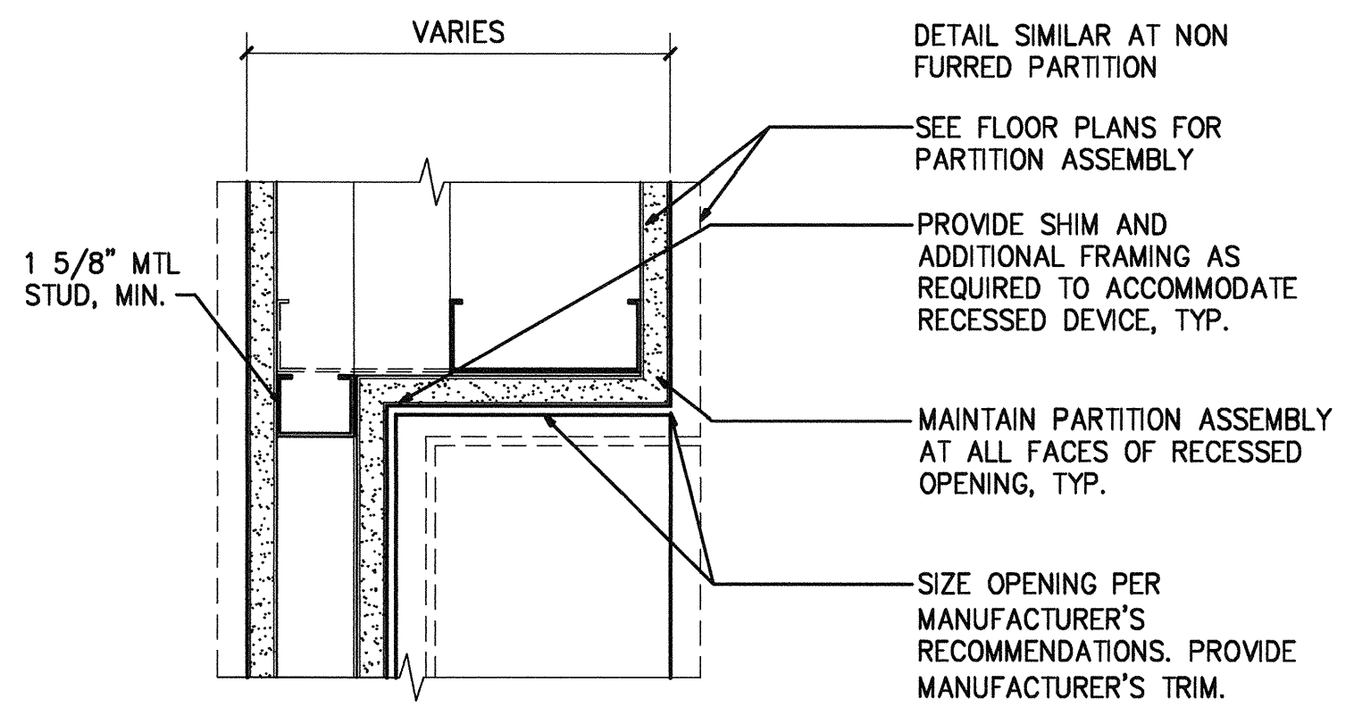
SCALE: NTS



NOTE:
OPENINGS FOR STEEL ELECTRICAL OUTLET BOXES NOT EXCEEDING 16 SQ. IN. ARE PERMITTED PROVIDED OPENINGS DO NOT AGGREGATE MORE THAN 100 SQ. IN. FOR ANY 100 SQ. FT. OF WALL AREA. OUTLET BOXES ON OPPOSITE SIDES OF WALLS OR PARTITIONS MUST BE SEPARATED BY A HORIZ. DISTANCE OF 24"

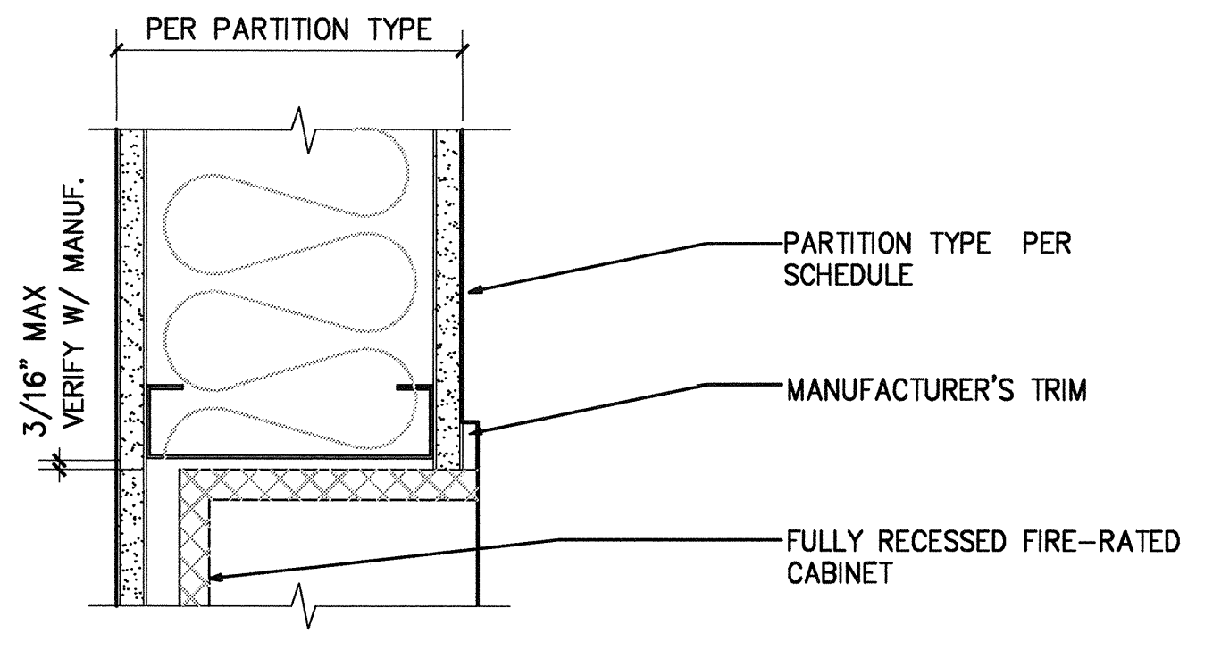
9 / A8.01 ELECTRICAL BOX @ RATED PARTITION

SCALE: NTS



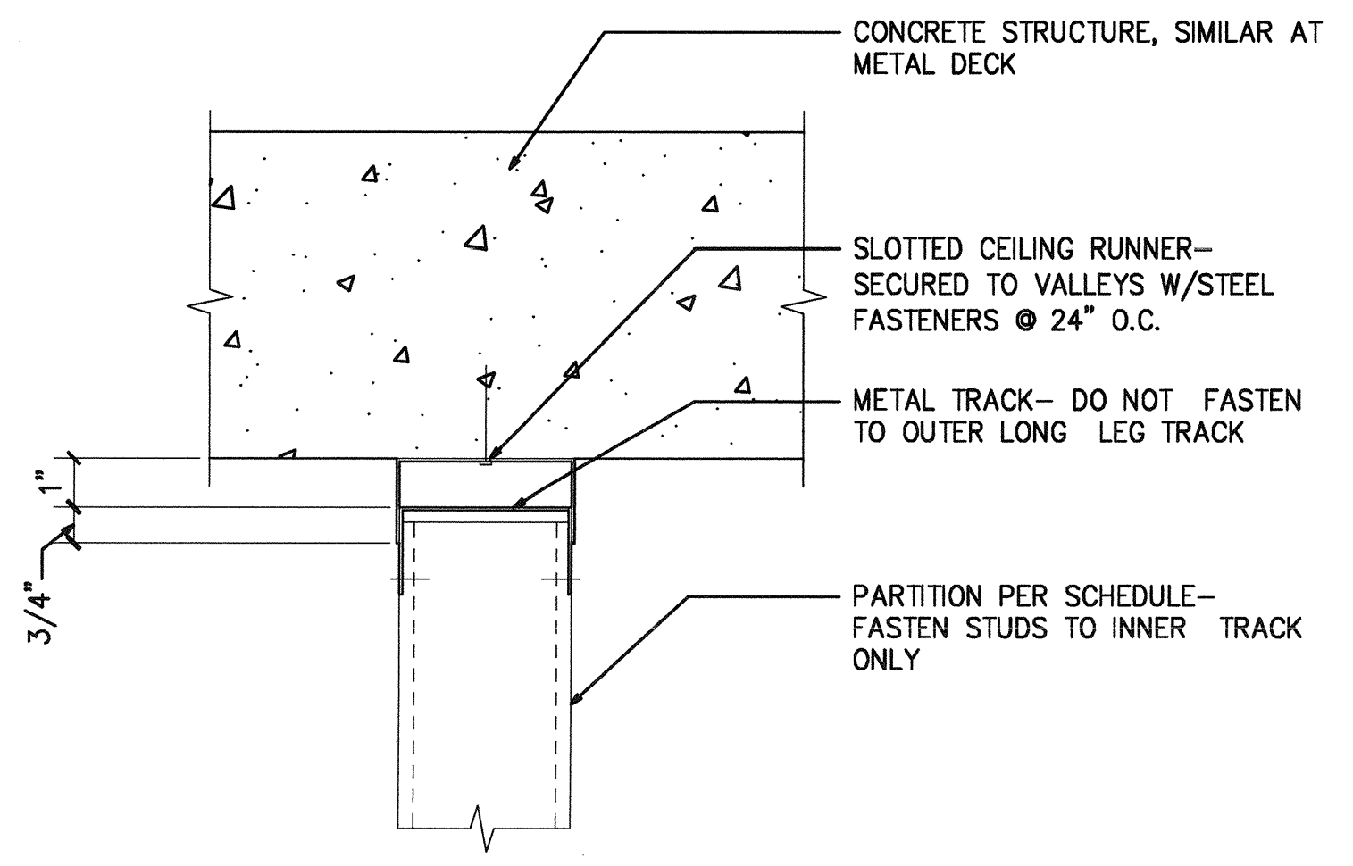
10 / A8.01 RECESSED DEVICE @ RATED PARTITION

SCALE: NTS



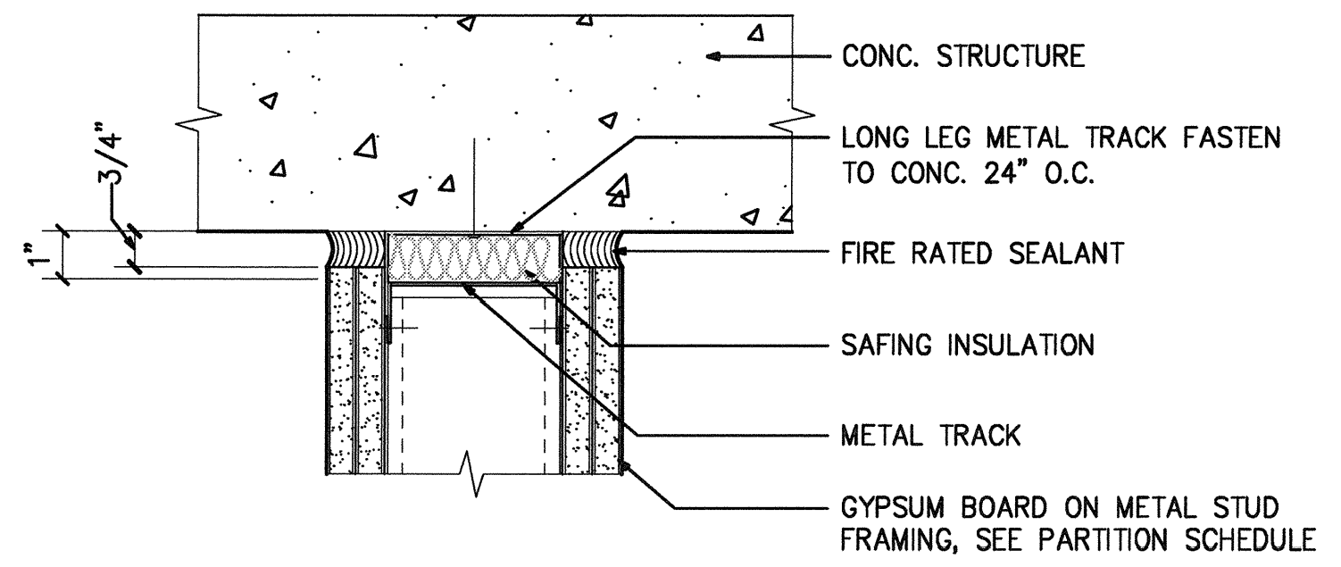
11 / A8.01 RATED CABINET @ RATED PARTITION

SCALE: NTS



1 / A8.01 DEFLECTION HEAD AT METAL STUDS

SCALE: NTS

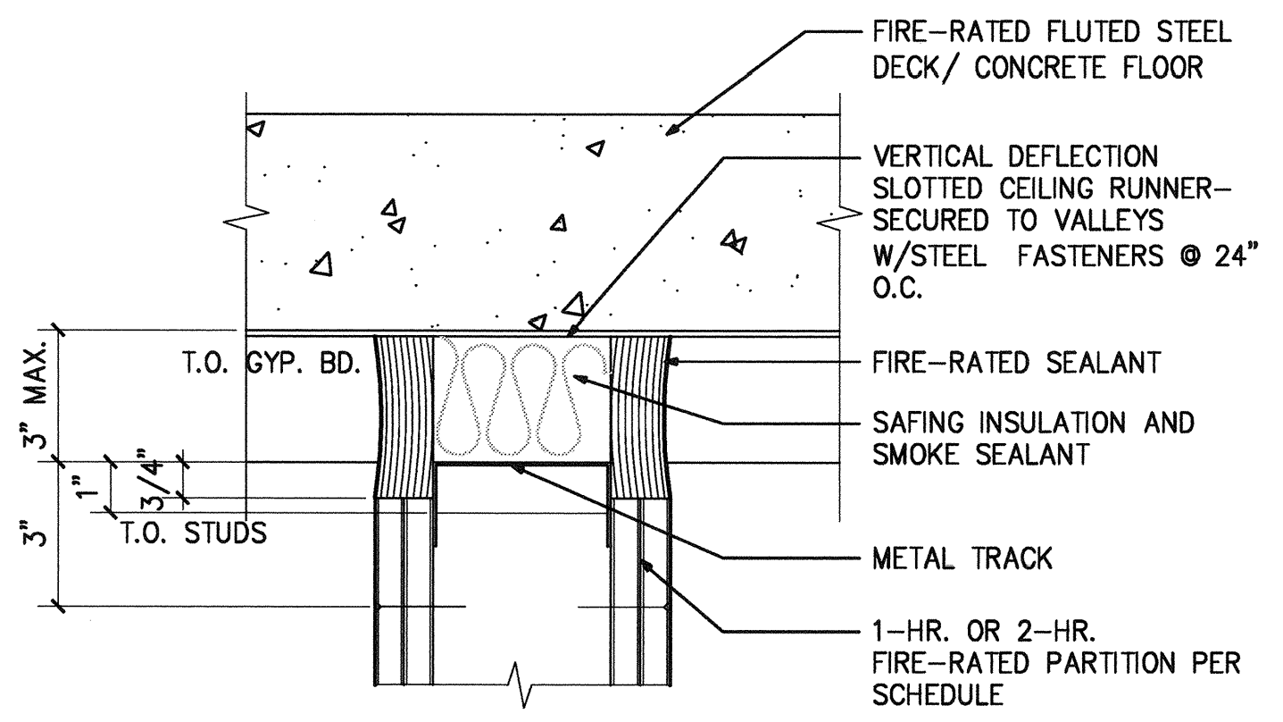


NOTE:
FOR 1 HR. FIRE RATED PARTITION USE U.L. SYSTEM NO. HWS0009.
FOR 2 HR. FIRE RATED PARTITION USE U.L. SYSTEM NO. HWS0010

SEE 1/A8.1 FOR ADDITIONAL NOTES

2 / A8.01 DEFLECTION HEAD WITH FIRE STOP

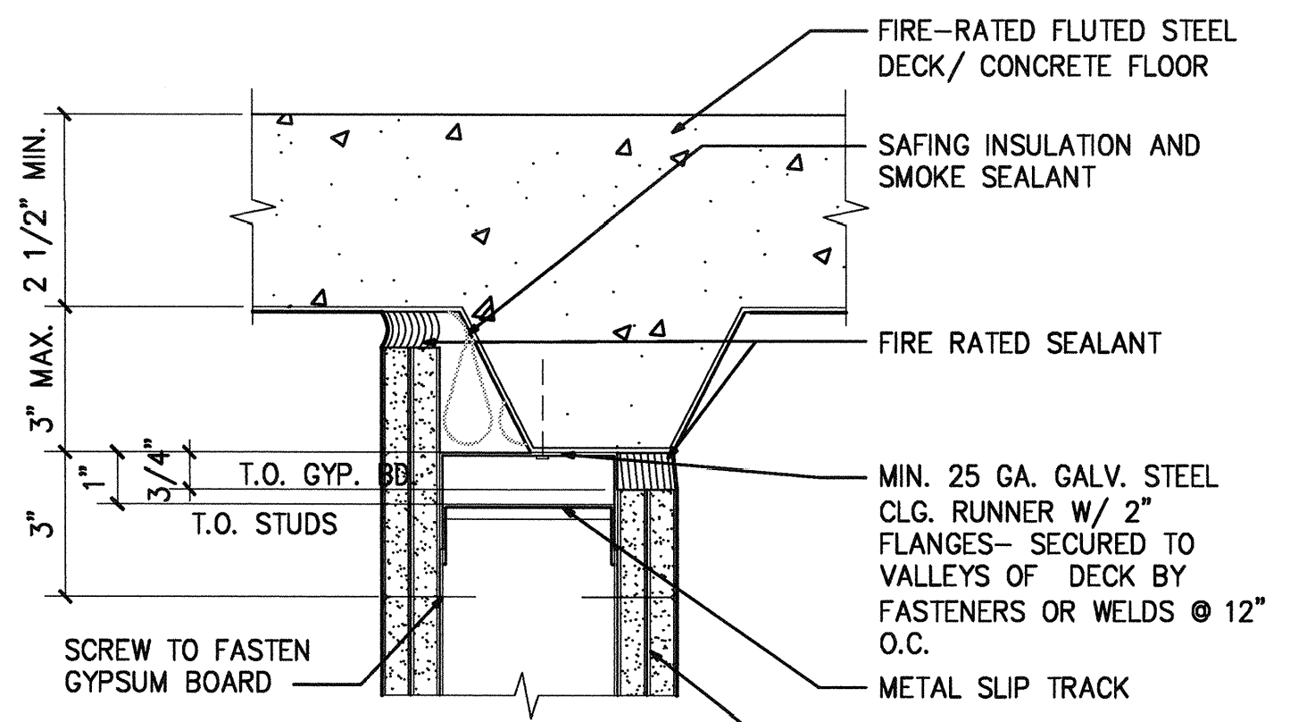
SCALE: NTS CONCRETE STRUCTURE



U.L. SYSTEM NO. HW-D-0045
ASSEMBLY RATING-1 AND 2 HOUR CLASS II MOVEMENT CAPABILITIES 33% COMPRESSION OR EXTENSION

3 / A8.01 DEFLECTION HEAD WITH FIRE STOP

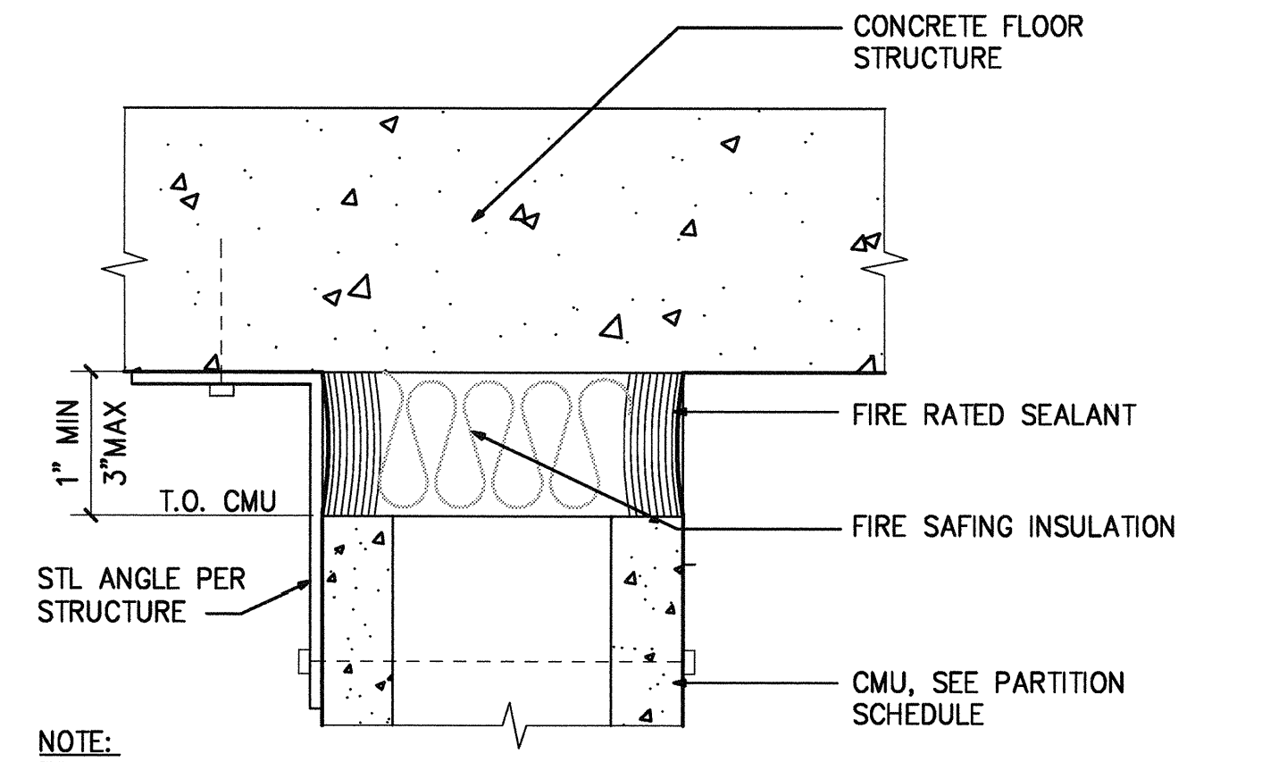
SCALE: NTS PERPENDICULAR TO FLUTE DECK



U.L. SYSTEM NO. HW-D-0045
ASSEMBLY RATING-1 AND 2 HOUR CLASS II MOVEMENT CAPABILITIES 33% COMPRESSION OR EXTENSION

4 / A8.01 DEFLECTION HEAD WITH FIRE STOP

SCALE: NTS PARALLEL TO FLUTE DECK

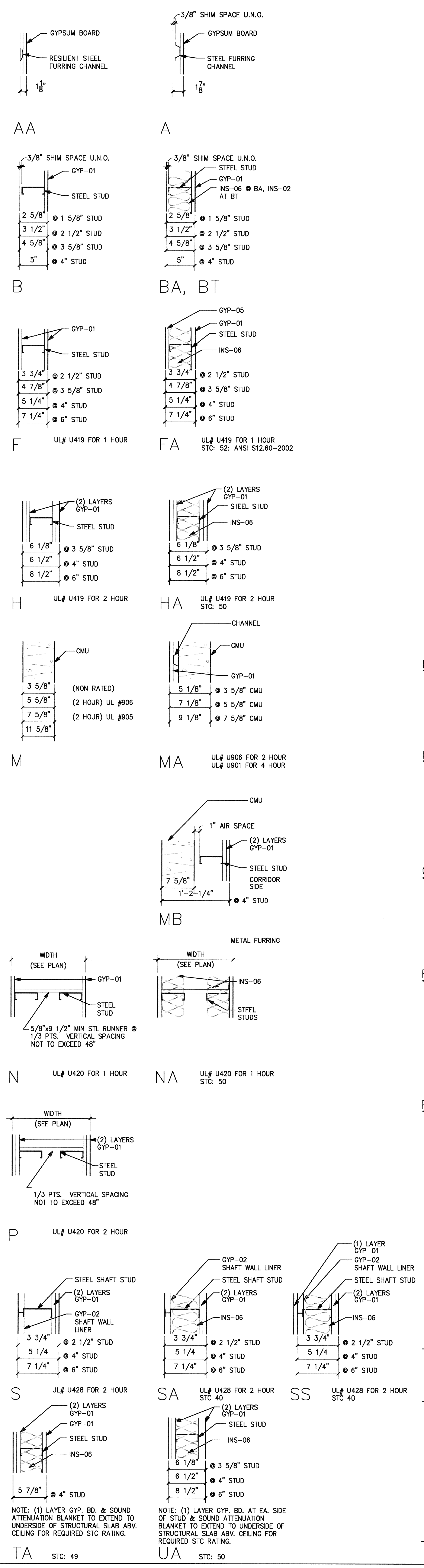


NOTE:
FOR 1 HR. AND 2 HR. FIRE RATED PARTITION USE U.L. SYSTEM NO. HWD1003.

5 / A8.01 CMU DEFLECTION HEAD WITH FIRE STOP

SCALE: NTS CONCRETE STRUCTURE

PARTITION TYPES



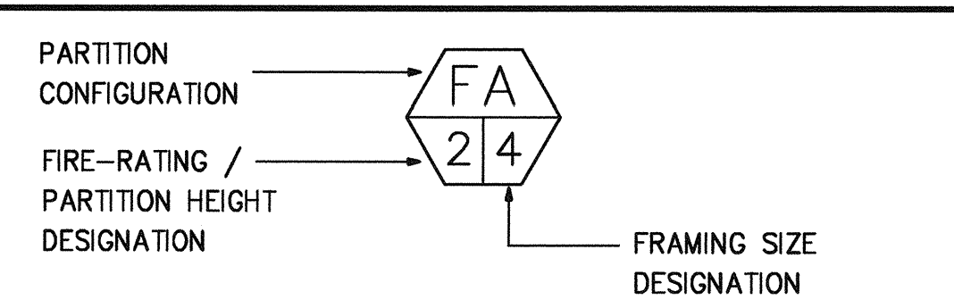
NOTE: (1) LAYER GYP. BD. & SOUND ATTENUATION BLANKET TO EXTEND TO UNDERSIDE OF STRUCTURAL SLAB ABV. CEILING FOR REQUIRED STC RATING.

NOTE: (1) LAYER GYP. BD. AT EA. SIDE OF STUD & SOUND ATTENUATION BLANKET TO EXTEND TO UNDERSIDE OF STRUCTURAL SLAB ABV. CEILING FOR REQUIRED STC RATING.

GENERAL NOTES:

1. 5/8" GYPSUM BOARD ON METAL STUDS @ 16" O.C. TYPICAL UNLESS OTHERWISE NOTED.
2. 5/8" CEMENT BOARD TYPICAL AT INTERIOR TILE FINISH. SEE INTERIOR ELEVATIONS FOR TILE LOCATION.
3. ABUSE RESISTANT PANELS USED AT SPECIFIC LOCATIONS. SEE FINISH SCHEDULE.
4. HIGH IMPACT PANELS USED AS SUBSTRATE FOR RESINOUS COATINGS. SEE FINISH SCHEDULE.
5. SOUND ATTENUATION BLANKET TO BE 3 1/2" UNLESS OTHERWISE NOTED.
6. PROVIDE ACOUSTIC SEAL AT PERIMETER AND PENETRATIONS OF SOUND RATED PARTITIONS AND OTHER CONSTRUCTION AS REQUIRED TO ACHIEVE STC INDICATED.
7. PROVIDE LABELED GYPSUM WALL BOARD AT FIRE RATED PARTITIONS.
8. FIRE RATED AND SMOKE ASSEMBLY PARTITIONS TO EXTEND TO STRUCTURE UNLESS OTHERWISE NOTED.
9. MAINTAIN FIRE RATING OF WALLS AROUND FIRE EXTINGUISHER CABINETS AND OTHER RECESSED ITEMS FOR TYPICAL CONDITIONS SEE. 10/A8.01
10. FRAME AROUND BEAMS AND OTHER STRUCTURAL ELEMENTS WHEN THEY OCCUR WITH THE SPACE OF A FIRE RATED OR ACOUSTICAL PARTITION. FOR TYPICAL CONDITIONS SEE 7/A8.01
11. AT LOCATIONS REQUIRING A FIRE RATED HORIZONTAL PARTITION, PROVIDE PER DETAILS 6/A8.01 12/A8.01
12. AT HORIZONTAL RATED DUCT ENCLOSURES, PROVIDE PER DETAILS 13/A8.01 14/A8.01 15/A8.01
13. WHEN METAL FRAMING CONTINUES PAST INTERMEDIATE STRUCTURE -AS IN MULTI-STORY STAIR ENCLOSURES AND SIMILAR CONDITIONS. ATTACHMENT TO INTERMEDIATE STRUCTURE SHALL BE WITH A SLOTTED CONNECTION OR OTHER MEANS SO THAT STRUCTURAL DEFLECTION WILL NOT TRANSFER LOADS TO METAL FRAMING.
14. FOR TYPICAL DEFLECTION HEAD DETAILS SEE 1/A8.01 2/A8.01 3/A8.01 4/A8.01 5/A8.01
15. SEE SHEET A8.02 FOR TYPICAL PARTITION DETAIL.
16. SEE PLANS FOR LOCATIONS OF RATED PARTITIONS (MINIMUM 1 HOUR RATING)
17. PLAN DIMENSIONS ARE TO FACE OF PARTITION ASSEMBLY, CENTERLINE OF COLUMN, OR FACE OF CONCRETE MASONRY UNLESS OTHERWISE NOTED.
18. L/360 REQUIRED AT ALL INTERIOR WALLS WHERE ADDITIONAL FINISH MATERIAL IS APPLIED TO GYP. BOARD. AT ALL OTHER LOCATIONS USE L/240
18. FOR TYPICAL PENETRATION DETAILS AT RATED ASSEMBLIES SEE 1/A8.03 2/A8.03 3/A8.03 4/A8.03

PARTITION TYPE PLAN SYMBOL



FRAMING SIZE DESIGNATION

0 = FURRING
1 = 1 5/8"
2 = 2 1/2"
3 = 3 5/8"
4 = 4"
6 = 6"
8 = 8"
P = PER PLAN

CONCRETE MASONRY SIZE DESIGNATION

4 = 3 5/8" C.M.U.
6 = 5 5/8" C.M.U.
8 = 7 5/8" C.M.U.
12= 11 5/8" C.M.U.

SEE 5/A8.01 FOR TOP OF WALL TERMINATION.

RATING ASSEMBLY

2 HOUR SOLID CONCRETE WALL – PER CBC 2007 EDITION TABLE NO. 721.2.1.1.

2 HOUR SOLID FLOOR OR ROOF SLAB – PER CBC 2007 EDITION TABLE NO. 721.2.2.1.

METAL DECK AND CONCRETE TOPPING ROOF/FLOOR CONSTRUCTION – ICBO ER-2614

SPRAY-APPLIED STEEL PIPE OR TUBE COLUMN FIREPROOFING – UL DESIGN NO. X771

SPRAY-APPLIED FIREPROOFING ON W-SHAPED STEEL COLUMN – UL DESIGN NO. X772

SPRAY-APPLIED FIREPROOFING ON W-SHAPED STEEL BEAM UL DESIGN NO. 917

FIRE RATING / PARTITION HEIGHT DESIGNATION

P = PARTIAL HEIGHT PARTITION (SEE PLAN & ELEVATIONS FOR PARTITION HT.)

D = NON-RATED- EXTEND STUDS ABOVE CEILING TO SUPPORT CEILING JOIST

C = NON-RATED- EXTEND STUDS TO UNDERSIDE OF STRUCTURE ABOVE. EXTEND ONE SIDE OF GYPSUM BD. TO UNDERSIDE OF STRUCTURE ABOVE AND EXTEND ONE SIDE OF GYPSUM BD. TO 4" ABOVE CEILING

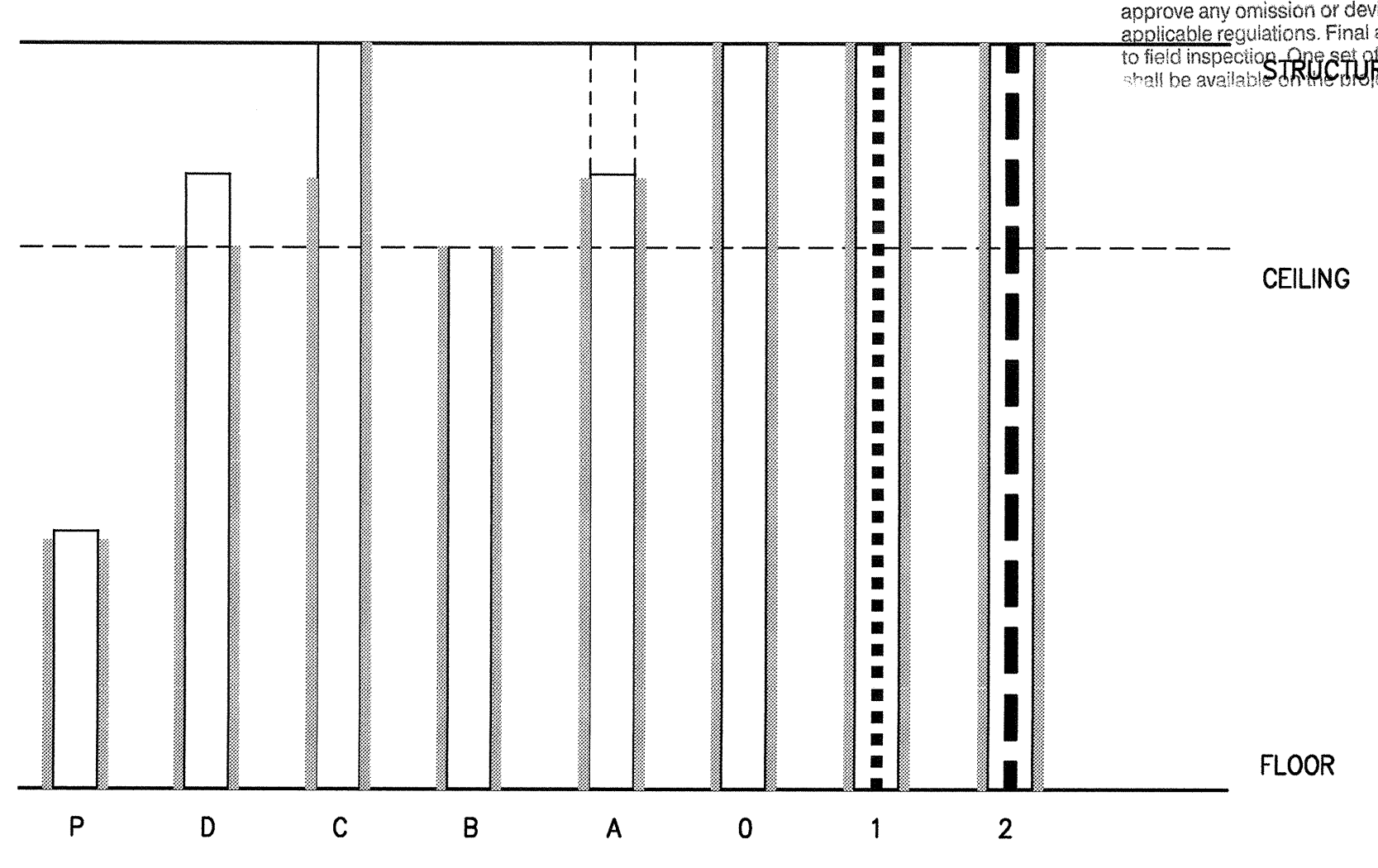
B = NON-RATED TO UNDERSIDE OF CEILING

A = NON-RATED- EXTEND STUDS AND GYP BD. TO 4" ABOVE CEILING AND BRACE AS REQUIRED TO STRUCTURE

0 = NON-RATED – TO UNDERSIDE OF STRUCTURE ABOVE.

1 = (1) HOUR FIRE-RATED.

2 = (2) HOUR FIRE-RATED.



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Reviewed by:
Fire & Life Safety South
NOV 10 2009
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ZGF

Architecture / Planning / Interior Design
Portland Seattle Los Angeles Washington DC New York

515 South Flower Street, Suite 3700
Los Angeles, California 90071

(PH) 213 617 1901
(FAX) 213 617 0047

Consultants

STRUCTURAL ENGINEER
John A. Martin & Associates, Inc
1212 S. Flower Street
Los Angeles, CA 90015

MECHANICAL ENGINEER
Rumsey Engineers
99 Linden Street
Oakland, CA 94607

ELECTRICAL ENGINEER
Integrated Design Associates, Inc
3140 De La Cruz Boulevard, Suite 110
Santa Clara, CA 95054

CIVIL ENGINEER
Cannon Associates
1050 Southwood Drive
San Luis Obispo, CA 93401

LANDSCAPE ARCHITECT
Katherine Spitz and Associates
4212 1/2 Glencoe Avenue
Marina del Rey, CA 90292

LABORATORY
Research Facilities Design
3965 Fifth Avenue, Suite 300
San Diego, CA 92103-3107

LIGHTING DESIGN
David Nelson & Associates, LLC
P.O. Box 270254
Littleton, CO 80127

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APPL 01-110181
AC ___ FLS ___ SS ___
DATE SEP 0 3 2009

Revisions

BID DOCUMENTS	10/23/09

CENTER FOR SCIENCE

SAN LUIS OBISPO, CA

Drawing Title

PARTITION SCHEDULE NOTES, & DETAILS

TED ALAN HYMAN

Date: OCTOBER 23, 2009
Job No: L40302.05
Drawn By:
Checked By:

Drawing No.

A8.01

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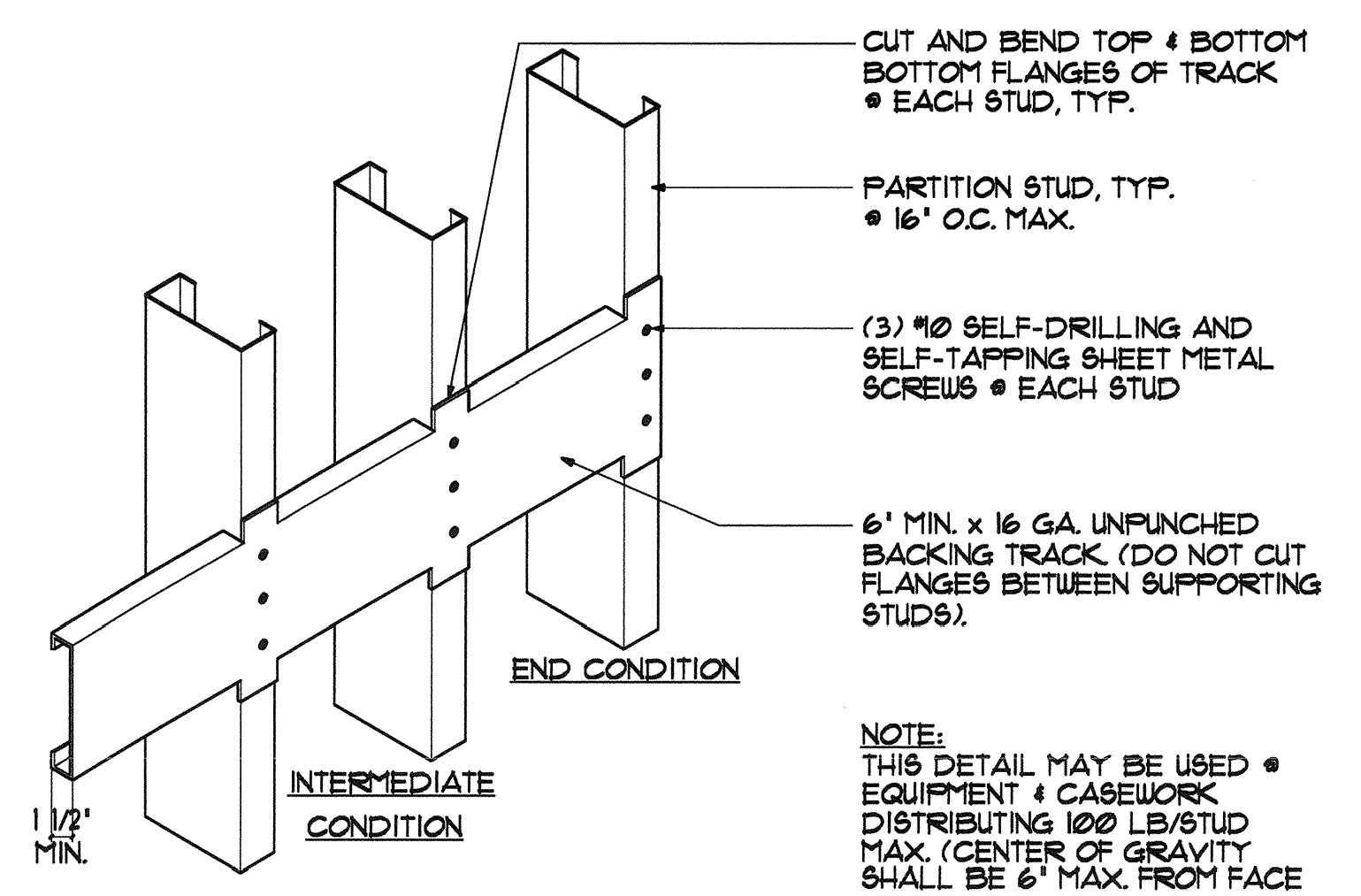
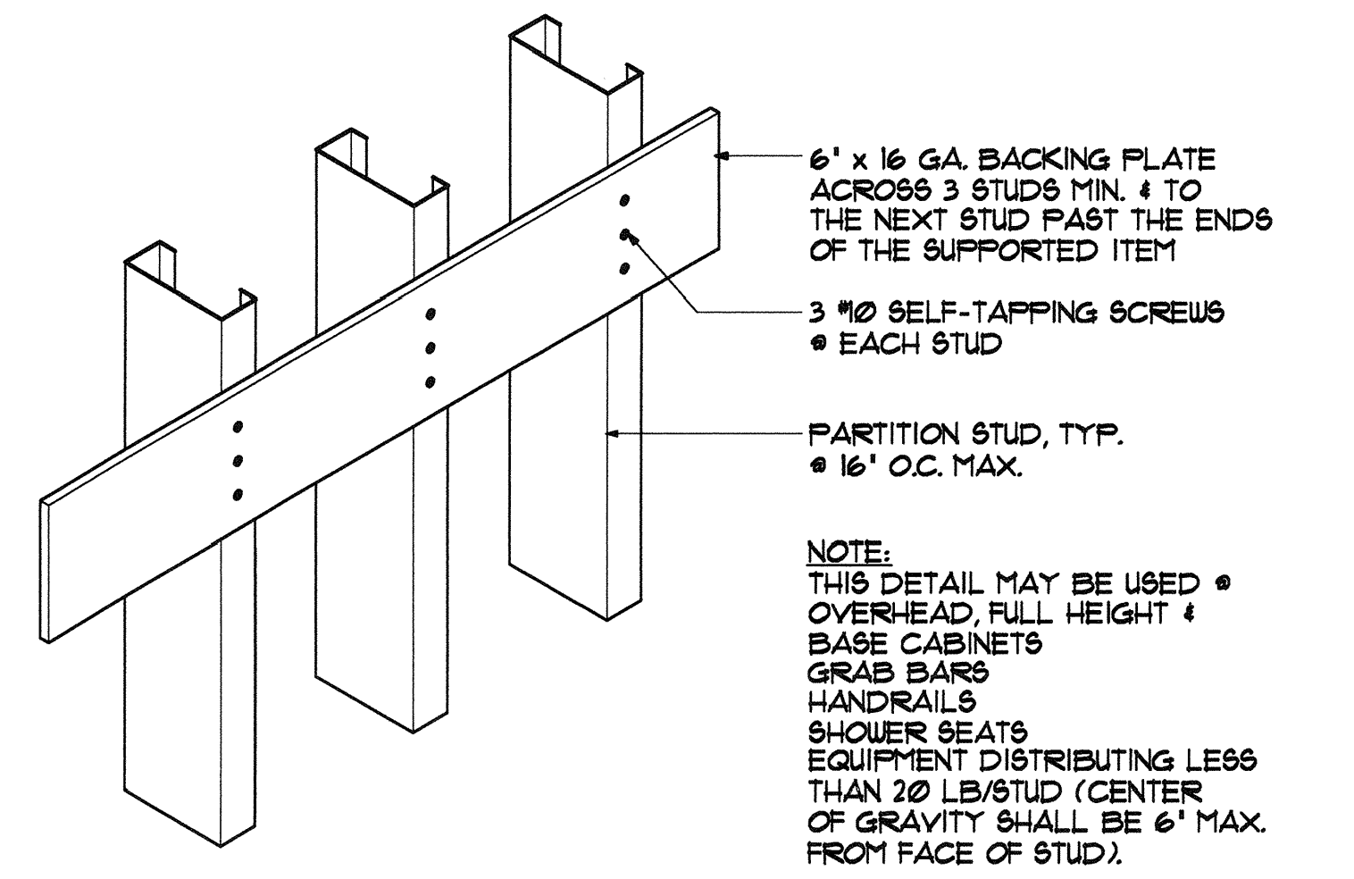


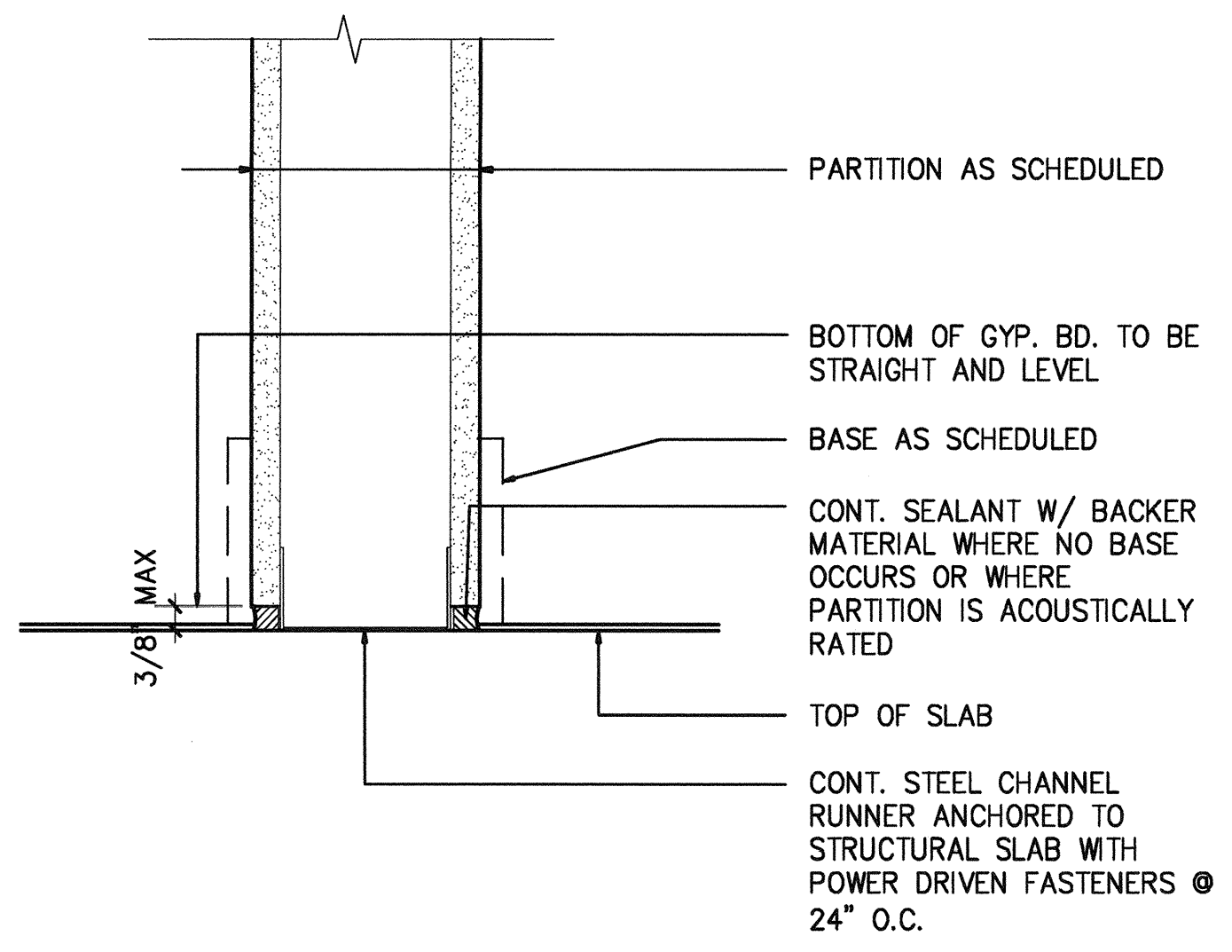
NOTE:
THIS DETAIL MAY BE USED @ EQUIPMENT & CASEWORK DISTRIBUTING 100 LB/STUD MAX. (CENTER OF GRAVITY SHALL BE 6' MAX. FROM FACE OF STUD).

18 / A8.02 **BACKING TRACK (HEAVY DUTY)**
SCALE: N.T.S.

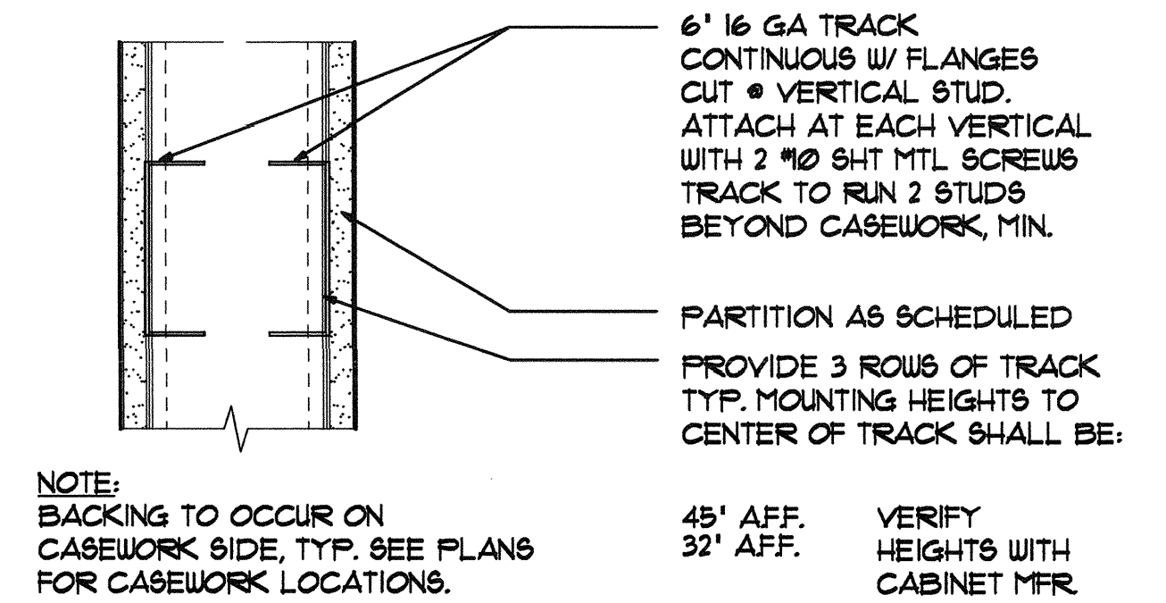


NOTE:
THIS DETAIL MAY BE USED @
OVERHEAD, FULL HEIGHT &
BASE CABINETS
GRAB BARS
HANDRAILS
SHOWER SEATS
EQUIPMENT DISTRIBUTING LESS THAN 20 LB/STUD (CENTER OF GRAVITY SHALL BE 6' MAX. FROM FACE OF STUD).

19 / A8.02 **BACKING PLATE (MEDIUM DUTY)**
SCALE: N.T.S.

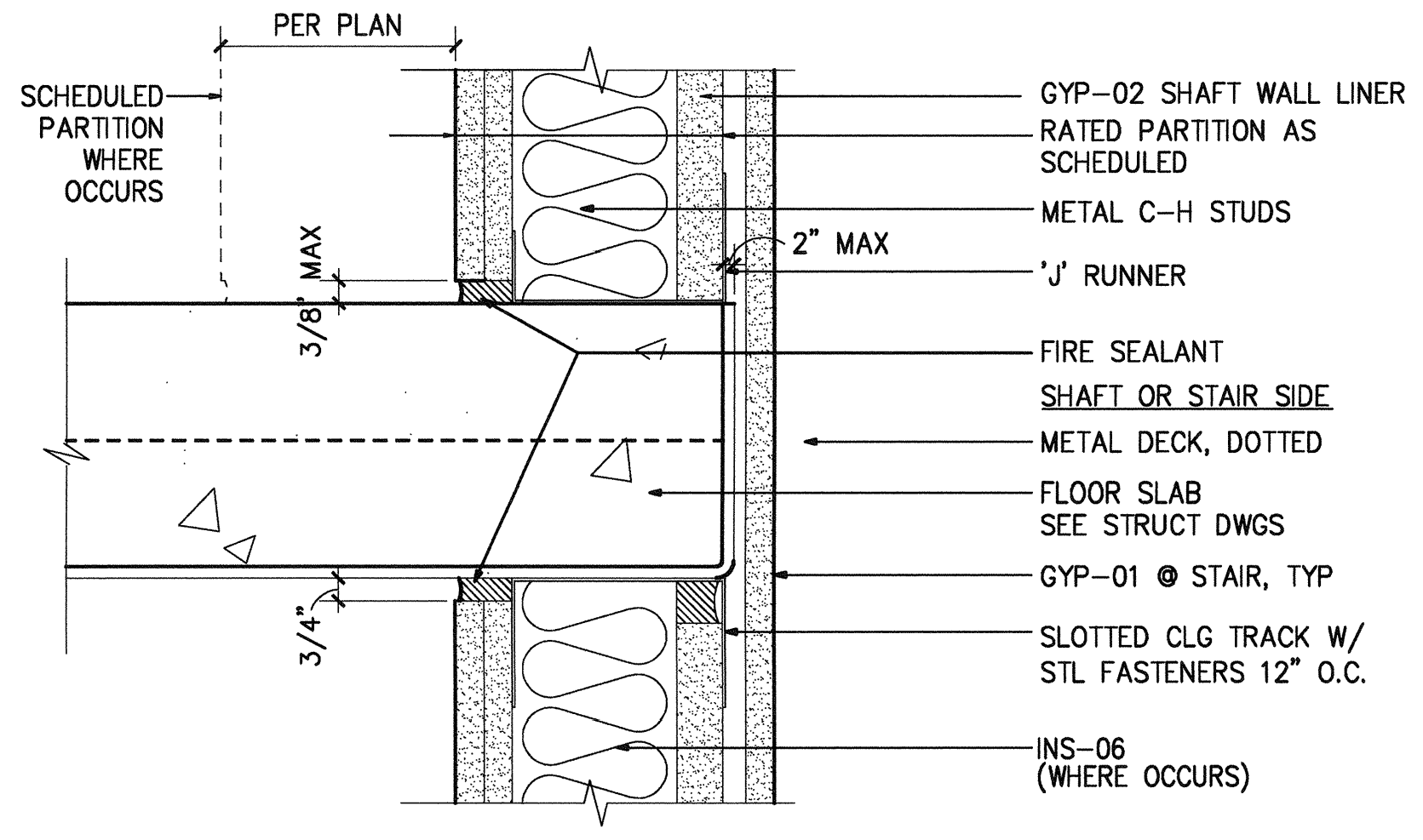


20 / 8.02 **PARTITION @ FLOOR SLAB**
SCALE: 3" = 1'-0"



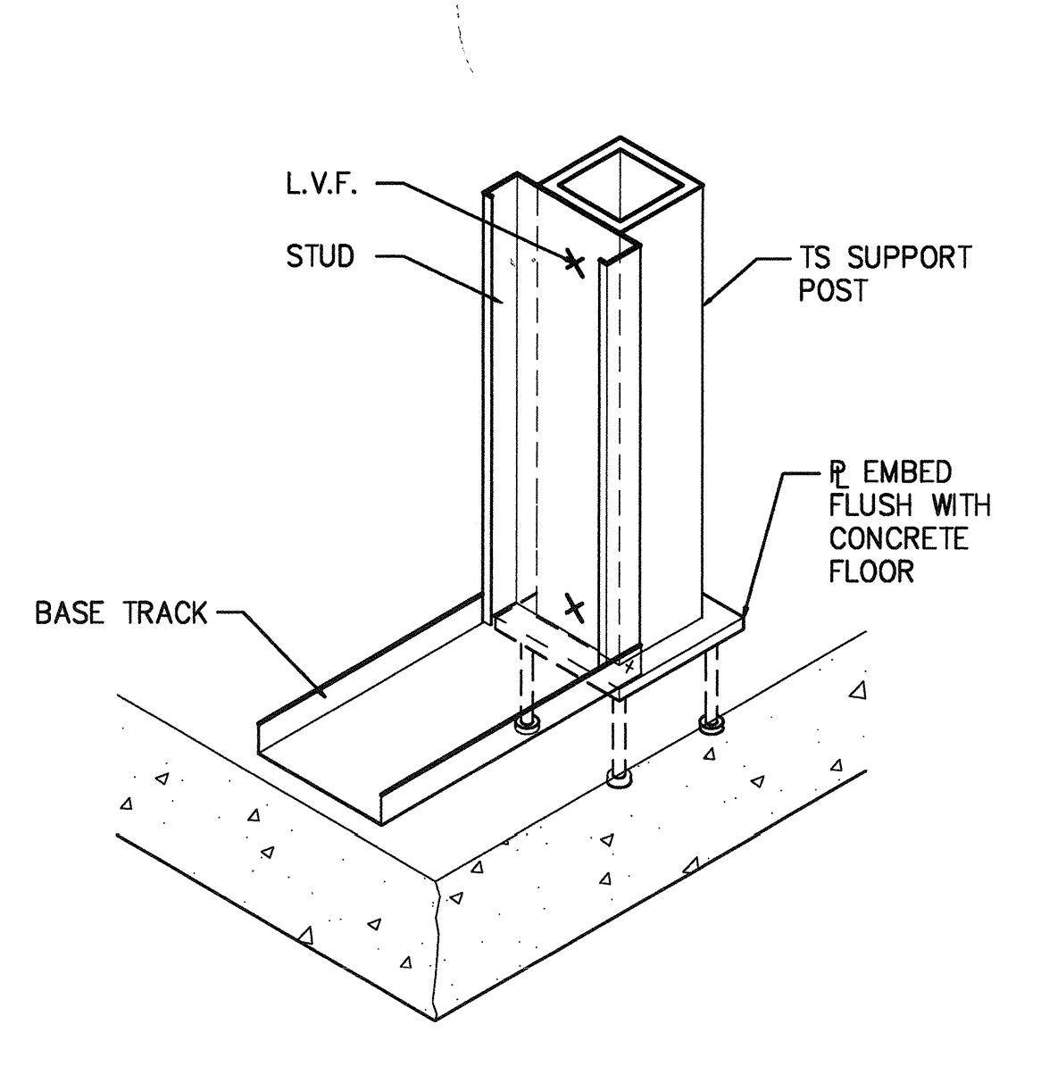
NOTE:
BACKING TO OCCUR ON CASEWORK SIDE, TYP. SEE PLANS FOR CASEWORK LOCATIONS. (DWG INDICATES CASEWORK ON BOTH SIDES)

21 / A8.02 **CASEWORK BACKING @ PARTITION**
SCALE: 3"=1'-0"

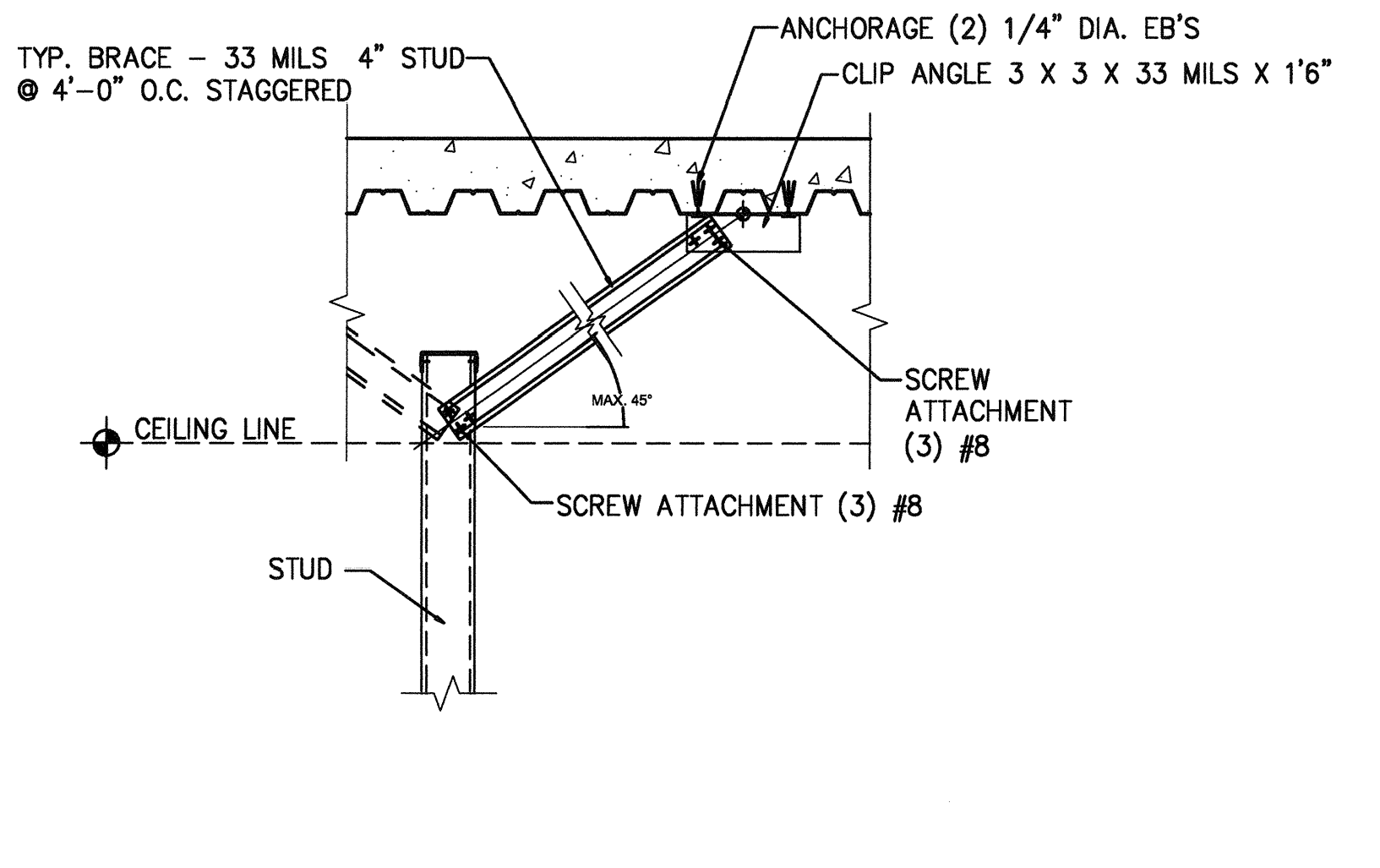


NOTE: COMPLY WITH 2HR RATED ASSEMBLY UL DESIGN NO. HW-D-0194

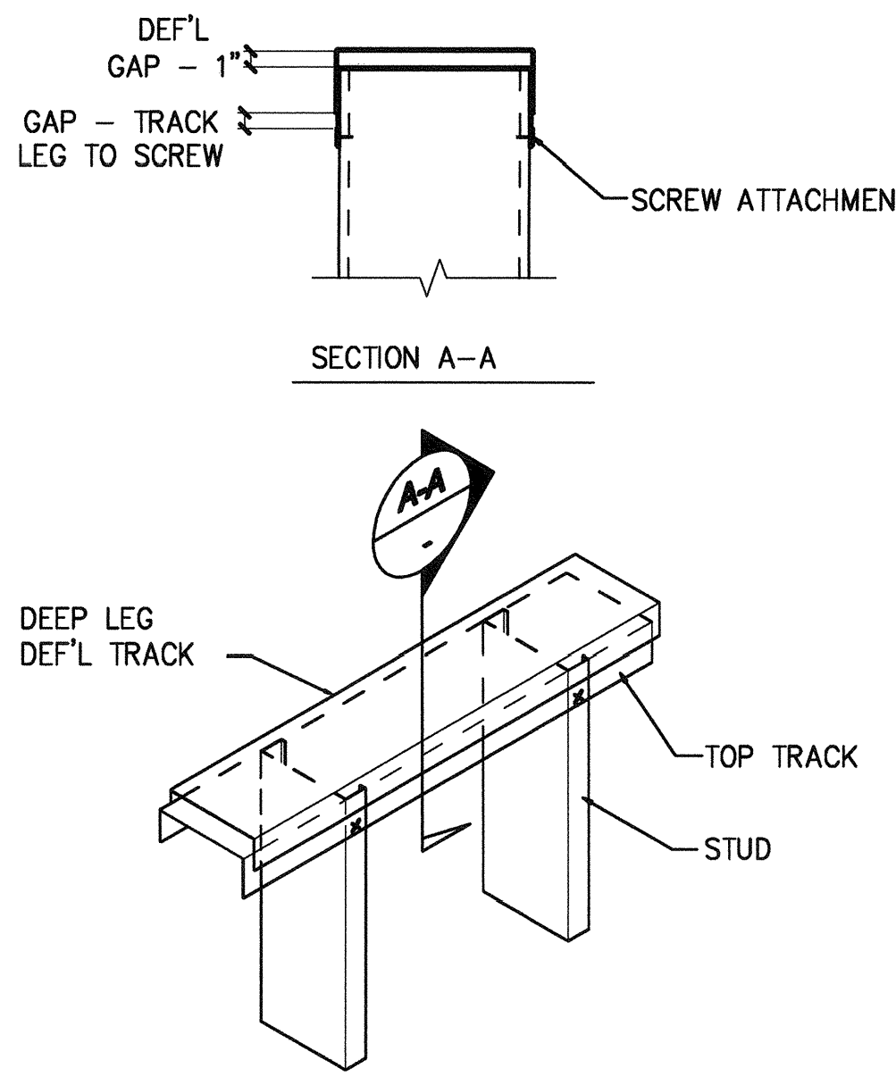
22 / 8.02 **SLAB EDGE @ SHAFT WALL**
SCALE: 3" = 1'-0"



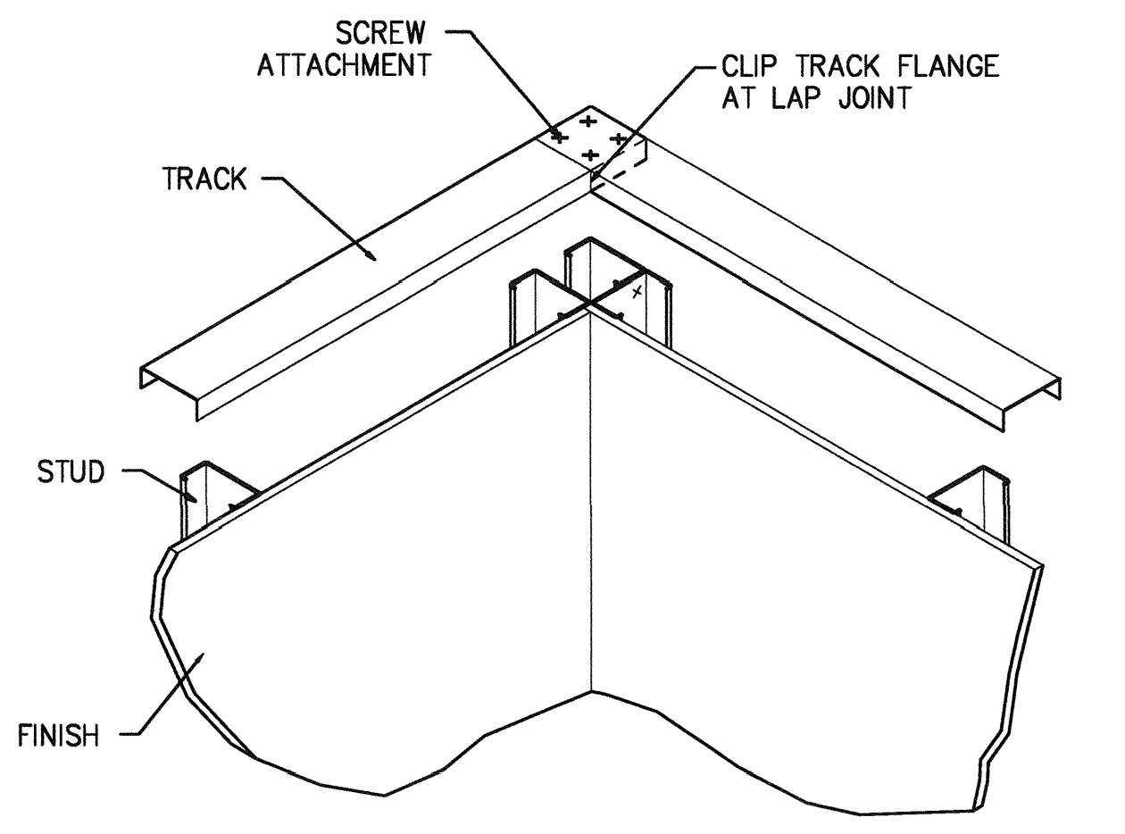
13 / A8.02 **TYP PARTIAL HEIGHT WALL**
SCALE: NO SCALE



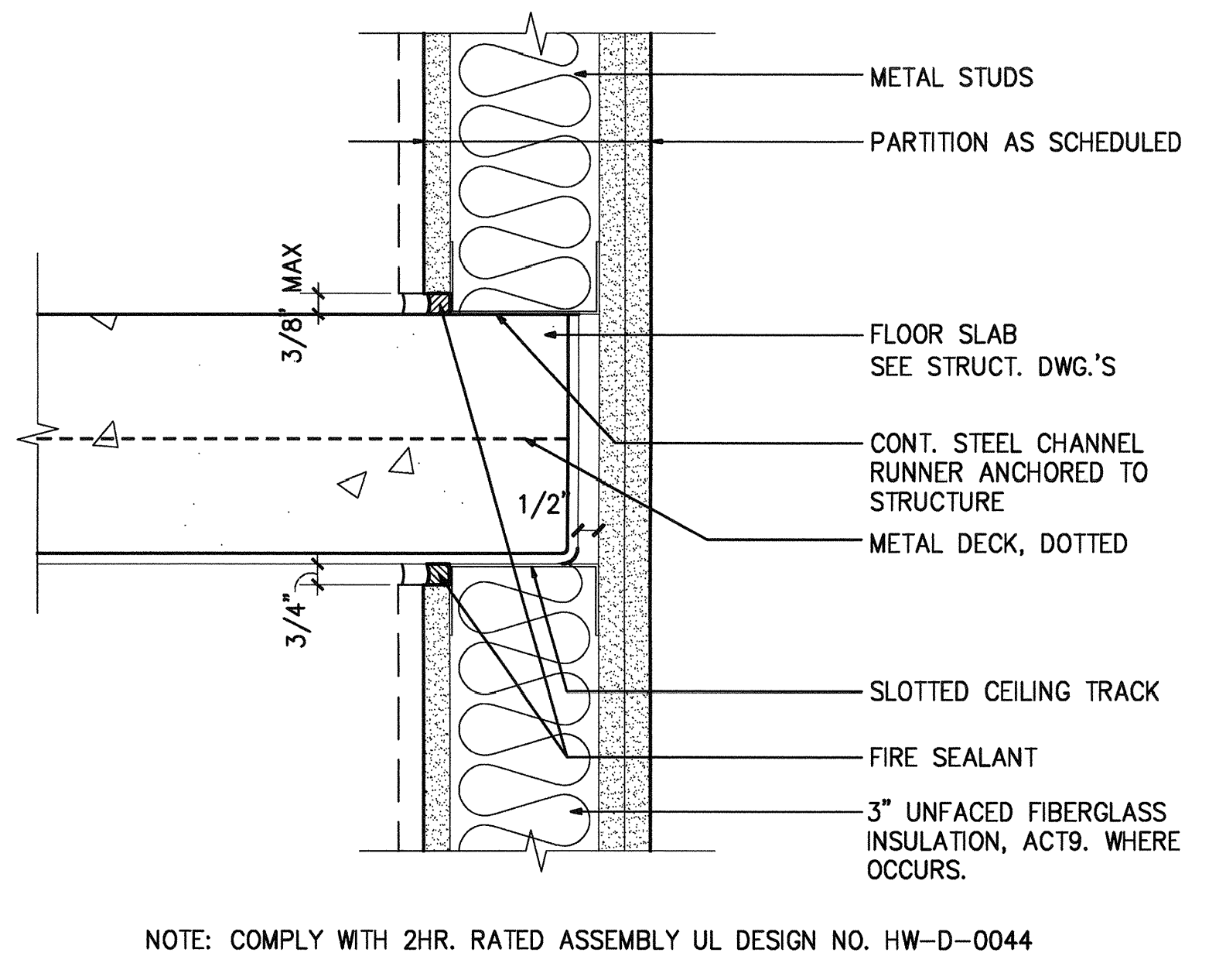
14 / A8.02 **TYP DIAGONAL KICKER**
SCALE: NO SCALE



15 / A8.02 **TYP DEFLECTION HEAD**
SCALE: NO SCALE

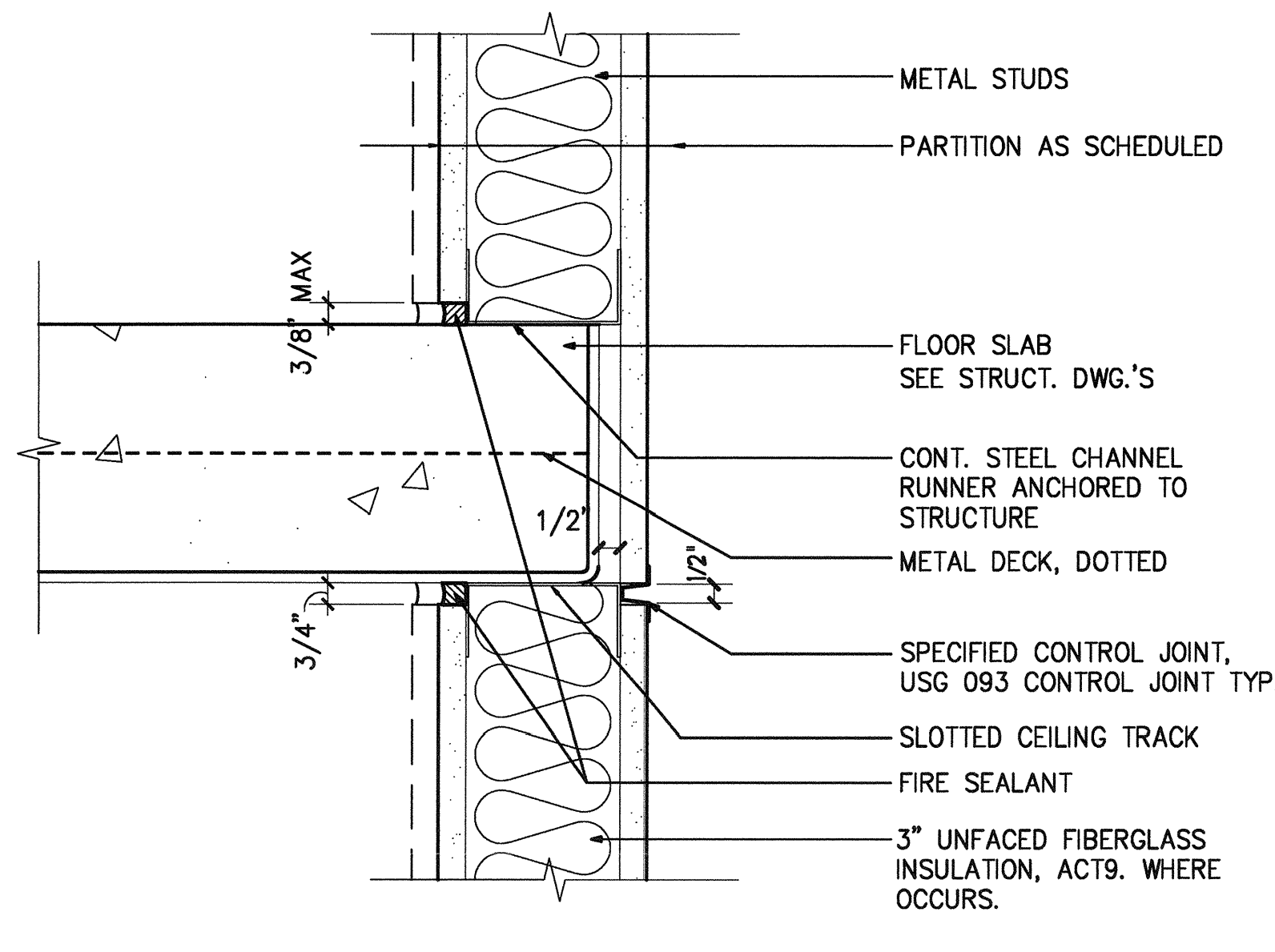


16 / A8.02 **TYP CORNER @ GYP BD PARTITION**
SCALE: NO SCALE

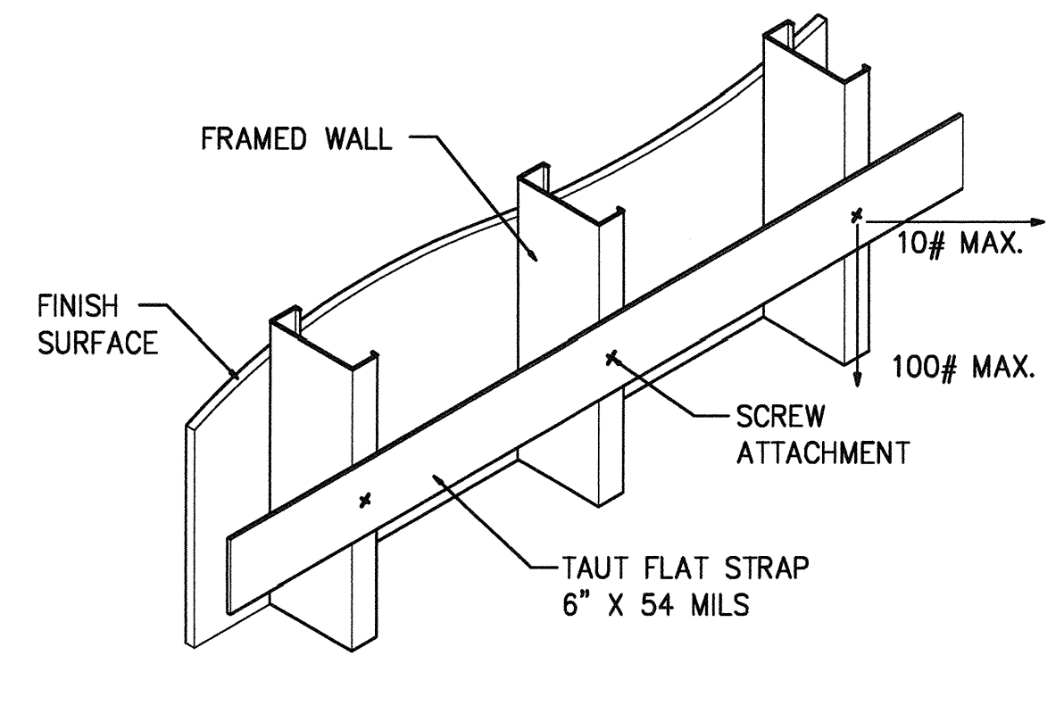


NOTE: COMPLY WITH 2HR. RATED ASSEMBLY UL DESIGN NO. HW-D-0044

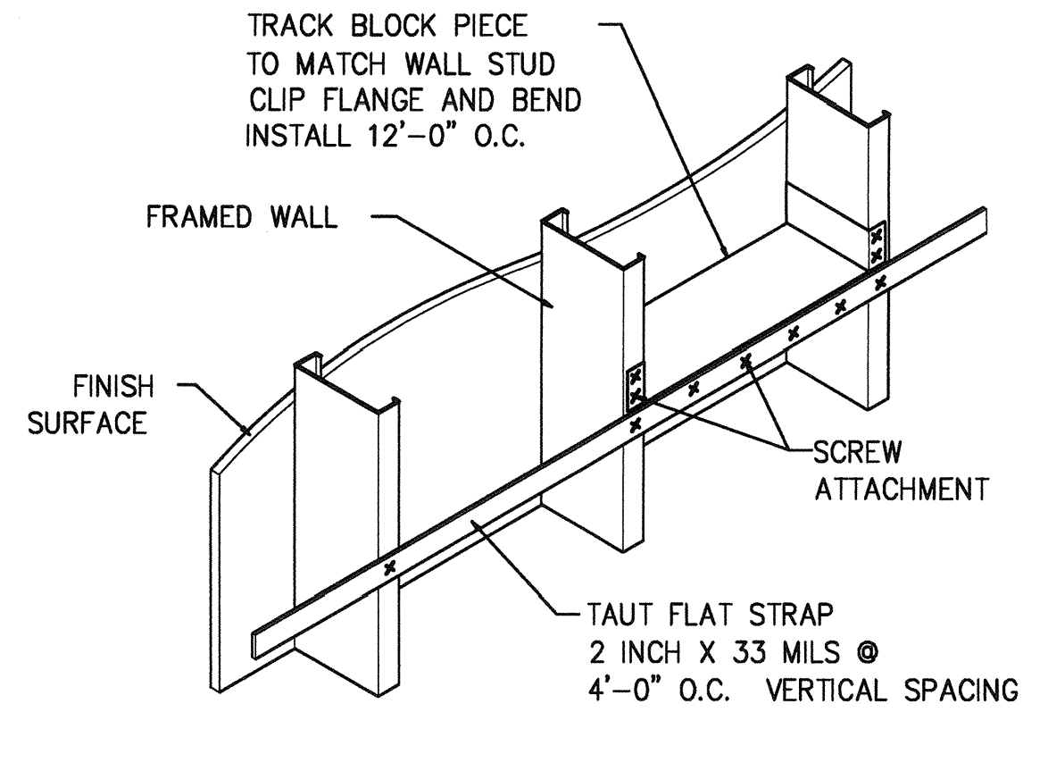
17 / 8.02 **SLAB EDGE @ RATED ENCLOSURE**
SCALE: 3" = 1'-0"



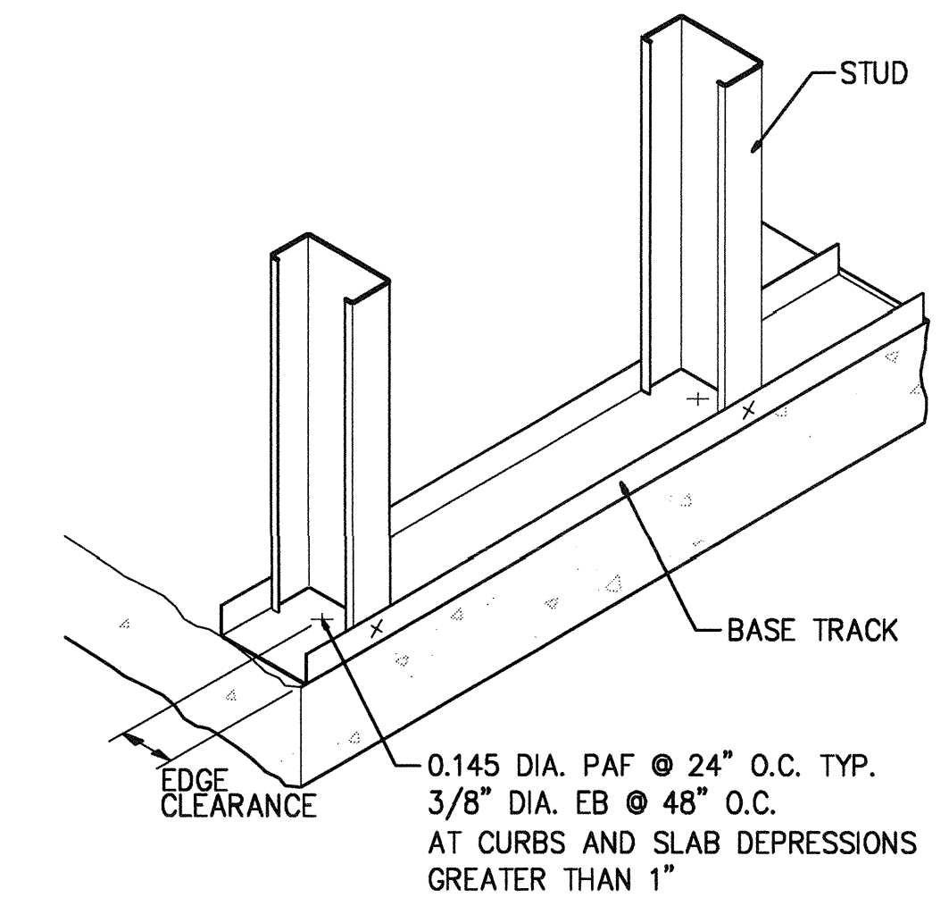
8 / 8.02 **SLAB EDGE @ NON-RATED ENCLOSURE**
SCALE: 3" = 1'-0"



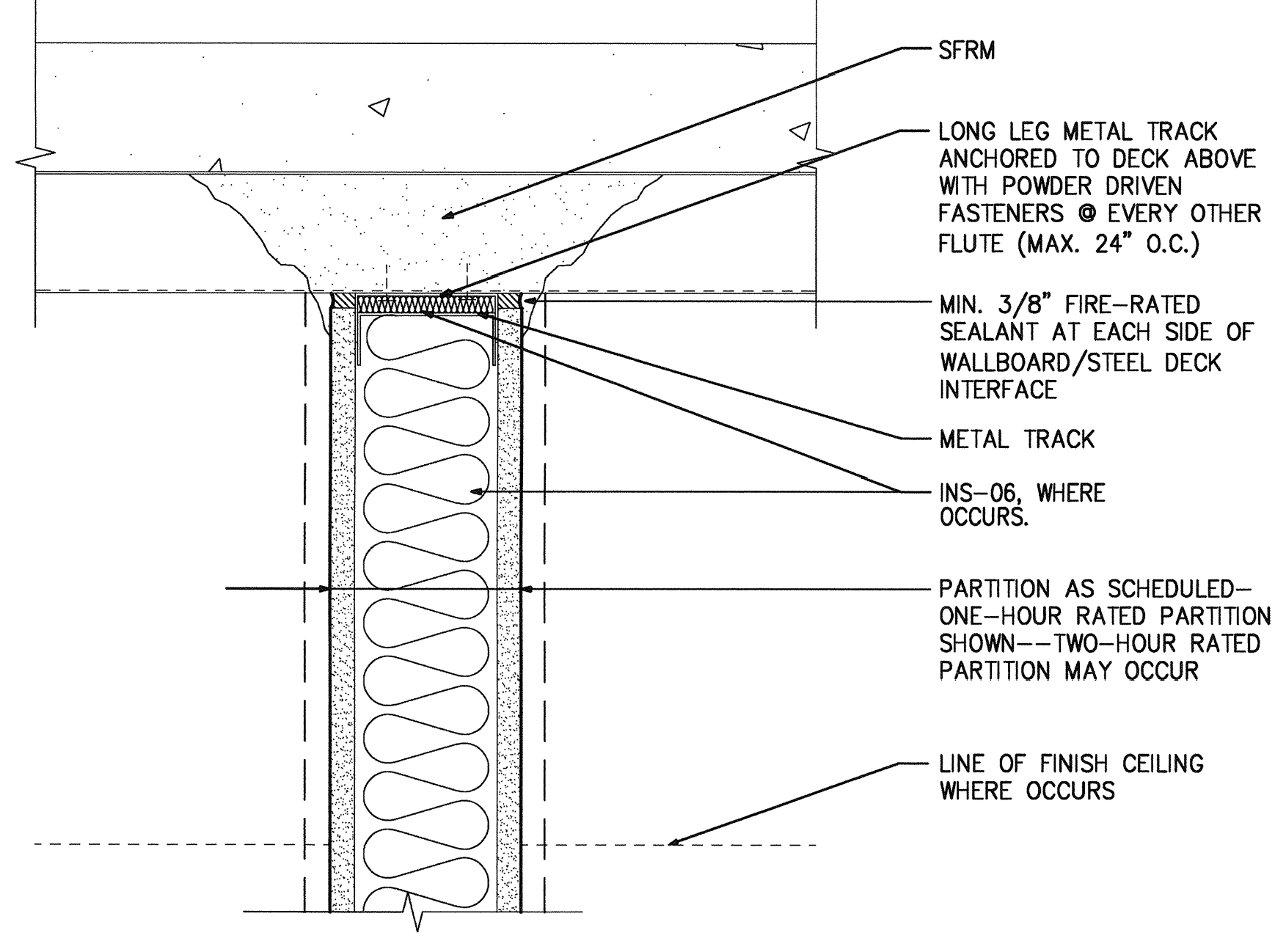
9 / A8.02 **TYP BACKING (LIGHT DUTY)**
SCALE: NO SCALE



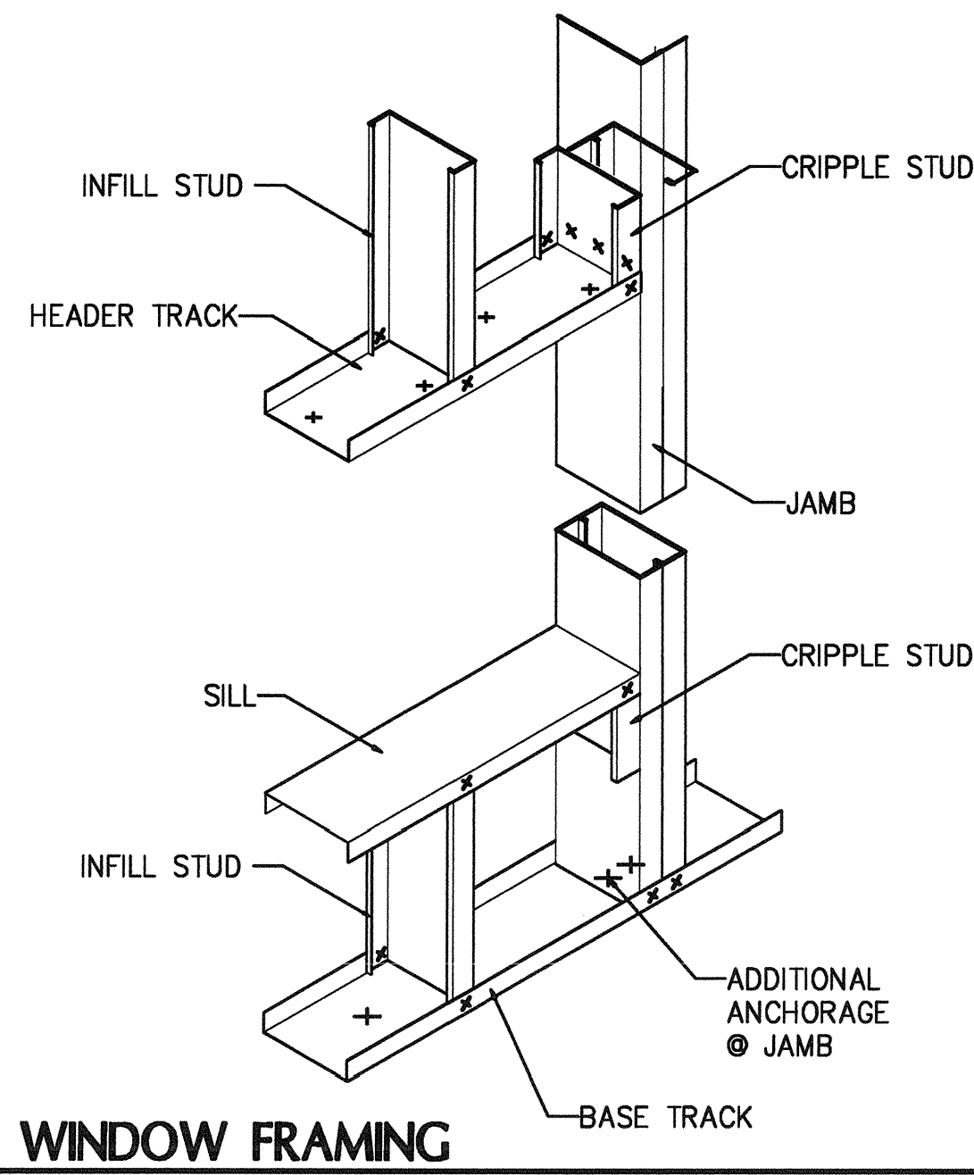
10 / A8.02 **TYP STRAPPING**
SCALE: NO SCALE



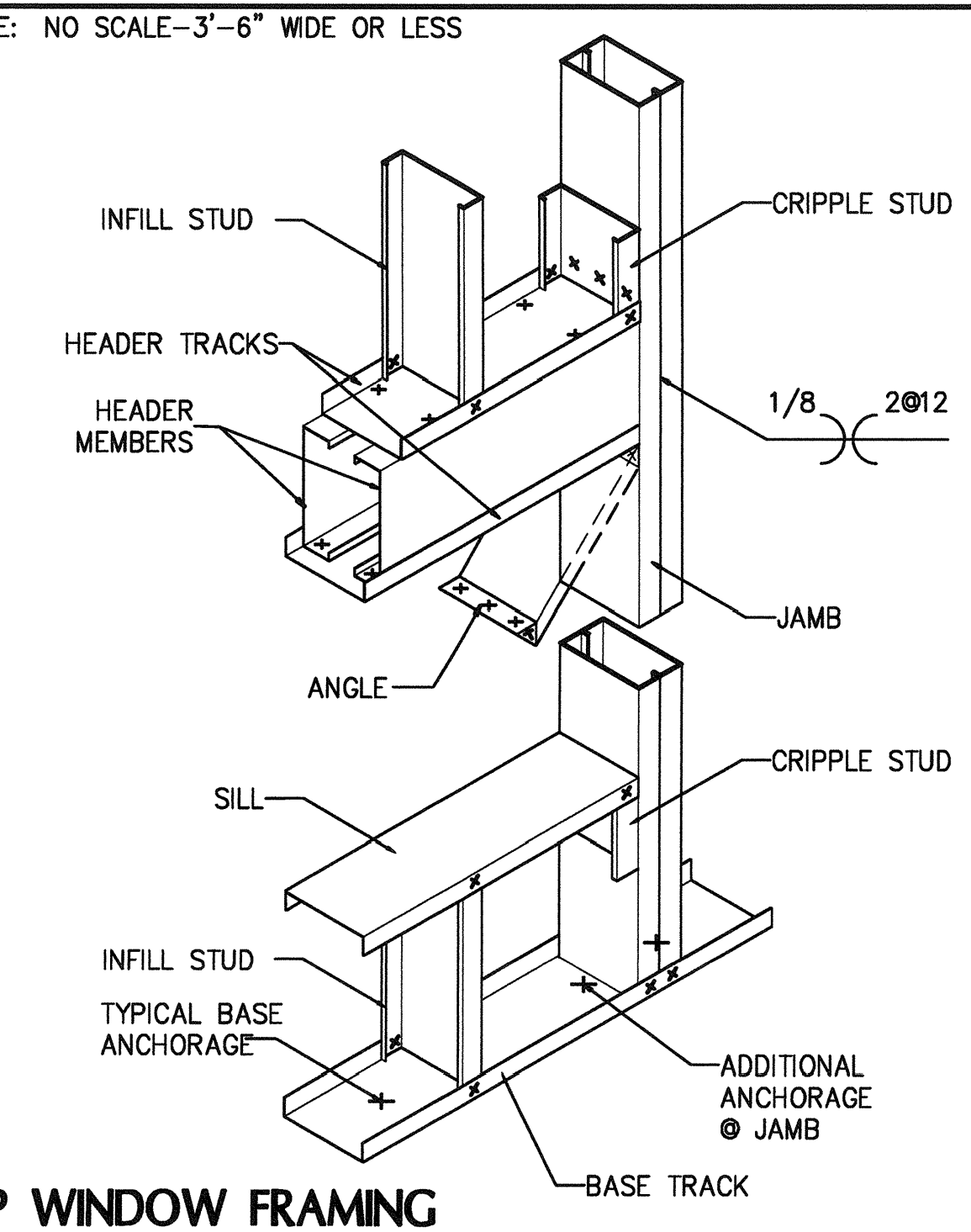
11 / A8.02 **TYP ATTACHMENT TO SLAB**
SCALE: NO SCALE



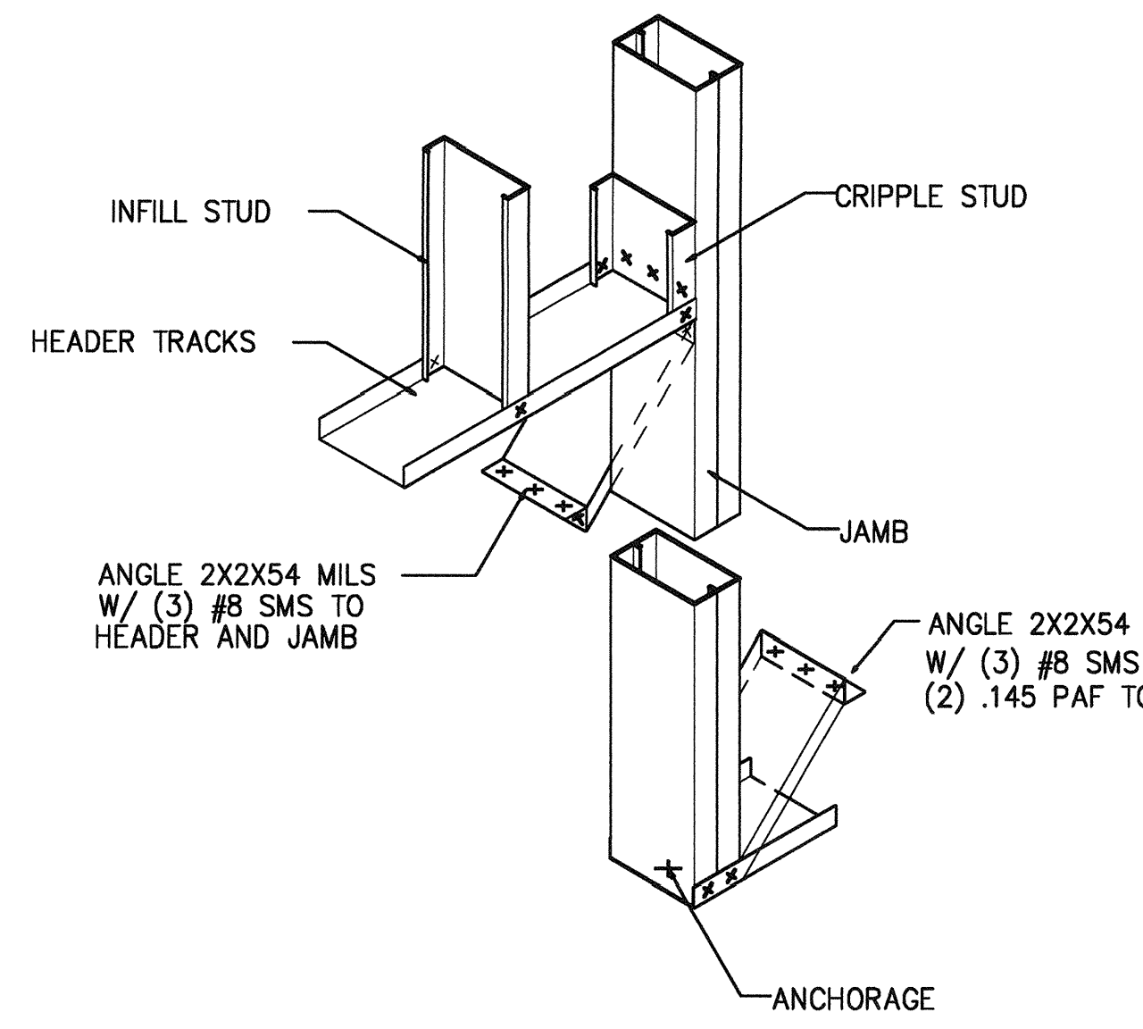
12 / 8.02 **T.O. NON-RATED PARTITION PERP TO MTL DECK**
SCALE: 3" = 1'-0"



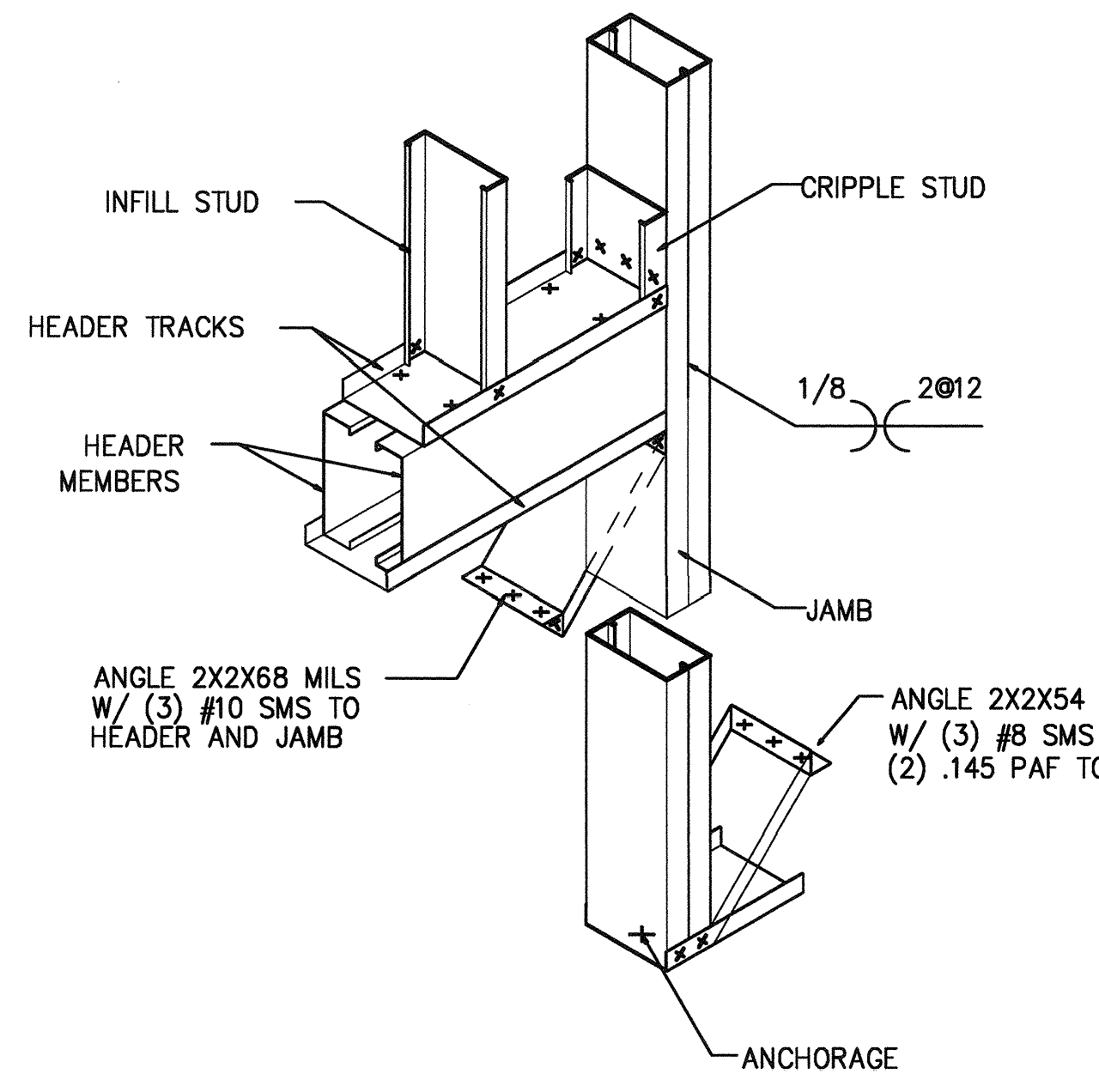
3 / A8.02 **TYP WINDOW FRAMING**
SCALE: NO SCALE–3'-6" WIDE OR LESS



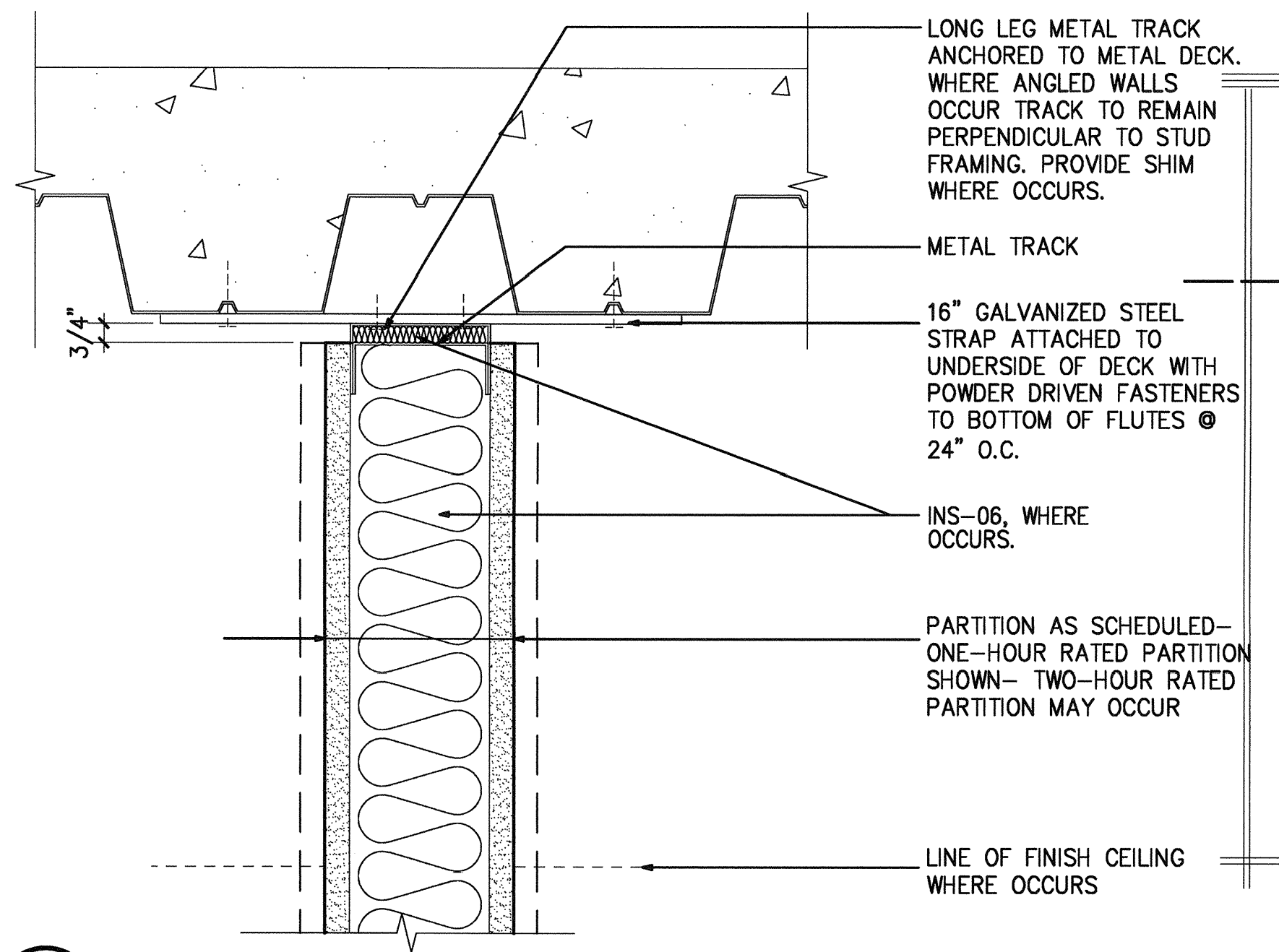
4 / A8.02 **TYP WINDOW FRAMING**
SCALE: NO SCALE– GREATER THAN 3'-6" WIDE & 8'-0" MAX (ENGINEER VERIFY)



5 / A8.02 **TYP HEADER**
SCALE: NO SCALE–3'-6" WIDE OR LESS



6 / A8.02 **TYP HEADER**
SCALE: NO SCALE–GREATER THAN 3'-6" WIDE & 8'-0" MAX (ENGINEER VERIFY)

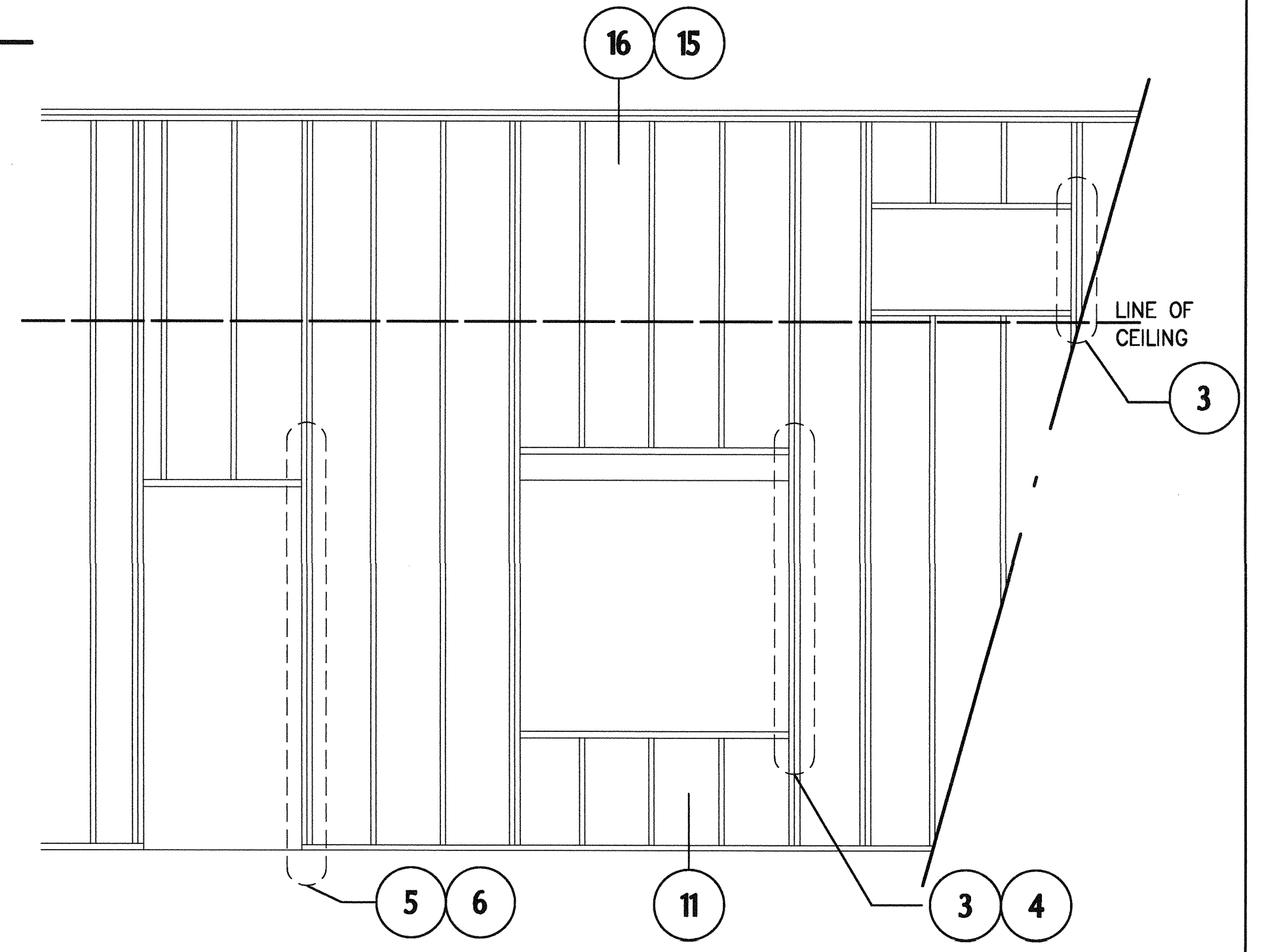


7 / 8.02 **T.O. NON-RATED PARTITION PARALLEL TO MTL DECK**
SCALE: 3" = 1'-0"

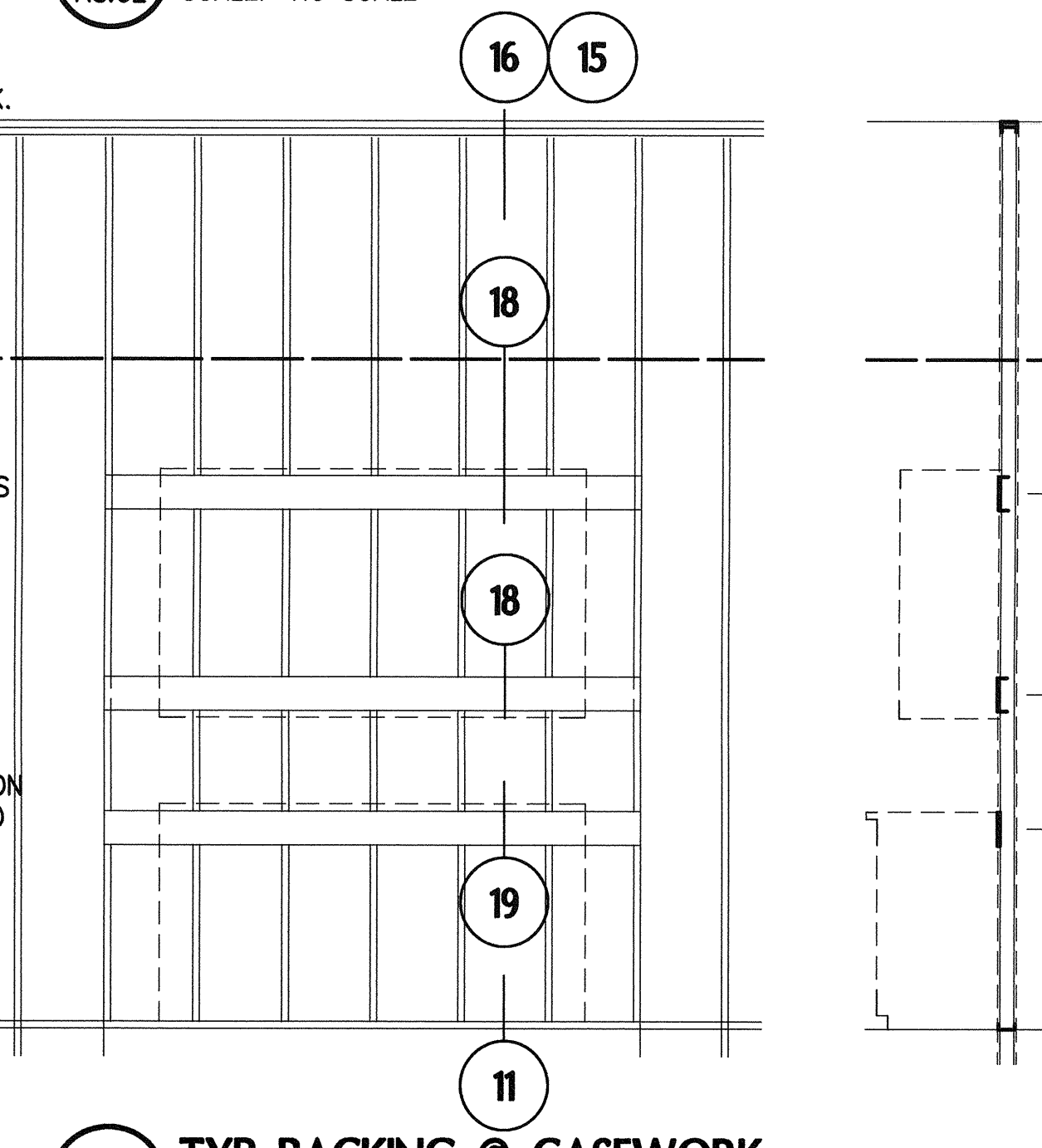
METAL STUD FRAMING NOTES:

DETAILS SHOWN ARE DIAGRAMMATIC AND ARE FOR INFORMATION ONLY. CONTRACTOR SHALL PROVIDE ENGINEERING CALCULATIONS & DETAILS.

1. STEEL PARTITION FRAMING MATERIAL SHALL BE AS SPECIFIED.
2. SHEET METAL SCREWS (SMS): USE #8 SMS UNLESS OTHERWISE INDICATED AS #10 OR #12 SMS AS ON DRAWINGS. THE SMS TYPE SHALL BE AS FOLLOWS:
   A. WHERE SCREW HEAD IS OVERLAID WITH GYPSUM BOARD OR OTHER FINISH USE WAFER HEAD SELF-DRILLING.
   B. WHERE SCREW HEAD IS NOT OVERLAID WITH GYPSUM BOARD OR OTHER FINISH USE HEX HEAD SELF-DRILLING.
3. PROVIDE FLAT STRAP LATERAL BRACING OF METAL STUD FLANGES ON FACES OF STUD WALLS THAT DO NOT HAVE SHEATHING ATTACHED. FLAT STRAPS SHALL BE 2" WIDE BY 33 MILS. SPACE VERTICAL 4'-0" O.C. AND PROVIDE BLOCKING STUD AT 12 FEET ON CENTER HORIZONTALLY AND AT THE ENDS OF WALLS.
4. POWER ACTUATED FASTENER (PAF): DN TYPE PINS WITH 0.145 SHANK DIAMETER AND 1-1/8 INCH PENETRATION BY HILTI INC. INSTALL IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
5. EXPANSION BOLTS (EB): KWIK BOLT II BY HILTI INC., USE DIAMETER AND EMBEDMENT AS INDICATED ON THE DRAWINGS. INSTALL IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
6. EPOXY ANCHORS (EA) AND HIGH STRENGTH EPOXY ANCHORS (HSEA): HIT HY 150 INJECTION ADHESIVE ANCHOR BY HILTI INC. ROD MATERIAL SHALL BE ASTM A36 FOR NORMAL EA AND ASTM A193, GRADE B7 FOR HIGH STRENGTH EPOXY ANCHOR (HSEA). USE DIAMETER AND EMBEDMENT AS INDICATED ON THE DRAWINGS. INSTALL IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
7. ALL STUD FRAMING SHALL BE 4" x 20 GA. @ 16" O.C. TYP, OR 16 GA AT MEDIUM OR HEAVY DUTY BACKING PLATE CONDITIONS U.N.O.
8. ALL STUDS SHALL BE "C" STUDS W/ STIFFENED FLANGES, EXCEPT FOR FRAMING AT SHAFT WALLS WHICH SHALL BE "CH" STUDS.
9. TOP AND BOTTOM TRACKS SHALL BE SAME GAUGE AS STUDS, EXCEPT AT SUSPENDED PARTITIONS. (REFER TO DETAILS) NESTING TRACKS SHALL BE 16 GAUGE, U.N.O.
10. ALL STUD FRAMING SHALL BE FULL HEIGHT, TO THE UNDERSIDE OF THE ROOF OR FLOOR DECK ABOVE, UNLESS NOTED OTHERWISE.
11. WHERE CONDITIONS IN THE FIELD OCCUR WHICH MAKE IT DIFFICULT TO FRAME A PARTITION FULL HEIGHT, THE ARCHITECT MAY, AT HIS DISCRETION, ALLOW THE CONTRACTOR TO FRAME THE PARTITION AT A LOWER HEIGHT PROVIDED THAT IT'S BRACED IN ACCORDANCE WITH THE DETAILS PROVIDED HEREIN, OR AS DIRECTED BY THE ARCHITECT.
12. DOUBLE STUDS AT THE SIDES OF OPENINGS SHALL NOT BE CUT FOR ANY REASON.
13. WHERE WELDING OF THE BACKING PLATES TO THE STUDS BURNS THROUGH EITHER THE STUD, PLATE OR BOTH, THE DAMAGED MATERIAL SHALL BE REPLACED WITH NEW MATERIAL.
14. PROVIDE SCREWS AT SIZE INDICATED BY KEYNOTE, LENGTH AS REQUIRED.
15. PROVIDE MEDIUM DUTY BACKING PLATES SPANNING A MINIMUM OF (3) STUDS AT THE FOLLOWING:
    HANDRAILS, WALL AND BASE CABINETS, TELEPHONE SHELVES COUNTERS, FIRE EXTINGUISHER CABINETS, SHOWER SEATS, URINAL PARTITIONS, CLOSET RODS, DOOR WALL STOP AND AT BRACKETS FOR ADJUSTABLE SHELVING, SEE DETAIL 19/A8.02
16. PROVIDE LIGHT DUTY BACKING PLATES AT THE FOLLOWING:
    PAPER TOWEL DISPENSERS, SOAP DISHES, SOAP DISPENSERS, HOMASOTE PANELS, METAL PANELS, WOOD VENEER PANELS, MARKER BOARDS, SEE DETAIL 9/A8.02
17. PROVIDE HEAVY DUTY BACKING PLATES AT LABORATORY SHELVING AND CASEWORK, SEE DETAIL 18/A8.02



1 / A8.02 **TYP INT FRAMING**
SCALE: NO SCALE



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2 / A8.02 **TYP BACKING @ CASEWORK**
SCALE: NO SCALE

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ZGF

Architecture / Planning / Interior Design
Portland Seattle Los Angeles Washington DC New York

515 South Flower Street, Suite 3700
Los Angeles, California 90071

(PH) 213 617 1901
(FAX) 213 617 0047

Consultants

STRUCTURAL ENGINEER
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CENTER FOR SCIENCE
SAN LUIS OBISPO, CA

Drawing Title

INTERIOR DETAILS PARTITION FRAMING DETAILS

TED ALAN YMAN

Date: OCTOBER 23, 2009
Job No: L40302.05
Drawn By:
Checked By:

Drawing No.

A8.02

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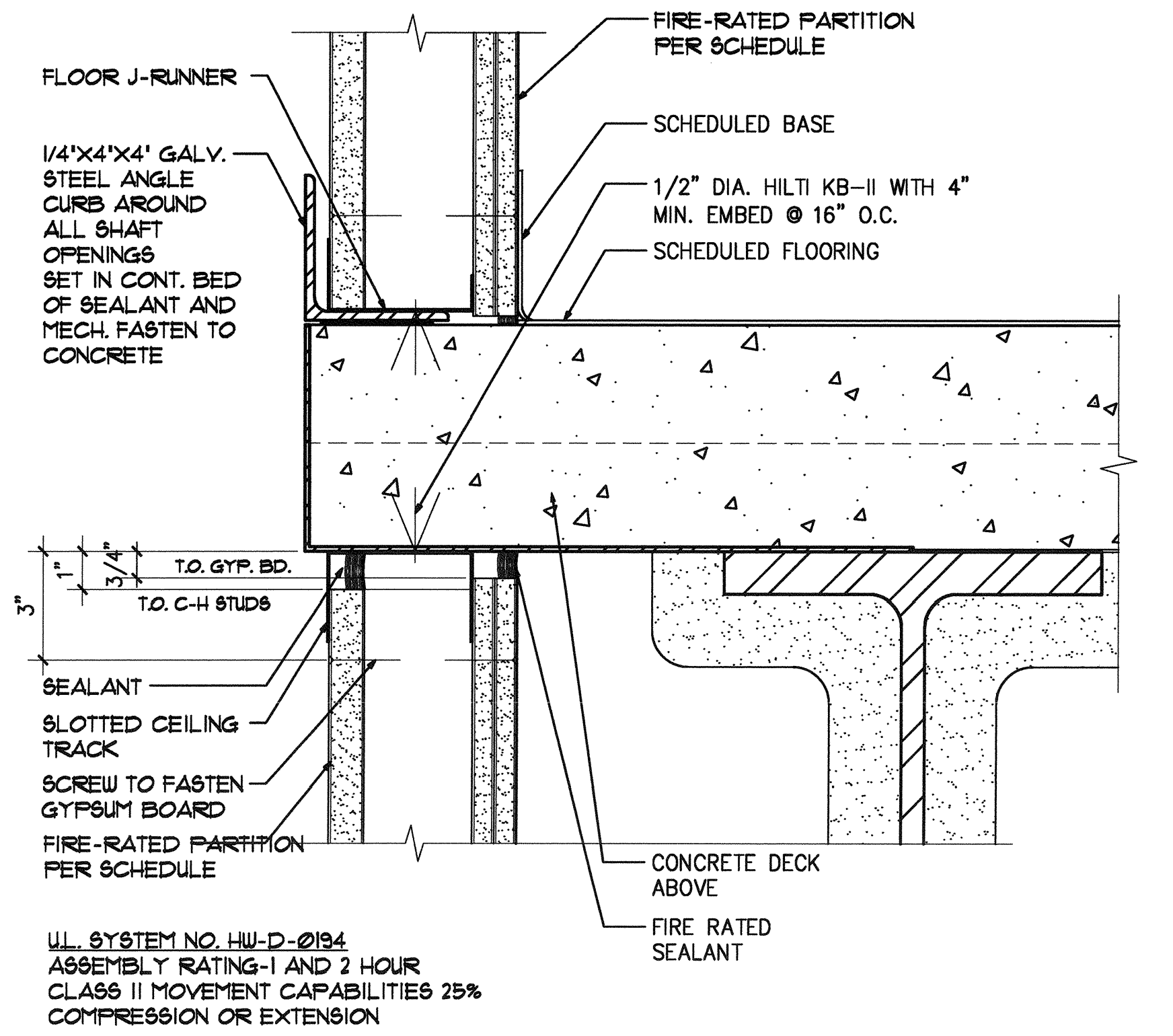
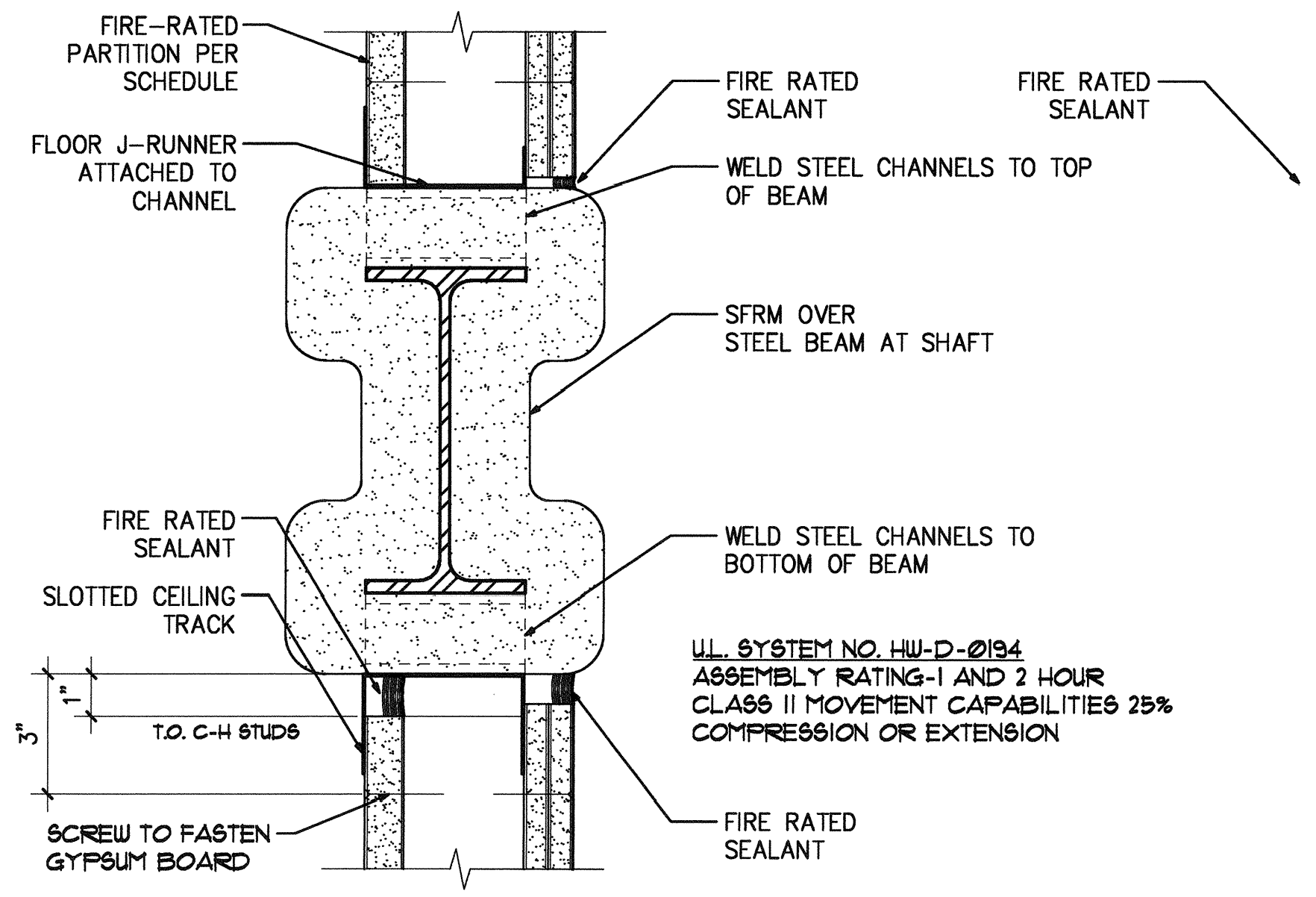


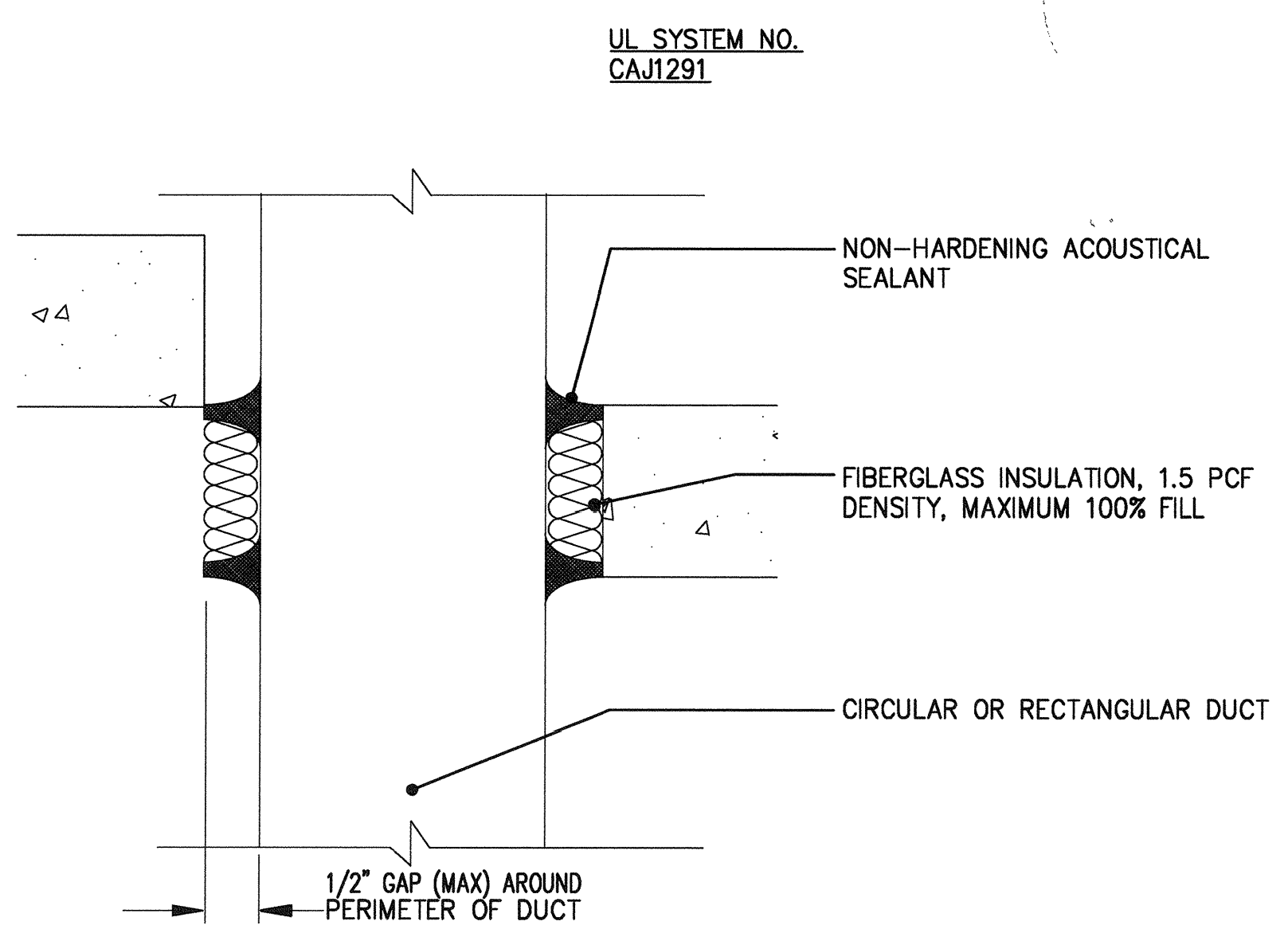
U.L. SYSTEM NO. HW-D-0194
ASSEMBLY RATING-1 AND 2 HOUR
CLASS II MOVEMENT CAPABILITIES 25%
COMPRESSION OR EXTENSION

11 A8.03 **SHAFT ENCLOSURE AT ROOF**
SCALE: 3" = 1'-0"

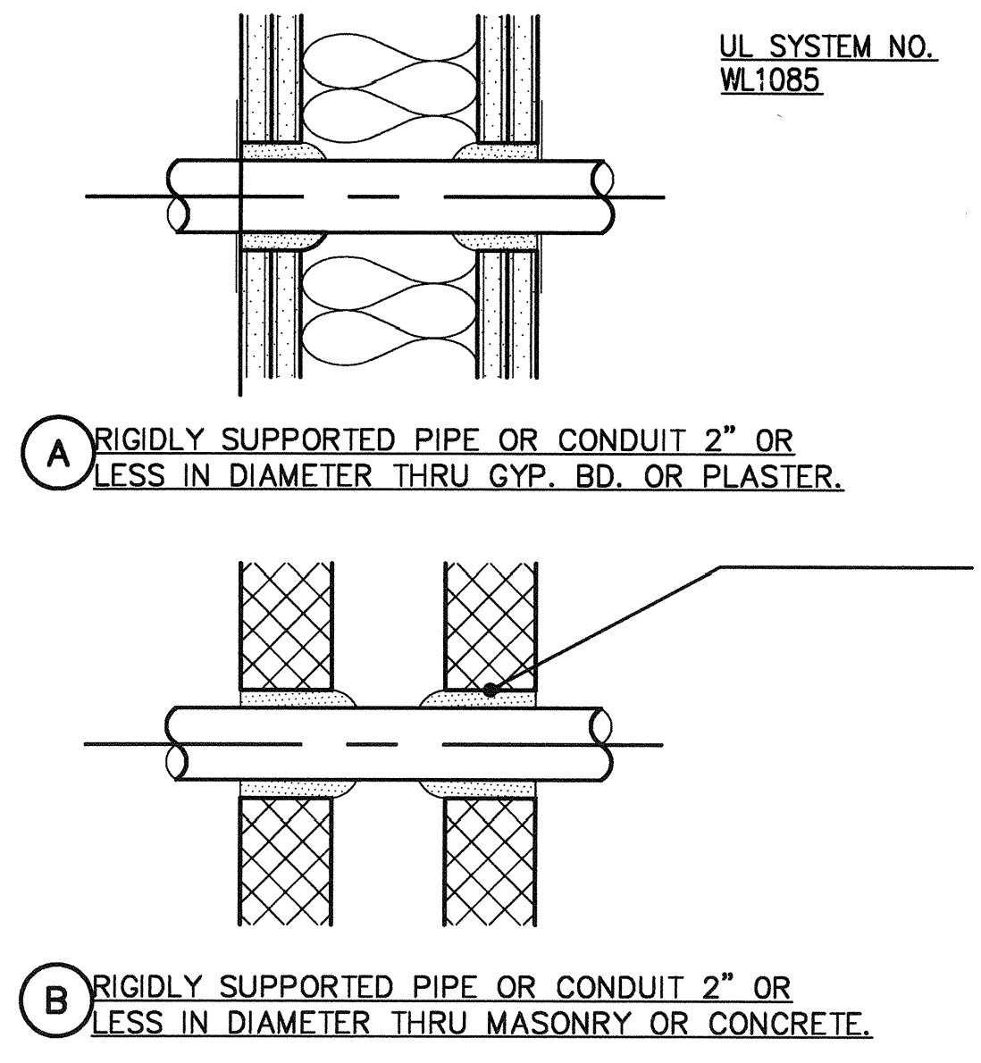


U.L. SYSTEM NO. HW-D-0194
ASSEMBLY RATING-1 AND 2 HOUR
CLASS II MOVEMENT CAPABILITIES 25%
COMPRESSION OR EXTENSION

12 A8.03 **SHAFT ENCLOSURE AT STEEL BEAM**
SCALE: 3" = 1'-0"



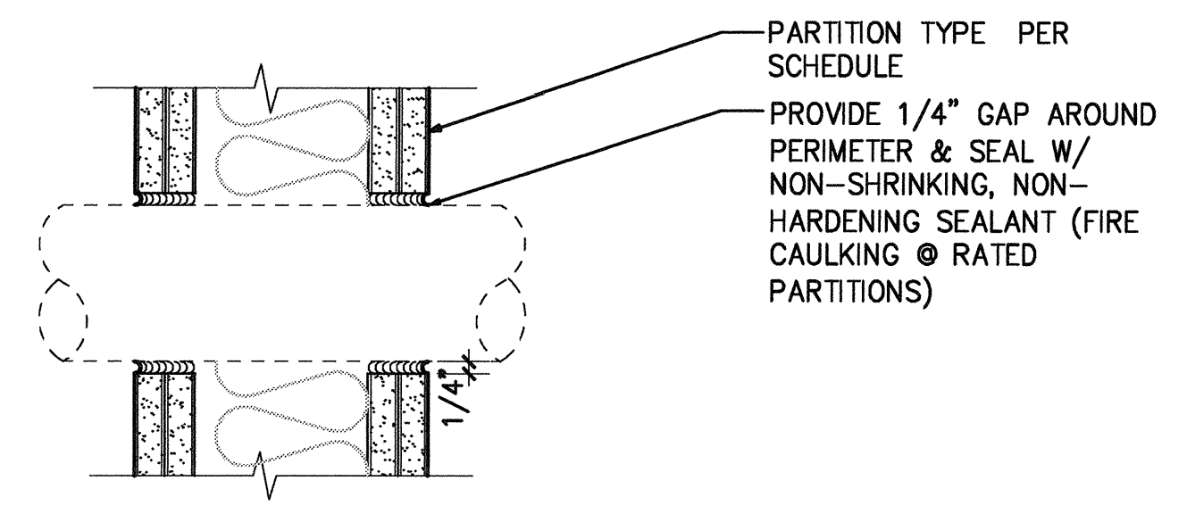
6 8.03 **RECT/CIRC. DUCT PENETRATION THRU FLR. SLAB**
SCALE: N.T.S.



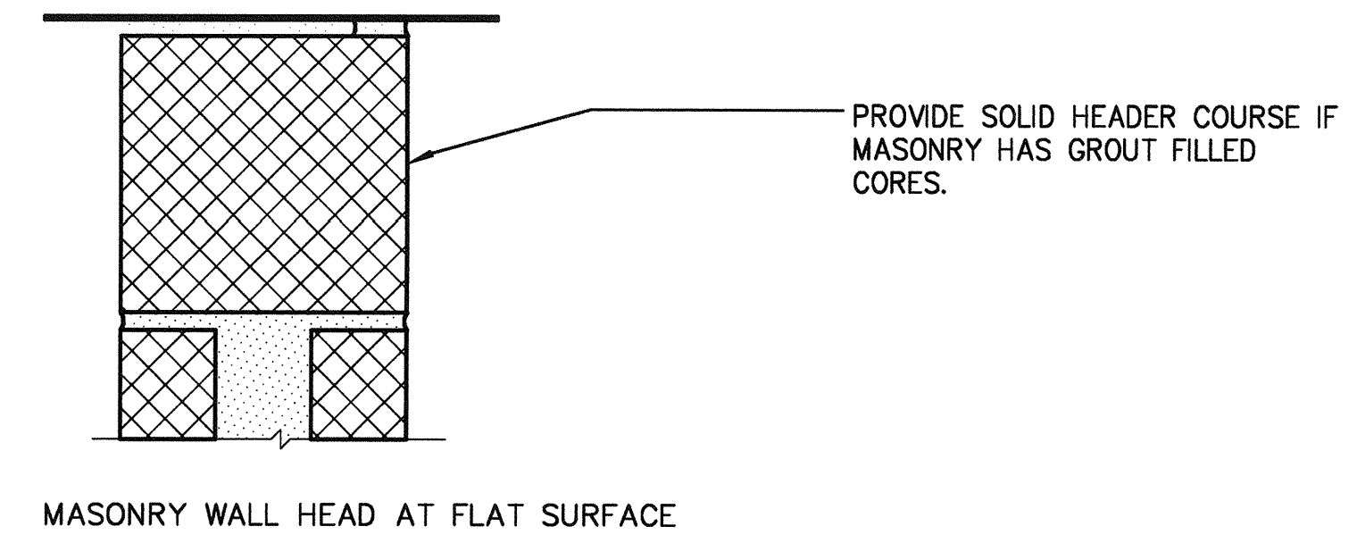
GROUT COMPLETELY, SOLIDLY AND FULL DEPTH ALL AROUND TO FORM A FULL SEAL AGAINST METAL SLEEVE.

NOTES:
1. PROVIDE LINTELS AS REQ'D. ABOVE PENETRATIONS.
2. INTERRUPT INSULATION OUTSIDE PIPES & DUCTSAT PENETRATIONS.
3. AS FAR AS POSSIBLE, SEPARATE PIPES AND CONDUITS SO THEY CAN BE TREATED INDIVIDUALLY AS SHOWN.

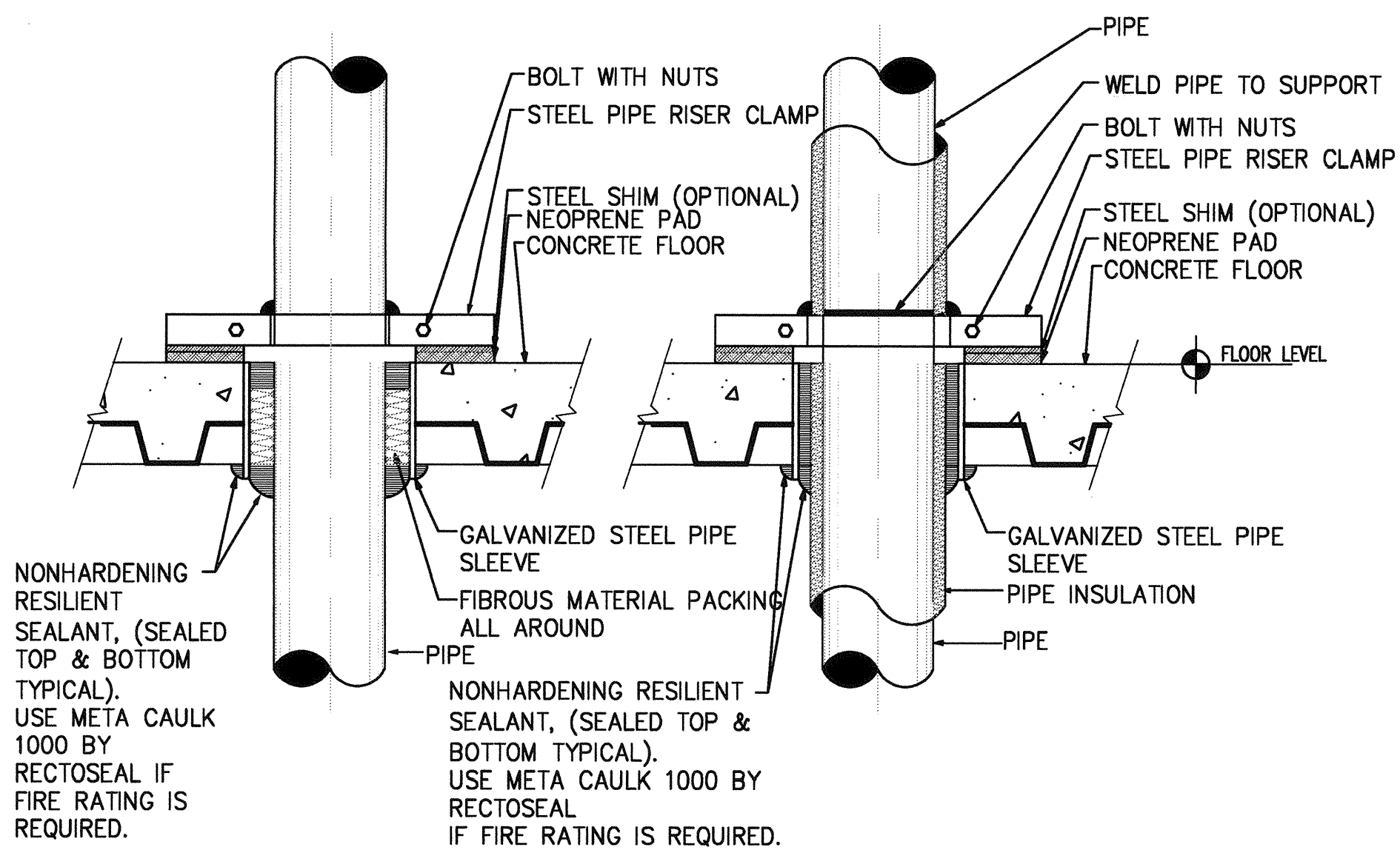
1 8.03 **PENETRATION DETAILS**
SCALE: N.T.S.



7 A8.03 **PENETRATIONS THROUGH ACOUSTICAL & RATED PARTITIONS**
SCALE: NTS

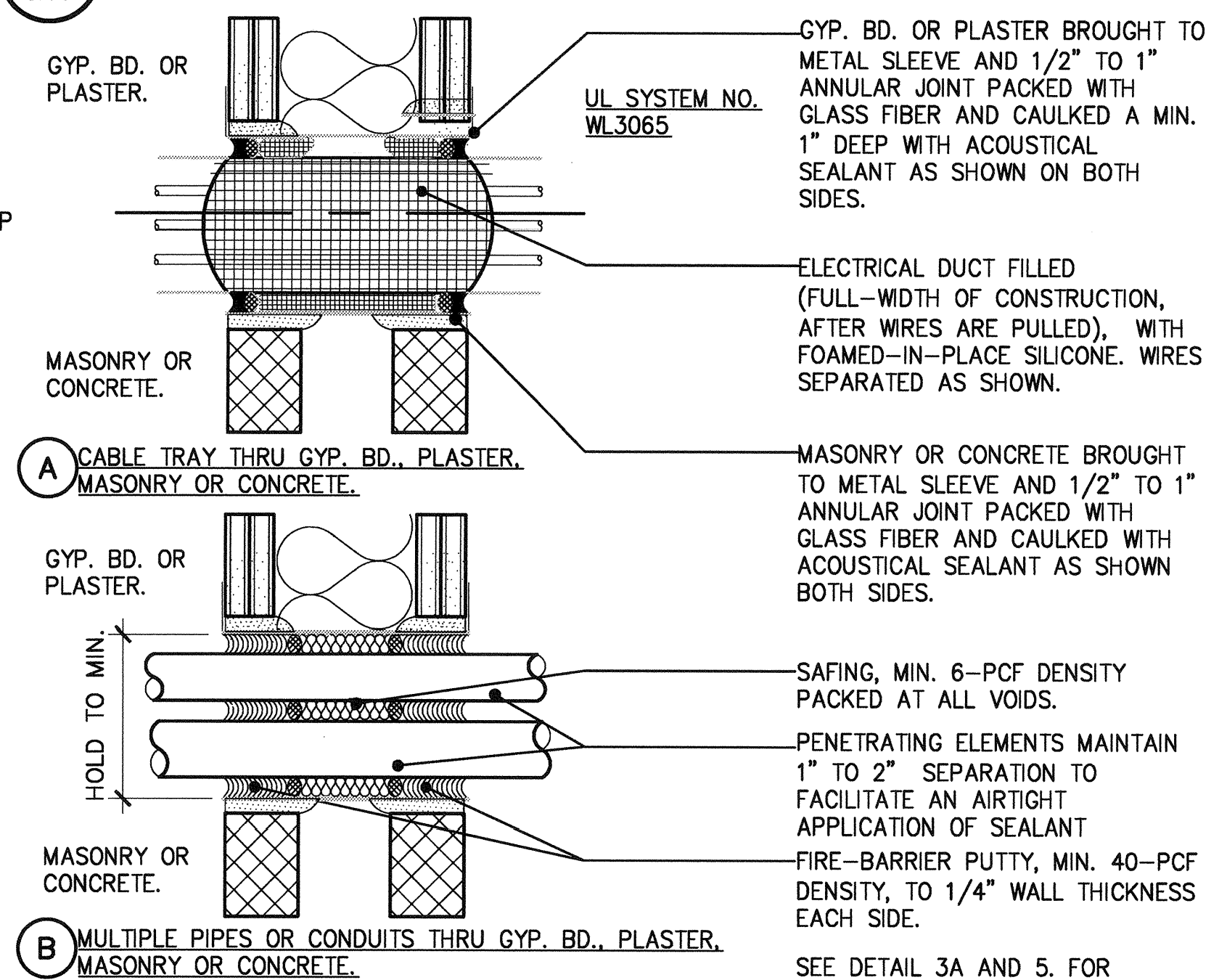


2 8.03 **EDGE DETAIL**
SCALE: N.T.S.



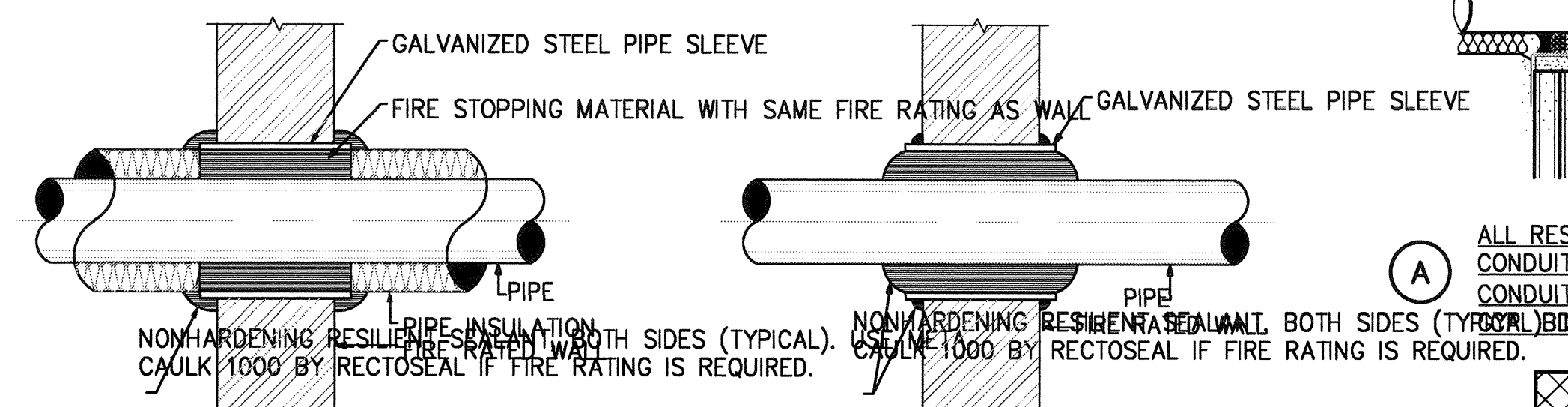
NOTE:
1. REFER TO SPECIFICATIONS FOR INSULATED PIPE RISER SUPPORTS.
2. COORDINATE RISER CLAMP ORIENTATION TO BE WITHIN WALL CAVITY.

8 A8.03 **TYPICAL PIPE PENETRATIONS THROUGH FLOOR RATED FLOOR**
SCALE: NTS



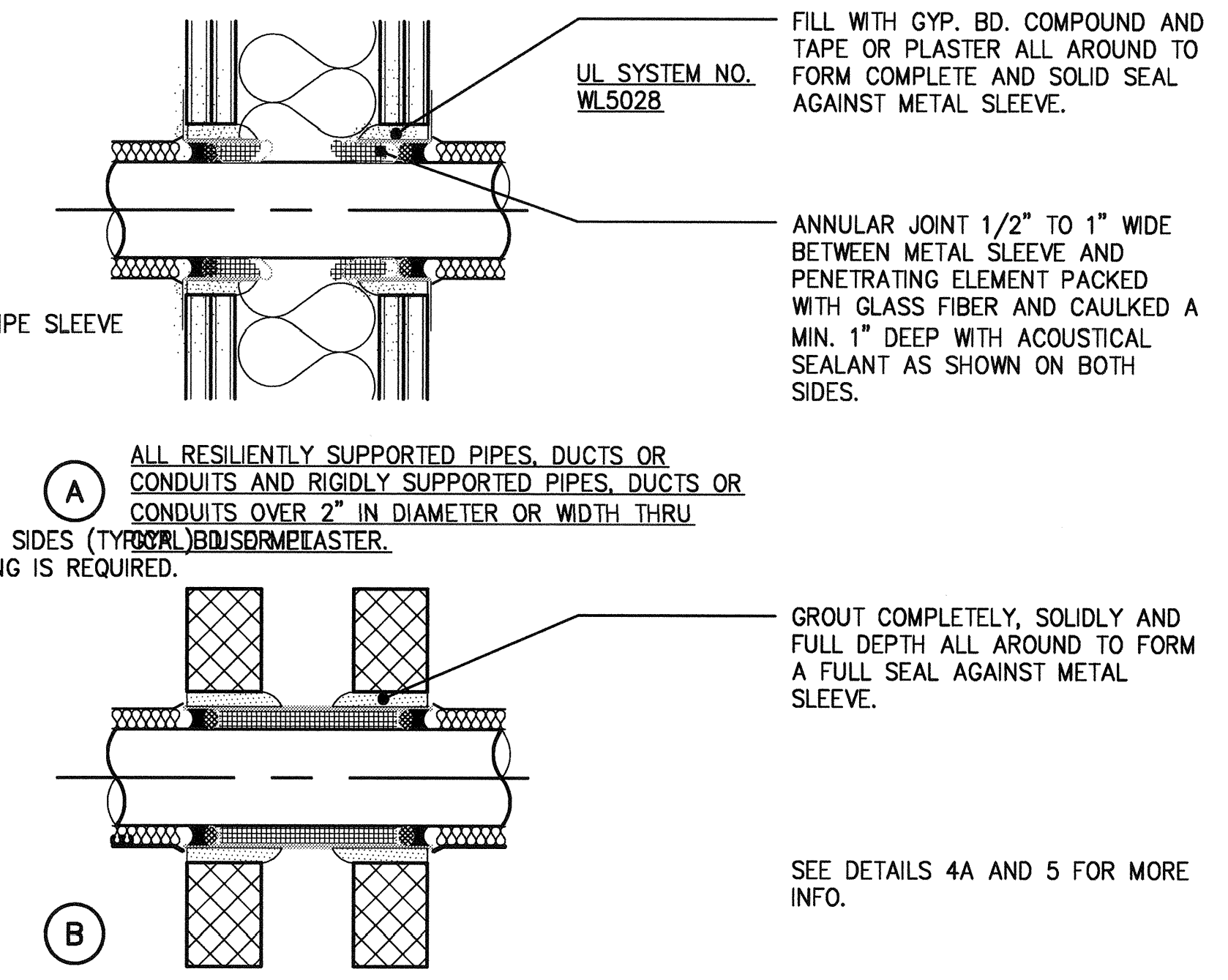
SEE DETAIL 3A AND 5. FOR MORE INFO.

3 8.03 **PENETRATION DETAILS**
SCALE: N.T.S.



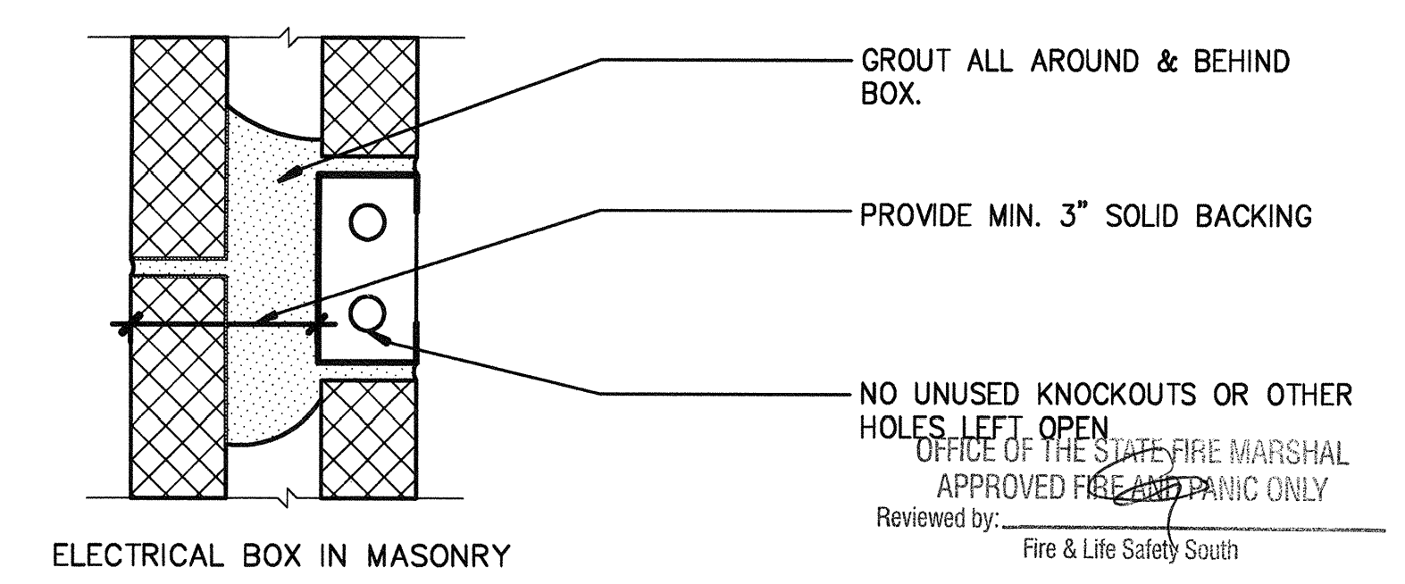
NOTE:
1. INSTALL FIRE STOPPING MATERIAL PER MANUFACTURER'S DETAIL.
2. REFER TO ARCHITECTURAL DRAWING FOR WALL FIRE RATING.

9 A8.03 **TYPICAL PIPE PENETRATIONS THROUGH FIRE RATED WALL**
SCALE: NTS



SEE DETAILS 4A AND 5 FOR MORE INFO.

4 8.03 **PENETRATION DETAILS**
SCALE: N.T.S.



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Reviewed by:
Fire & Life Safety South

NOV 10 2009

Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times

5 8.03 **RECESSED ELEMENT DETAIL**
SCALE: N.T.S.

ZIMMER · GUNSUL · FRASCA · ARCHITECTS · LLP
ZGF

Architecture / Planning / Interior Design
Portland Seattle Los Angeles Washington DC New York

515 South Flower Street, Suite 3700
Los Angeles, California 90071

(PH) 213 617 1901
(FAX) 213 617 0047

Consultants

STRUCTURAL ENGINEER
John A. Martin & Associates, Inc
1212 S. Flower Street
Los Angeles, CA 90015

MECHANICAL ENGINEER
Rumsey Engineers
99 Linden Street
Oakland, CA 94607

ELECTRICAL ENGINEER
Integrated Design Associates, Inc
3140 De La Cruz Boulevard, Suite 110
Santa Clara, CA 95054

CIVIL ENGINEER
Cannon Associates
1050 Southwood Drive
San Luis Obispo, CA 93401

LANDSCAPE ARCHITECT
Katherine Spitz and Associates
4212 1/2 Glencoe Avenue
Marina del Rey, CA 90292

LABORATORY
Research Facilities Design
3965 Fifth Avenue, Suite 300
San Diego, CA 92103-3107

LIGHTING DESIGN
David Nelson & Associates, LLC
P.O. Box 270254
Littleton, CO 80127

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SAN LUIS OBISPO, CA

Drawing Title

INTERIOR DETAILS
PENETRATIONS

Date: OCTOBER 23, 2009
Job No: L40302.05
Drawn By:
Checked By:

Drawing No.

A8.03

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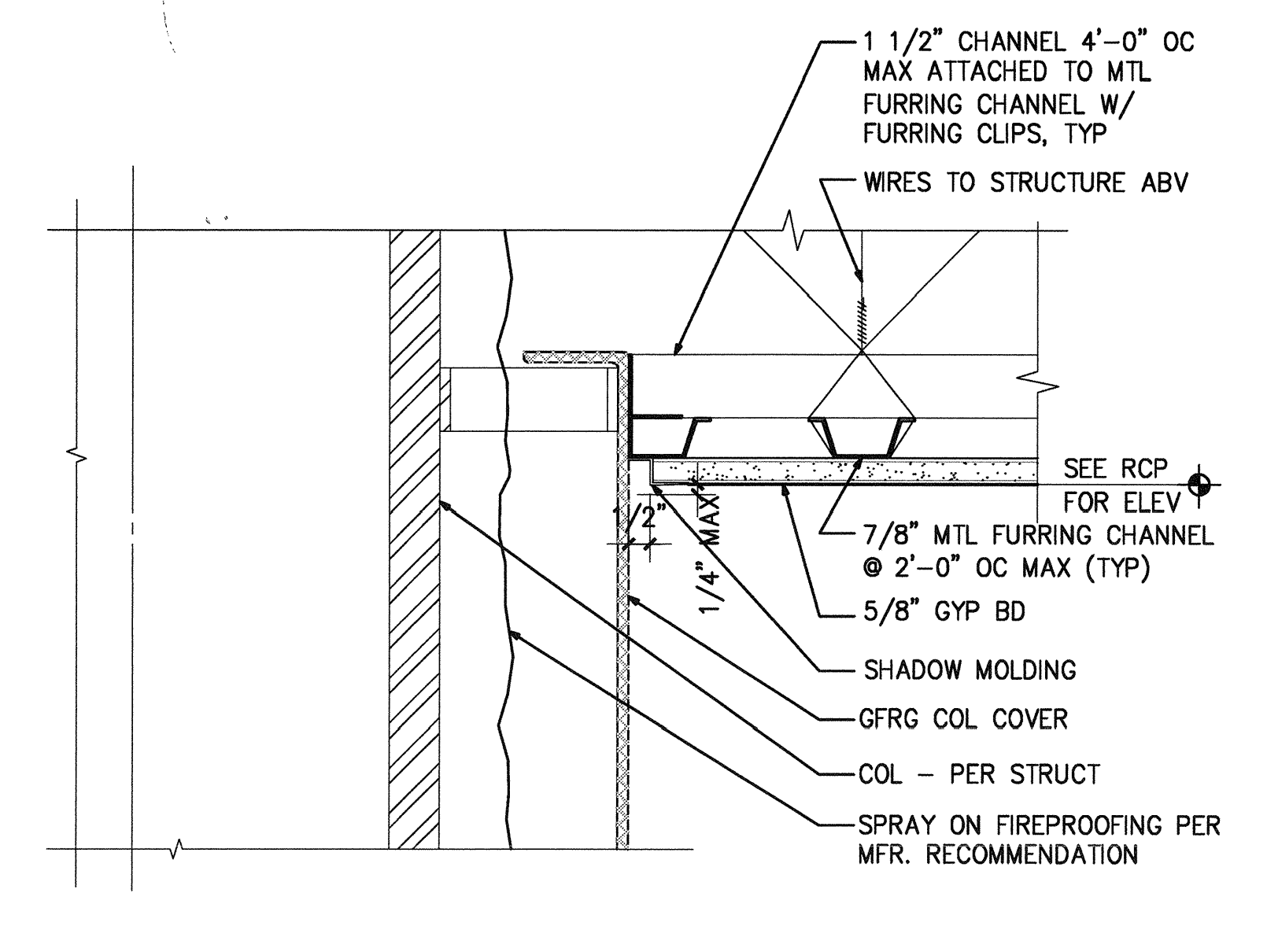
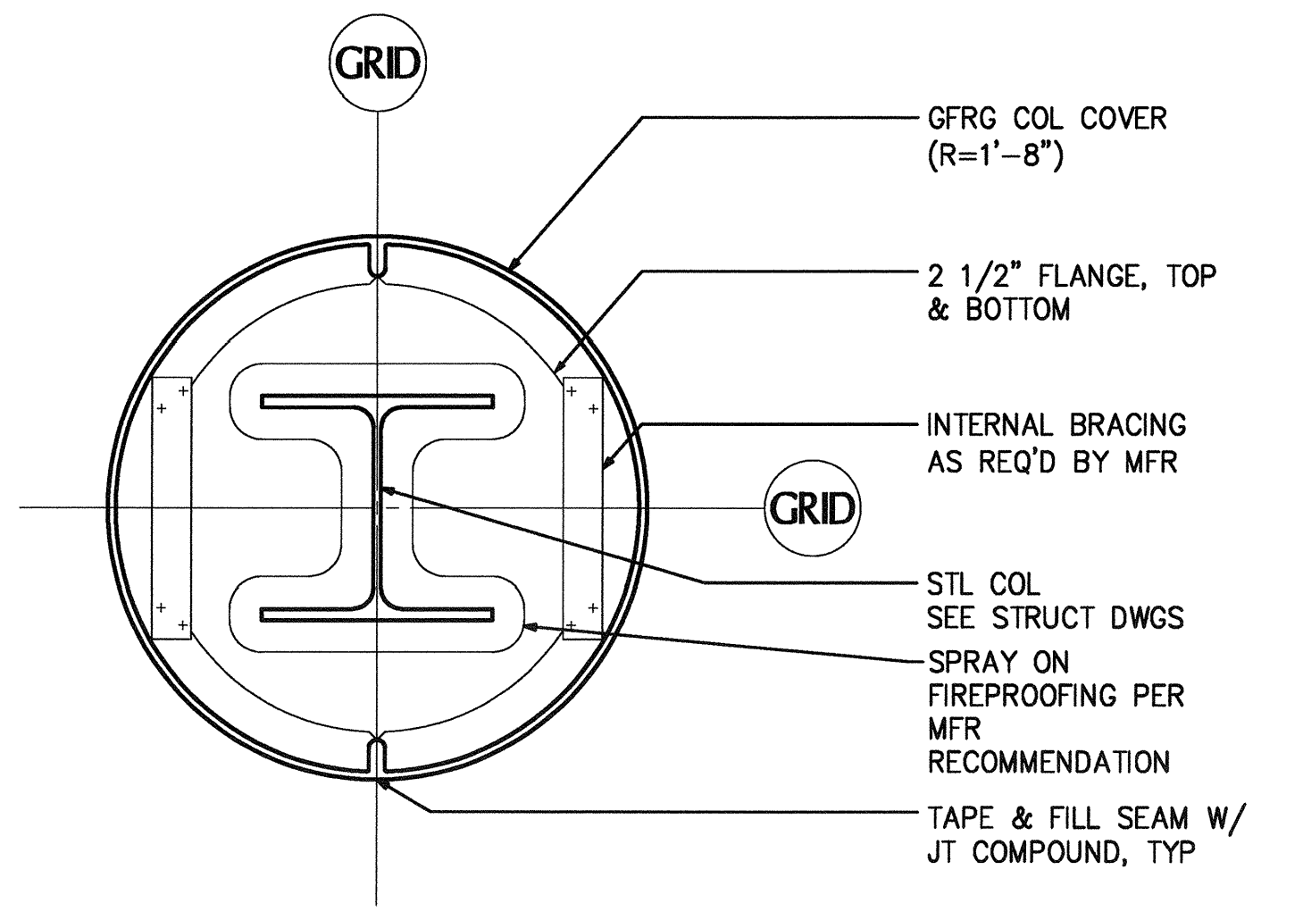
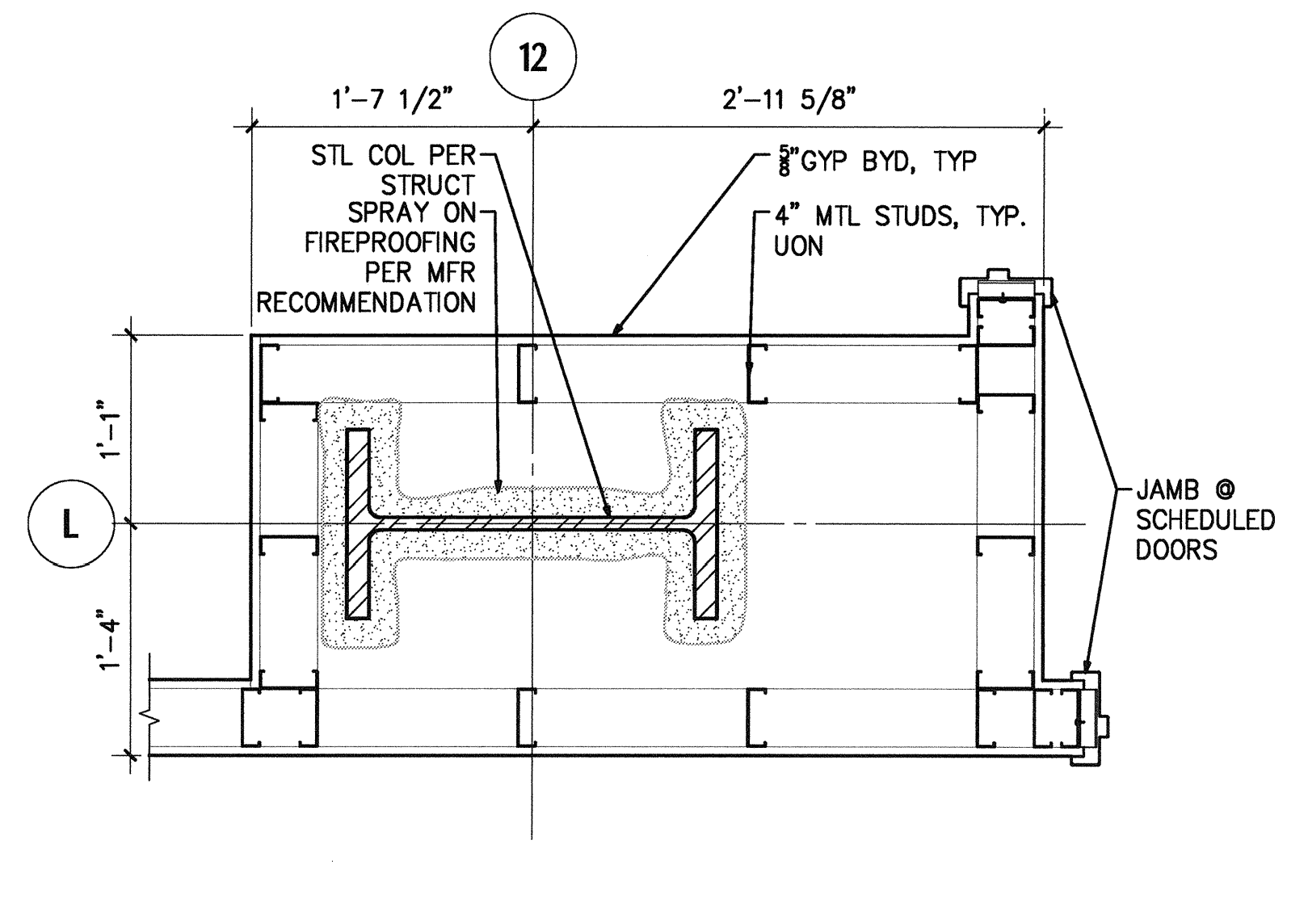


21 A8.04 **GFRG COL/ GYP BD CLG JUNCTION**
SCALE: 3" = 1'-0"



16 A8.04 **GFRG COL COVER**
SCALE: 1" = 1'-0"

NOTE: SEE 2.3.8/A8.04 FOR BASE & CLG DTLS



11 A8.04 **COL DTL**
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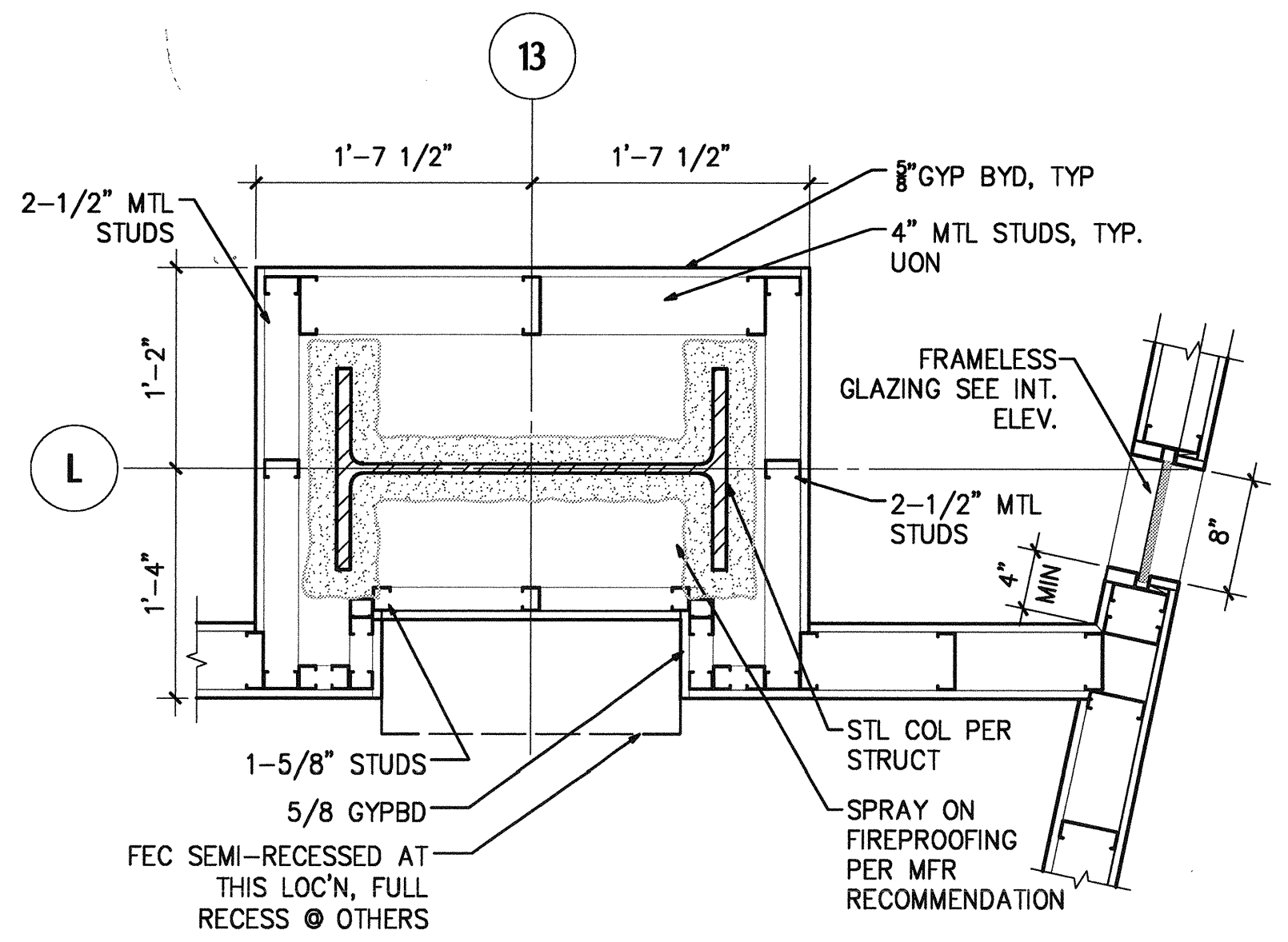

6 A8.04 **COL DTL - RM 306E, 304E**
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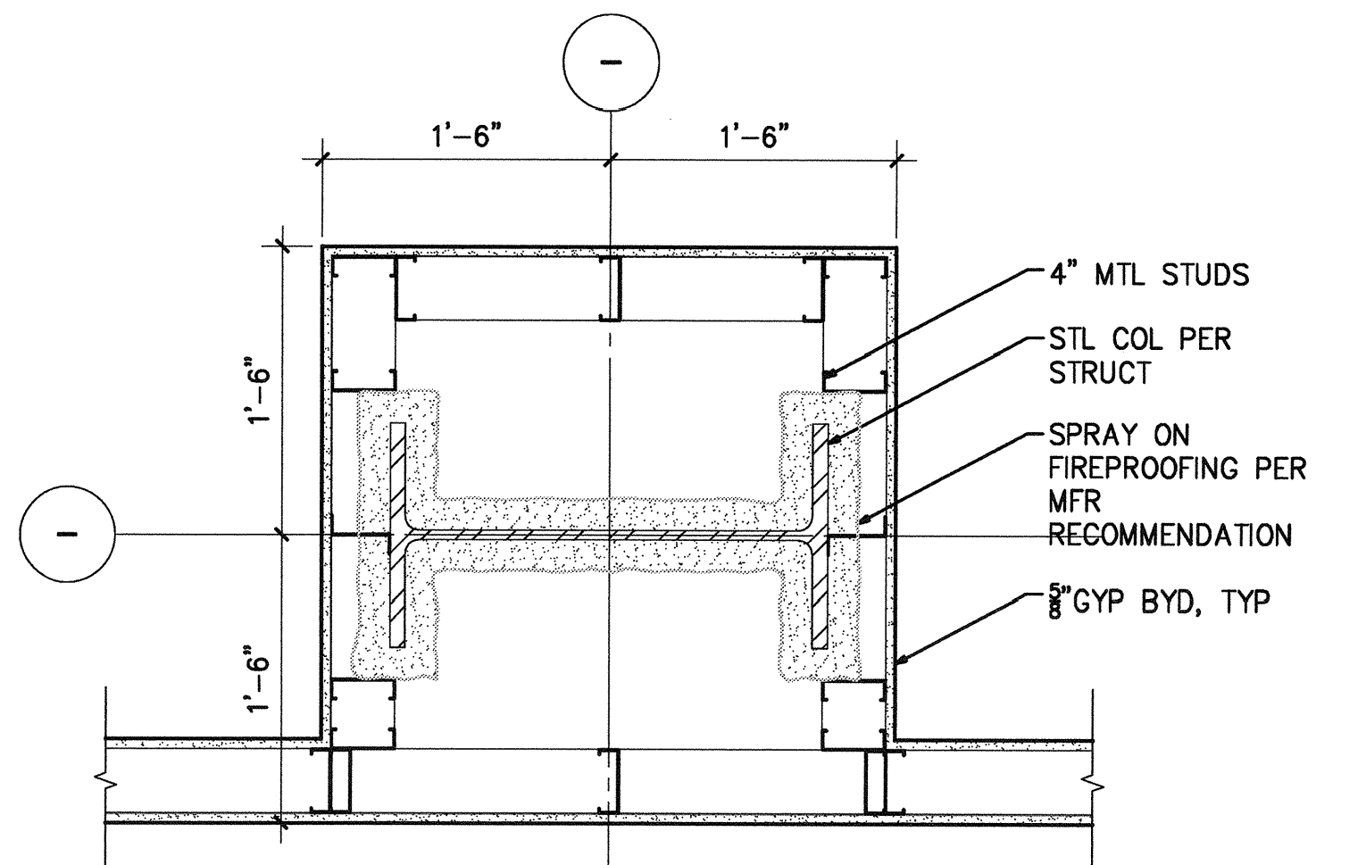

1 A8.04 **TYP COL DTL**
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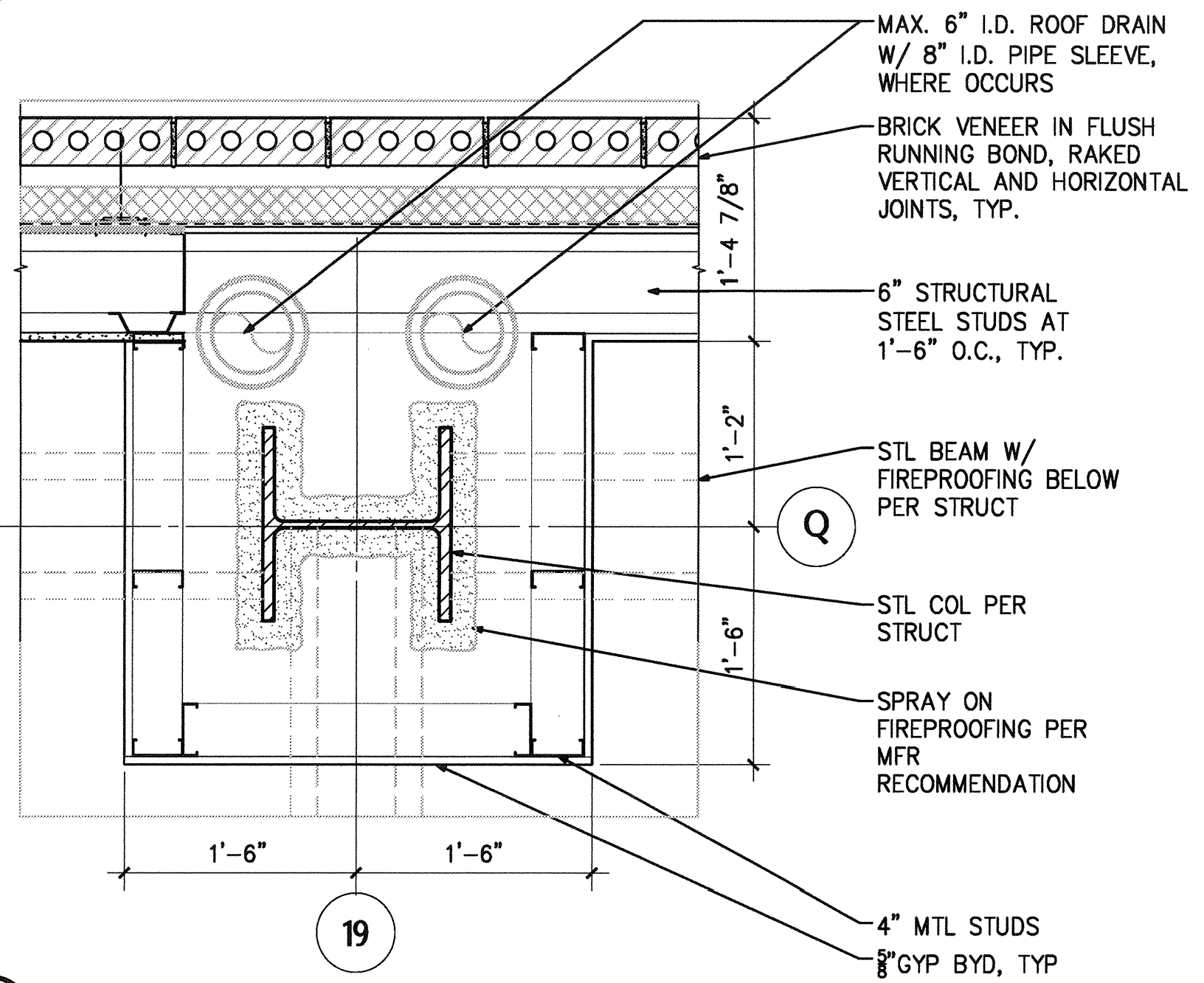

22 A8.04 **COL DTL - RM 634**
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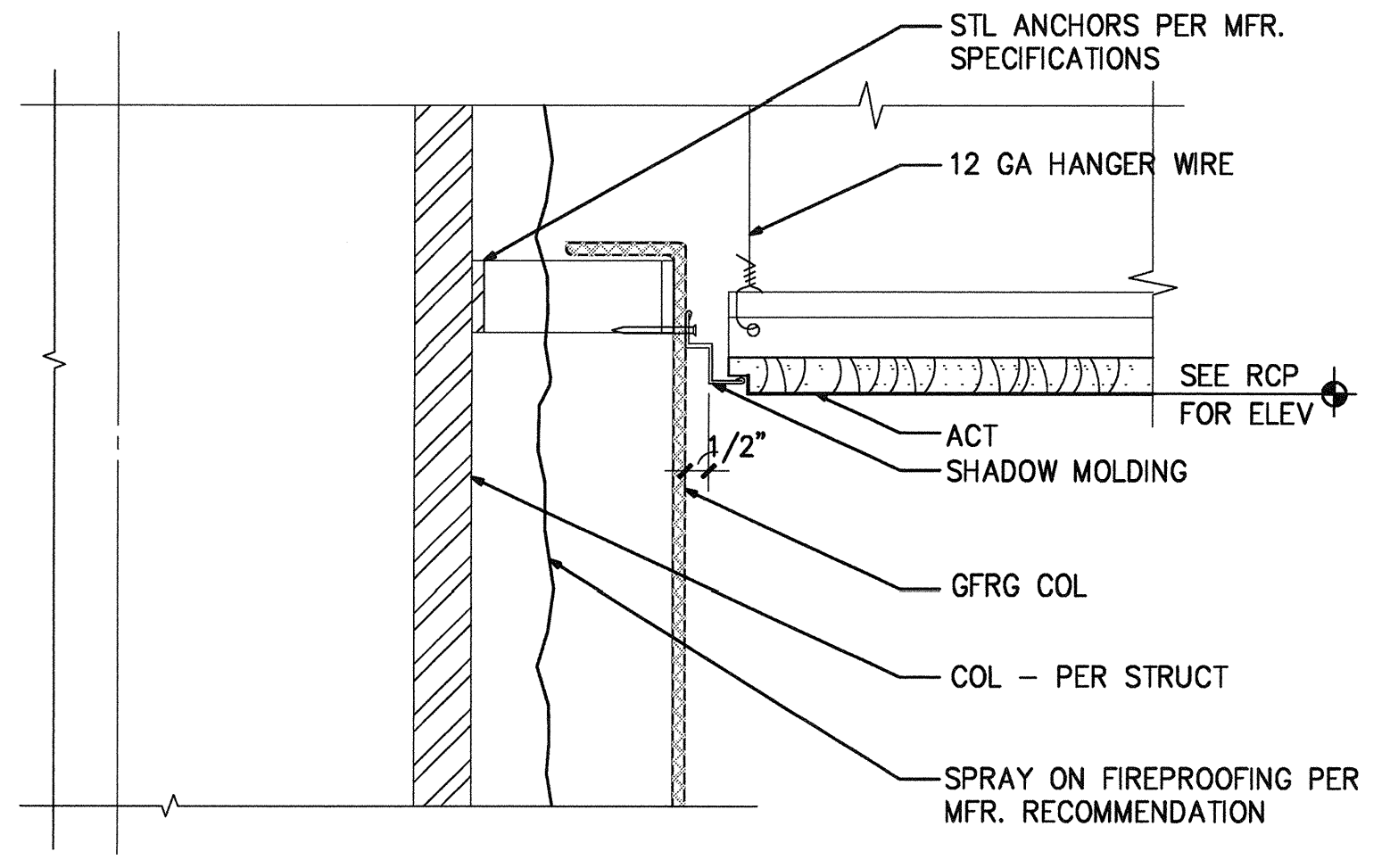

17 A8.04 **GFRG COL/ ACT CLG JUNCTION**
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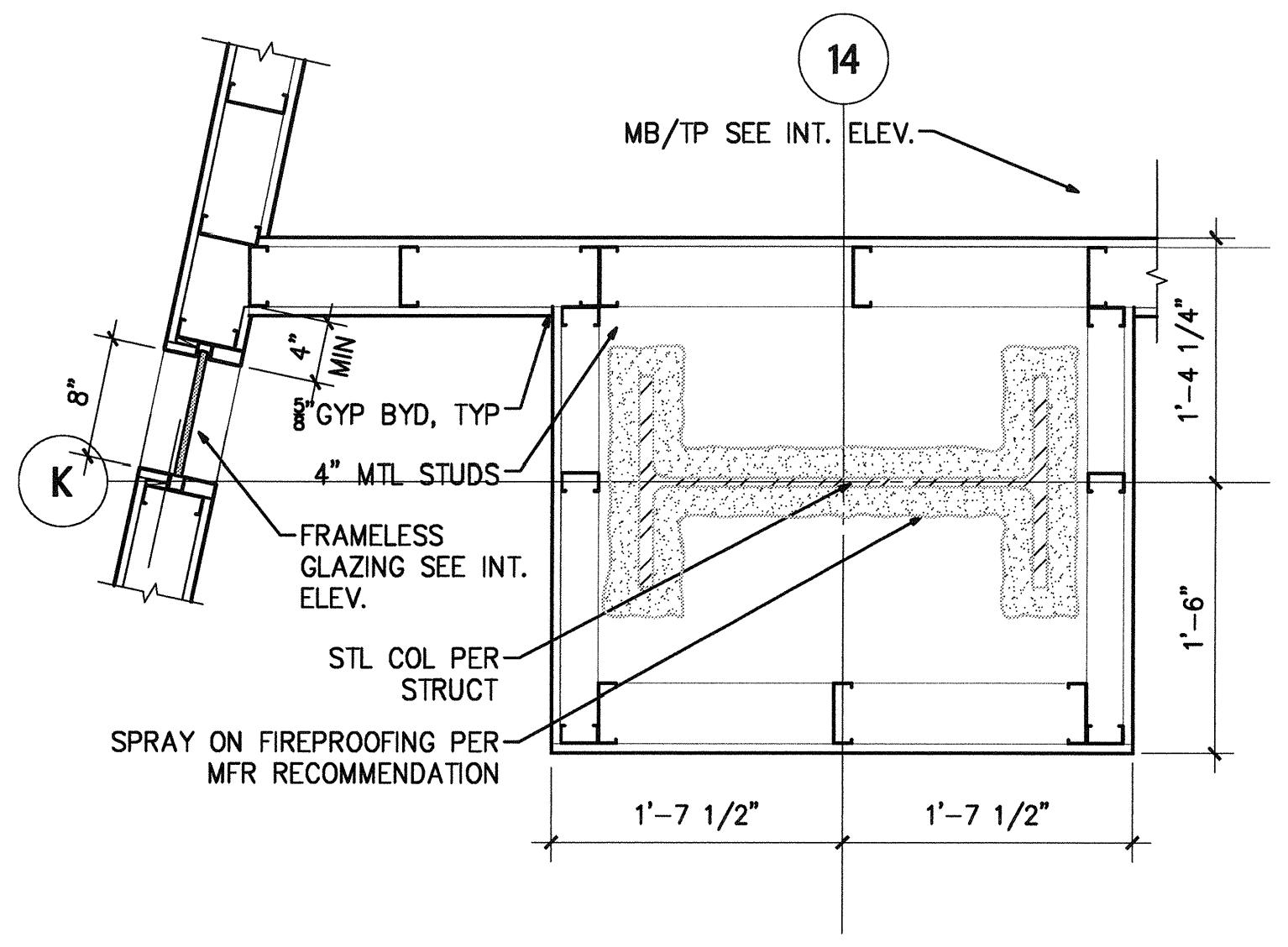

12 A8.04 **COL DTL - RM 209, 206**
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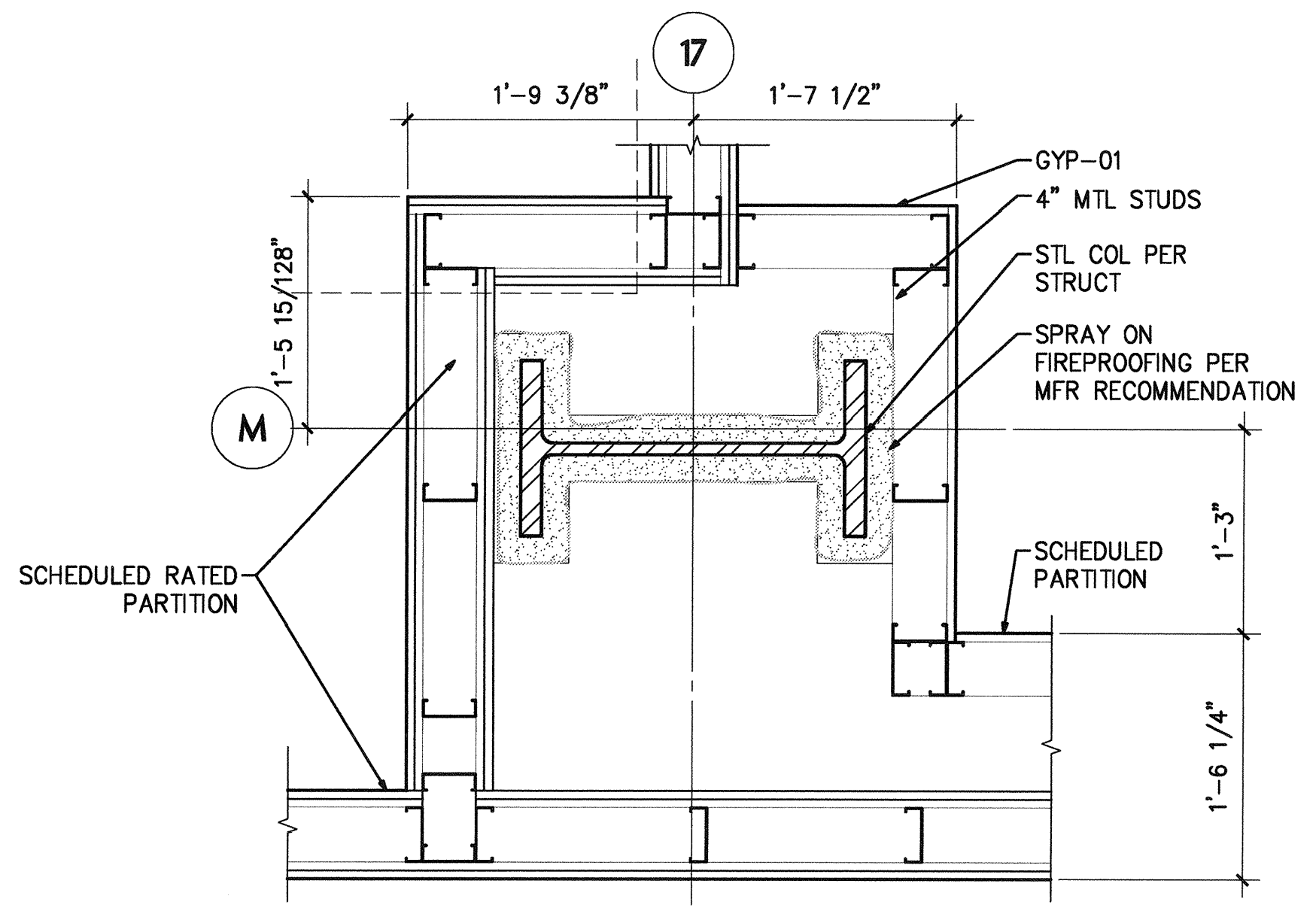

7 A8.04 **COL DTL - RM 231A**
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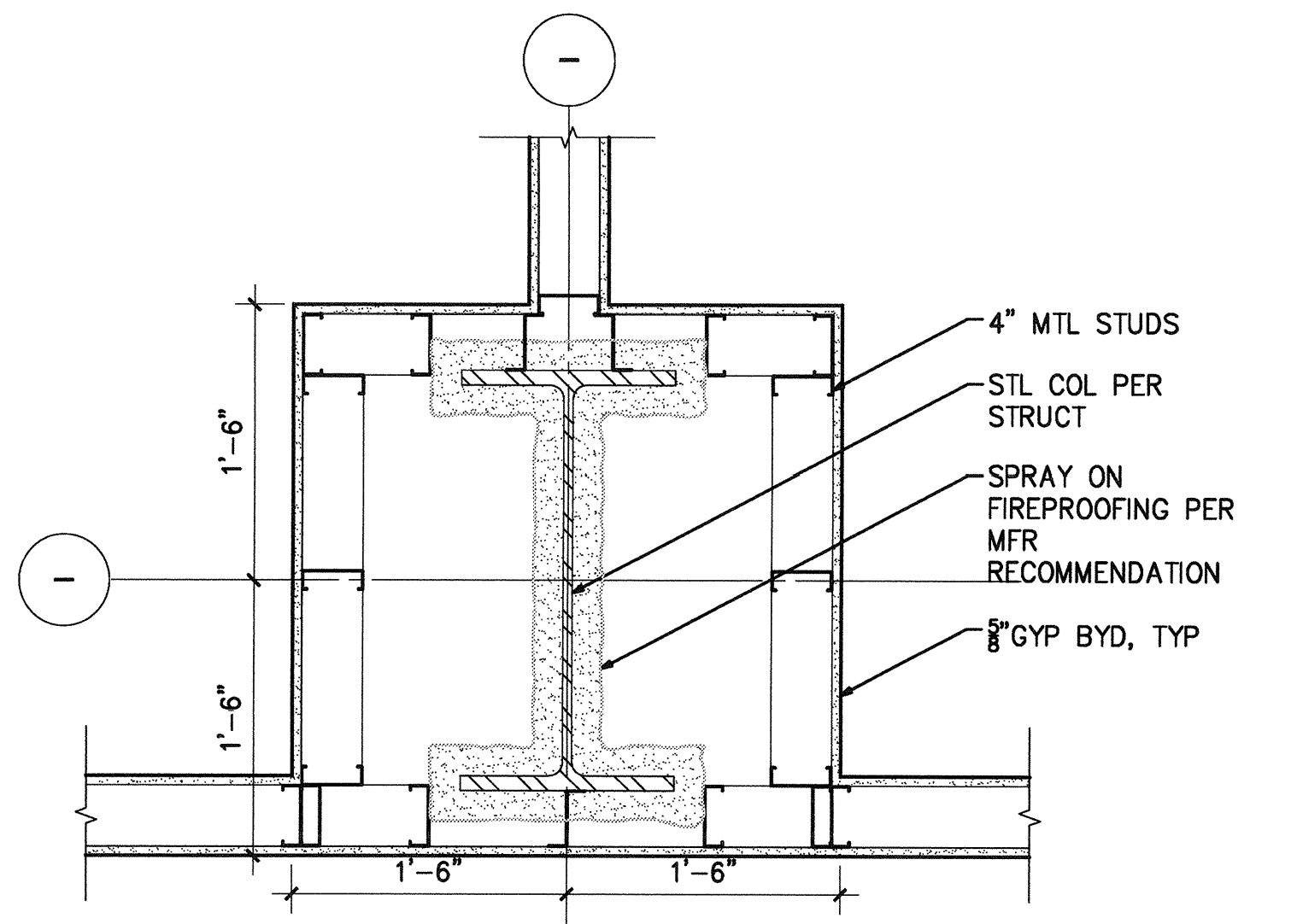

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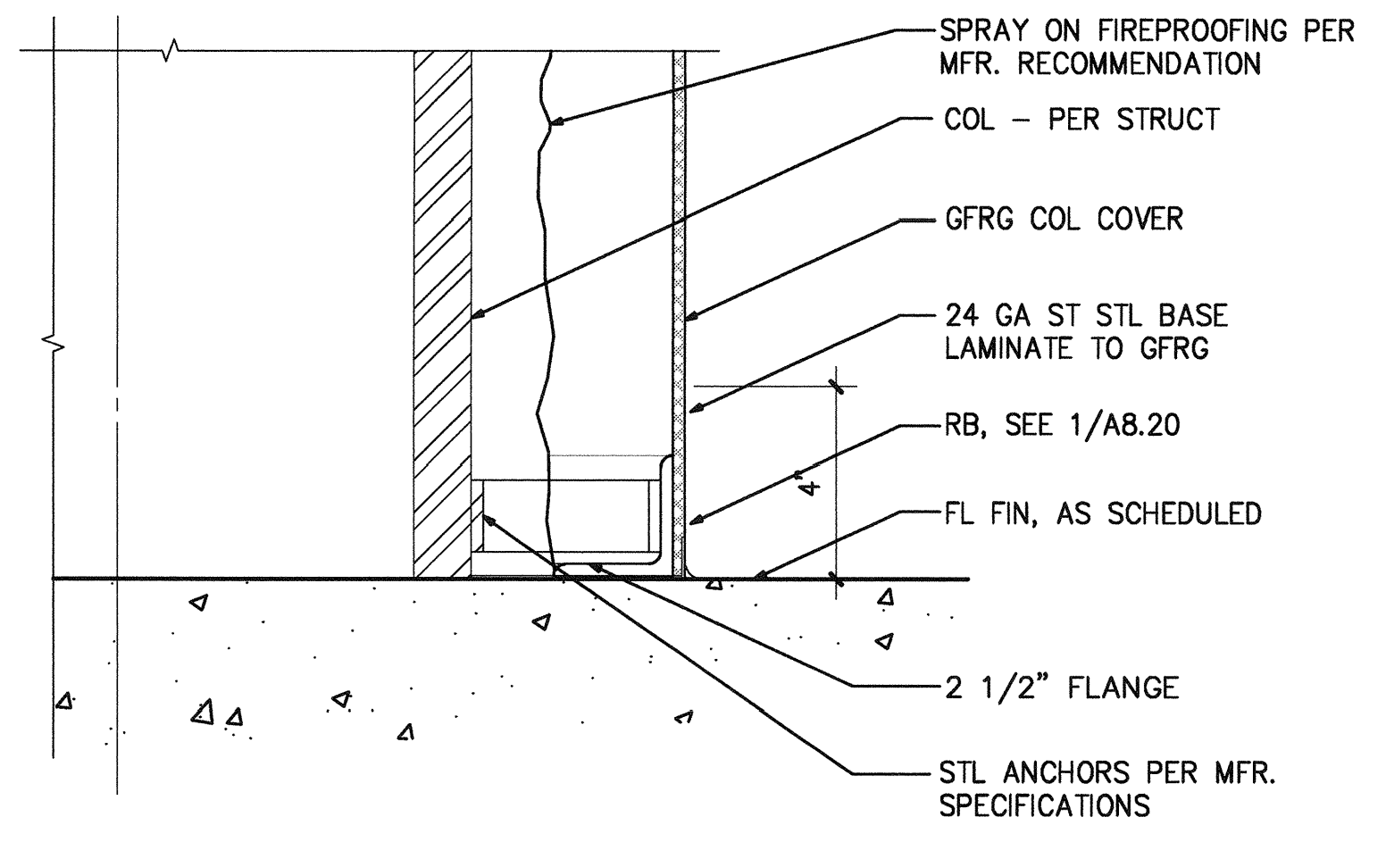

18 A8.04 **RB @ GRFG COL**
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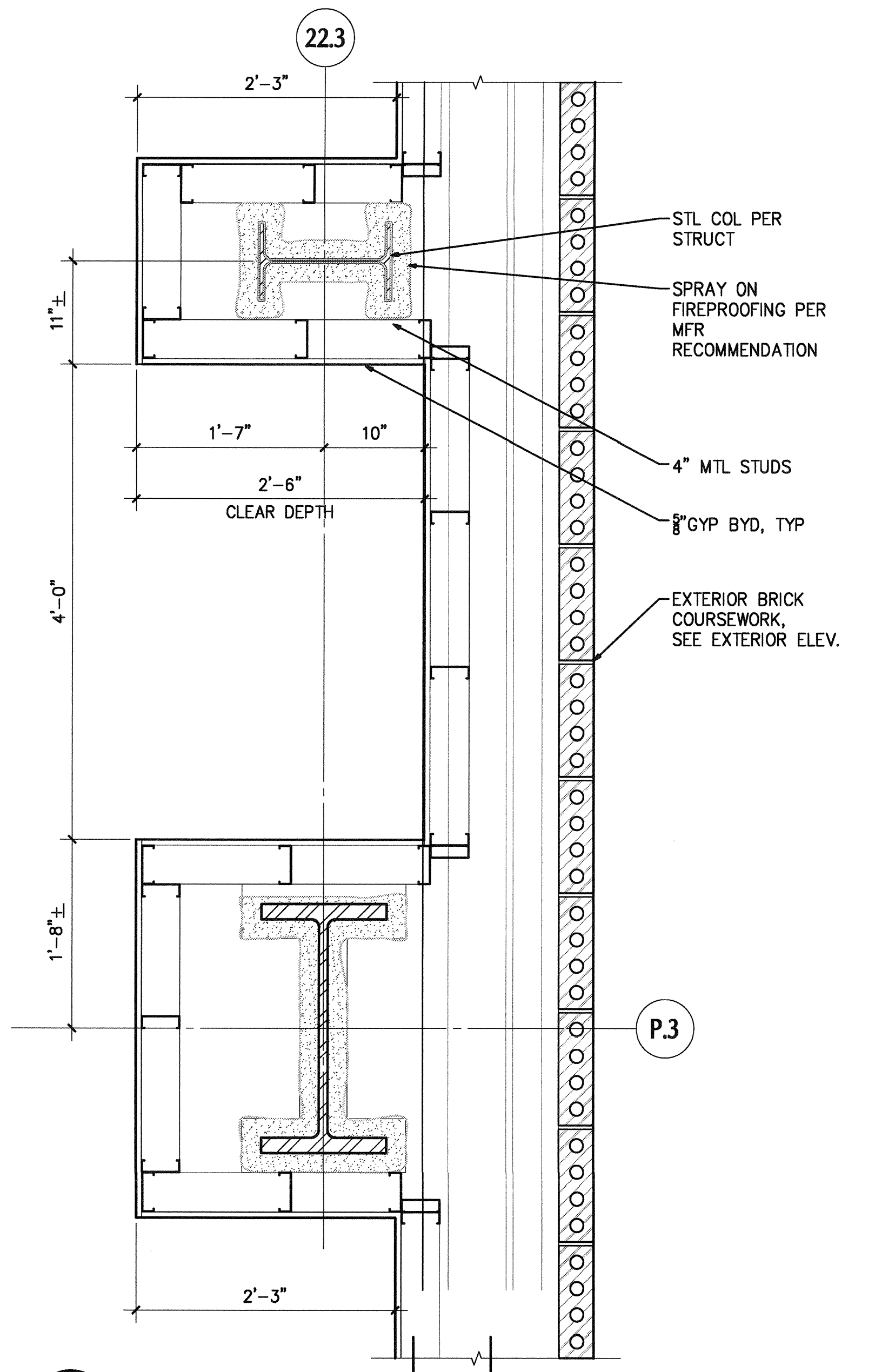

14 A8.04 **COL DTL - RM 338**
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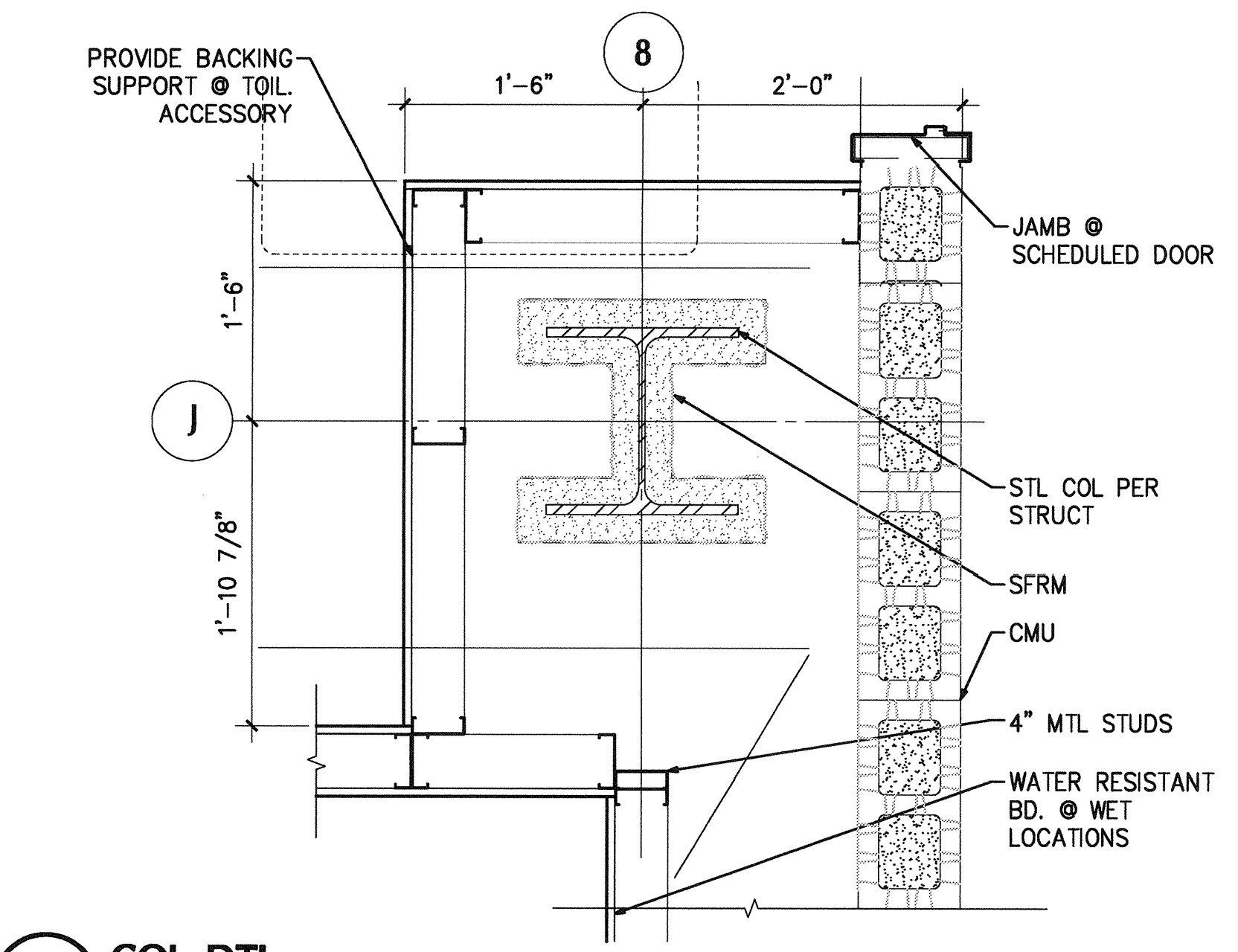

8 A8.04 **COL DTL**
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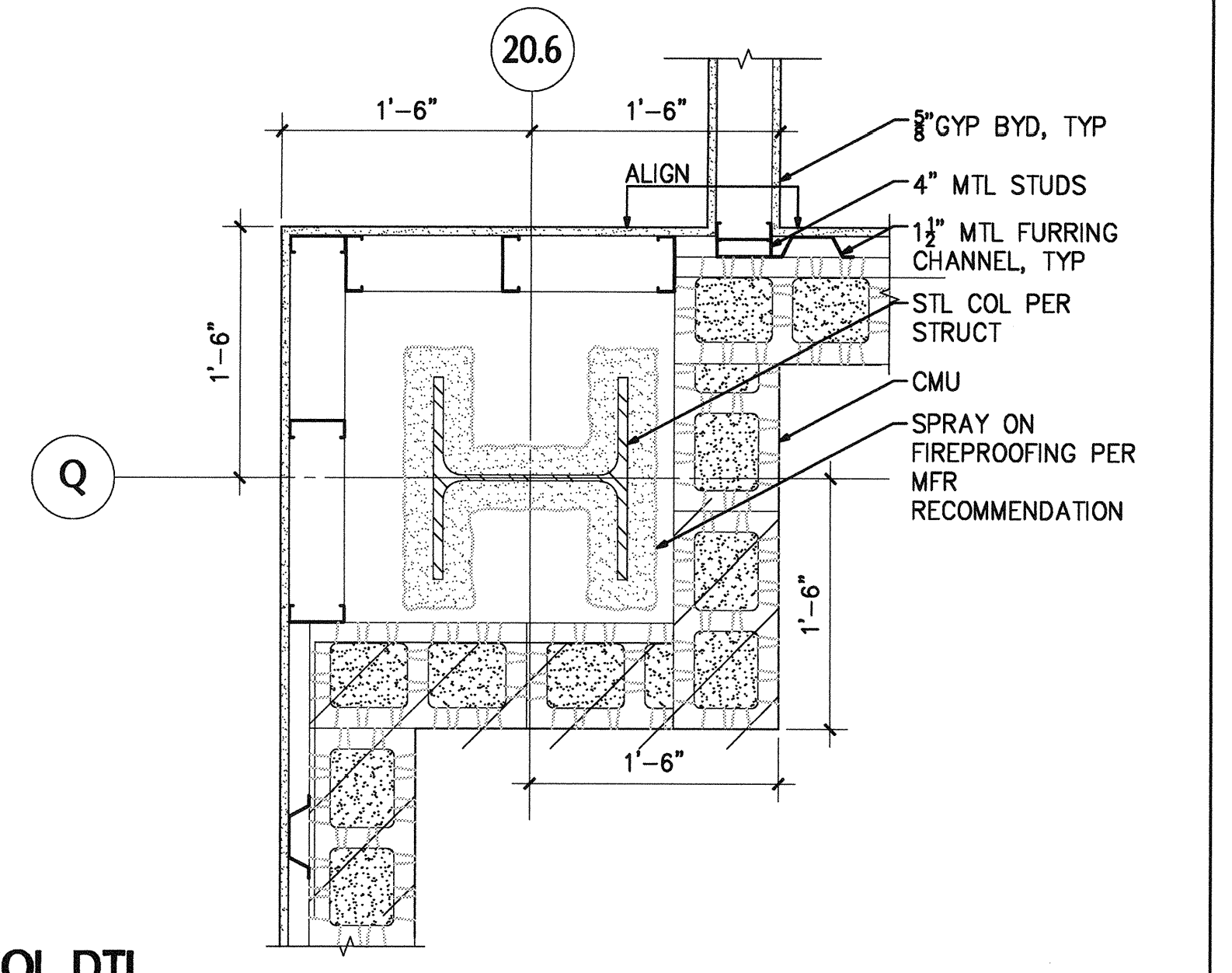

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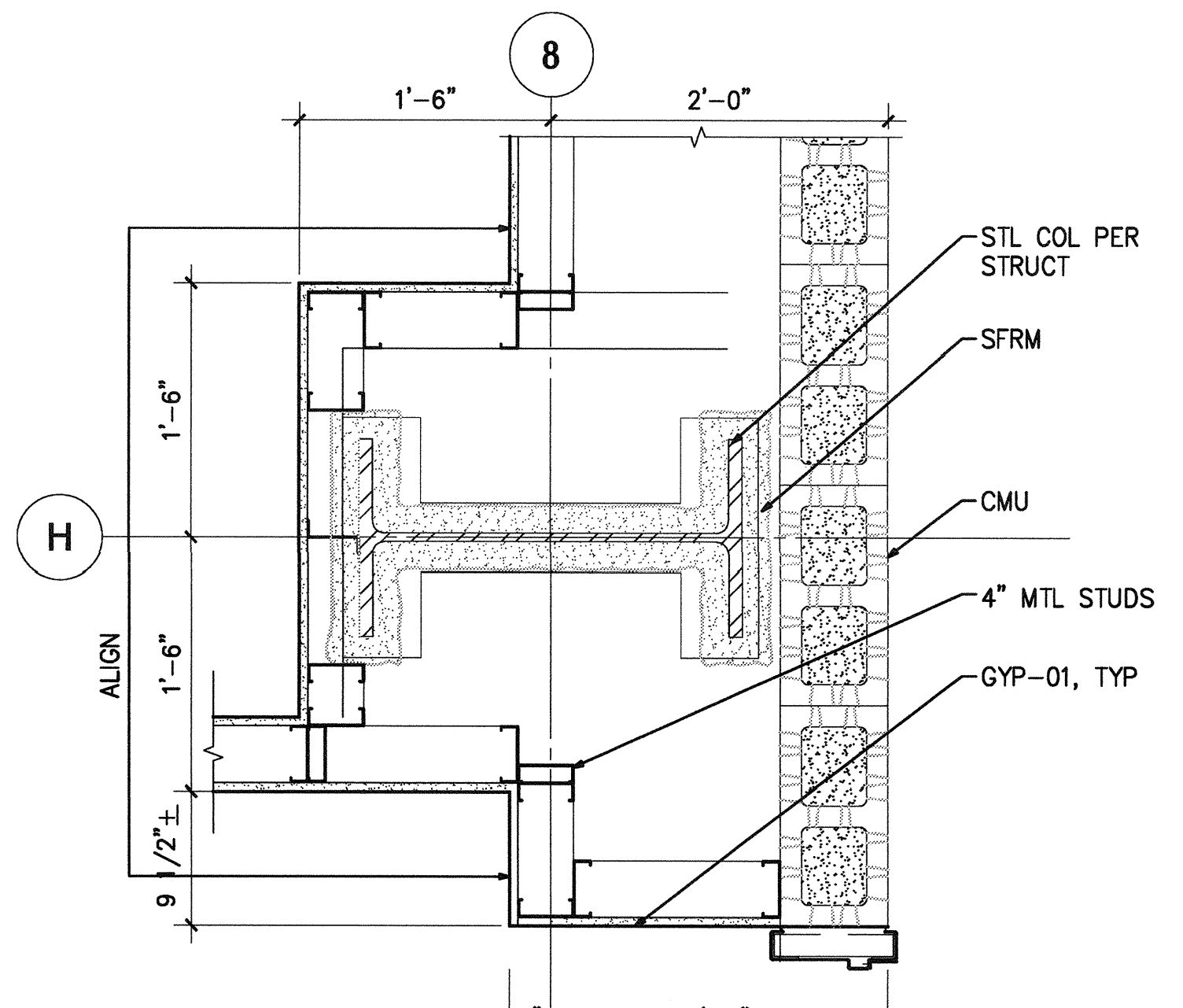

9 A8.04 **COL DTL**
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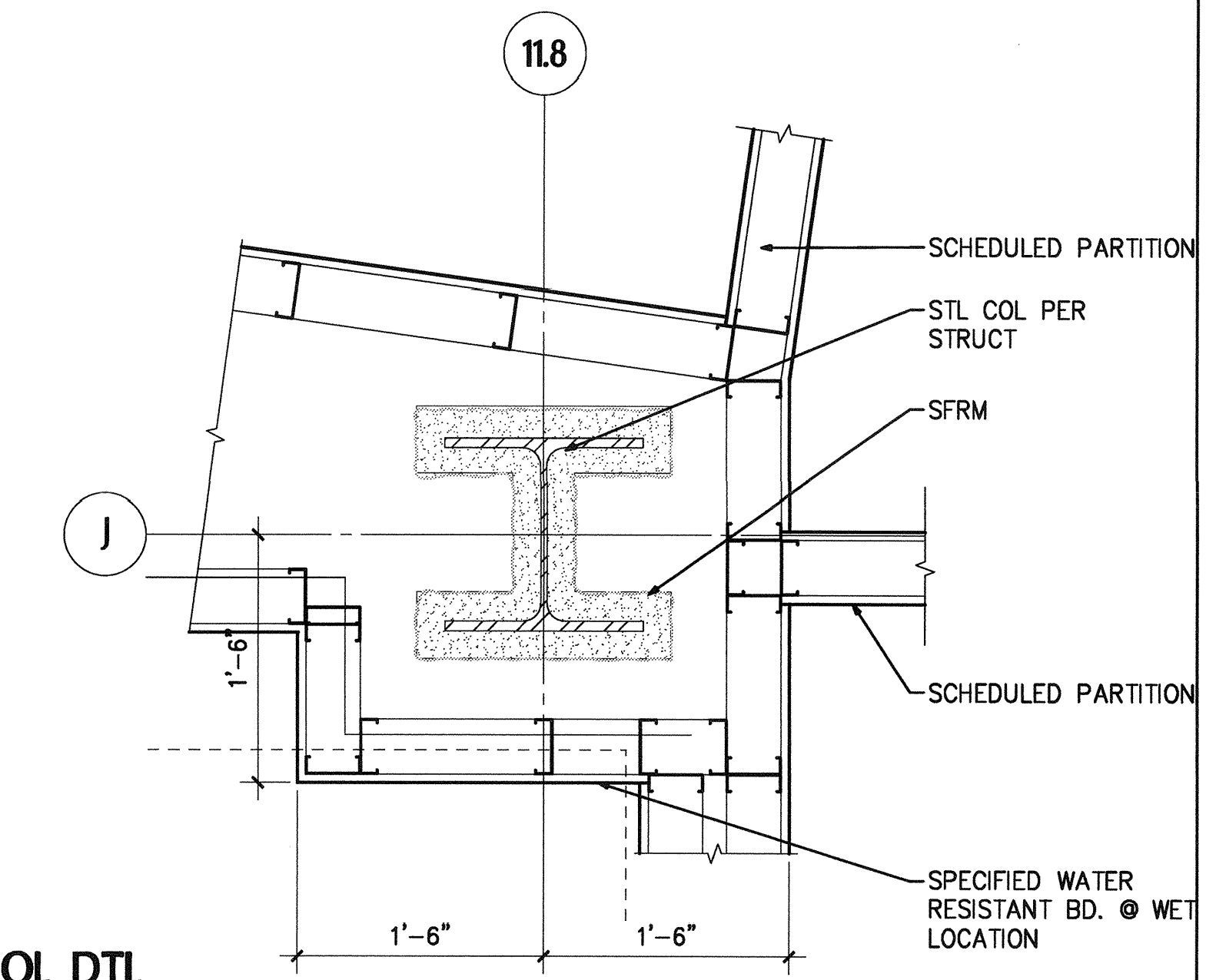

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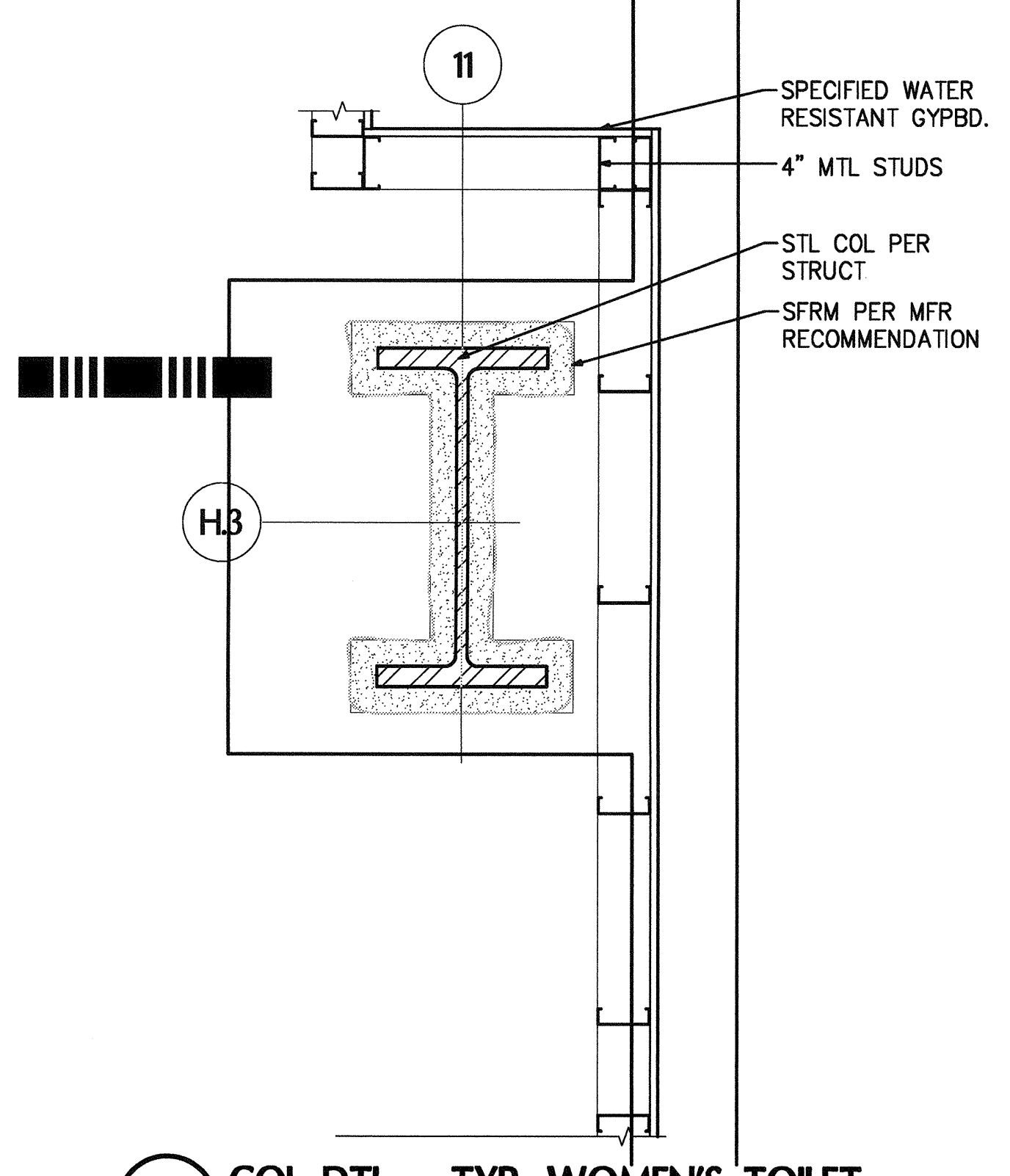

15 A8.04 **COL DTL - TYP. WOMEN'S TOILET**
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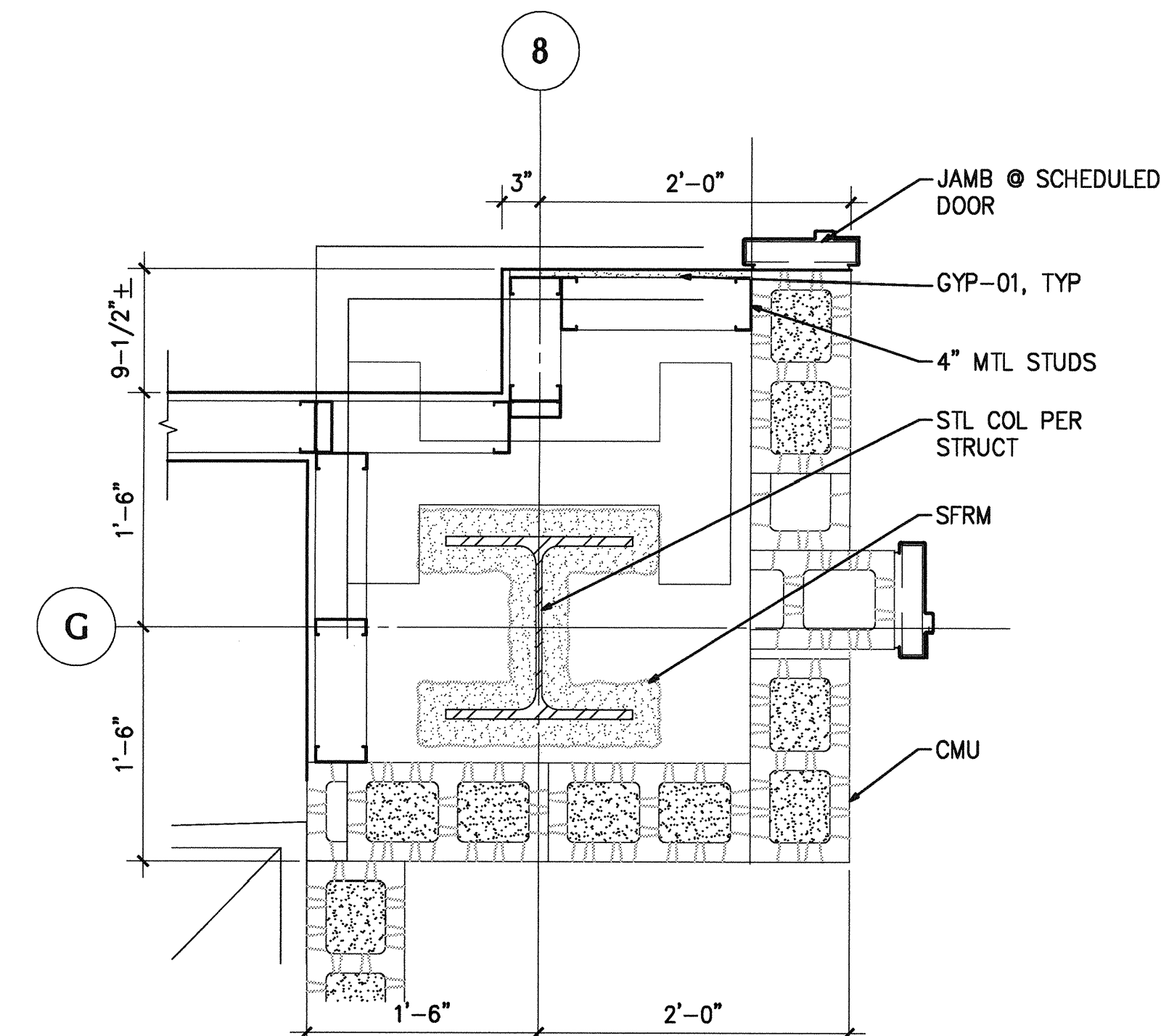

10 A8.04 **COL DTL**
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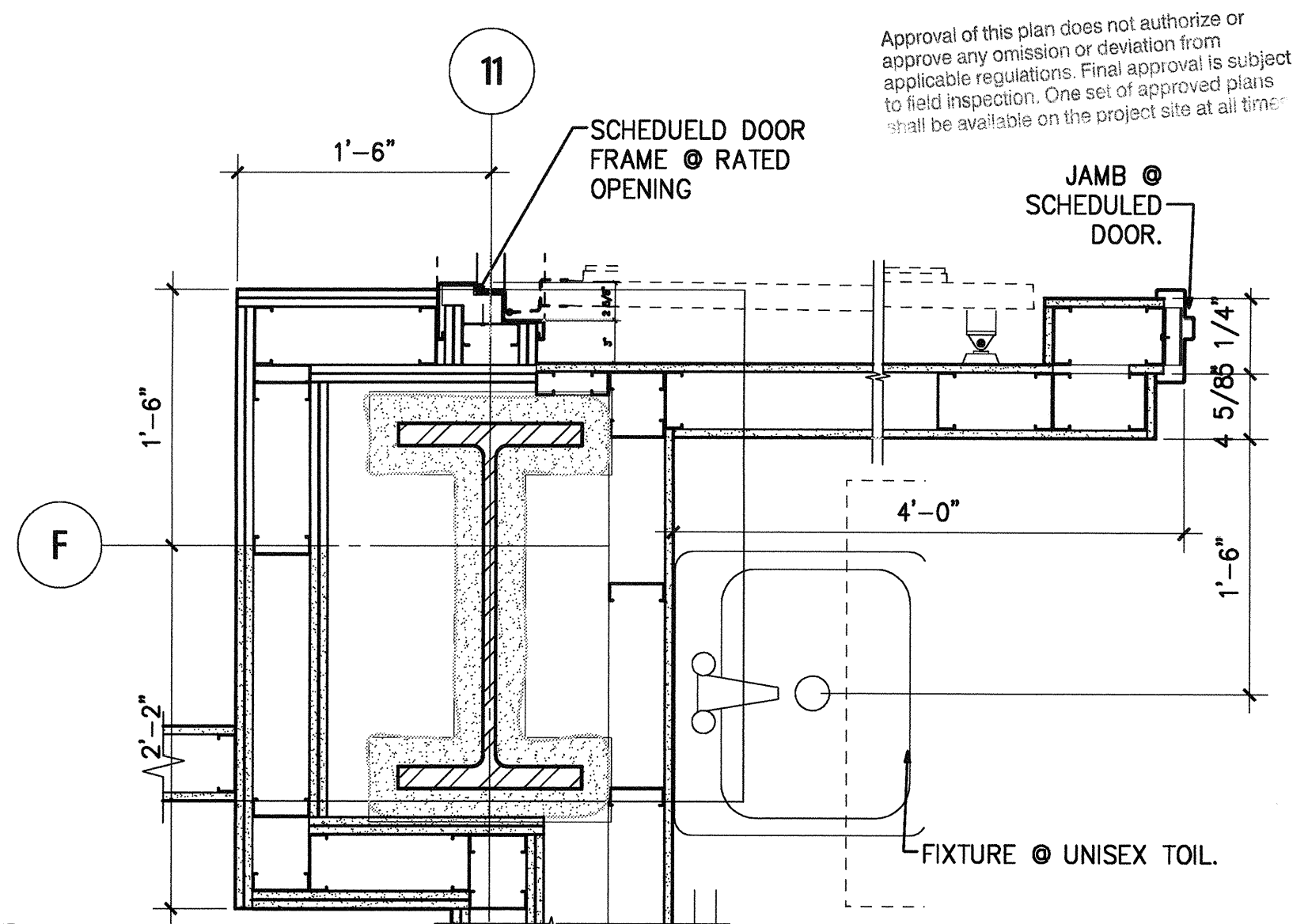

5 A8.04 **COL DTL**
SCALE: 1" = 1'-0"

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Architecture / Planning / Interior Design
Portland Seattle Los Angeles Washington DC New York

515 South Flower Street, Suite 3700
Los Angeles, California 90071

(PH) 213 617 1901
(FAX) 213 617 0047

Consultants
STRUCTURAL ENGINEER
John A. Martin & Associates, Inc
1212 S. Flower Street
Los Angeles, CA 90015

MECHANICAL ENGINEER
Rumsey Engineers
99 Linden Street
Oakland, CA 94607

ELECTRICAL ENGINEER
Integrated Design Associates, Inc
3140 De La Cruz Boulevard, Suite 110
Santa Clara, CA 95054

CIVIL ENGINEER
Cannon Associates
1050 Southwood Drive
San Luis Obispo, CA 93401

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Katherine Spitz and Associates
4212 1/2 Glencoe Avenue
Marina del Rey, CA 90292

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3965 Fifth Avenue, Suite 300
San Diego, CA 92103-3107

LIGHTING DESIGN
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P.O. Box 270254
Littleton, CO 80127

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SAN LUIS OBISPO, CA

Drawing Title
INTERIOR DETAILS FLOORING & BASES

TED ALAN HYMAN

Date: OCTOBER 23, 2009
Job No: L40302.05
Drawn By:
Checked By:

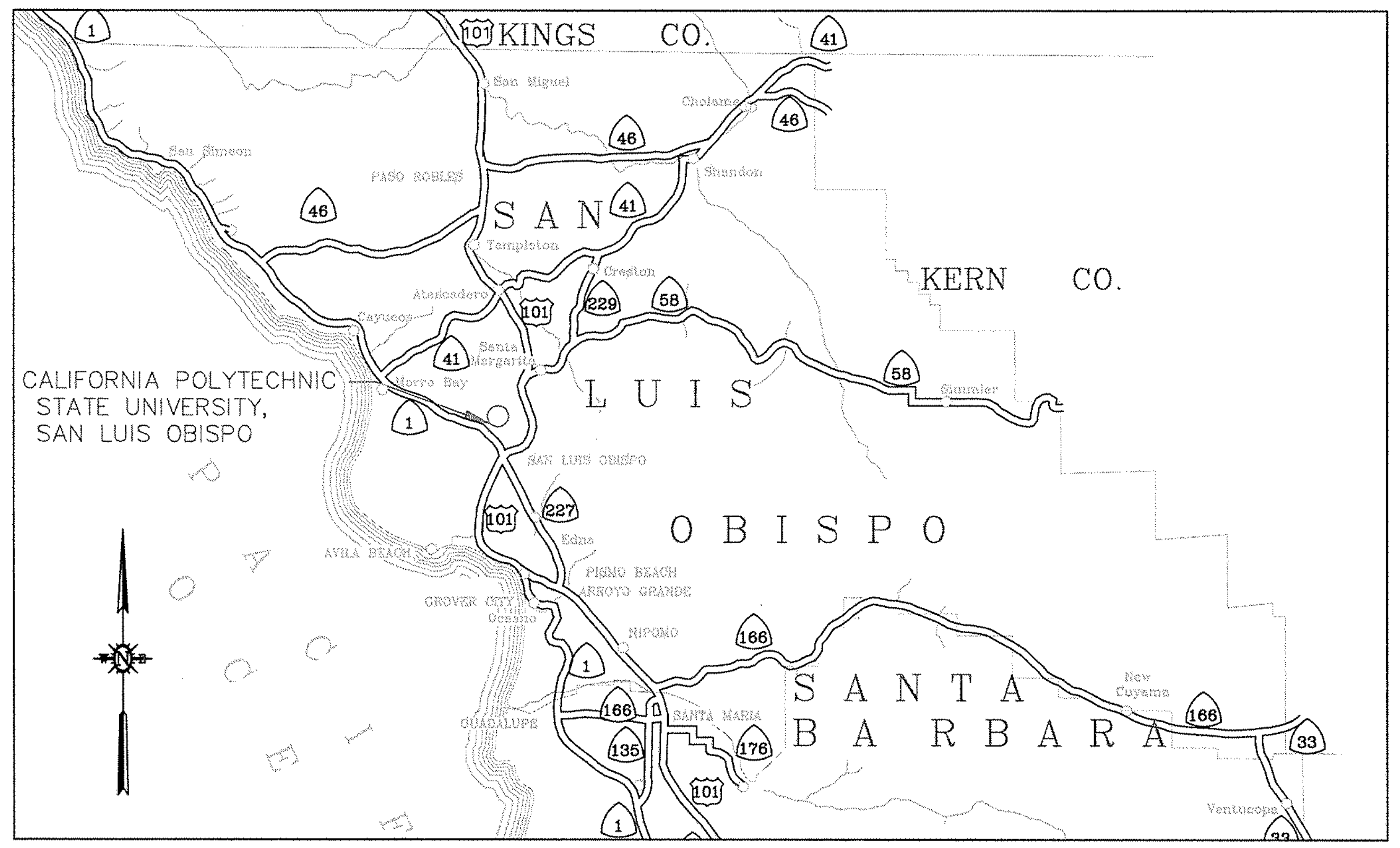
Drawing No.
A8.04

APPENDIX D – FIRE SPRINKLER PLANS

CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

DESIGNED AND INSTALLED
BY

AERO AUTOMATIC SPRINKLER CO.



REGIONAL MAP
N.T.S.

PROJECT DIRECTORY

OWNER	CALIFORNIA STATE POLYTECHNIC UNIVERSITY FACILITIES PLANNING & CAPITAL PROJECTS BUILDING 70 SAN LUIS OBISPO, CA 93047 TEL- (805) 756-2581 FAX- (805) 756-7566
ARCHITECT	ZIMMER GUNSUL FRASCA ARCHITECTS, LLP 515 SOUTH FLOWER ST. SUITE 3700 LOS ANGELES, CA 90071 TEL- (213) 617-1901 FAX- (213) 617-0047
STRUCTURAL ENGINEER	JOHN A. MARTIN & ASSOCIATES 950 S. GRAND AVENUE 4TH FLOOR LOS ANGELES, CA 90015 TEL- (213) 483-6490 FAX- (213) 483-3084
MECHANICAL/ PLUMBING ENGINEER	RUMSEY ENGINEERS 99 LINDEN STREET OAKLAND, CA 94607 TEL- (510) 663-2070 FAX- (510) 663-2080
ELECTRICAL ENGINEER	INTEGRATED DESIGN ASSOCIATES 1084 FOXWORTHY AVENUE, SUITE 150 SAN JOSE, CA 95118 TEL- (408) 448-6300 FAX- (408) 448-6301
CIVIL ENGINEER	CANNON ASSOCIATES 364 PACIFIC STREET SAN LUIS OBISPO, CA 93401 TEL- (805) 544-7407 FAX- (805) 544-3863
LANDSCAPE ARCHITECT	KATHERINE SPITZ ASSOCIATES 4212 1/2 GLENCOE AVENUE MARINA DEL REY, CA 90292 TEL- (310) 574-4460 FAX- (310) 574-4462
LABORATORY CONSULTANT	RESEARCH FACILITIES DESIGN 3965 FIFTH AVENUE, SUITE 300 SAN DIEGO, CA. 92103-3107 TEL- (619) 297-0159 FAX- (619) 294-4901
LIGHTING DESIGN	DAVID NELSON AND ASSOCIATES, LLC P.O. BOX 270254 LITTLETON, CO 80127 TEL- (720) 981-4560 FAX- (303) 484-3230

PROJECT DATA

NEW BUILDING DATA

NUMBER OF STORIES:	SIX (6) STORIES
ZGF PROJECT NUMBER:	L40302
TYPE CONSTRUCTION:	1B, FIRE-RESISTIVE
BUILDING OCCUPANCY:	GROUP B, BUSINESS OCCUPANCY, CONTAINING THE FOLLOWING USES:

USE	OCCUPANCY
LOBBIES/ LECTURE	A-3
OFFICES:	B
CONFERENCE ROOMS: (LESS THAN 50 OCCUPANTS)	B
LABORATORIES:	B
ELECTRICAL AND TELEPHONE / DATA	S-1
MECHANICAL ROOMS:	S-1
STORAGE	H-3
STORAGE	S-2

FIRE PROTECTION:	FULLY FIRE SPRINKLERED
HEIGHT:	108'
FLOOR AREA:	

FLOOR	SQ FT
LEVEL ONE:	23,146 G.S.F.
LEVEL TWO:	43,458 G.S.F.
LEVEL THREE:	43,209 G.S.F.
LEVEL FOUR:	33,307 G.S.F.
LEVEL FIVE:	25,294 G.S.F.
LEVEL SIX:	19,958 G.S.F.
TOTAL:	188,372 G.S.F.

BUILDING CODES:

2007 (CBC) CALIFORNIA BUILDING CODE
2007 (CFC) CALIFORNIA FIRE CODE
2007 (CMC) CALIFORNIA MECHANICAL CODE
2007 (CPC) CALIFORNIA PLUMBING CODE
2006 (NFPA 70) NATIONAL ELECTRICAL CODE
2006 (NFPA 101) LIFE SAFETY CODE
ADA STANDARDS FOR ACCESSIBLE DESIGN
ADA ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES (ADAAG)
[28 CFR PART 36, APPENDIX A]
NFPA 13 - AUTOMATIC SPRINKLER SYSTEMS, 2007 EDITION.
NFPA 14 - STANDPIPE AND HOSE SYSTEMS, 2004 EDITION.
NFPA 20 - STATIONARY PUMPS FOR FIRE PROTECTION, 2003 EDITION.

FIRE PROTECTION SYMBOLS

SYMBOL	DESCRIPTION
●	RECESSED PENDENT SPRINKLER
● 200	HIGH TEMPERATURE PENDENT SPRINKLER
○	UPRIGHT SPRINKLER
⊗	EXT. COVERAGE PENDENT SPRINKLER
◎	UPRIGHT SPRINKLER ON SPRIG UP
◁	HORZ. SIDEWALL SPRINKLER
⊕	RISE OR DROP IN PIPING w/ TEE
⊖	RISE OR DROP IN PIPING w/ ELBOW
—/—	PIPE HANGER LOCATIONS
—×—	PIPE HANGER LOCATION W/ STIFFNER
⊗	FIRE SPRINKLER RISER
—⊃	INSPECTOR'S TEST CONNECTION
——	NEW PIPING
— —	EXISTING PIPING
⬡ XX	HYDRAULIC REFERENCE POINT
↓ LAT	LATERAL SWAY BRACE
↔ LONG	LONGITUDAL SWAY BRACE
× BLR	BRANCH LINE RESTRAINT (BLR)
✛	4 WAY SWAY BRACE
*3'-1 1/2"	DECK TO CENTERLINE
10'-4" AFF	CENTERLINE ABOVE FINISH FLOOR
✳	DENOTES EXISTING 1" OUTLET

SCOPE OF WORK / HAZARD ANALYSIS

PROVIDE A COMPLETE WET PIPE FIRE SPRINKLER SYSTEM FOR A NEW 6-STORY CLASSROOM/LABRATORY BUILDING WITH FIRE PUMP & CLASS 1 STANDPIPE SYSTEM.
ALL SPRINKLERS TO BE QUICK RESPONSE TYPE UNLESS NOTED OTHERWISE.
SPRINKLERS IN FINISHED CEILINGS TO BE RECESSED CHROME PENDENT SPRINKLERS.
SPRINKLERS IN EXPOSED AREAS TO BE CHROME UPRIGHT OR PENDENT SPRINKLERS.
PIPING TO BE BLACK STEEL SCHEDULE 10 AND SCHEDULE 40.

DESIGN CRITERIA:
OCCUPANCY CLASSIFICATION

◇	OCCUPANCY	HAZARD	MAX SPACING	DESIGN	HOSE
A-3	LOBBIES/LECTURE	LIGHT HAZARD	225	.10/1500	100/0
B	OFFICE/CONFERENCE RM	LIGHT HAZARD	130	.10/1500	100/0
B	LABORATORIES	O.H. GR. 1	130	.15/1500	100/150
S-1	STORAGE/MECH/ELECT RM	O.H. GR. 1	130	.15/1500	100/150

FLOW TEST INFORMATION:	ACTUAL	REDUCED 10 PERCENT
STATIC:	60 psi	54 psi
RESIDUAL:	55 psi	49 psi
FLOW:	914 gpm	914 gpm

TEST DATE: 8-19-2011 9:12 AM
ORIFICE SIZE: 2-1/2"
ORIFICE COEFFICIENT: 0.90

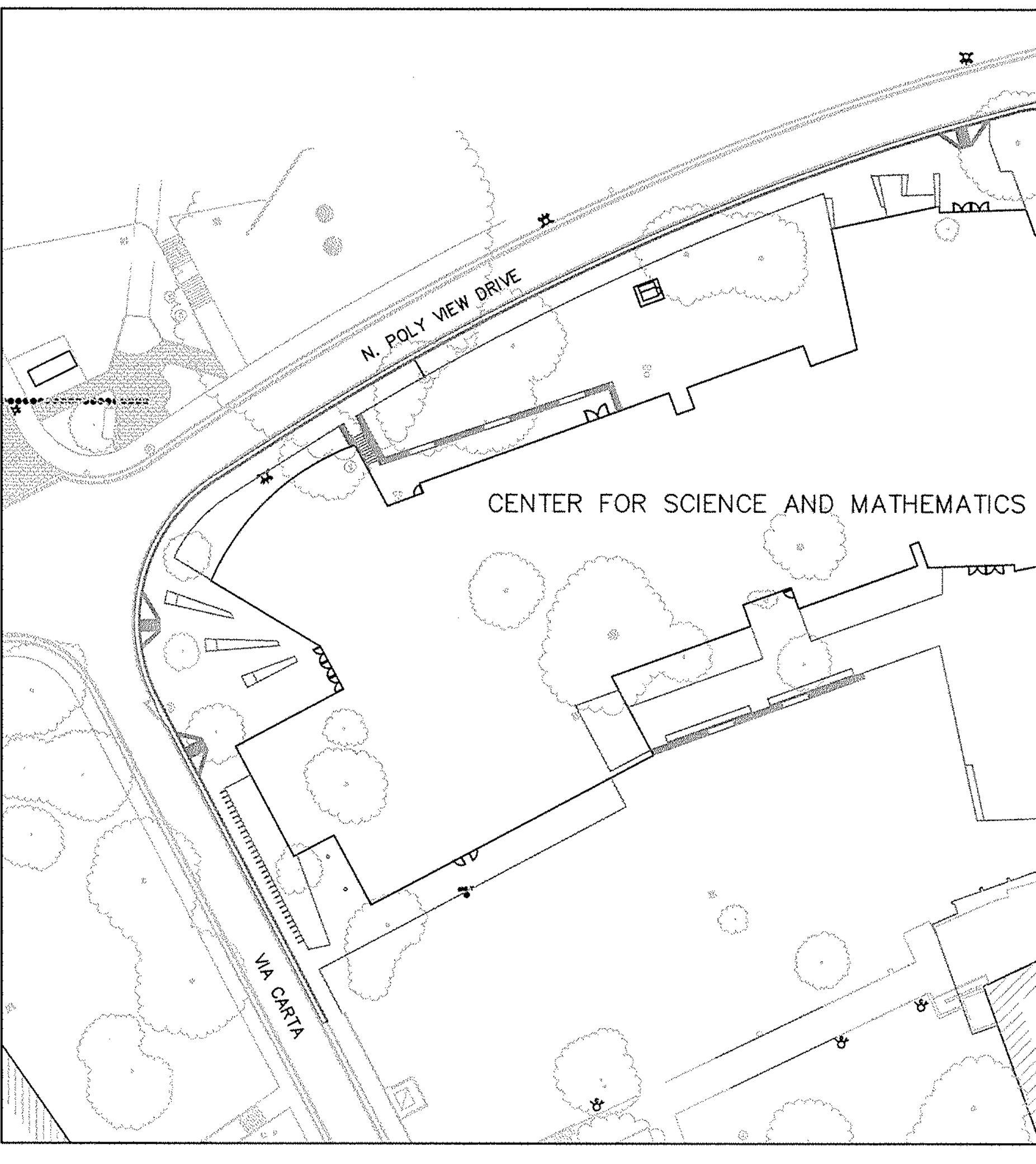
FLOW TEST PERFORMED BY FLUID RESOURCE MANAGEMENT
NOTE: FLOWING HYDRANT # 64 WITH STATIC & RESIDUAL PRESSURE FROM HYDRANT # 63

GENERAL SYSTEM NOTES:

1. ALL SYSTEM PIPING SHALL BE HYDROSTATICALLY TESTED AT 200 PSI OR AT 50 PSI ABOVE THE OPERATIONAL STATIC PRESSURE OF THE SYSTEM, WHICHEVER IS GREATER FOR TWO HOURS.
2. EACH VALVE SHALL HAVE A PERMANENTLY AFFIXED SIGN INDICATING ITS FUNCTION. ALL SPRINKLER SYSTEM CONTROL VALVE HANDLES TO BE LOCATED 7'-0" MAX. A.F.F.
3. A STOCK OF SPARE SPRINKLERS OF EACH STYLE AND TEMPERATURE RATING, WITH A SPRINKLER WRENCH, SHALL BE LOCATED NEAR THE RISER WHERE THE TEMPERATURE TO WHICH THEY
4. SPRINKLERS SHALL BE QUICK RESPONSE
   WITH CHROME RECESSED ESCUTCHEONS U.O.N. AND SHALL BE IN ALIGNMENT AND PARALLEL TO CEILING GRIDS
   SPRINKLERS IN UNFINISHED AREAS TO BE TYCO MODEL TY-FRB QUICK RESPONSE BRASS UPRIGHT
5. MAIN PIPING FOR THIS SYSTEM SHALL BE SCHEDULE 10 PIPE WITH GROOVED ENDS WITH APPLICABLE FITTINGS.
   BRANCH LINE CONNECTIONS TO THE MAIN SHALL BE PRE-DRILLED WITH SHOP WELDED OUTLETS.
   THREADED PIPING 1" TO 2" TO BE BLACK STEEL BMT SCHEDULE 40 WITH BLACK CAST IRON OR DUCTILE IRON FITTINGS
   1 1/4" AND LARGER BRANCH LINE & MAIN PIPING TO BE SCHEDULE 10 PIPE WITH GROOVED ENDS WITH GROOVED FITTINGS.
6. ALL MATERIALS USED IN THE INSTALLATION OF THESE SYSTEMS SHALL BE NEW AND OF CURRENT ISSUE, AND APPROVED BY U.L. (UNDERWRITERS LAB) AND/OR FM (FACTORY MUTUAL). ALL MATERIALS SHALL BE IN CONFORMANCE WITH NFPA-13, 2007 AS WELL AS THE AUTHORITY HAVING JURISDICTION.
7. SYSTEM PIPING WILL BE SUPPORTED WITH HANGERS IN ACCORDANCE WITH NFPA-13, 2007.
8. SPACING AND DETAILS OF THE SUPPORT AND BRACING OF FIRE SPRINKLER PIPING SHALL COMPLY WITH THE 2007 EDITION OF NFPA 13.
9. PAINTING OF THE SYSTEM PIPING AND COMPONENTS IS NOT PART OF THIS SCOPE AND, IF REQUIRED, IT SHALL BE PERFORMED BY OTHERS
10. UNDERGROUND PIPING IS NOT PART OF THIS SCOPE. FIRE PROTECTION CONTRACT TO START AT FLANGE (BY OTHERS) AT 6" ABOVE FINISHED FLOOR.
11. WIRING OF WATERFLOW SWITCH & CONTROL VALVE TAMPER SWITCHES BY OTHERS. ALL OTHER ALARM DEVICES TO BE PROVIDED, INSTALLED AND TESTED BY OTHERS

Sheet List Table

Sheet Number	Sheet Title
FP-1.0	COVER SHEET
FP-2.0	FIRE SPRINKLER SITE PLAN
FP-3.0	FIRE PUMP PLAN
~~FP-4.9~~	~~TEMP. STANDPIPE~~
FP-4.0	STANDPIPE - OVERALL ISOMETRIC
FP-4.1	STANDPIPE # 1 DETAILS
FP-4.2	STANDPIPE # 3 DETAILS
FP-4.3	STANDPIPE # 4 DETAILS
FP-4.4	STANDPIPE # 5 DETAILS
FP-5.0	HANGER & E.Q. DETAILS
FP-6.01W	FIRE SPRINKLER PLAN LEVEL 1 WEST
FP-6.02W	FIRE SPRINKLER PLAN LEVEL 2 WEST
FP-6.02E	FIRE SPRINKLER PLAN LEVEL 2 EAST
FP-6.03W	FIRE SPRINKLER PLAN LEVEL 3 WEST
FP-6.03E	FIRE SPRINKLER PLAN LEVEL 3 EAST
FP-6.04W	FIRE SPRINKLER PLAN LEVEL 4 WEST
FP-6.04E	FIRE SPRINKLER PLAN LEVEL 4 EAST
FP-6.05E	FIRE SPRINKLER PLAN LEVEL 5 EAST
FP-6.06E	FIRE SPRINKLER PLAN LEVEL 6 EAST
FP-7.01W	FIRE SPRINKLER RCP LEVEL 1 WEST
FP-7.02W	FIRE SPRINKLER RCP LEVEL 2 WEST
FP-7.02E	FIRE SPRINKLER RCP LEVEL 2 EAST
FP-7.03W	FIRE SPRINKLER RCP LEVEL 3 WEST
FP-7.03E	FIRE SPRINKLER RCP LEVEL 3 EAST
FP-7.04W	FIRE SPRINKLER RCP LEVEL 4 WEST
FP-7.04E	FIRE SPRINKLER RCP LEVEL 4 EAST
FP-7.05E	FIRE SPRINKLER RCP LEVEL 5 EAST
FP-7.06E	FIRE SPRINKLER RCP LEVEL 6 EAST



VICINITY MAP
0 50 100
1 INCH = 50 FEET

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181

REGISTERED PROFESSIONAL ENGINEER
GEORGE PROVENCHER
FP 693
exp 12-31-11
FIRE PROTECTION
STATE OF CALIFORNIA
09/29/11

---SECTION 210500---
COMMON WORK
RESULTS FOR FIRE
SUPPRESSION

PART 1 GENERAL
1.8.3 SHOP DRAWINGS

---SECTION 211200---
FIRE SUPRESSION
STANDPIPES

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

---SECTION 211300---
FIRE SUPPRESSION
SPRINKLER SYSTEMS

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

---SECTION 213000---
FIRE PUMP

PART 1 GENERAL
1.4.3 SHOP DRAWINGS

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET | QTY

#	DATE	BY	DESCRIPTION
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△1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

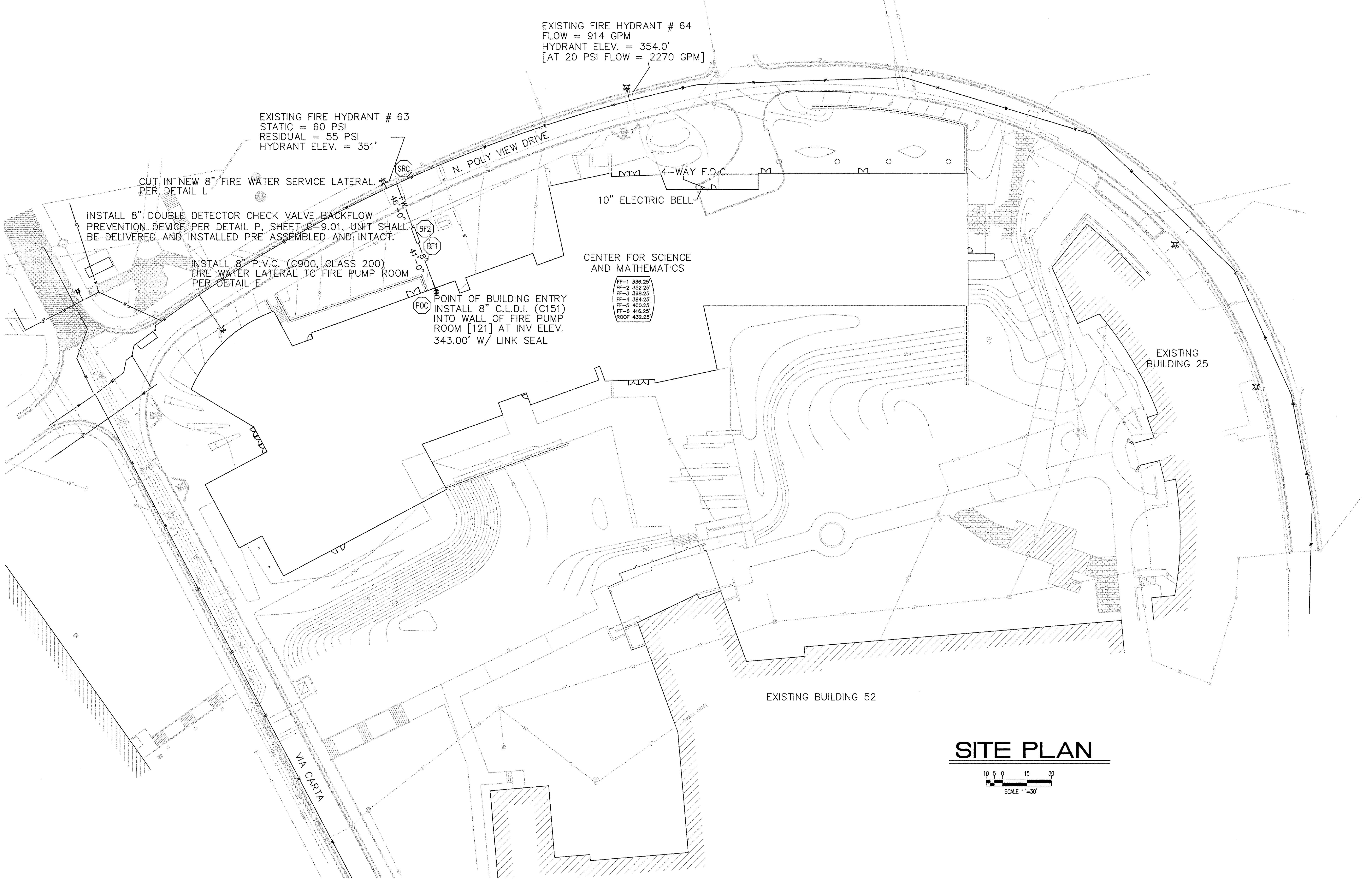
AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-8370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
COVER SHEET

DRAWN BY: NRL
SCALE: AS NOTED
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-1.0



SITE PLAN

10 5 0 15 30
SCALE 1"=30'

FLOW TEST SUMMARY

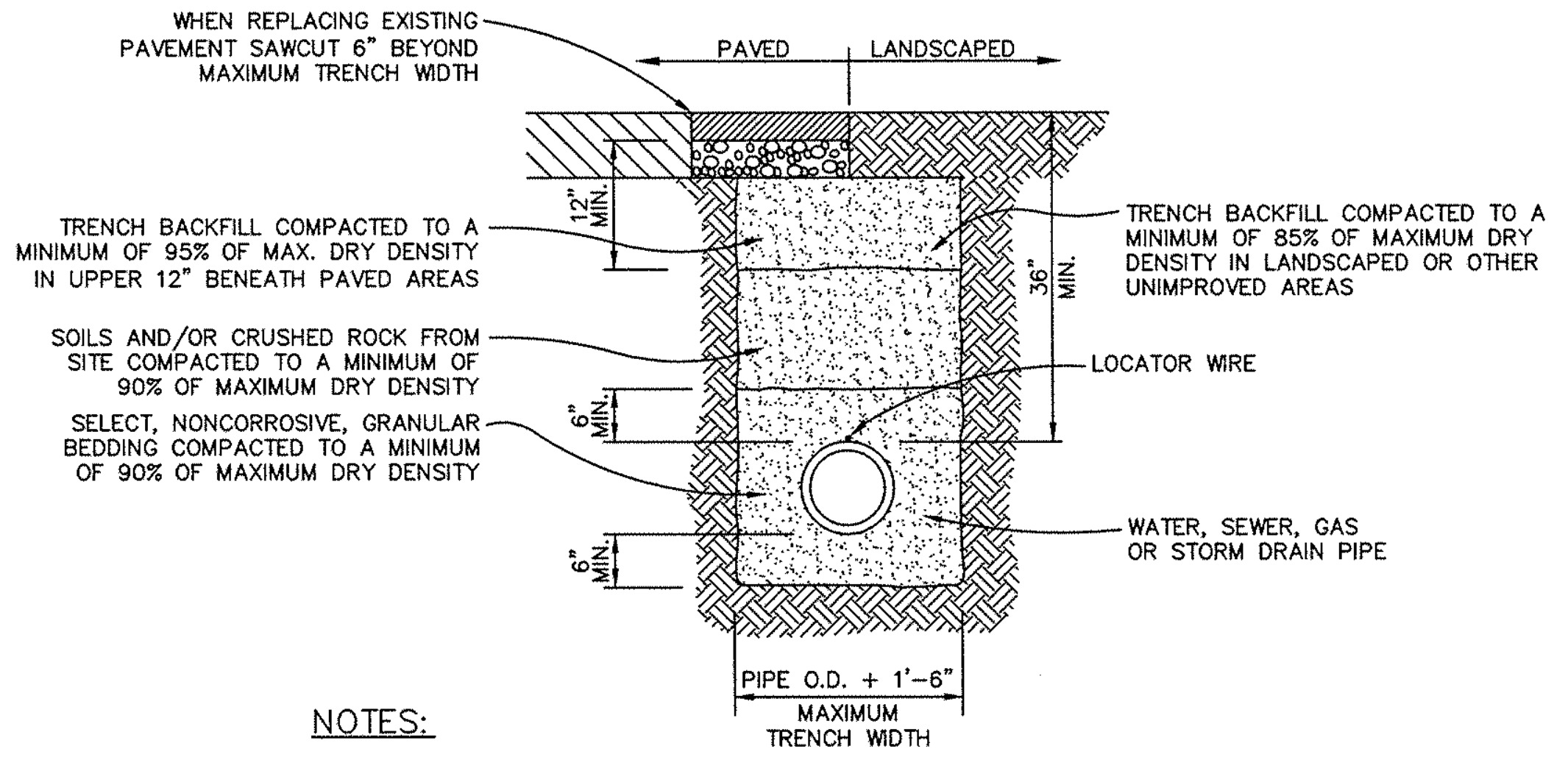
STATIC PSI	60
RESIDUAL PSI	55
PITOT PSI	35
ORIFICE DIAMETER	2 1/2
COEFFICIENT OF DISCHARGE	0.9
GPM	914

DATE 8-19-2011
LOCATION N. POLY VIEW DRIVE
BY WHO FLUID RESOURCE MANAGEMENT, INC.

ADJUSTED FLOW
10 % REDUCTION

STATIC PSI	54
RESIDUAL PSI	49
GPM	914

STATIC & RESIDUAL TAKEN FROM HYD. # 63
FLOW TAKEN FROM HYD. # 64



NOTES:

A. ALL MATERIAL USED AS TRENCH BACKFILL SHALL BE FREE OF DEBRIS, TRASH, OLD PAVEMENT AND ORGANIC MATERIAL AND SHALL BE CLEANED OF ANY ROCKS AND IRREDUCIBLE MATERIAL LARGER THAN 3 INCHES.

B. WHEN BACKFILL MATERIAL INCLUDES ROCKS, THE ROCKS SHALL BE PLACED IN A SUFFICIENT SOIL MATRIX TO ENSURE THAT VOIDS CAUSED BY NESTING OF THE ROCKS WILL NOT OCCUR AND THAT THE FILL CAN BE PROPERLY COMPACTED.

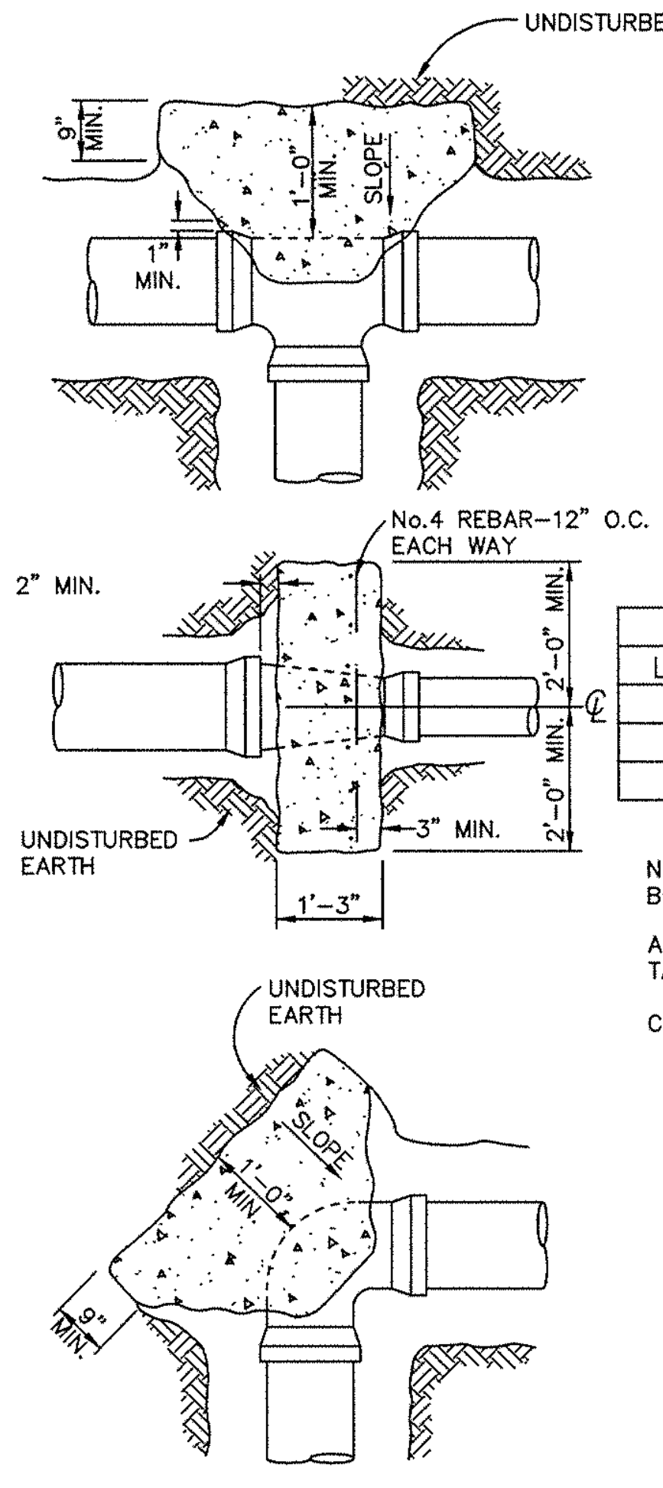
C. SELECT BEDDING SHALL NOT CONTAIN ANY ROCKS.

D. THE PAVEMENT AND LANDSCAPED AREAS SHALL BE INSTALLED PER APPROPRIATE PLANS AND SPECIFICATIONS.

E. No. 12 AWG LOCATOR WIRE SHALL BE TAPED TO THE TOP OF ALL PIPES.

E PIPE IN TRENCH DETAIL
N.T.S.

NOTE: UTILITY PLAN PREVIOUSLY APPROVED BY THE OFFICE OF STATE FIRE MARSHAL (FIRE and PANIC ONLY) ON NOV. 10, 2009. THESE DETAILS ARE ALL FROM THAT CIVIL PACKAGE.



PIPE SIZE	BEARING SIZE
12"	15 S.F.
10"	11 S.F.
8"	7 S.F.
6"	4 S.F.
4"	2 S.F.

REDUCER SIZE		
LARGE END	SMALL END	BEARING AREA
12"	8"	9 S.F.
12"	10"	5 S.F.
8"	6"	4 S.F.

NOTE:
BEARING AREA SHALL BE AGAINST UNDISTURBED EARTH

ALL BOLTS AND FITTINGS SHALL BE COVERED AND TAPED WITH PLASTIC WRAP, CUMULATIVE 15 MIL.

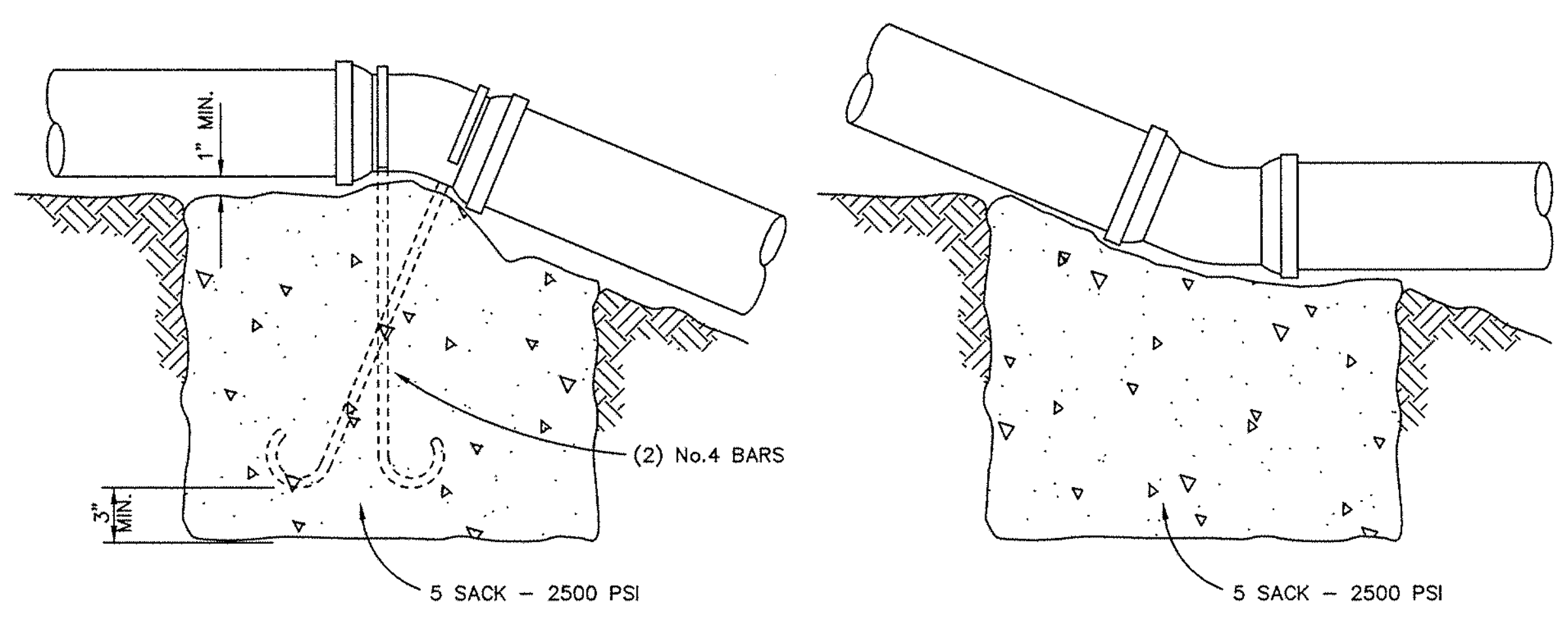
CONCRETE SHALL BE 5-SACK, 2500 PSI

	BEARING AREA			
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND	90° BEND
12"	3 S.F.	6 S.F.	12 S.F.	21 S.F.
10"	2 S.F.	4 S.F.	8 S.F.	15 S.F.
8"	2 S.F.	3 S.F.	5 S.F.	10 S.F.
6"	1 S.F.	2 S.F.	3 S.F.	4 S.F.
4"	1 S.F.	1 S.F.	1 S.F.	2 S.F.

N THRUST BLOCK DETAIL
N.T.S.

NOTE:
1. CONCRETE BLOCK SHOULD BE APPROX. EQUAL IN ALL DIMENSIONS.

2. ALL BOLTED FLANGED ITEMS SHALL HAVE CUMULATIVE 15 MIL PLASTIC WRAP AND TAPED COVERING BOLTS AND FITTINGS.

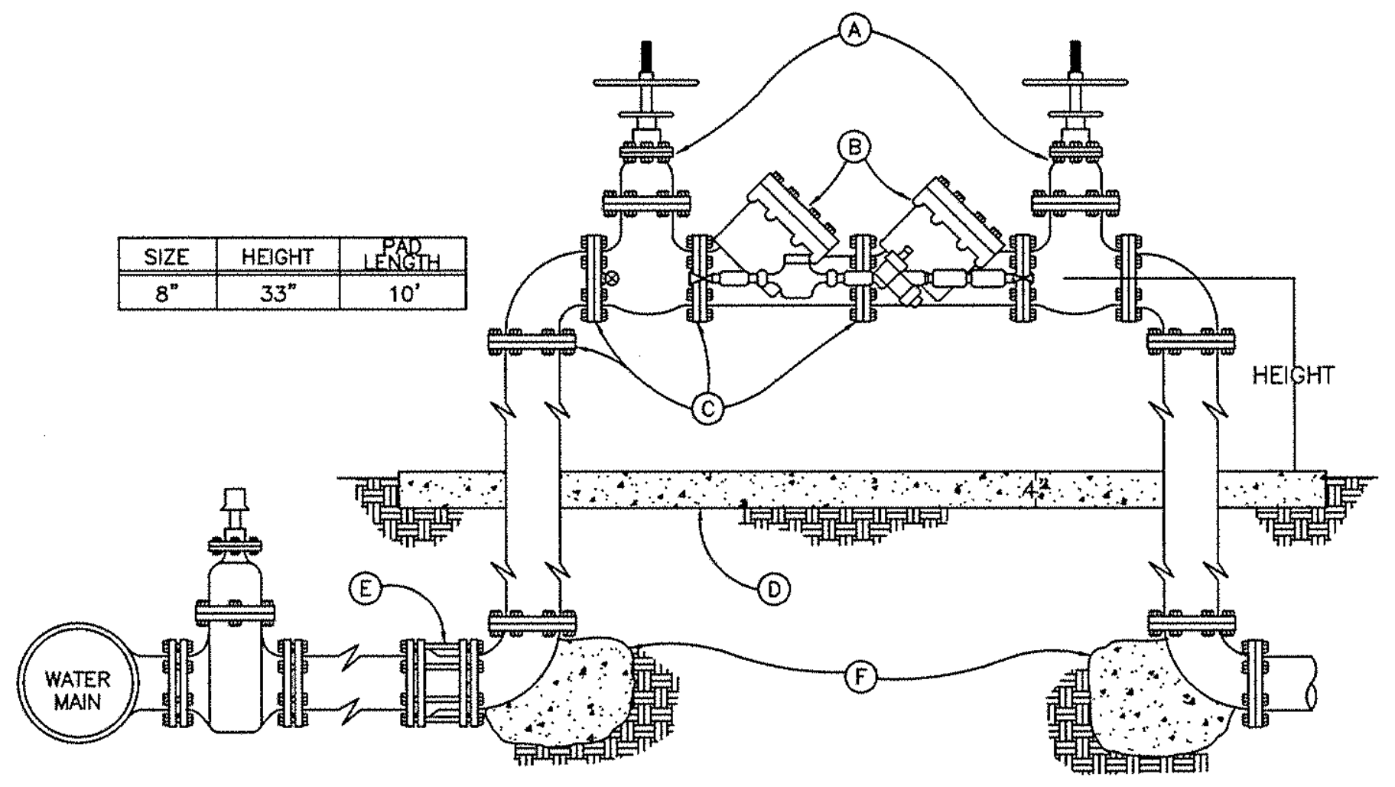


	CONCRETE VOLUMES		
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND
12"	1 YD	3 YDS	6 YDS
10"	1 YD	2 YDS	4 YDS
8"	0.5 YD	1 YD	2 YDS

	BEARING AREA			
PIPE SIZE	11-1/4° BEND	22-1/2° BEND	45° BEND	90° BEND
12"	3 S.F.	6 S.F.	12 S.F.	21 S.F.
10"	2 S.F.	4 S.F.	8 S.F.	15 S.F.
8"	2 S.F.	3 S.F.	5 S.F.	10 S.F.
6"	1 S.F.	2 S.F.	3 S.F.	4 S.F.
4"	1 S.F.	1 S.F.	1 S.F.	2 S.F.

O VERTICAL THRUST BLOCK DETAIL
N.T.S.

SIZE	HEIGHT	PAD LENGTH
8"	33"	10'



Ⓐ 8" O.S.&Y. GATE VALVES WITH FULLY-ENCAPSULATED RESILIENT SEAT – Dresser or Kennedy (CONFORMING TO LATEST EDITION OF AWWA STANDARD C509-80.

Ⓑ U.S.C. APPROVED DOUBLE DETECTOR CHECK VALVE BACKFLOW PREVENTION ASSEMBLY, WITH 3/4" NON-VALVED BYPASS METER ASSEMBLY.
[8" WILKINS MODEL 350ADA]

Ⓒ ALL RISERS AND ABOVE-GROUND MAINLINE FITTINGS SHALL BE FLANGE-TYPE.

Ⓓ P.C.C. PAD, 12" MIN. AROUND RISERS, 5-SACK.

Ⓔ M.J. x FLANGE ADAPTOR.

Ⓕ P.C.C. THRUST BLOCKS, 5-SACK.

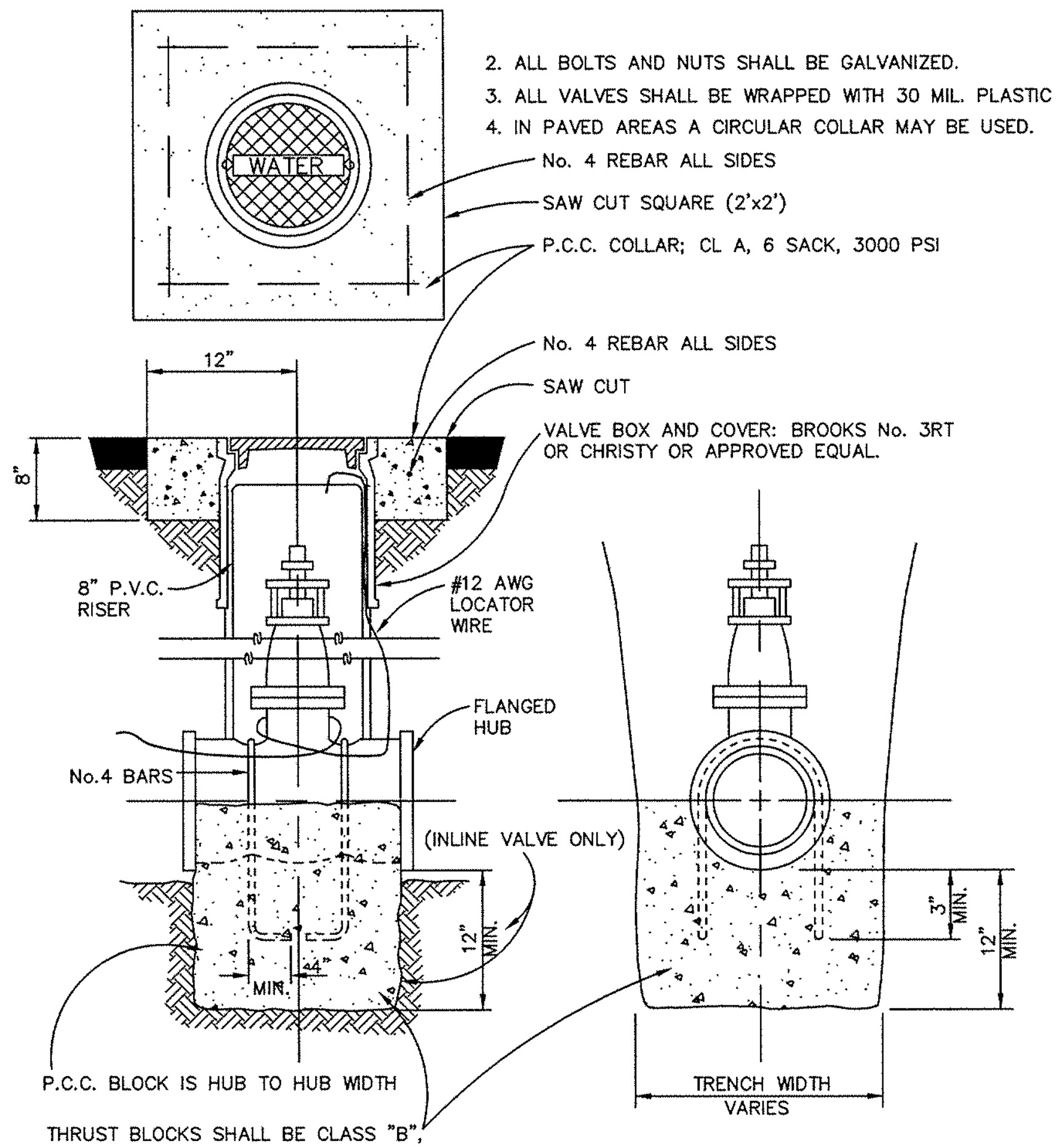
Ⓖ 2-2 1/2" FDC ON DOWN STREAM SIDE OF BACKFLOW PREVENTION DEVICE.

Ⓗ DOUBLE CHECK ASSEMBLY SHALL BE PROVIDED PER THE COUNTY OF SAN LUIS OBISPO APPROVED BACK FLOW DEVICES LIST.
[8" WILKINS MODEL 350ADA]

P DOUBLE CHECK ASSEMBLY
N.T.S.

LID LABELED "WATER", BROOKS No. 3RT OR CHRISTY OR APPROVED EQUAL

2. ALL BOLTS AND NUTS SHALL BE GALVANIZED.
3. ALL VALVES SHALL BE WRAPPED WITH 30 MIL. PLASTIC AND TAPED.
4. IN PAVED AREAS A CIRCULAR COLLAR MAY BE USED.



P.C.C. BLOCK IS HUB TO HUB WIDTH

THRUST BLOCKS SHALL BE CLASS "B", 6 SACK CONCRETE ON UNDISTURBED SOIL

L GATE VALVE BOX & ANCHOR
N.T.S.

IDENTIFICATION STAMP
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OFFICE OF REGULATION SERVICES
APPL 01-110181

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

ESCUTCHEON

TOTAL SPRINKLERS THIS SHEET

#	DATE	BY	DESCRIPTION
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△	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

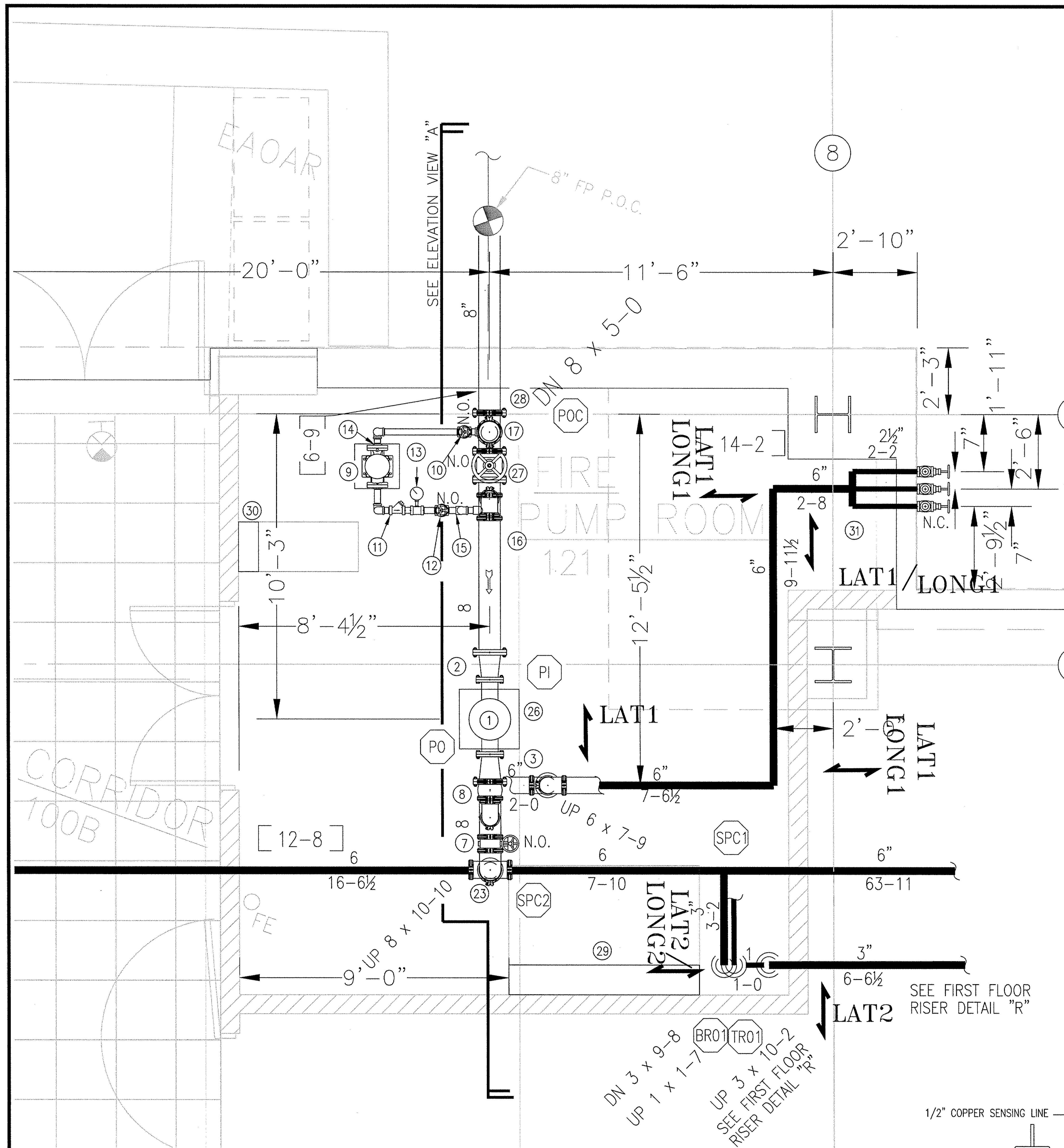
AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER SITE PLAN

DRAWN BY: NRL
SCALE: AS NOTED
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-2.0



FIRE PUMP ROOM

SCALE 1/2"=1'-0"

FIRE PUMP KEY NOTES

1- VERTICAL INLINE FIRE PUMP RATED 113 P.S.I. @ 750 GPM W/ELECTRIC MOTOR DRIVE (60 H.P.)
2- 8"x6" ECCENTRIC FLANGED REDUCER
3- 8"X6" CONCENTRIC FLANGED INCREASER
4- DISCHARGE GUAGE
5- SUCTION GAGE
6- 8" GROOVED TEE
7- 8" GROOVED BUTTERFLY VA. W/ TAMPER SWITCH
8- 8" GROOVED CHECK VALVE. (250 PSI)
9- JOCKEY PUMP (CRN 3-11 [2.0 H.P.])
10- 1 1/4" THREADED O.S.& Y. VALVE
11- 1 1/4" THREADED CHECK VALVE
12- 1 1/4" THREADED H.D. O.S.& Y. VALVE
13- WATER GAGE ON 1/4" 3-WAY VALVE
14- 1 1/4" TO JOCKEY PUMP
15- 1 1/4" FROM JOCKEY PUMP
16- 8" CITY BYPASS
17- 8" GROOVED 90° ELBOW
18- 8" GROOVED COUPLING FLEXIBLE
19- 6" GROOVED COUPLING FLEXIBLE
20- 1" AIR RELEASE VALVE
21- 2" PIPE STAND.
22- 6" GROOVED 90° ELBOW.
23- 6" GROOVED TEE.
24- 6" GROOVED BUTTERFLY VA. W/ TAMPER SWITCH.
25- 8" X 6" GROOVED REDUCING COUPLING.
26- 24" X 24" X 8" FIRE PUMP HOUSEKEEPING PAD
27- 8" O.S.&Y. W/ TAMPER SWITCH
28- 8" GROOVED FLANGE
29- FIRE PUMP CONTROL PANEL WITH AUTOMATIC TRANSFER SWITCH.
30- JOCKEY PUMP CONTROL PANEL.
31- 6" TEST HEADER W/ THREE (3) 2 1/2" HOSE VA.
32- 6" FLOW METER [GROOVED]

FLOW TEST SUMMARY

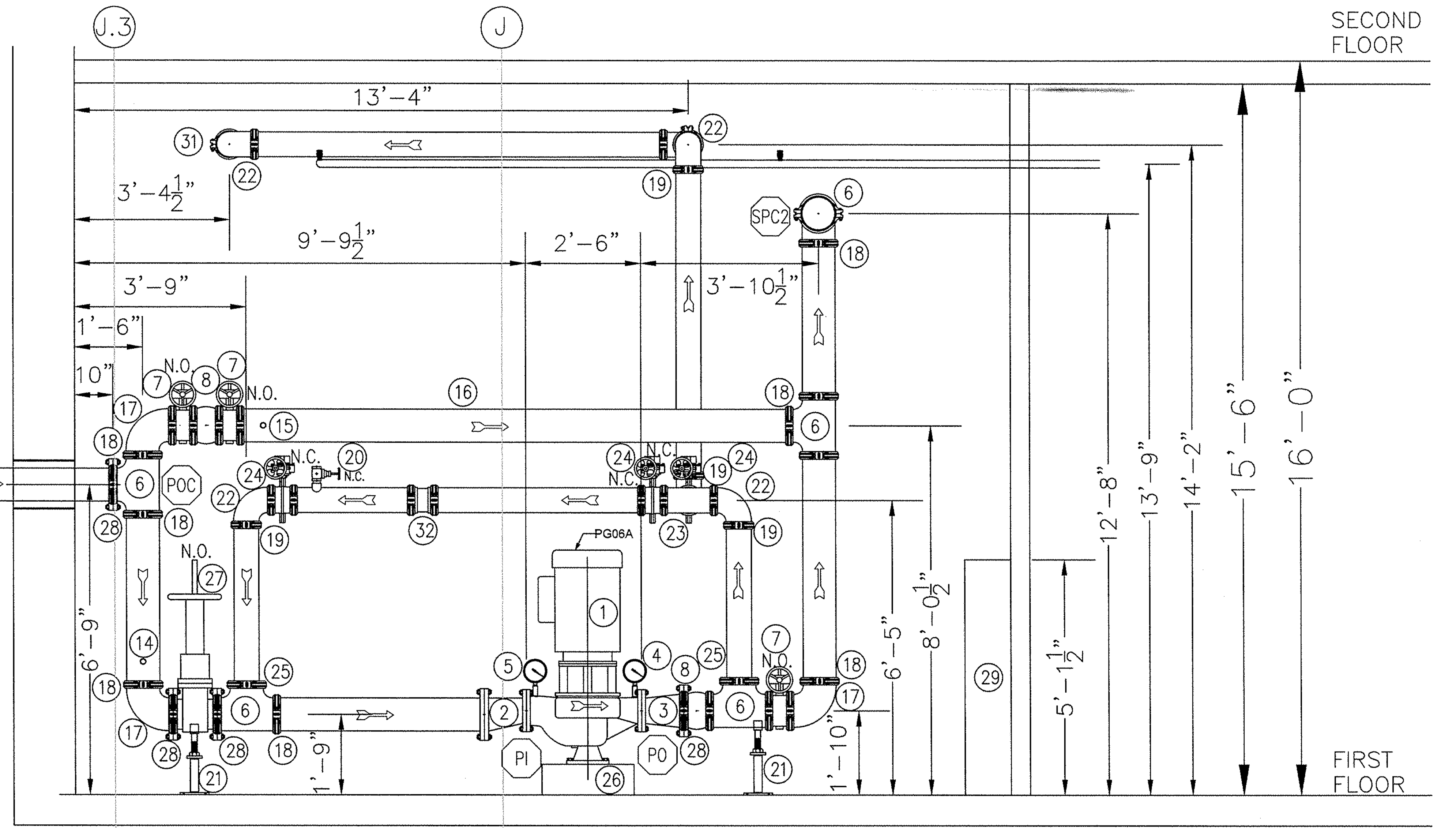
STATIC PSI	60
RESIDUAL PSI	55
PITOT PSI	35
ORIFICE DIAMETER	2 1/2
COEFFICIENT OF DISCHARGE	0.9
GPM	914

DATE 8-19-2011
LOCATION N. POLY VIEW DRIVE
BY WHO FLUID RESOURCE MANAGEMENT, INC.

ADJUSTED FLOW
10 % REDUCTION

STATIC PSI	54
RESIDUAL PSI	49
GPM	914

STATIC & RESIDUAL TAKEN FROM HYD. # 63
FLOW TAKEN FROM HYD. # 64



ELEVATION VIEW "A"

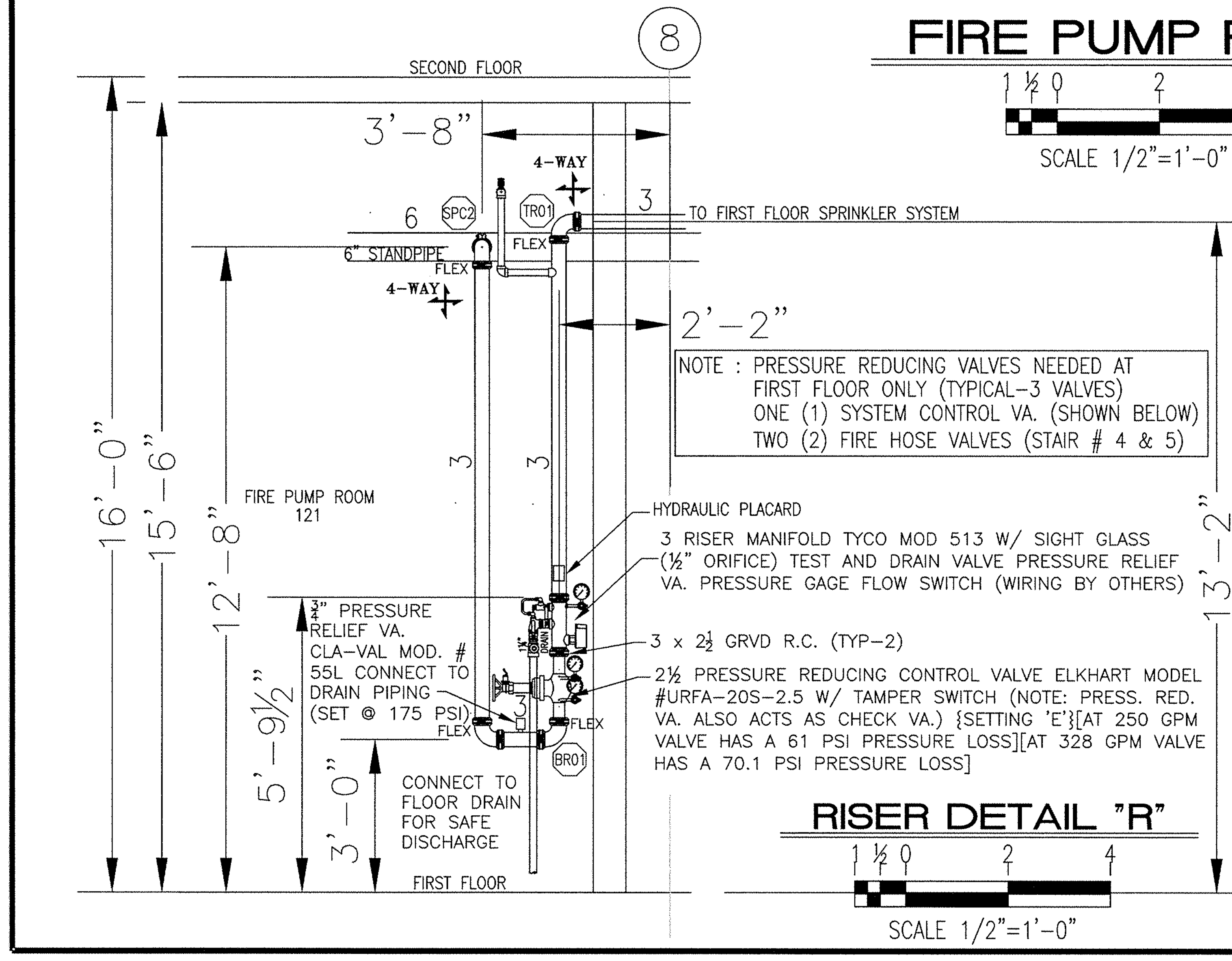
SCALE 1/2"=1'-0"

GENERAL FIRE PUMP NOTES:

1. ALL PIPING TO BE INSTALLED AND TESTED PER NFPA-13 2007 EDITION & NFPA-20 2003 EDITION.
2. ALL HANGERS AND SUPPORTS TO BE STANDARD AS PER NFPA-13 2010 EDITION.
3. ALL GROOVED COUPLINGS SHALL BE FLEX. (TYCO) OR EQUAL. ALL COUPLINGS AND FITTINGS ON DISCHARGE SIDE OF PUMP SHALL 175# RATED.
4. ALL MATERIALS TO BE U.L. LISTED.
5. ALL VALVES TO BE MONITORED WITH TAMPER SWITCHES.
6. MATERIALS SHALL BE U.S. MANUFACTURE.
7. PUMP ROOM TO BE PROVIDED WITH SUFFICIENT HEAT AND VENTILATION TO MAINTAIN A MINIMUM TEMPERATURE OF 40°F.
8. ALL ELECTRICAL WIRING TO BE PROVIDED BY OTHERS.
9. ALL PAINTING OF PIPING TO BE PROVIDED BY OTHERS.
10. ALL CONCRETE PADS, FOUNDATIONS, ETC., TO BE PROVIDED BY OTHERS.
11. ADEQUATE CLEARANCE SHALL BE PROVIDED AROUND ALL PUMPS AND VALVES.

SPECIFIC FIRE PUMP NOTES:

1. ALL 1" THRU 2" PIPE SHALL BE BLACK SCHEDULE 40 W/DUCTILE IRON SCREWED FITTINGS.
2. 8" PIPE ON SUCTION SIDE OF PUMP SHALL BE GALVANIZED SCH 40 WITH CUT GROOVED OR WELDED, W/GROOVED, FLANGED AND WELDED FITTINGS.
3. ALL 6" & 8" DISCHARGE PIPE SHALL BE BLACK SCHEDULE 40 WITH EITHER GROOVED OR FLANGED FITTING/COUP.
4. CITY FLOW TEST: STATIC=60 psi; RESIDUAL=55 psi; FLOW=914 gpm
5. PUMP DESIGN CURVE: CHURN--125 PSI @ 0 GPM
   DESIGN--113 PSI @ 750 GPM
   150%--- 86 PSI @ 1125 GPM
6. PUMP SHALL BE PERFORMANCE TESTED TO THE THREE (3) POINTS LISTED IN NOTE 5, PER NFPA-20, PARAGRAPH 14.2.7.2 CONTROLLER SHALL BE TESTED WITH SIX (6) AUTOMATIC STARTS, AND SIX (6) MANUAL STARTS; EACH SHALL HAVE A MINIMUM OF FIVE (5) MINUTES OF PUMP OPERATION, PER NFPA-20, PARAGRAPH 14.2.8.1, 14.2.8.2 TOTAL PUMP OPERATION SHALL BE A MINIMUM OF ONE (1) HOUR, PER NFPA-20, PARAGRAPH 14.2.12.



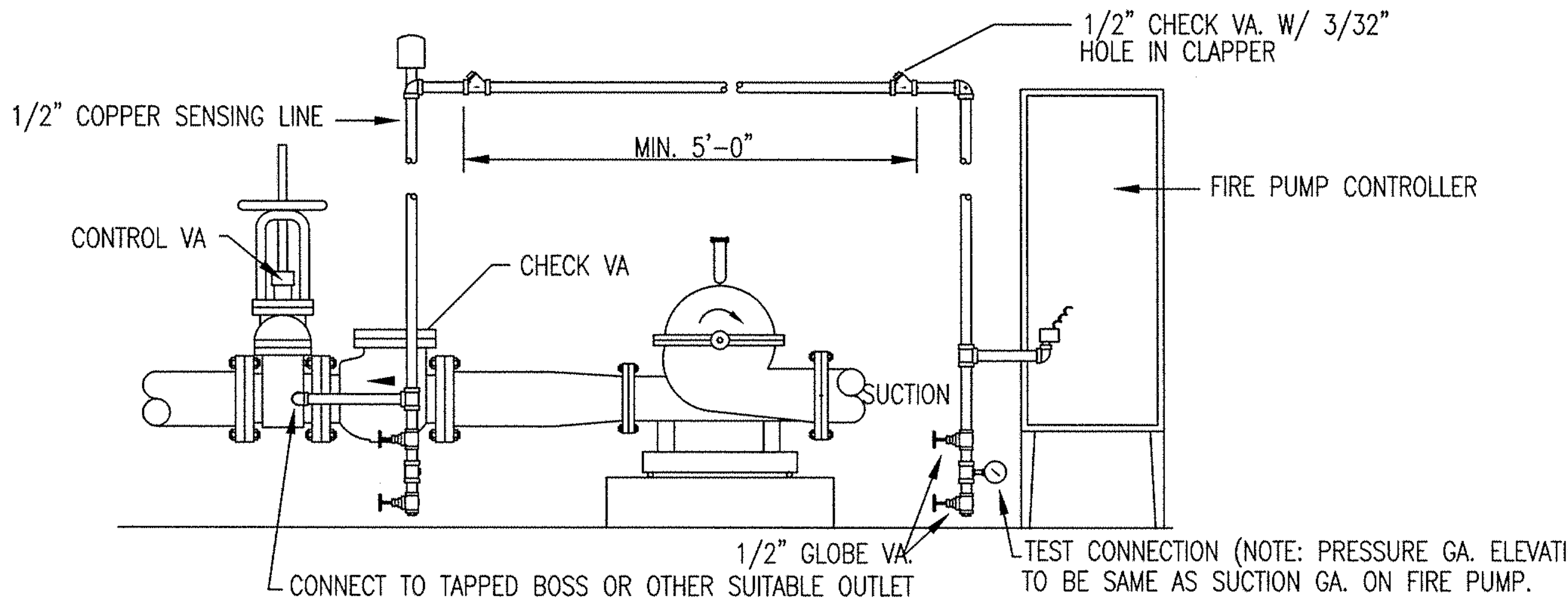
NOTE : PRESSURE REDUCING VALVES NEEDED AT FIRST FLOOR ONLY (TYPICAL-3 VALVES)
ONE (1) SYSTEM CONTROL VA. (SHOWN BELOW)
TWO (2) FIRE HOSE VALVES (STAIR # 4 & 5)

3 RISER MANIFOLD TYCO MOD 513 W/ SIGHT GLASS (½" ORIFICE) TEST AND DRAIN VALVE PRESSURE RELIEF VA. PRESSURE GAGE FLOW SWITCH (WIRING BY OTHERS)

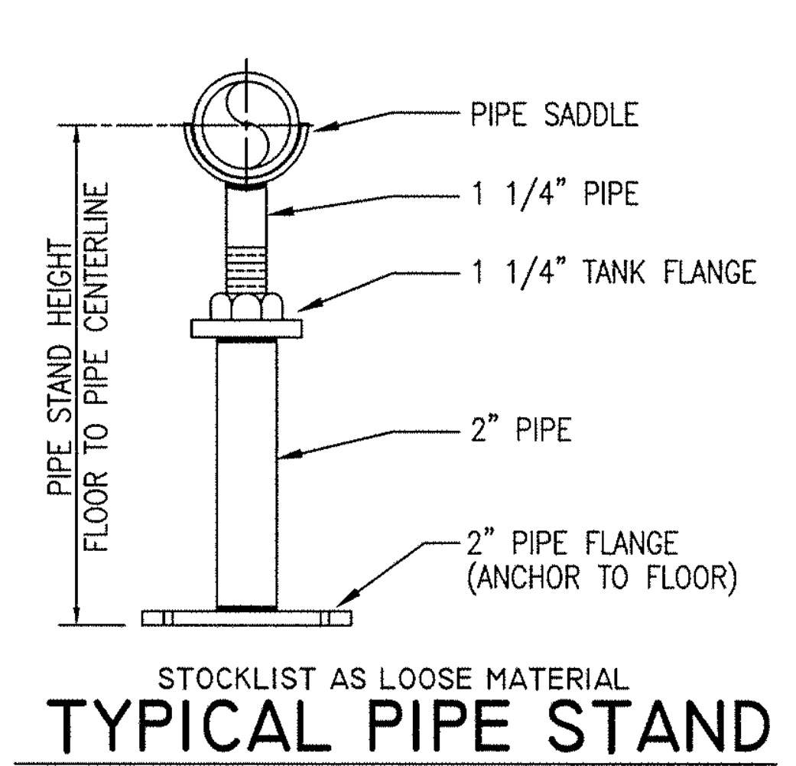
2½ PRESSURE REDUCING CONTROL VALVE ELKHART MODEL #URFA-20S-2.5 W/ TAMPER SWITCH (NOTE: PRESS. RED. VA. ALSO ACTS AS CHECK VA.) {SETTING 'E'}[AT 250 GPM VALVE HAS A 61 PSI PRESSURE LOSS][AT 328 GPM VALVE HAS A 70.1 PSI PRESSURE LOSS]

RISER DETAIL "R"

SCALE 1/2"=1'-0"



(NOTE: EACH OF THE TWO (2) FIRE PUMPS AND JOCKEY PUMP SHALL HAVE SEPARATE SENSING LINES AS SHOWN)



STOCKLIST AS LOOSE MATERIAL

TYPICAL PIPE STAND

NO SCALE

FIRE PUMP SETTINGS :

FIRE PUMP MAXIMUM CHURN = 191 PSI
JOCKEY PUMP STOP = 165 PSI
JOCKEY PUMP START = 155 PSI
FIRE PUMP START = 150 PSI

PROVIDE AUX. DRAINS FOR
ALL TRAPPED PORTIONS OF
PUMPROOM PIPING
SUPPORT ALL PIPE WITH
PIPE STANDS OR FROM CONCRETE
STRUCTURE AS APPROPRIATE.
FIELD VERIFY ALL INCOMING
SPIGOT LOCATIONS AND ADJUST
PIPING AS REQUIRED TO COMPENSATE
FOR ACTUAL FIELD DIMENSIONS

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
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SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE PUMP PLAN

DRAWN BY: NRL
SCALE: AS NOTED
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-3.0

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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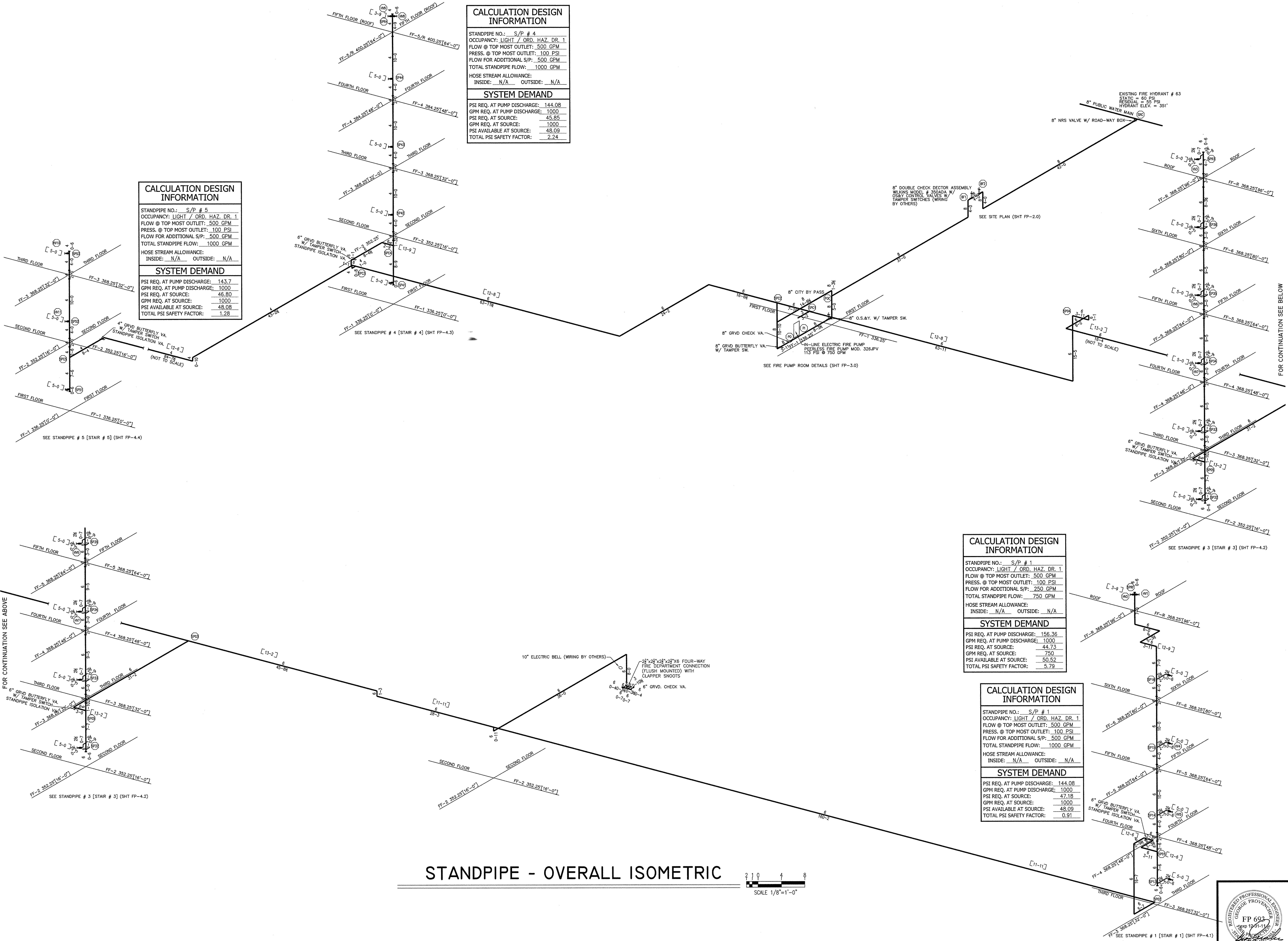
REVISIONS

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP.	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.
TOTAL SPRINKLERS THIS SHEET														



CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 4
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	45.85
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	2.24

CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 5
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	143.7
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	46.80
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.08
TOTAL PSI SAFETY FACTOR:	1.28

CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 1
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 250 GPM
TOTAL STANDPIPE FLOW: 750 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	156.36
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	44.73
GPM REQ. AT SOURCE:	750
PSI AVAILABLE AT SOURCE:	50.52
TOTAL PSI SAFETY FACTOR:	5.79

CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 1
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	47.18
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	0.91

STANDPIPE - OVERALL ISOMETRIC

2 1 0 4 8
SCALE 1/8"=1'-0"

REVISIONS

#	DATE	BY	DESCRIPTION
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1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP.	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET | QTY

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

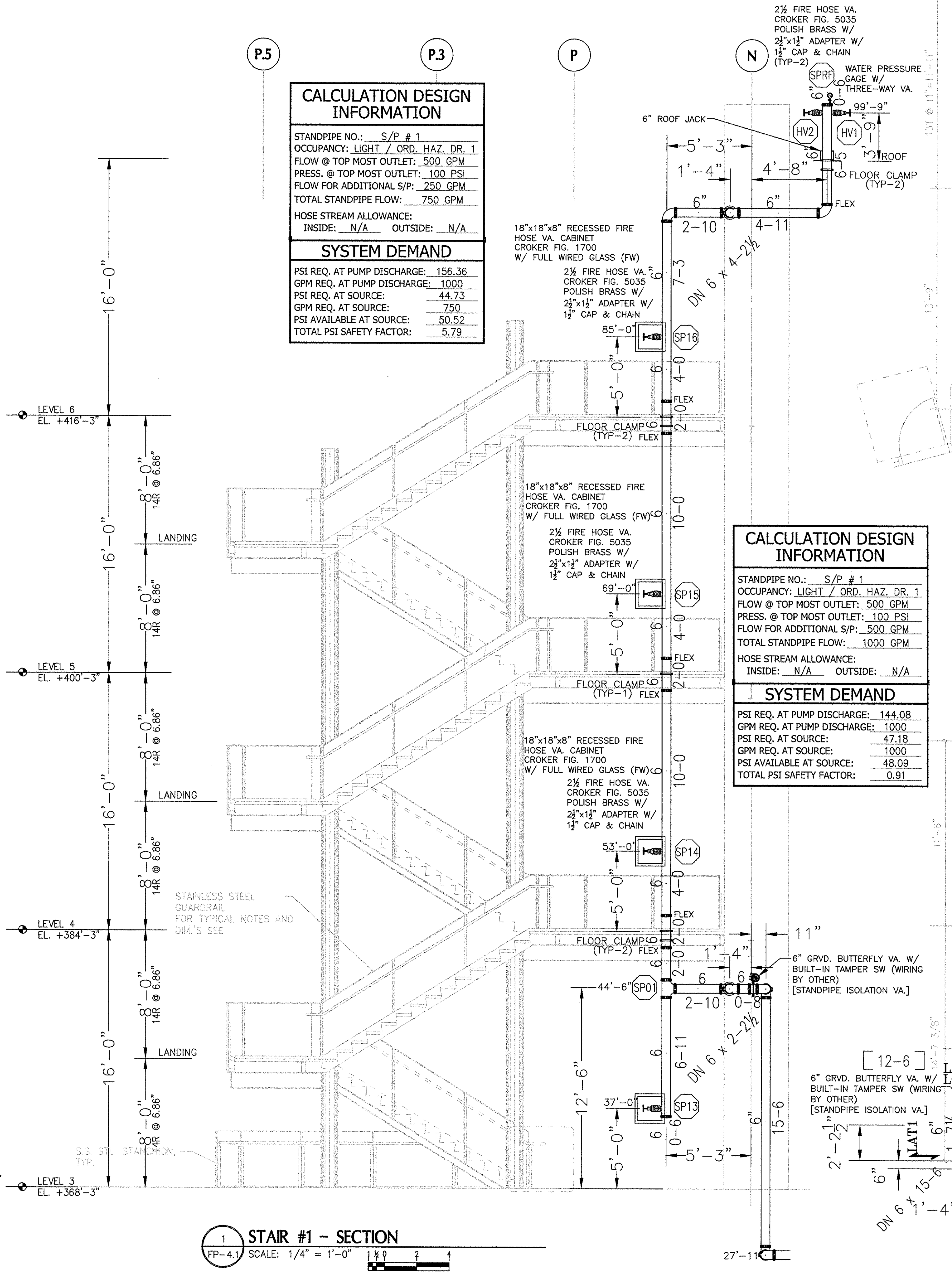
PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
STANDPIPE - OVERALL ISOMETRIC

DRAWN BY: ----
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-4.0

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11



CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 1
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 250 GPM
TOTAL STANDPIPE FLOW: 750 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE: 156.36
GPM REQ. AT PUMP DISCHARGE: 1000
PSI REQ. AT SOURCE: 44.73
GPM REQ. AT SOURCE: 750
PSI AVAILABLE AT SOURCE: 50.52
TOTAL PSI SAFETY FACTOR: 5.79

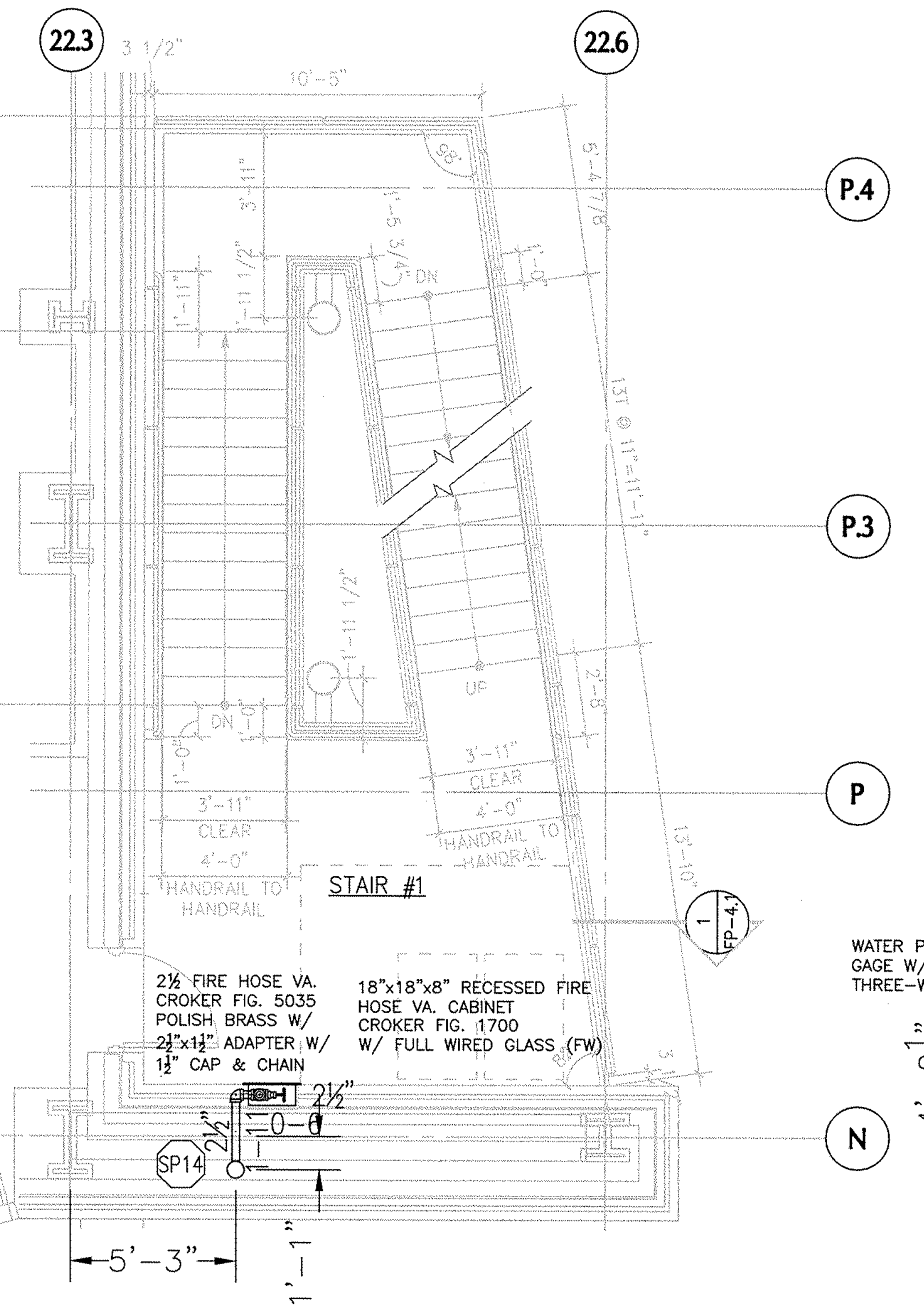
CALCULATION DESIGN INFORMATION

STANDPIPE NO.: S/P # 1
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

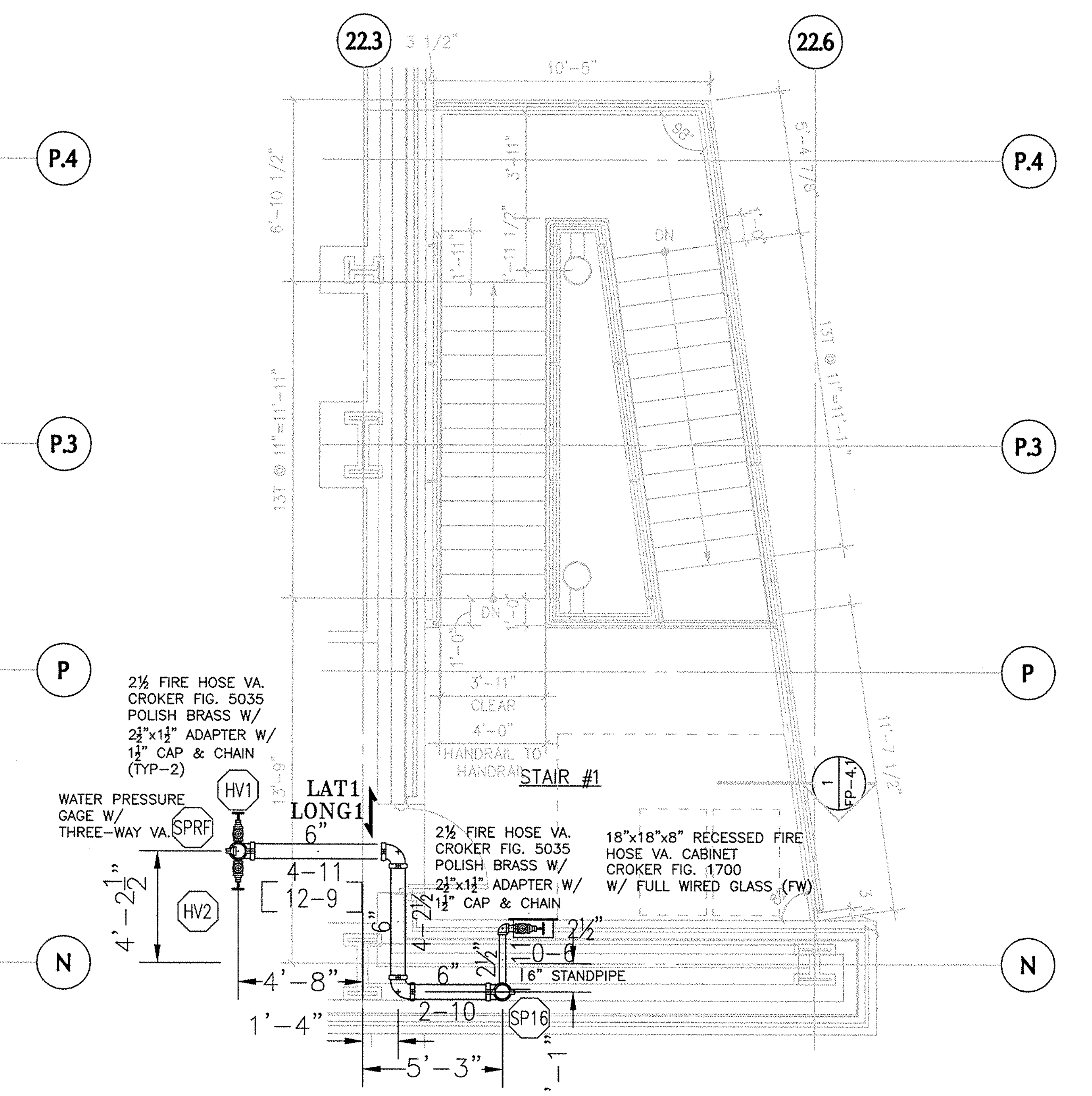
SYSTEM DEMAND

PSI REQ. AT PUMP DISCHARGE: 144.08
GPM REQ. AT PUMP DISCHARGE: 1000
PSI REQ. AT SOURCE: 47.18
GPM REQ. AT SOURCE: 1000
PSI AVAILABLE AT SOURCE: 48.09
TOTAL PSI SAFETY FACTOR: 0.91

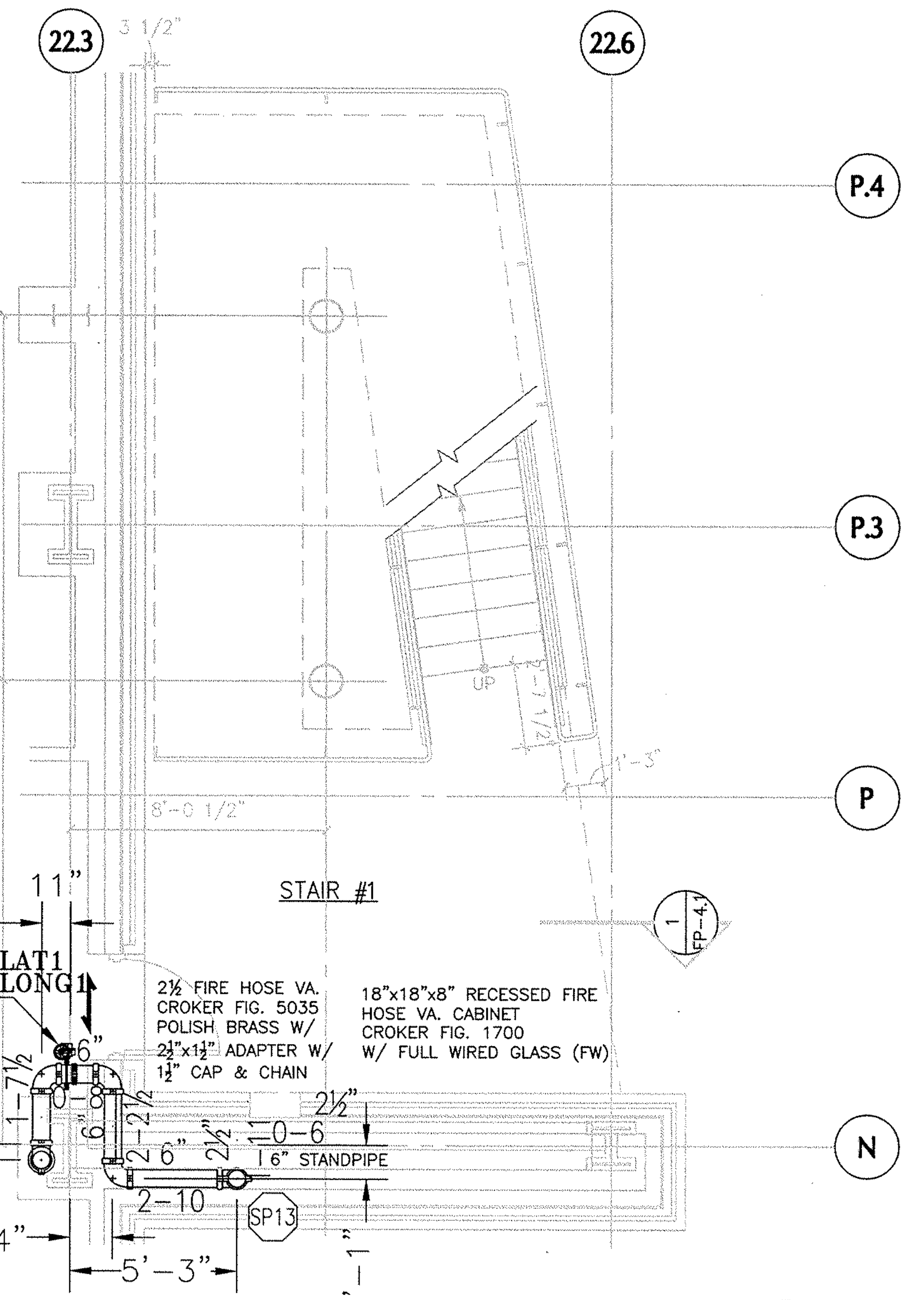
1 / FP-4.1 **STAIR #1 - SECTION**
SCALE: 1/4" = 1'-0"
SCALE 1/4"=1'-0"



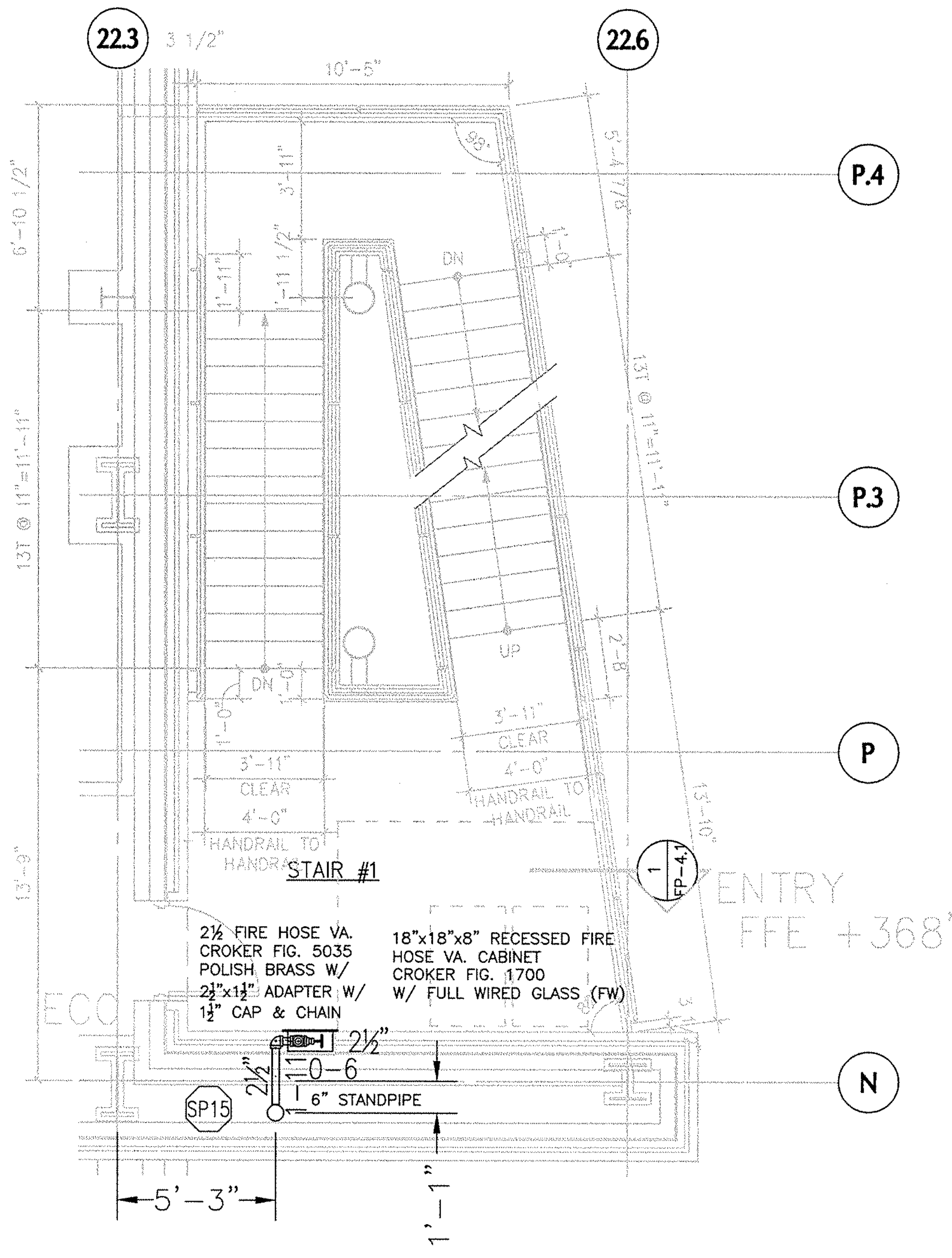
1B / FP-4.1 **STAIR #1 - LEVEL 4**
SCALE: 1/4" = 1'-0"
SCALE 1/4"=1'-0"



1D / FP-4.1 **STAIR #1 - LEVEL 6**
SCALE: 1/4" = 1'-0"
SCALE 1/4"=1'-0"



1A / FP-4.1 **STAIR #1 - LEVEL 3**
SCALE: 1/4" = 1'-0"
SCALE 1/4"=1'-0"



1C / FP-4.1 **STAIR #1 - LEVEL 5**
SCALE: 1/4" = 1'-0"
SCALE 1/4"=1'-0"

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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REVISIONS

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET QTY

NORTH

AERO AUTOMATIC SPRINKLER CO.
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Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
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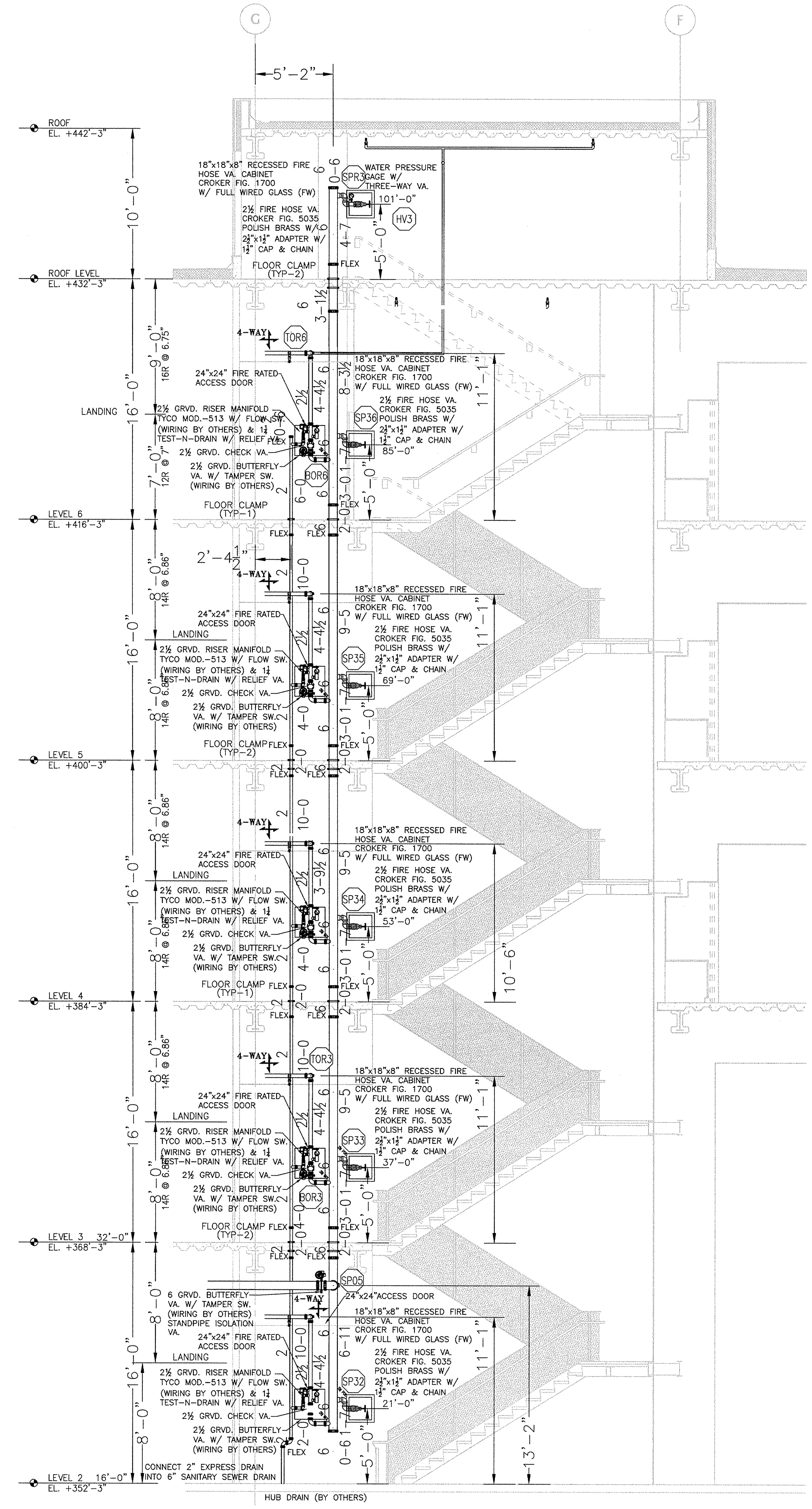
PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

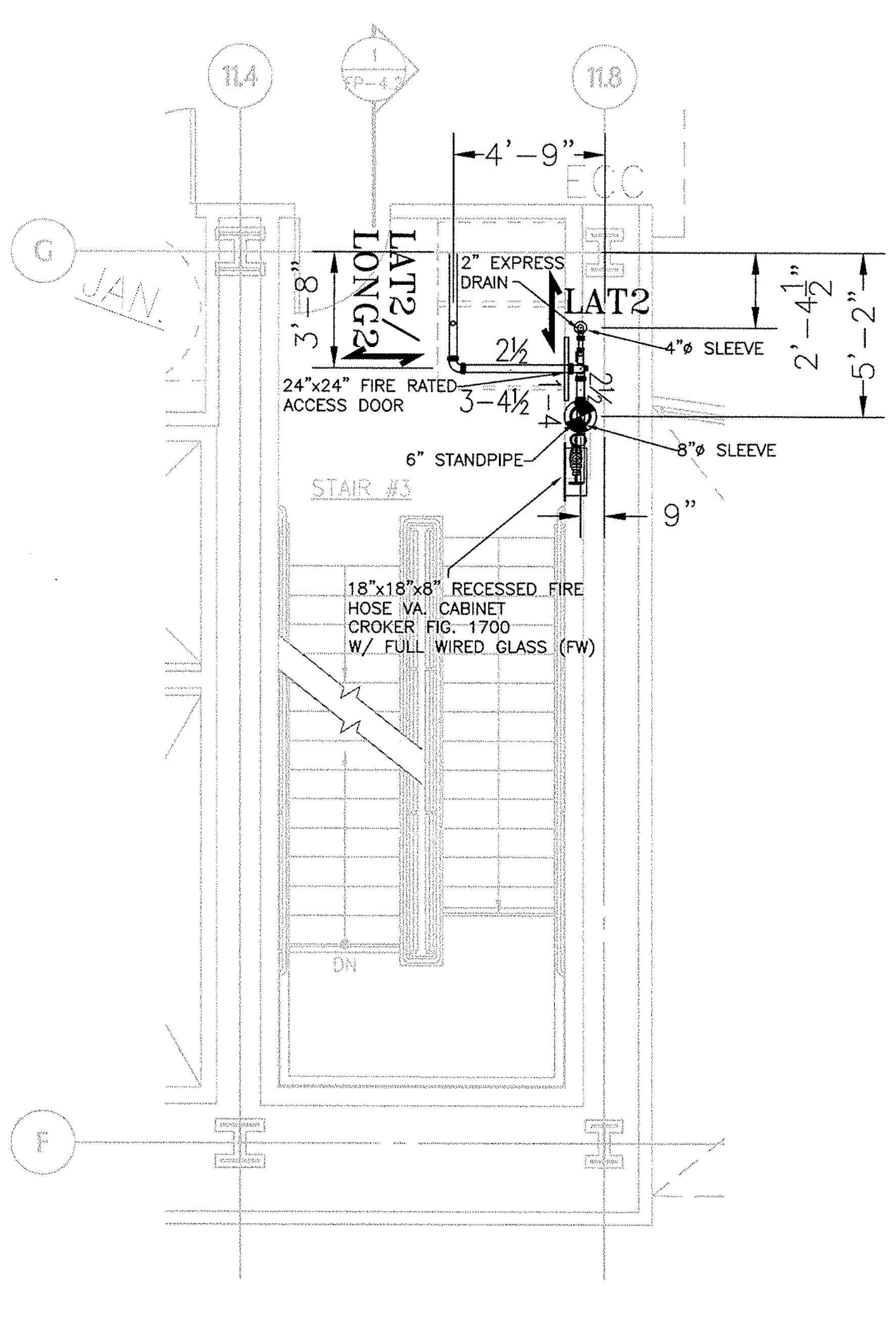
PLAN DESCRIPTION:
STANDPIPE # 1 DETAILS

DRAWN BY: ----
SCALE: 1/4"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-4.1

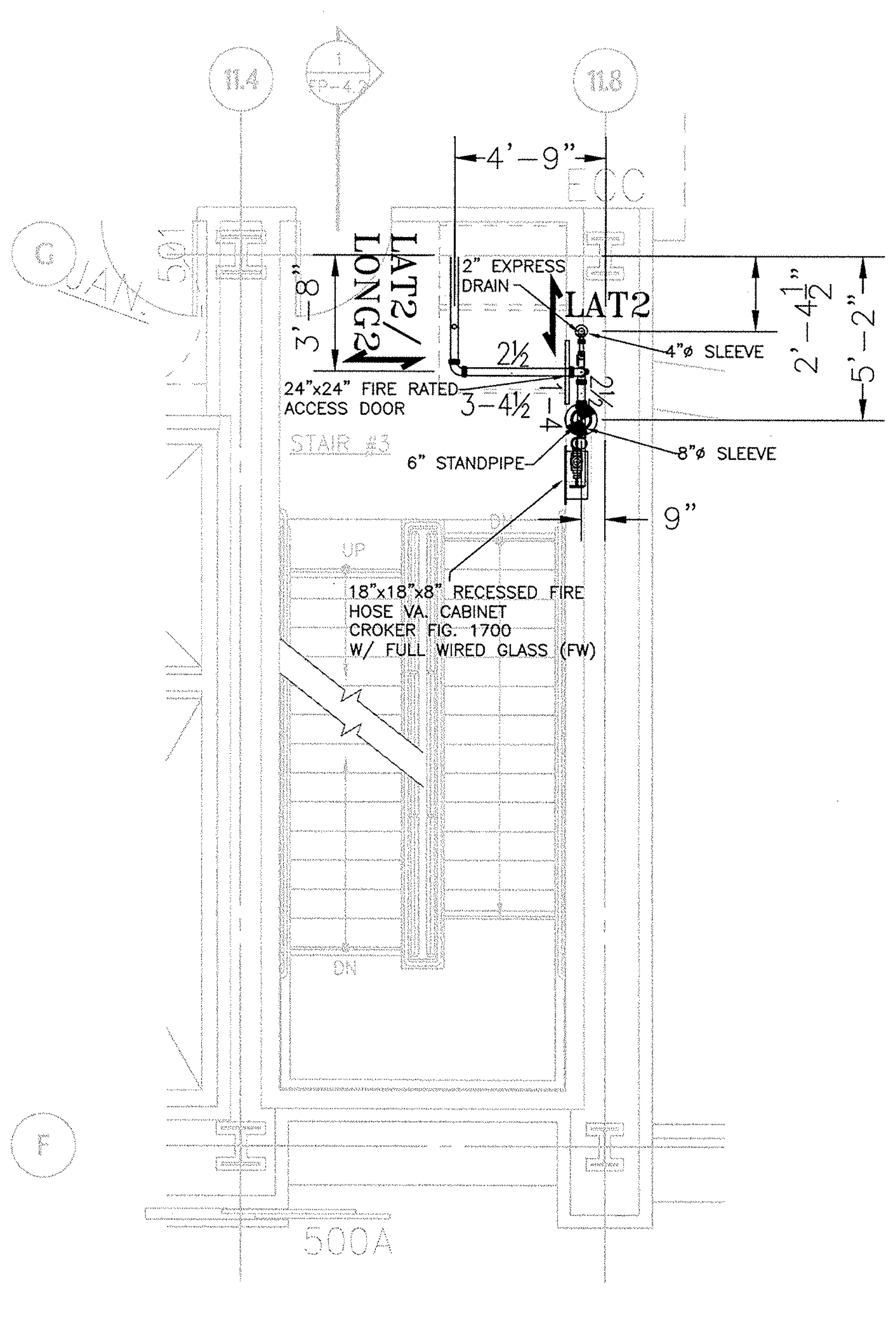
FP 693
exp 12-31-11
09/29/11



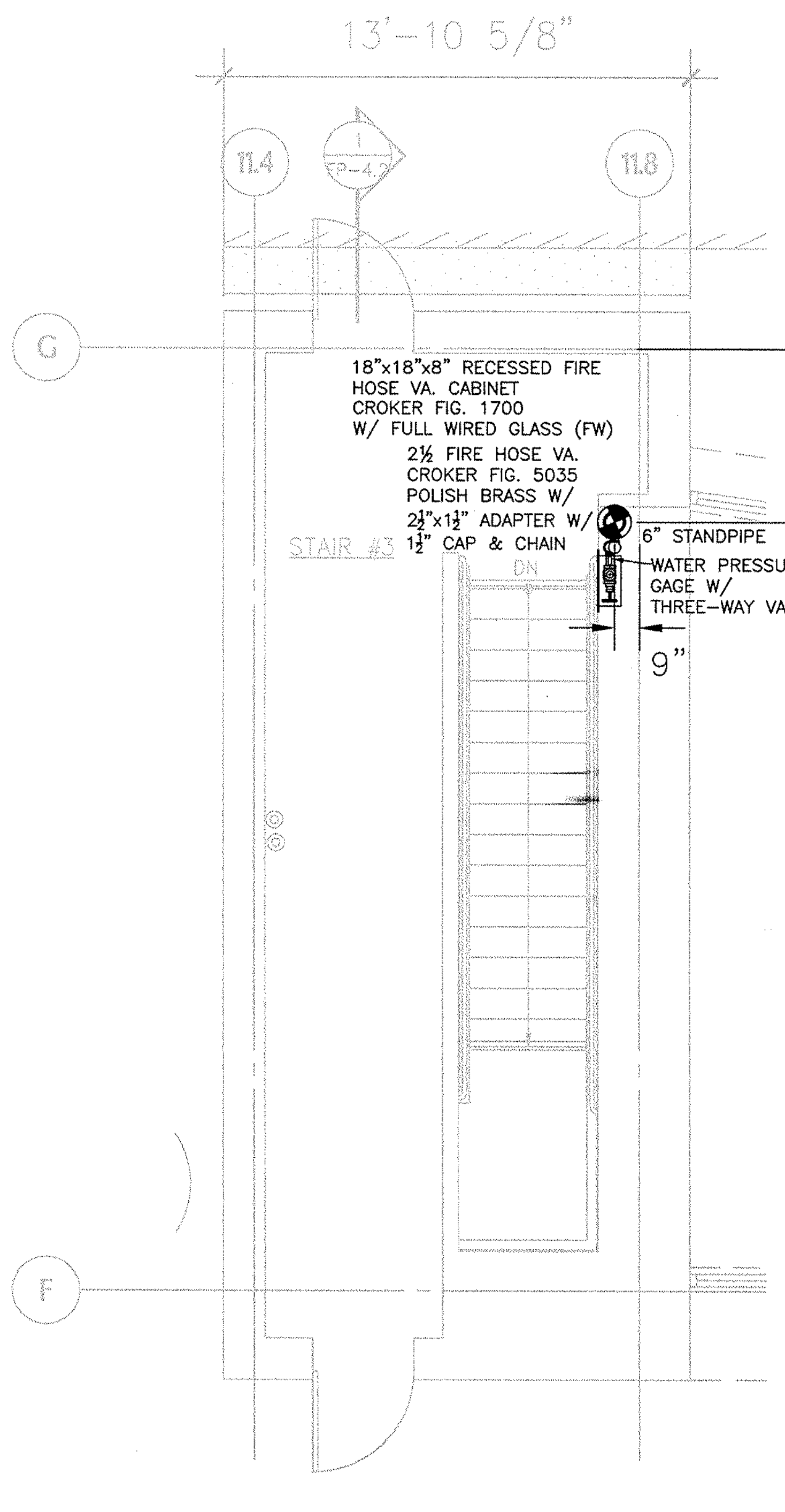
1 SECTION- STAIR #3
FP-4.2 SCALE: 1/4" = 1'-0"



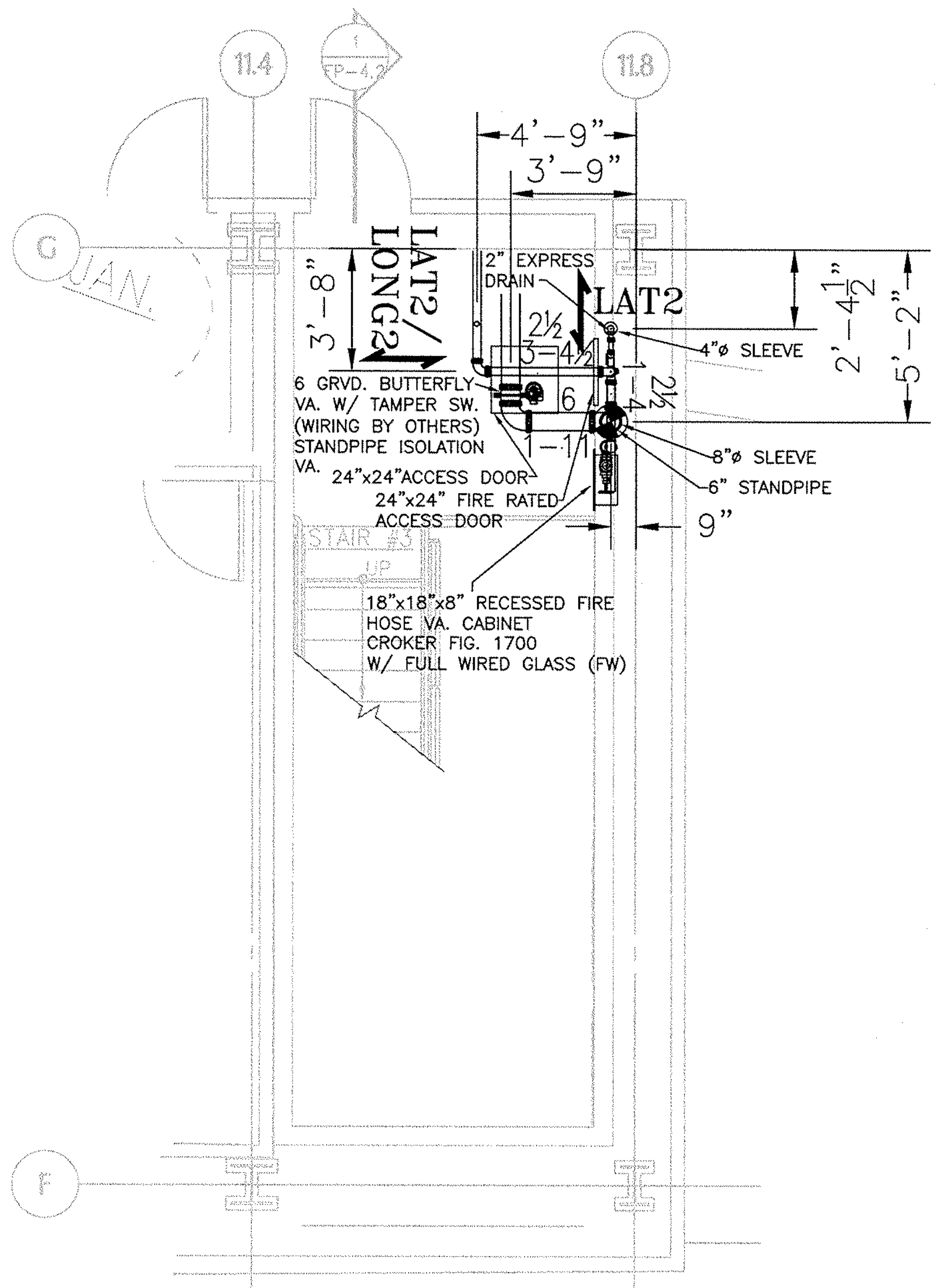
1B STAIR #3 - LEVEL 3
FP-4.2 SCALE: 1/4" = 1'-0"



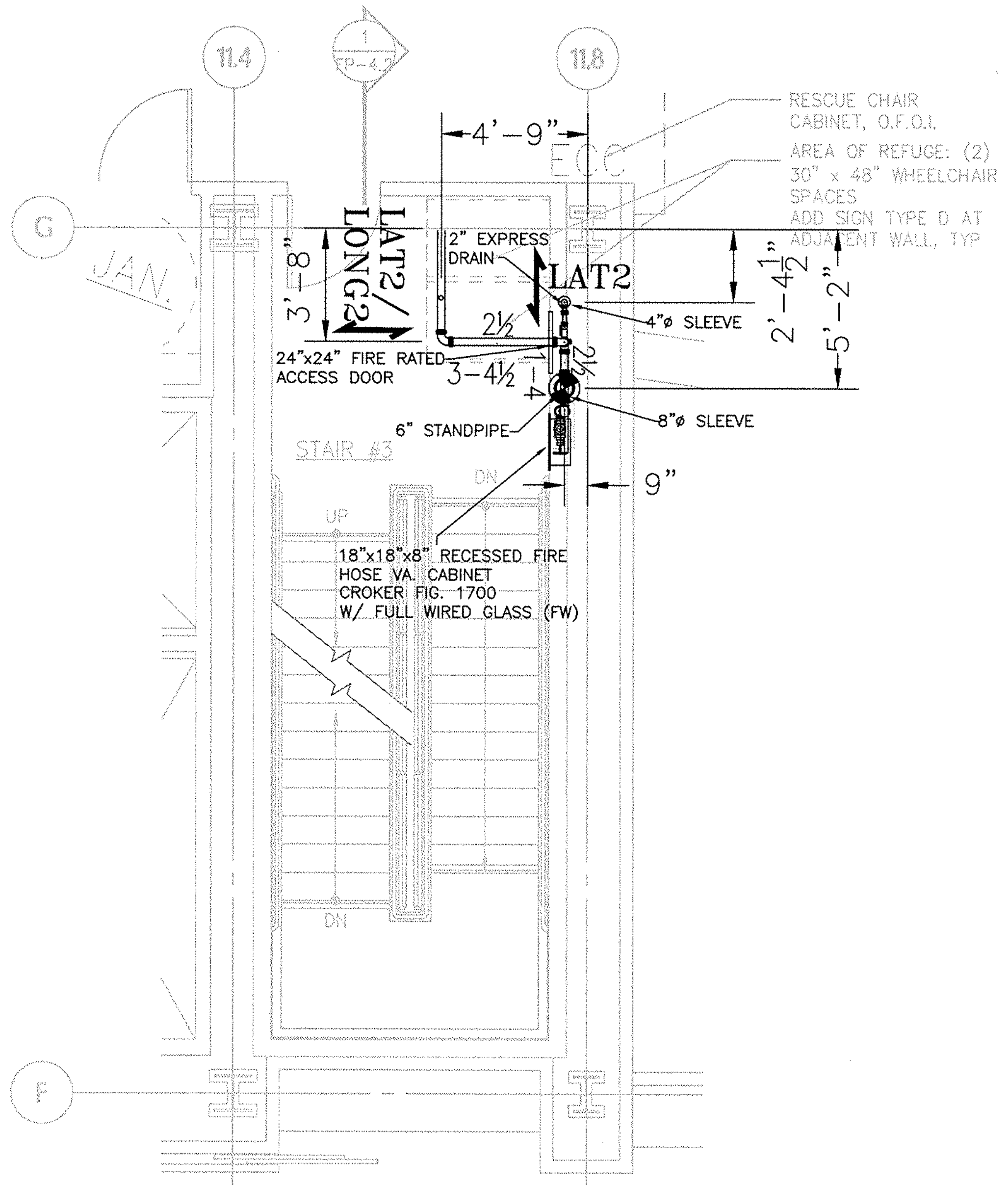
1D STAIR #3 - LEVEL 5
FP-4.2 SCALE: 1/4" = 1'-0"



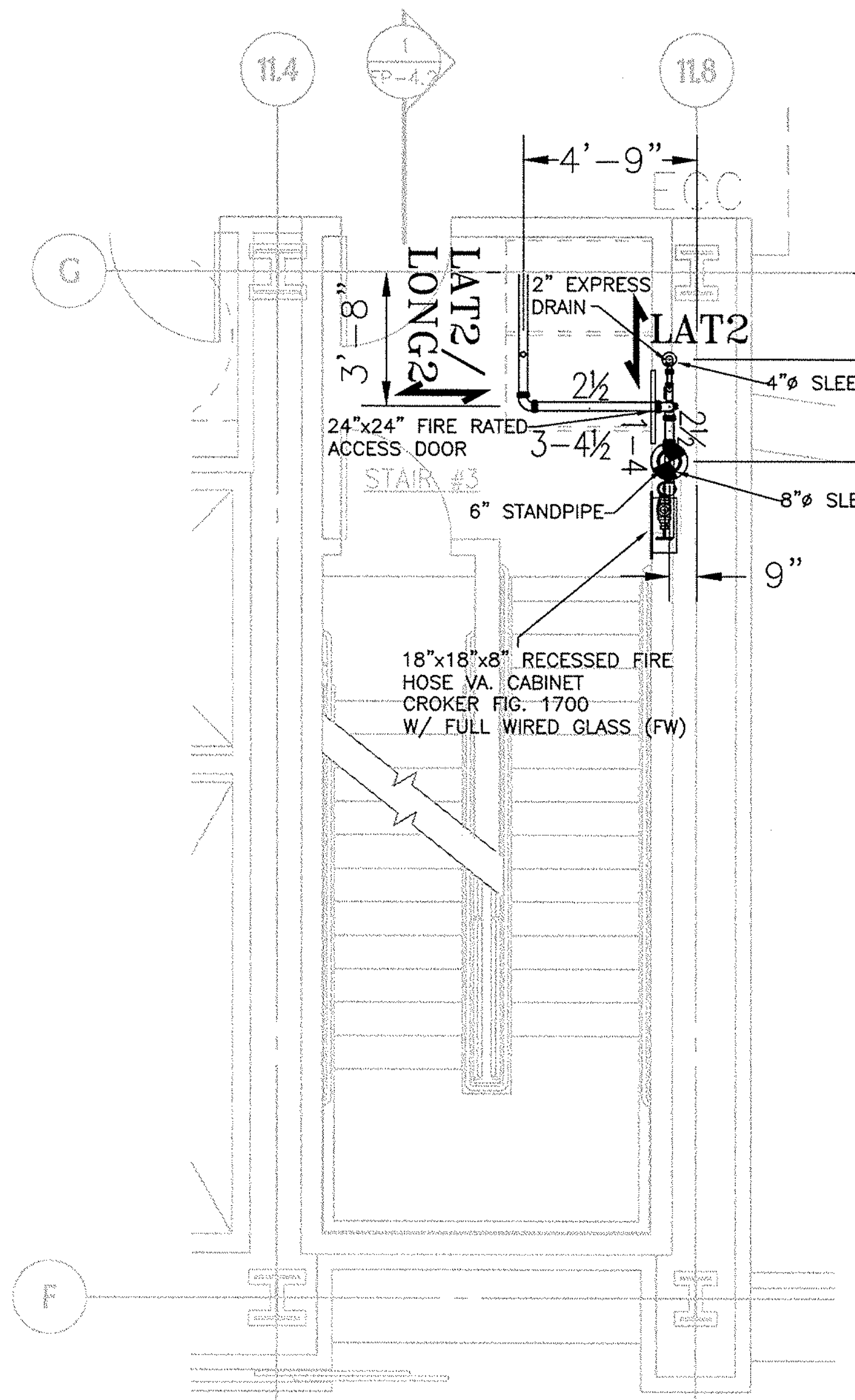
1F STAIR #3 - ROOF LEVEL
FP-4.2 SCALE: 1/4" = 1'-0"



1A STAIR #3 - LEVEL 2
FP-4.2 SCALE: 1/4" = 1'-0"



1C STAIR #3 - LEVEL 4
FP-4.2 SCALE: 1/4" = 1'-0"



1E STAIR #3 - LEVEL 6
FP-4.2 SCALE: 1/4" = 1'-0"

FP 693
Exp 12-31-11
GEORGE PROVENCHER
09/29/11

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.
TOTAL SPRINKLERS THIS SHEET														QTY

REVISIONS

#	DATE	BY	DESCRIPTION
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1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

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21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
STANDPIPE # 3 DETAILS

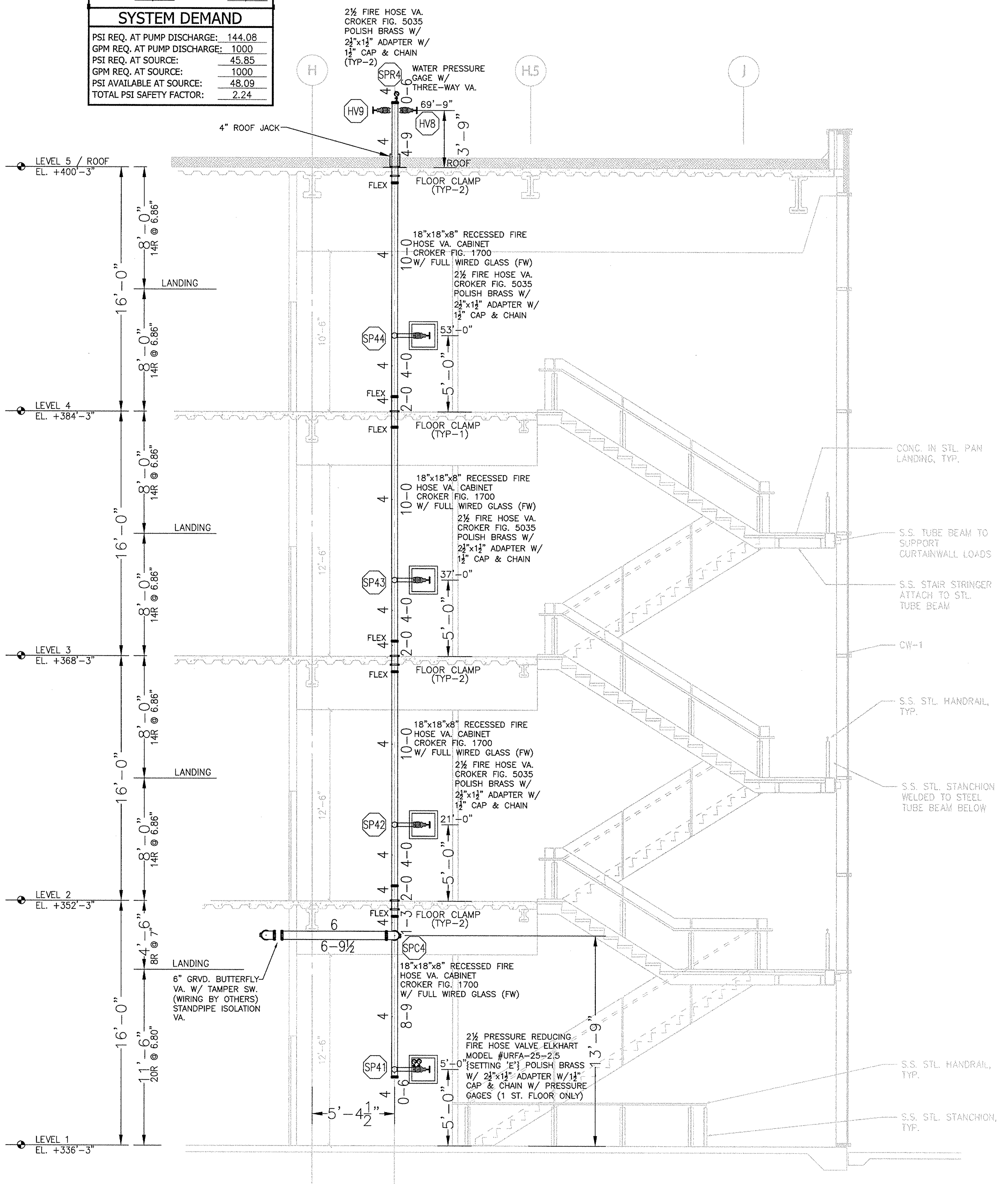
DRAWN BY: ----
SCALE: 1/4"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-4.2

CALCULATION DESIGN INFORMATION

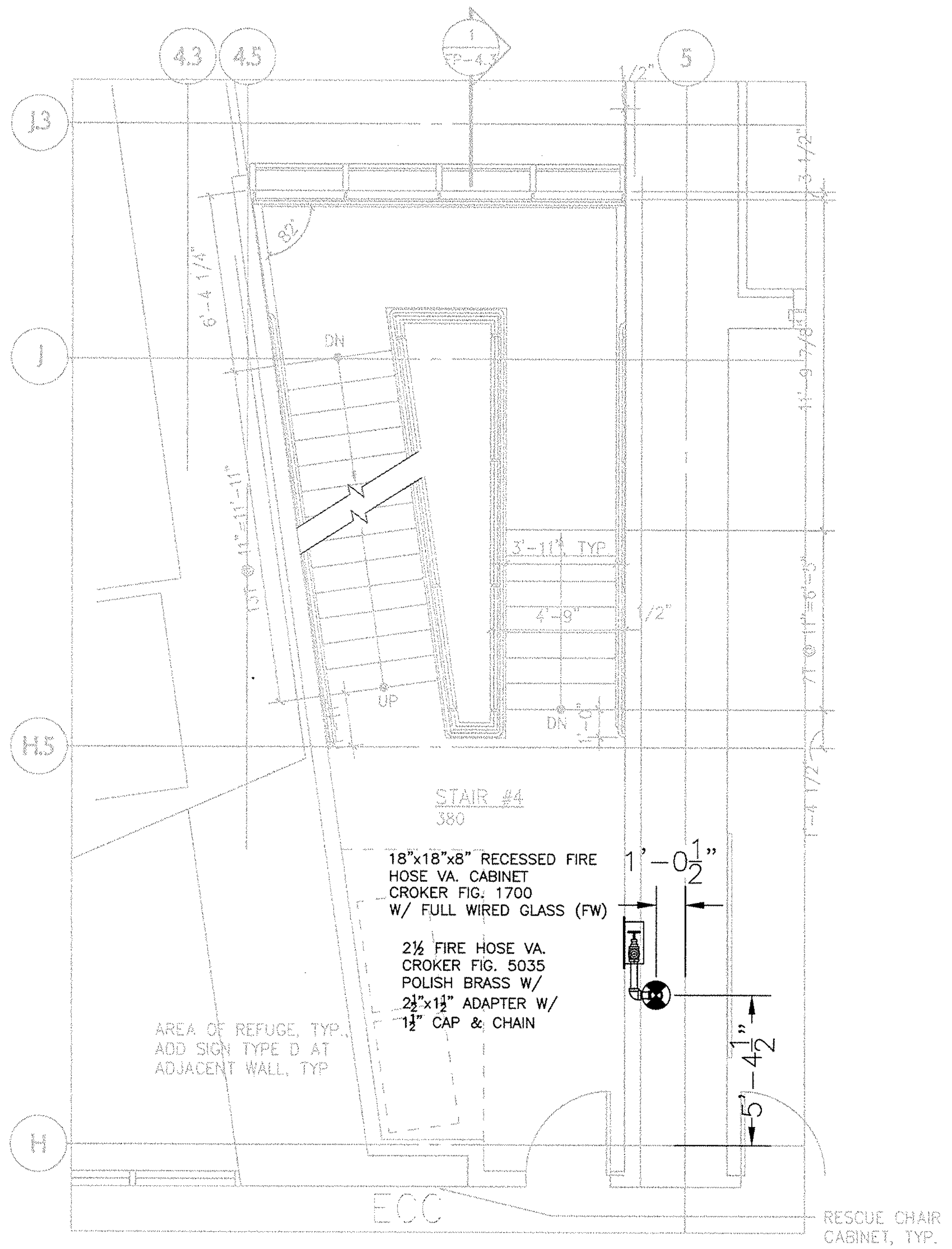
STANDPIPE NO.: S/P # 4
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

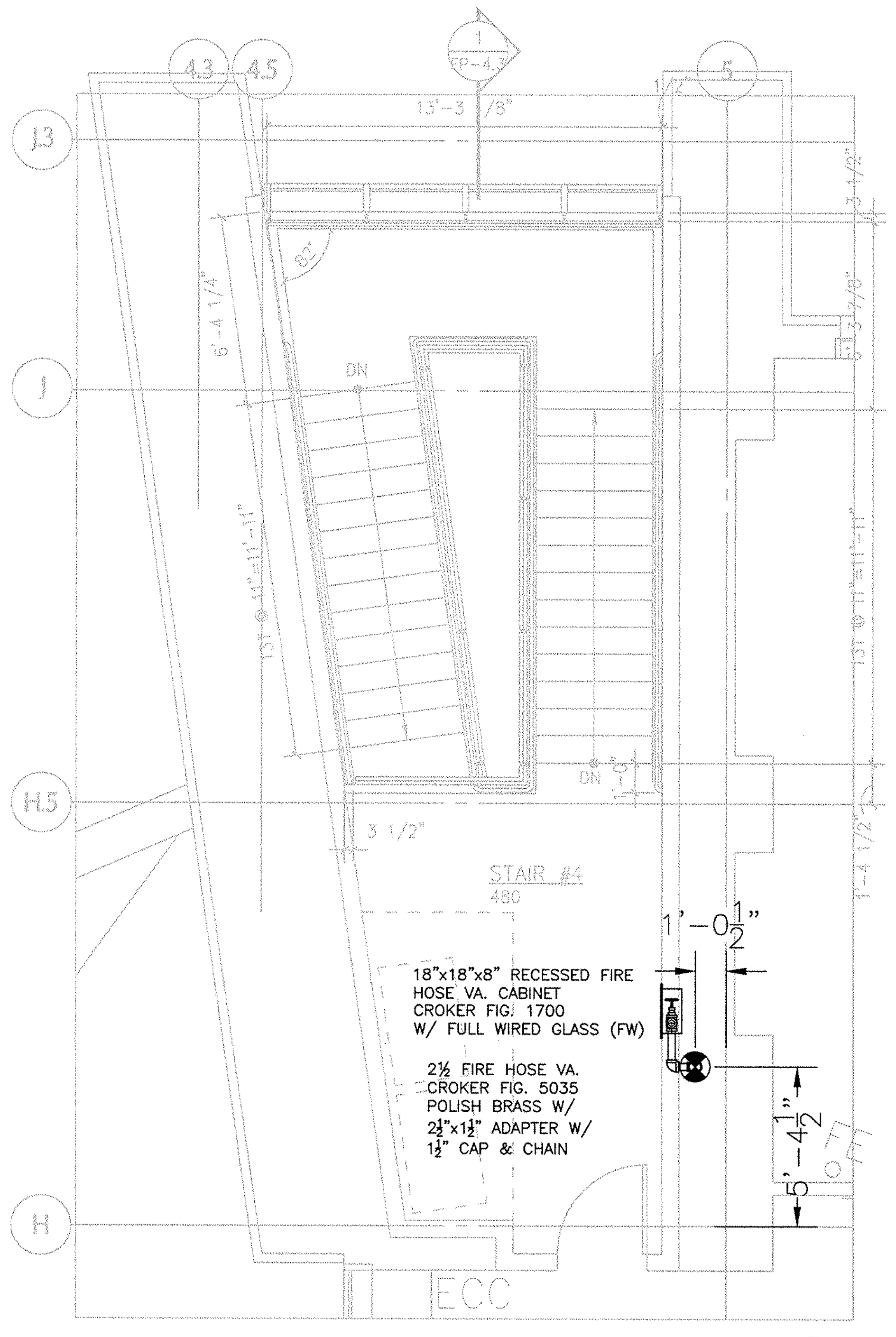
PSI REQ. AT PUMP DISCHARGE:	144.08
GPM REQ. AT PUMP DISCHARGE:	1000
PSI REQ. AT SOURCE:	45.85
GPM REQ. AT SOURCE:	1000
PSI AVAILABLE AT SOURCE:	48.09
TOTAL PSI SAFETY FACTOR:	2.24



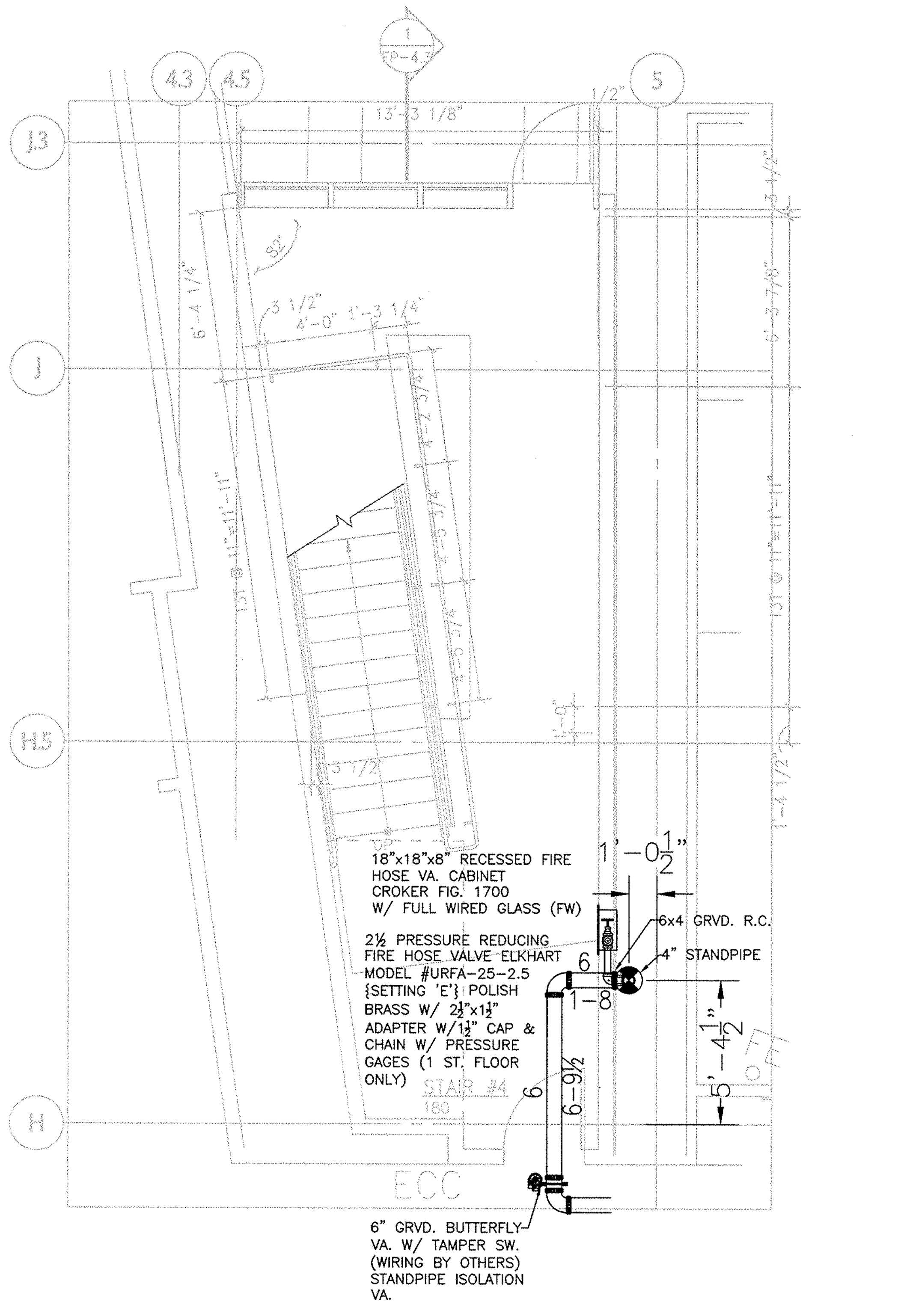
1
FP-4.3
STAIR #4 - SECTION
SCALE: 1/4" = 1'-0"



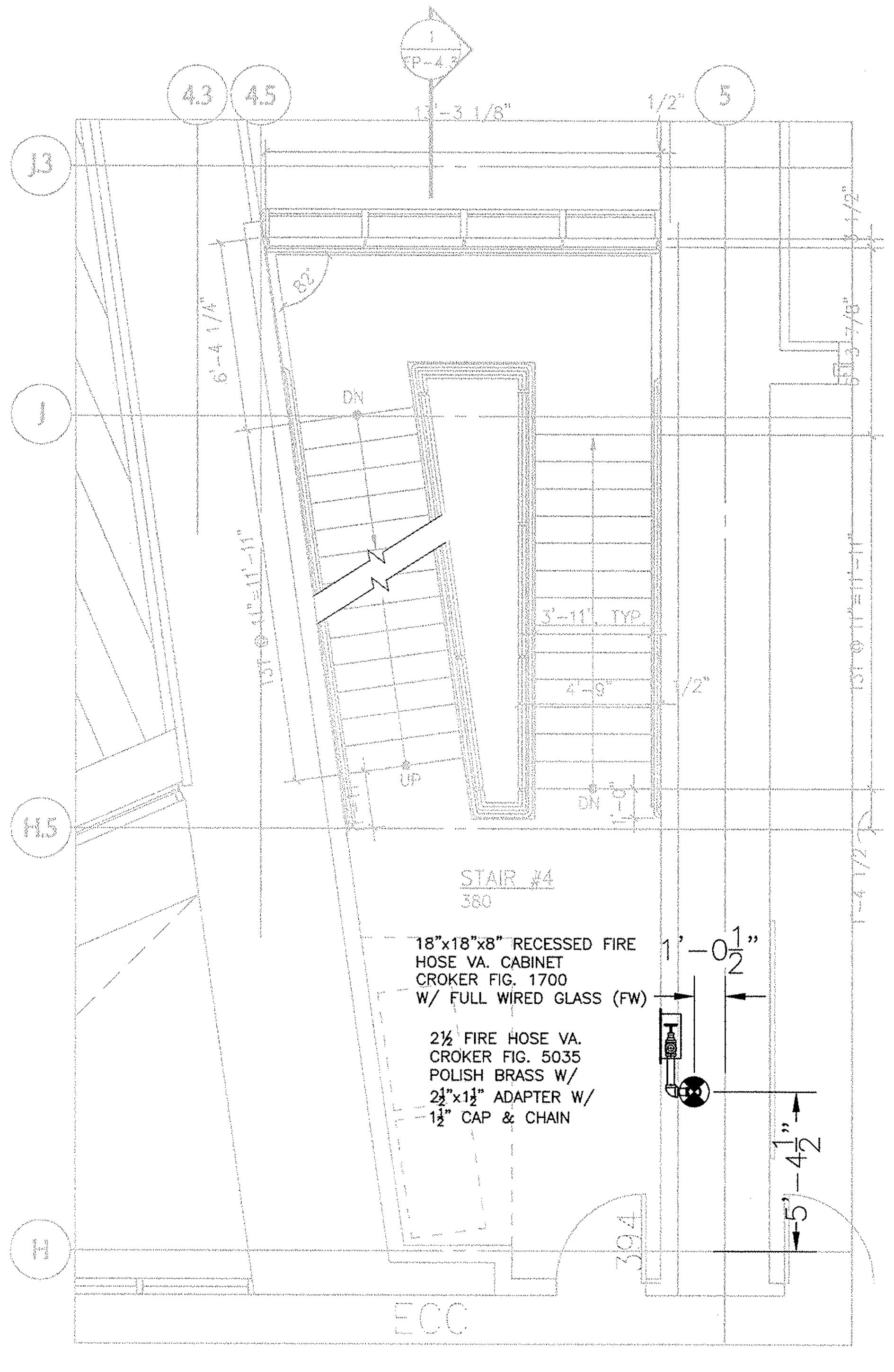
1B
FP-4.3
STAIR #4 - LEVEL 2
SCALE: 1/4" = 1'-0"



1D
FP-4.3
STAIR #4 - LEVEL 4
SCALE: 1/4" = 1'-0"



1A
FP-4.3
STAIR #4 - LEVEL 1
SCALE: 1/4" = 1'-0"



1C
FP-4.3
STAIR #4 - LEVEL 3
SCALE: 1/4" = 1'-0"

GEORGE PROVENCHER
FP 693
EXP 12-31-11
09/29/11

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET QTY

#	DATE	BY	DESCRIPTION
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1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-9370-6690455-5501 NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
STANDPIPE # 4 DETAILS

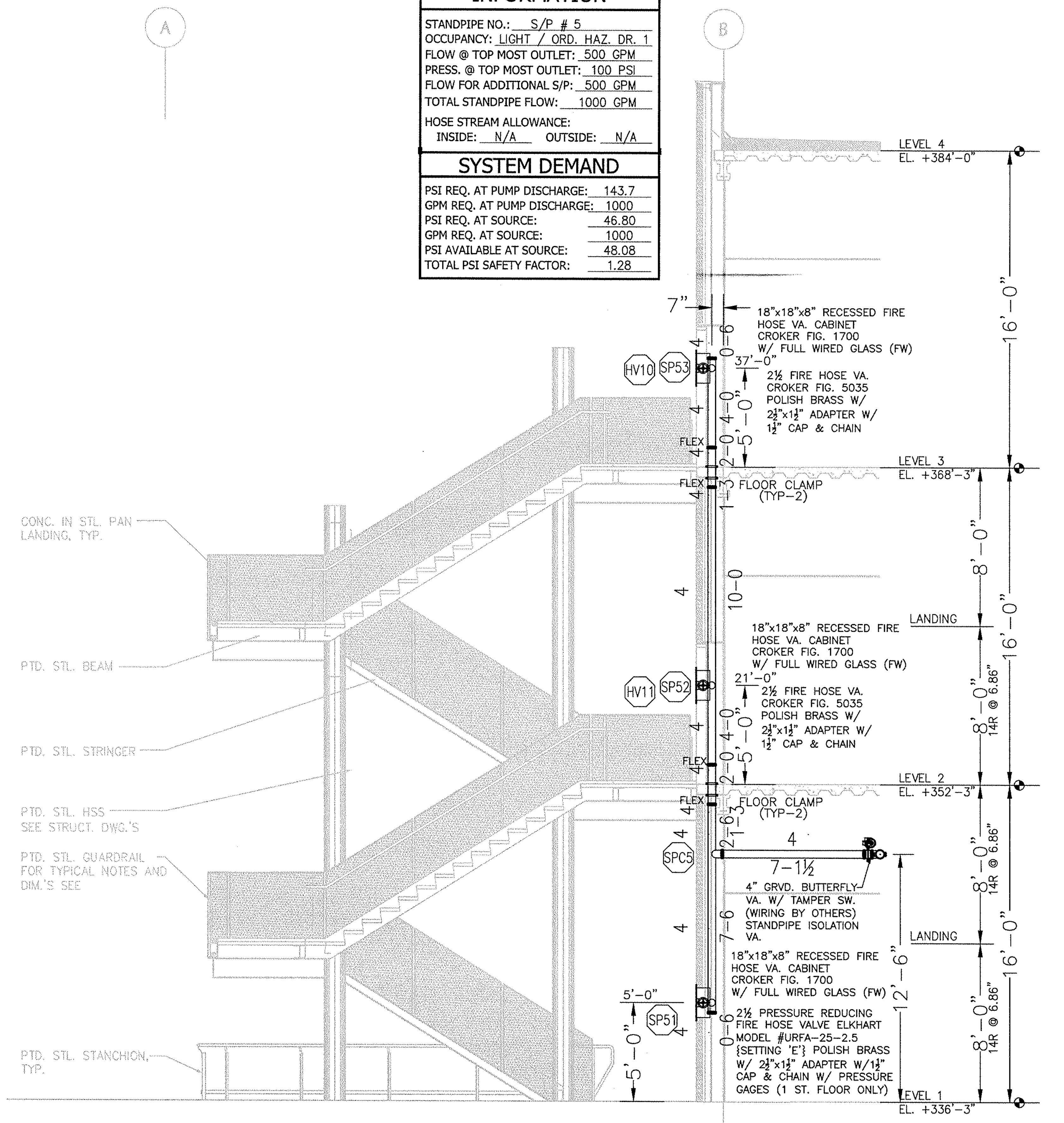
DRAWN BY: ----
SCALE: 1/4"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-4.3

CALCULATION DESIGN INFORMATION

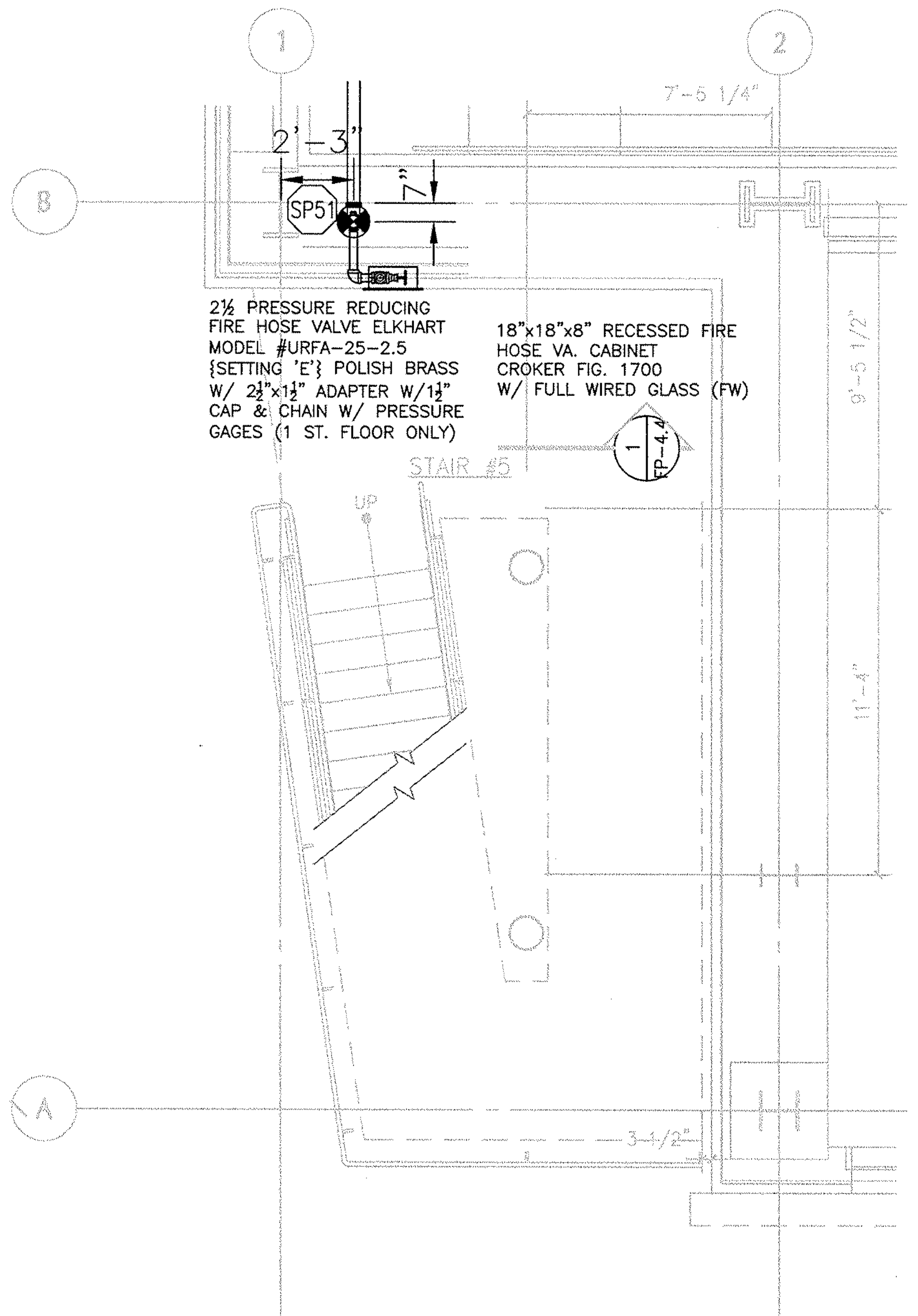
STANDPIPE NO.: S/P # 5
OCCUPANCY: LIGHT / ORD. HAZ. DR. 1
FLOW @ TOP MOST OUTLET: 500 GPM
PRESS. @ TOP MOST OUTLET: 100 PSI
FLOW FOR ADDITIONAL S/P: 500 GPM
TOTAL STANDPIPE FLOW: 1000 GPM
HOSE STREAM ALLOWANCE:
INSIDE: N/A OUTSIDE: N/A

SYSTEM DEMAND

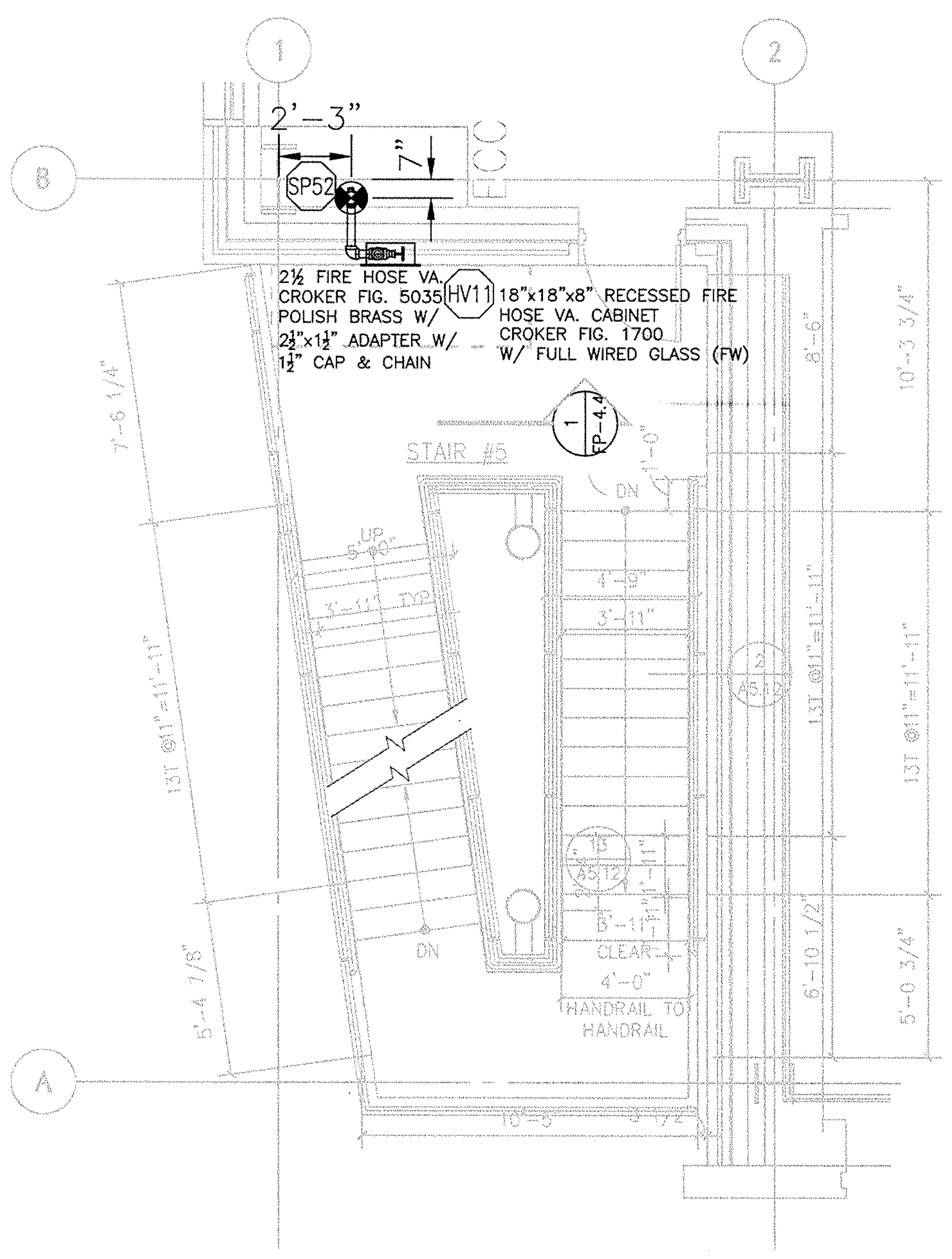
PSI REQ. AT PUMP DISCHARGE: 143.7
GPM REQ. AT PUMP DISCHARGE: 1000
PSI REQ. AT SOURCE: 46.80
GPM REQ. AT SOURCE: 1000
PSI AVAILABLE AT SOURCE: 48.08
TOTAL PSI SAFETY FACTOR: 1.28



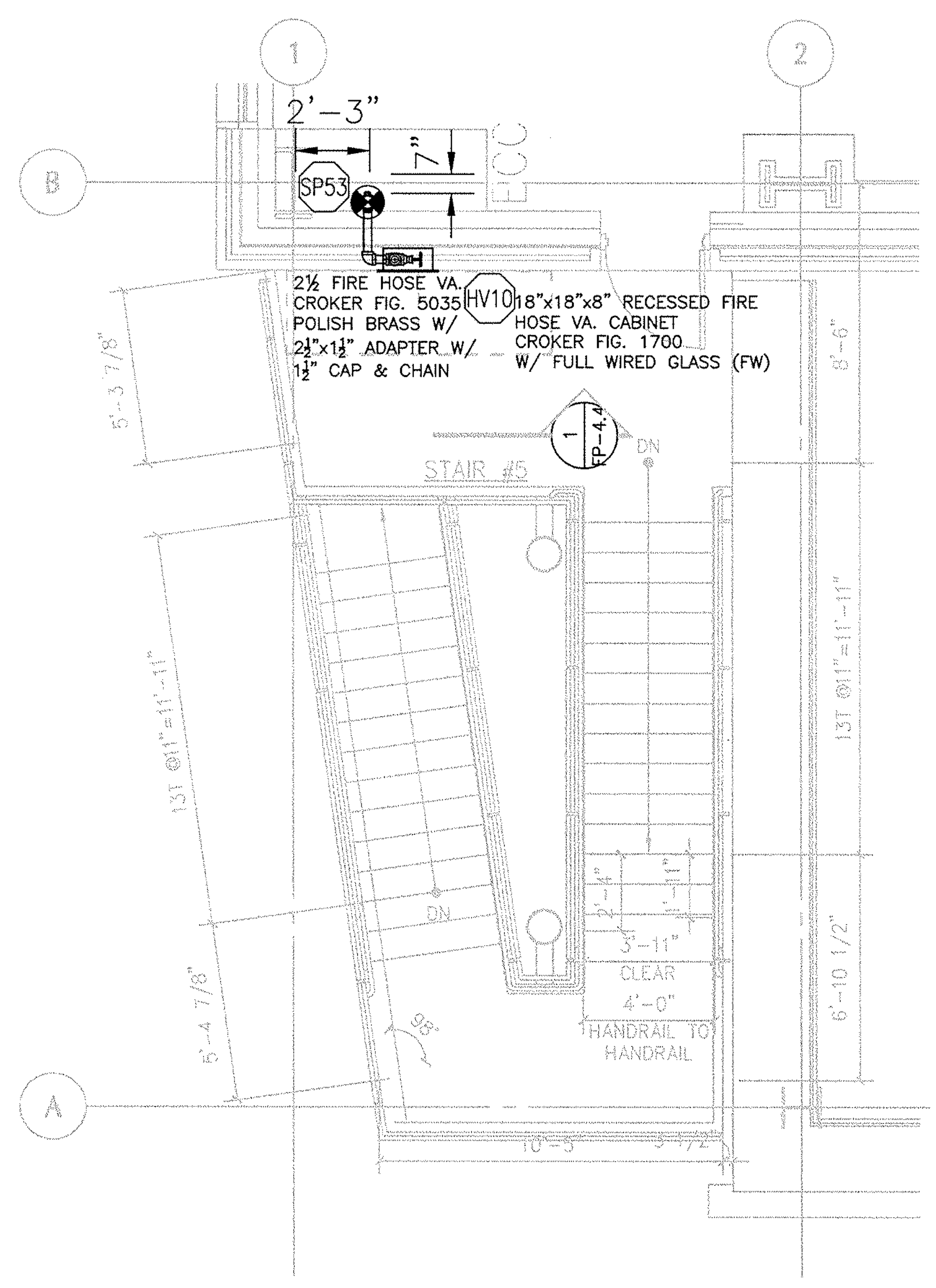
1 FP-4.4 **SECTION-STAIR #5**
SCALE: 1/4" = 1'-0"



1A FP-4.4 **STAIR #5 - LEVEL 1**
SCALE: 1/4" = 1'-0"



1B FP-4.4 **STAIR #5 - LEVEL 2**
SCALE: 1/4" = 1'-0"



1C FP-4.4 **STAIR #5 - LEVEL 3**
SCALE: 1/4" = 1'-0"

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP.	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

TOTAL SPRINKLERS THIS SHEET QTY

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
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NV-C41-69370
NM-MS 12-354807

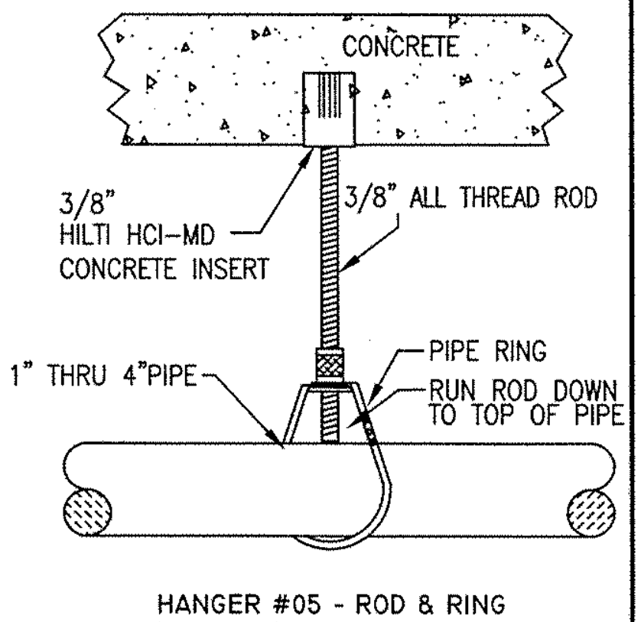
PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

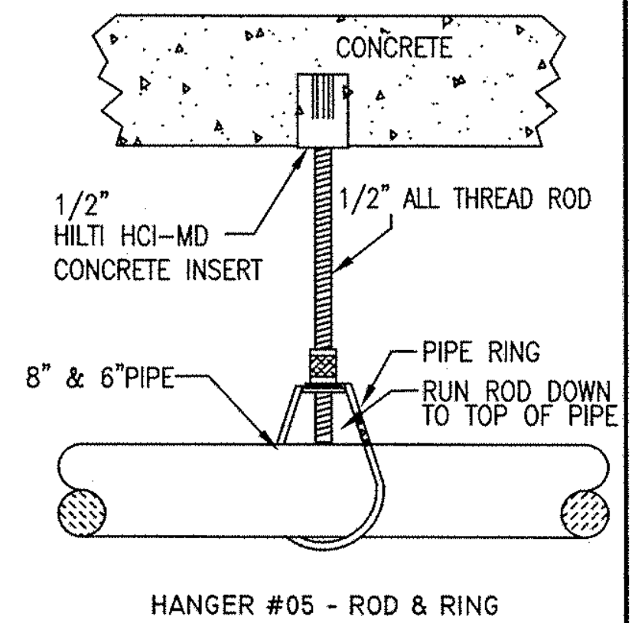
PLAN DESCRIPTION:
STANDPIPE # 5 DETAILS

DRAWN BY: ----
SCALE: 1/4"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-4.4

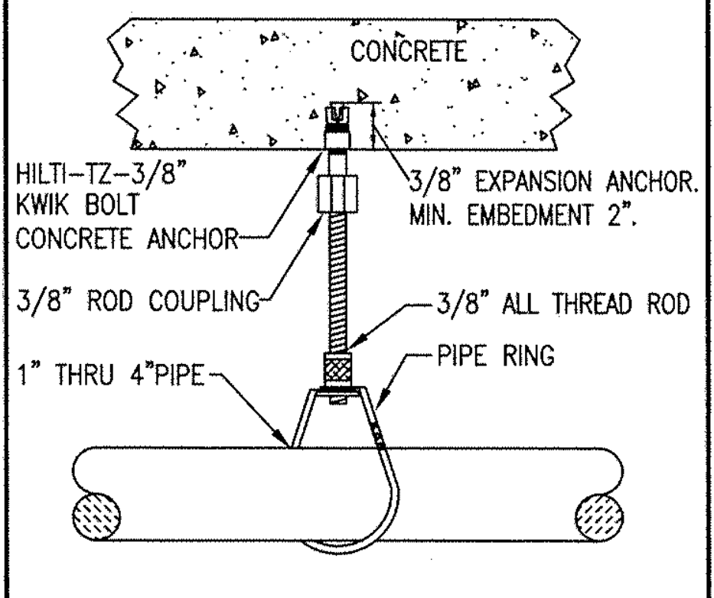
GEORGE PROVENCHER FP 693 Exp 12-31-11
09/29/11



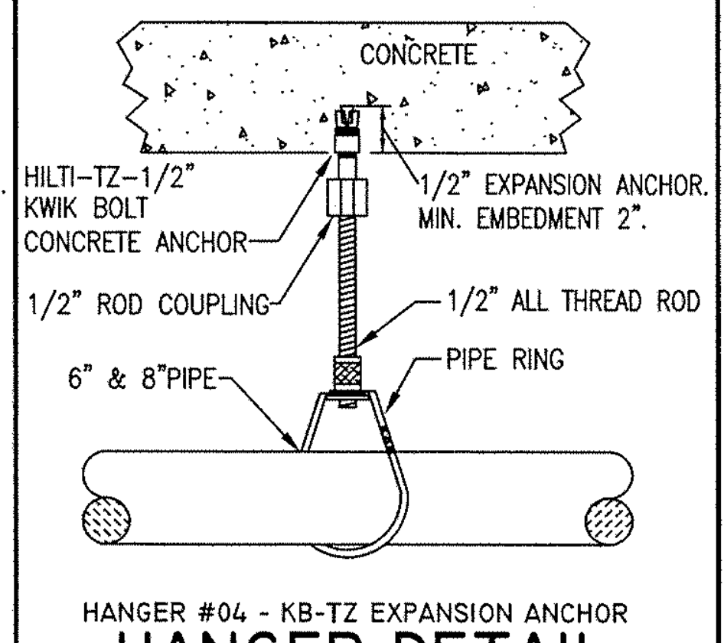
HANGER #05 - ROD & RING
HANGER DETAIL
NO SCALE



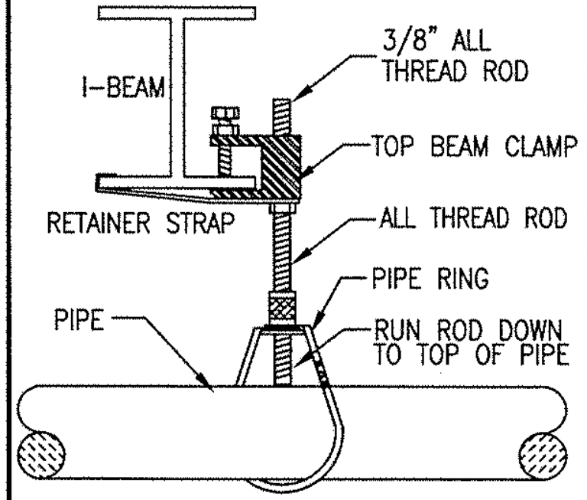
HANGER #05 - ROD & RING
HANGER DETAIL
NO SCALE



HANGER #04 - KB-TZ EXPANSION ANCHOR
HANGER DETAIL
NO SCALE

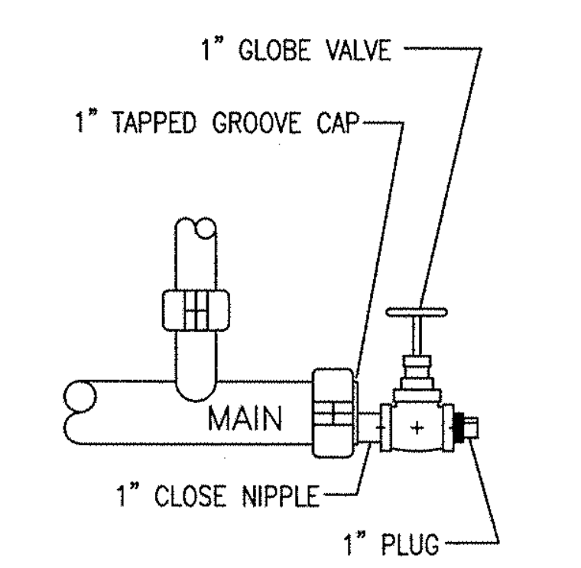


HANGER #04 - KB-TZ EXPANSION ANCHOR
HANGER DETAIL
NO SCALE

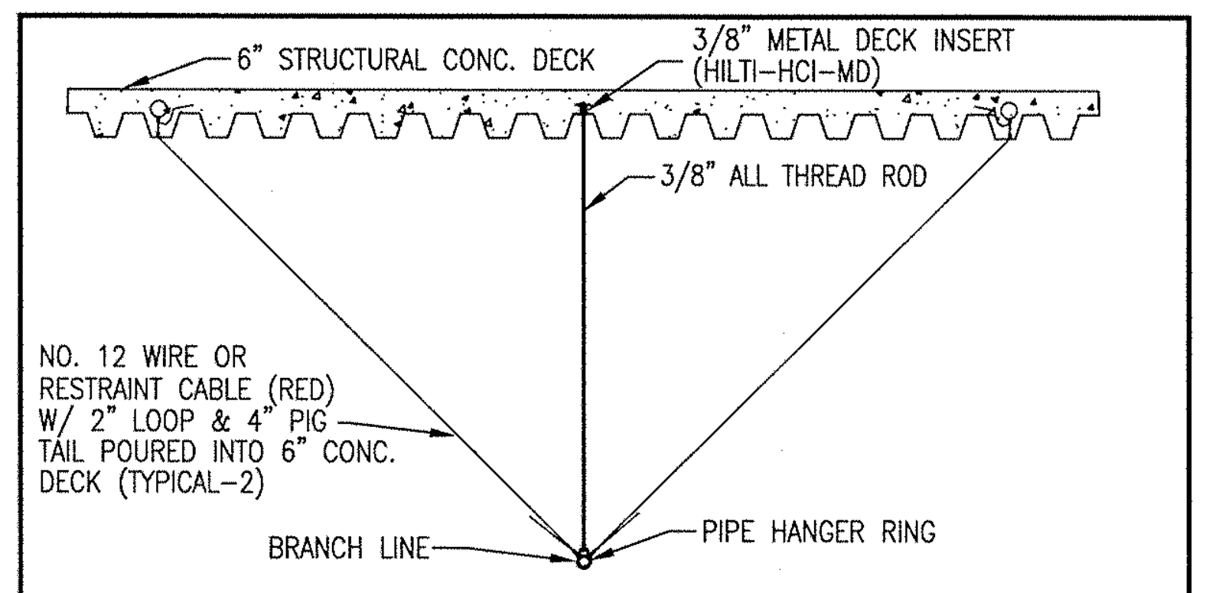


NOTE: HANGER ROD 6" OR LESS ACT AS LATERAL E.Q. BRACING AND BRANCH LINE RESTRAINT (BLR)

HANGER #01 - TOP BEAM CLAMP
HANGER DETAIL
NO SCALE



AUXILIARY DRAIN
NO SCALE



BRANCH LINE RESTRANT DETAIL (BLR)
NO SCALE

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science
California Polytechnic State University
San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

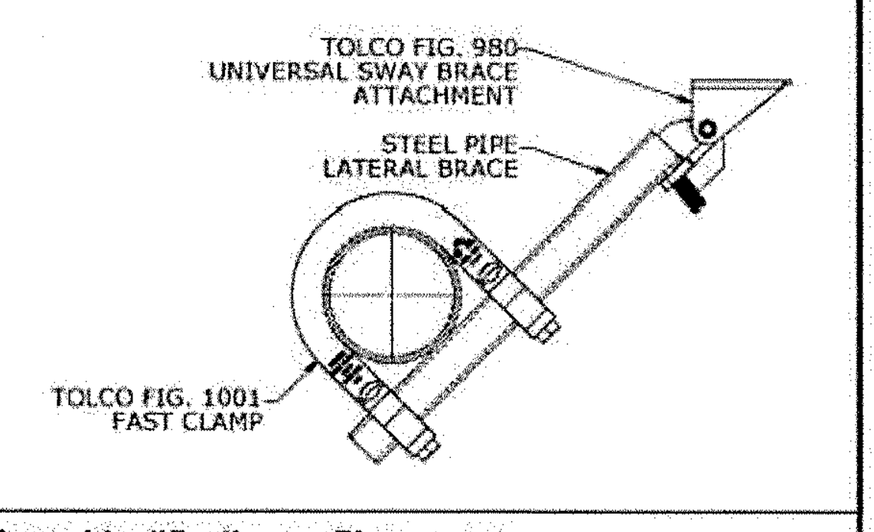
Maximum Spacing	40' 0" (12.19 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.1001 Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans LAT 1
Orientation of Brace Lateral

Braced Pipe: 6" Sch.40 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
6" Sch.40 Steel Pipe (152.4 mm)	40ft (12.2 m)	773 lbs (351 kg)
Percentage added for Fittings and Sprinklers	15%	116 lbs (52.62 kg)
Total Adjusted Load of all pipe within Zone of Influence		889 lbs (403 kg)

{Tol-Brace Version 7}

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science
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San Luis Obispo, Ca.
Job # 10034

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21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

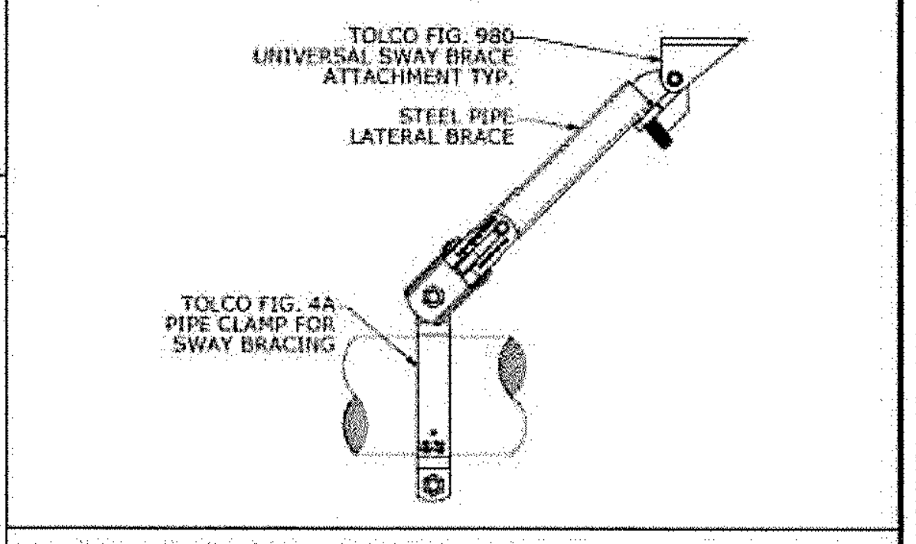
Maximum Spacing	45' 0" (13.72 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.4A Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans LONG 1
Orientation of Brace Longitudinal

Braced Pipe: 6" Sch.40 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
6" Sch.40 Steel Pipe (152.4 mm)	45ft (13.7 m)	870 lbs (395 kg)
Percentage added for Fittings and Sprinklers	15%	130 lbs (58.97 kg)
Total Adjusted Load of all pipe within Zone of Influence		1000 lbs (454 kg)

{Tol-Brace Version 7}

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science
California Polytechnic State University
San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

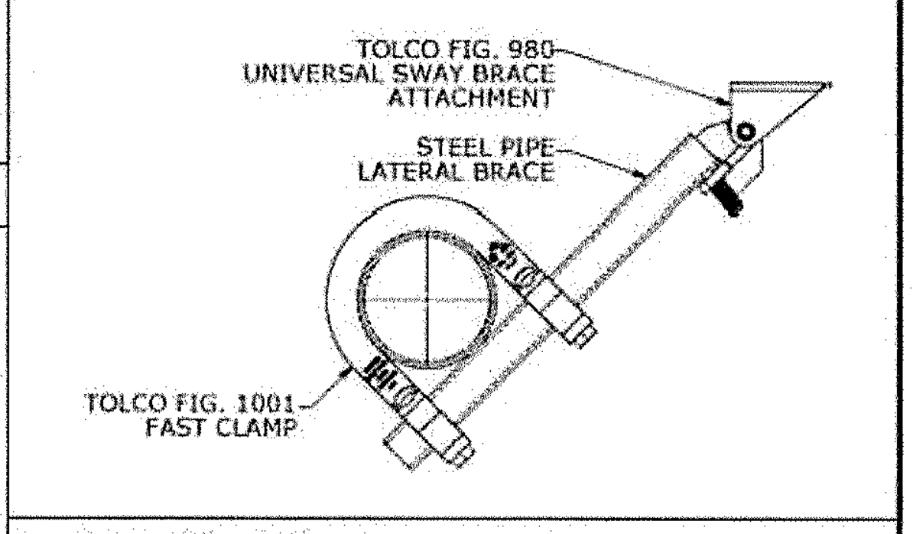
Maximum Spacing	35' 0" (10.67 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.1001 Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans LAT 2
Orientation of Brace Lateral

Braced Pipe: 3" Sch.10 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
3" Sch.10 Steel Pipe (76.2 mm)	35ft (10.7 m)	170 lbs (77 kg)
1.5" Sch.40 Steel Pipe (38.1 mm)	10ft (3 m)	22 lbs (10 kg)
1.25" Sch.40 Steel Pipe (31.75 mm)	31ft (9.4 m)	55 lbs (25 kg)
1" Sch.40 Steel Pipe (25.4 mm)	140ft (42.7 m)	175 lbs (79 kg)
Percentage added for Fittings and Sprinklers	15%	63 lbs (28.58 kg)
Total Adjusted Load of all pipe within Zone of Influence		485 lbs (220 kg)

{Tol-Brace Version 7}

Tol-Brace Seismic Calculations

Project Address: Cal Poly Center for Science
California Polytechnic State University
San Luis Obispo, Ca.
Job # 10034

Aero Automatic Sprinkler C
21605 N. Central Ave.
Phoenix, Az. 85024
(623)580-7847
CA-C16-901529

TOLCO a brand of NIBCO

Calculations based on 2007 NFPA Pamphlet #13

Brace Information

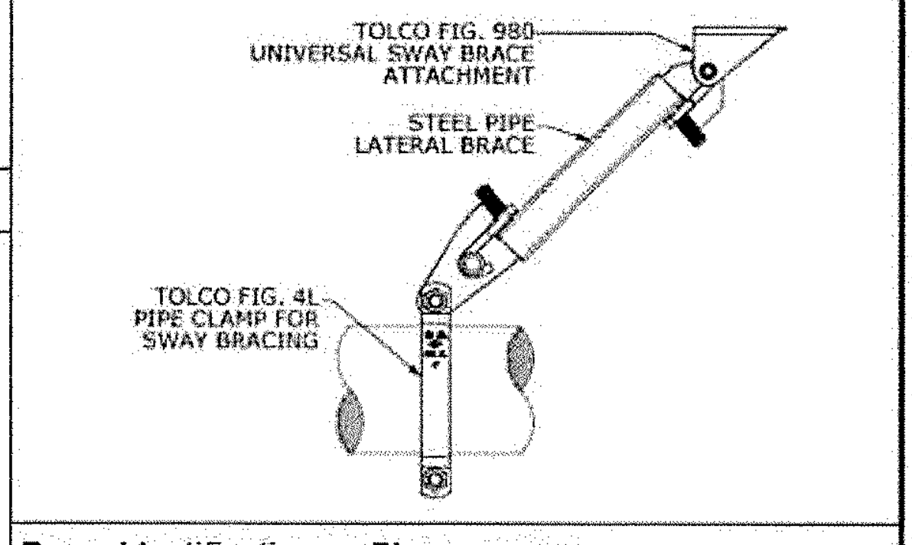
Maximum Spacing	80' 0" (24.38 m)
Maximum Brace Length	7' 0" (2.14 m)
Bracing Material	1" Sch.40
Angle from Vertical	30° Min.
Least Rad. of Gyration	0.421" (11 mm)
L/R Value	200
Max Horizontal Load	1227 lbs (557 kg)
Force Factor (Cp)	0.61

Tolco Brace Components

Tolco Component Fig. Number	Adjusted Load
Fig.4L Clamp	1007 lbs (457 kg)
Fig.980 Universal Swivel	1382 lbs (627 kg)

*Calculation Based on CONCENTRIC Loading
*Please Note: These calculations are for Tolco components only. Use of any other components voids these calculations and the listing of the assembly.

Assembly Detail



Fastener Information

Fastener Orientation	NFPA Type A
Type	HILTI-TZ
Diameter	1/2
Length	3 3/4
Maximum Load	1412 lbs (640 kg)

Brace Identification on Plans LONG 2
Orientation of Brace Longitudinal

Braced Pipe: 3" Sch.10 Steel Pipe

Load Information

Size and Type of Pipe	Total Length	Total Calculated Load
3" Sch.10 Steel Pipe (76.2 mm)	80ft (24.4 m)	387 lbs (176 kg)
Percentage added for Fittings and Sprinklers	15%	58 lbs (26.31 kg)
Total Adjusted Load of all pipe within Zone of Influence		446 lbs (202 kg)

{Tol-Brace Version 7}

SPRINKLER PIPE HANGER SPACING
N.F.P.A. 13, 2007 EDITION

TABLE 9.2.2.1 MAXIMUM DISTANCE BETWEEN HANGERS (FT-IN.)

NOMINAL PIPE SIZE	¾"	1"	1¼"	1½"	2"	2½"	3"&4"	6"	8"
STEEL PIPE	N/A	12-0	12-0	15-0	15-0	15-0	15-0	15-0	15-0
THREADED LIGHTWALL	N/A	12-0	12-0	12-0	12-0			N/A	N/A
COPPER TUBE									
CPVC	5-6	6-0	6-6	7-0	8-0	9-0	N/A	N/A	N/A

FIGURE A-9.2.3.4 DISTANCE FROM SPRINKLER TO HANGER

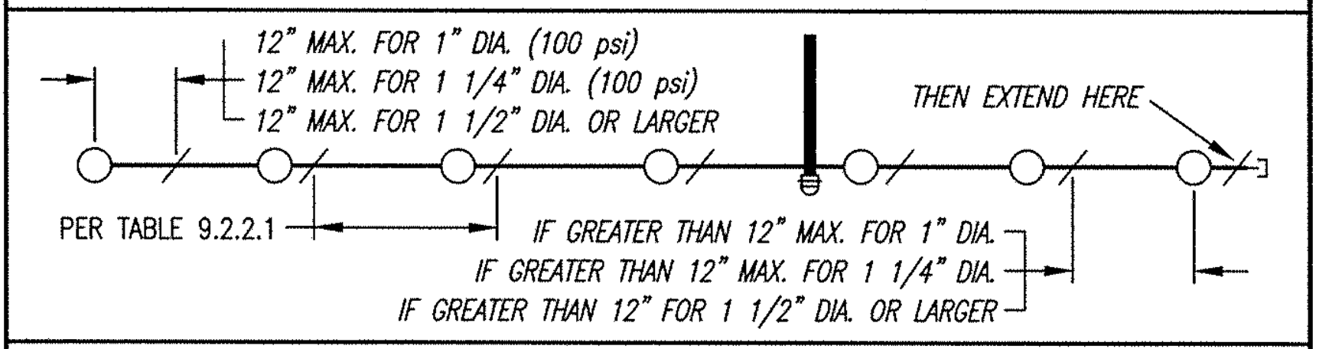


TABLE 9.1.2.1 HANGER ROD SIZE

PIPE SIZE	DIAMETER OF ROD	PIPE SIZE	DIAMETER OF ROD
UP TO AND INCLUDING 4"	3/8"	6" AND 8"	1/2"

THE CUMULATIVE HORIZONTAL LENGTH OF AN UNSUPPORTED ARMOVER TO A SPRINKLER, SPRINKLER DROP, OR SPRIG-UP SHALL NOT EXCEED 12 IN. FOR STEEL OR 6 IN. FOR COPPER TUBE. (PRESSURE EXCEEDS 100 psi)

SWAY BRACING

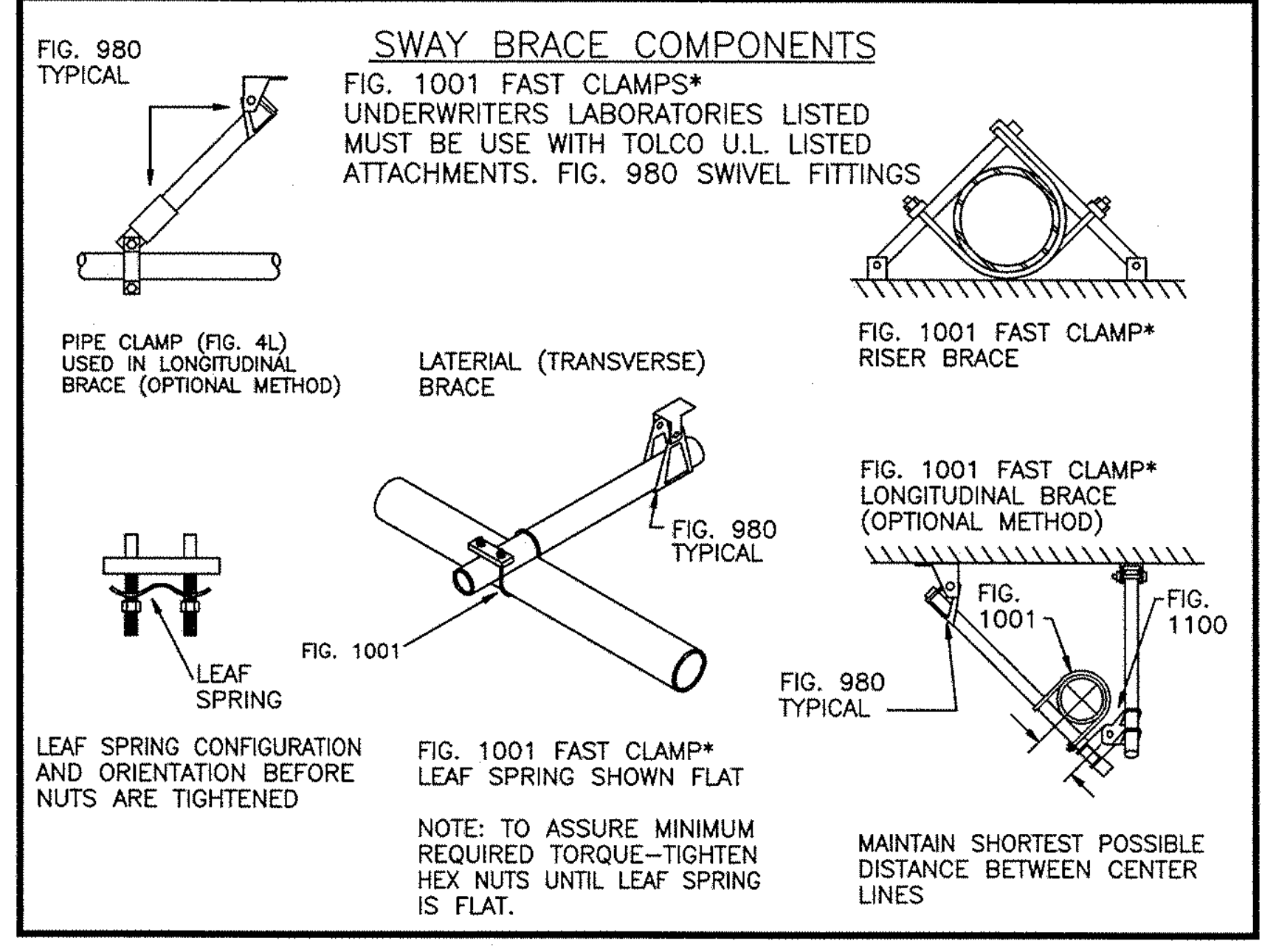


FIG. 1001 FAST CLAMPS* UNDERWRITERS LABORATORIES LISTED MUST BE USE WITH TOLCO U.L. LISTED ATTACHMENTS. FIG. 980 SWIVEL FITTINGS

LEAF SPRING CONFIGURATION AND ORIENTATION BEFORE NUTS ARE TIGHTENED

FIG. 1001 FAST CLAMP* LEAF SPRING SHOWN FLAT

NOTE: TO ASSURE MINIMUM REQUIRED TORQUE-TIGHTEN HEX NUTS UNTIL LEAF SPRING IS FLAT.

MAINTAIN SHORTEST POSSIBLE DISTANCE BETWEEN CENTER LINES

NOTES

1. LAT 1 TO BE USED FOR LATERAL SWAY BRACING OF SPRINKLER SYSTEM 6" MAINS. MAX SPACING 40'-0".
2. LAT 2 TO BE USED FOR LATERAL SWAY BRACING OF SPRINKLER SYSTEM 3" OR 2½" MAINS WITH BRANCH LINES. MAX SPACING 35'-0".
3. LONG 1 TO BE USED FOR LONGITUDINAL SWAY BRACING OF SPRINKLER SYSTEM 6" MAINS. MAX SPACING 45'-0".
4. LONG 2 TO BE USED FOR LONGITUDINAL SWAY BRACING OF SPRINKLER SYSTEM 3" OR 2½ " MAINS. MAX SPACING 80'-0".

SEISMIC CRITERIA

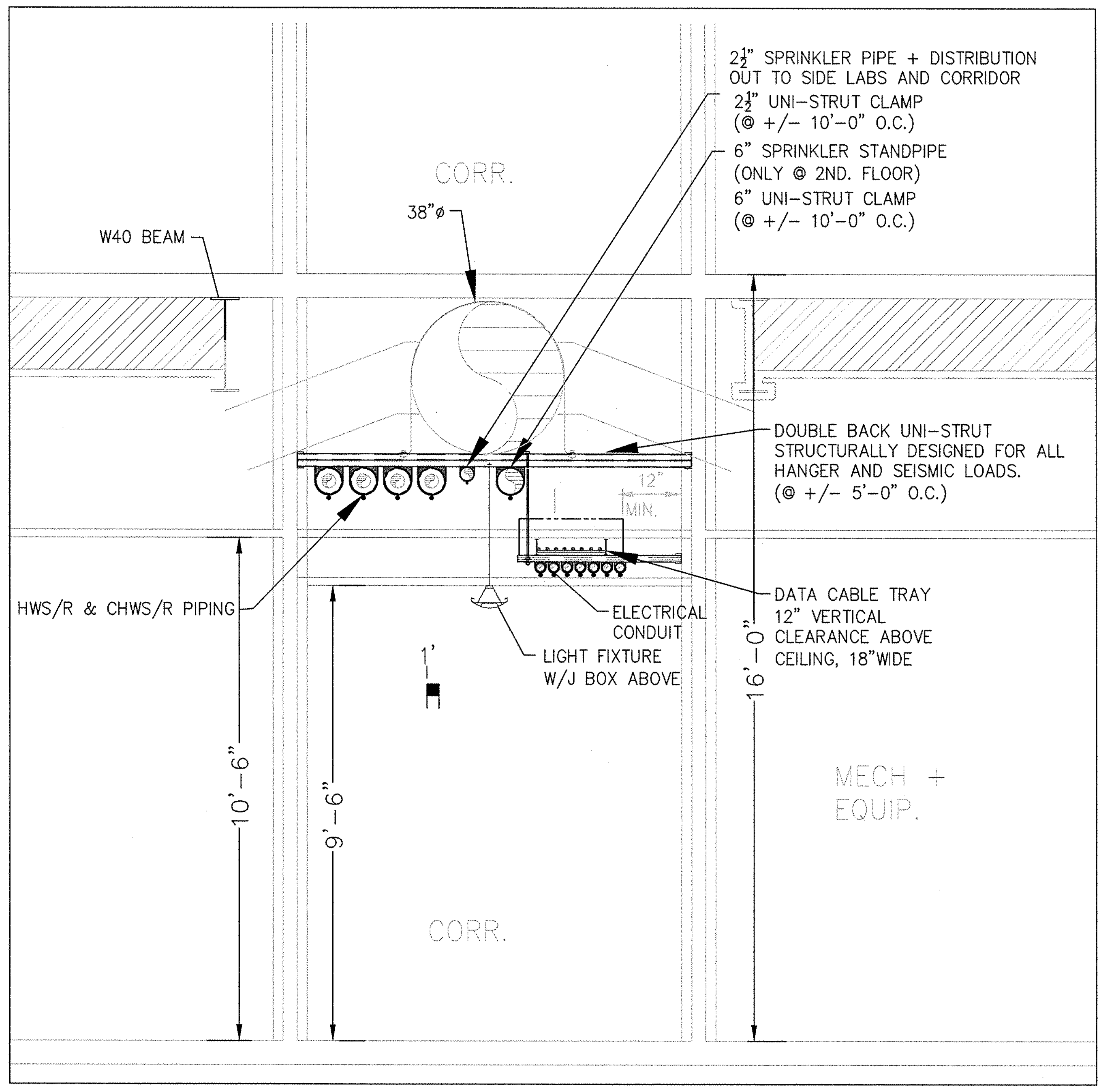
SEISMIC DESIGN CATEGORY	D
SEISMIC IMP. FACTOR	1.0
SITE SOIL PROFILE TYPE	B

SPECTRAL RESPONSE ACCELERATIONS:
Ss = 1.26*
S1 = 0.481*

SEISMIC COEFFICIENT:
Cp = 0.61**

*Ss & S1 VALUES TAKEN FROM STRUCTURAL DRAWING S 1.01 - DATED 10-23-2009

** VALUE INTERPOLATED FROM TABLE 9.3.5.6.2 OF N.F.P.A.



HANGER DETAIL # 10

6" 0 2' 4'
SCALE 1/2"=1'-0"

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECH
OFFICE OF REGULATION SERVICES
APPL 01-110181

WEIGHT OF WATER FILLED PIPE [LB./FT.]

		NOMINAL SIZE	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
THREADED OR GROOVED PIPE	SCHEDULE 40	I.D.	2.05	2.93	3.61	5.13	7.89	10.82	16.40	31.69	47.70
GROOVED PIPE	SCHEDULE 10	I.D.	NOT USED	NOT USED	NOT USED	4.22	5.89	7.94	11.78	23.03	40.08

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.

ESCUTCHEON
TOTAL SPRINKLERS THIS SHEET QTY

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-8370-6690455-5501 NM-MS 12-354807

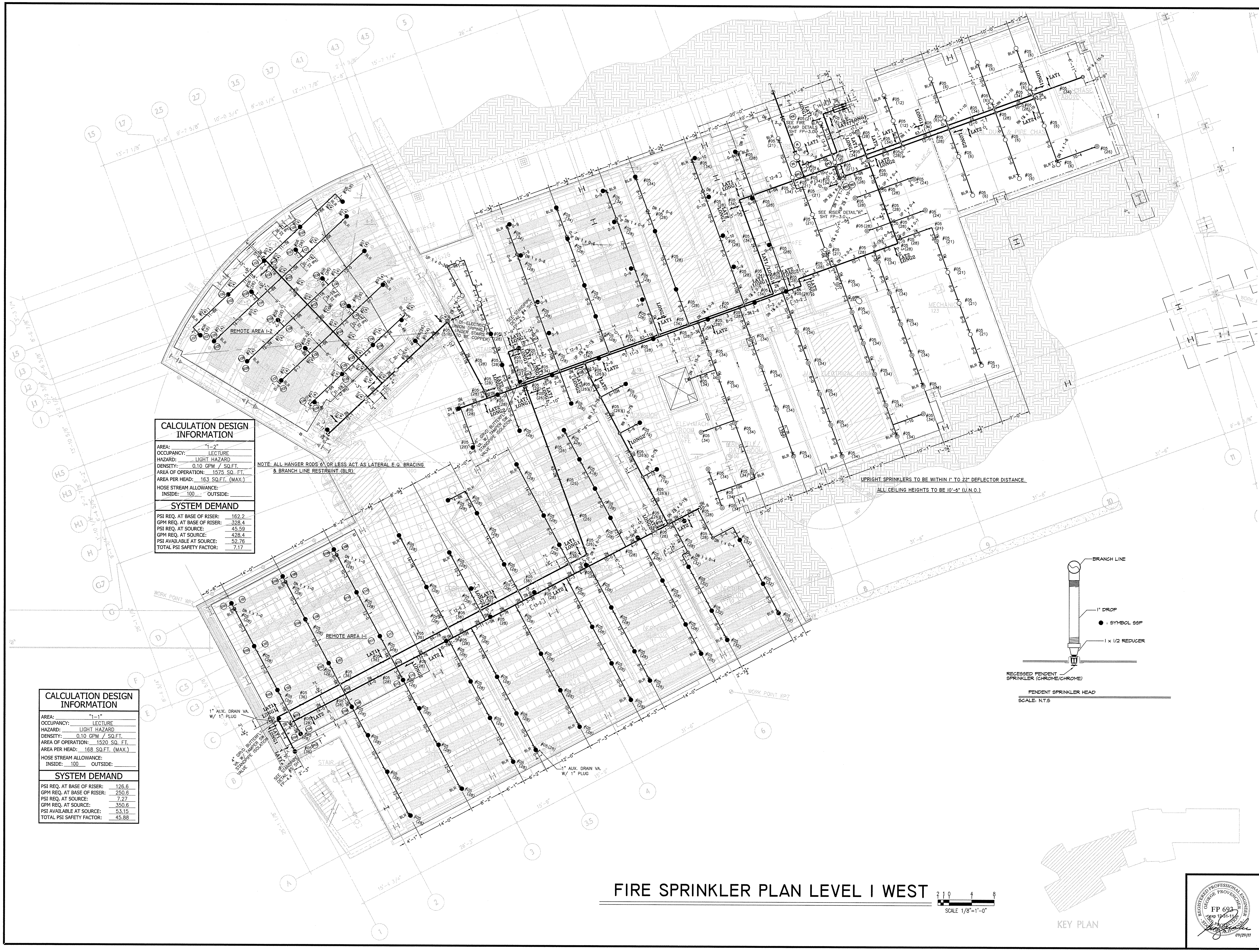
NORTH

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
HANGER & E.Q. DETAILS

DRAWN BY: NRL
SCALE: AS NOTED
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-5.0



CALCULATION DESIGN INFORMATION

AREA:	"1–2"
OCCUPANCY:	LECTURE
HAZARD:	LIGHT HAZARD
DENSITY:	0.10 GPM / SQ.FT.
AREA OF OPERATION:	1575 SQ. FT.
AREA PER HEAD:	163 SQ.FT. (MAX.)

HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: ______

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	162.2
GPM REQ. AT BASE OF RISER:	328.4
PSI REQ. AT SOURCE:	45.59
GPM REQ. AT SOURCE:	428.4
PSI AVAILABLE AT SOURCE:	52.76
TOTAL PSI SAFETY FACTOR:	7.17

NOTE: ALL HANGER RODS 6" OR LESS ACT AS LATERAL E.Q. BRACING & BRANCH LINE RESTRAINT (BLR)

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

CALCULATION DESIGN INFORMATION

AREA:	"1–1"
OCCUPANCY:	LECTURE
HAZARD:	LIGHT HAZARD
DENSITY:	0.10 GPM / SQ.FT.
AREA OF OPERATION:	1520 SQ. FT.
AREA PER HEAD:	168 SQ.FT. (MAX.)

HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: ______

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	126.6
GPM REQ. AT BASE OF RISER:	250.6
PSI REQ. AT SOURCE:	7.27
GPM REQ. AT SOURCE:	350.6
PSI AVAILABLE AT SOURCE:	53.15
TOTAL PSI SAFETY FACTOR:	45.88

PENDENT SPRINKLER HEAD
SCALE: N.T.S

FIRE SPRINKLER PLAN LEVEL I WEST

2 1 0 4 8
SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
											ESCUTCHEON			
●	TYCO	TY–FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	123
◎/○	TYCO	TY–FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	66
△	TYCO	TY–FRB	TY3331	QR	HSW	BRASS	1/2"	1/2"	5.6	200	–	–	–	1

TOTAL SPRINKLERS THIS SHEET 190

REVISIONS

#	DATE	BY	DESCRIPTION
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△	----	----	----
△	----	----	----
△	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO
AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-S370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL I WEST

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.01W

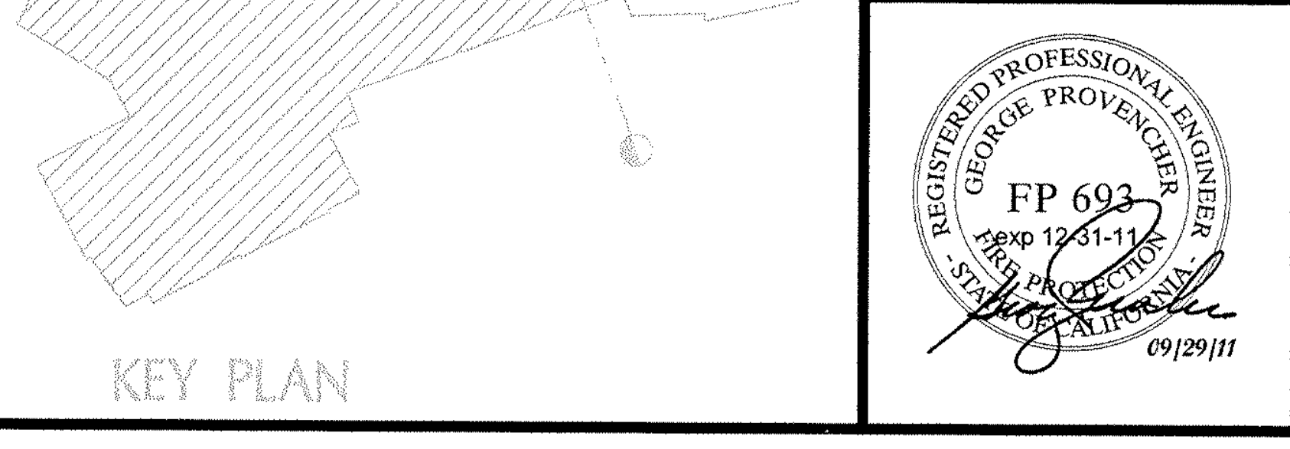
PENDENT SPRINKLER HEAD
SCALE: N.T.S

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

FIRE SPRINKLER PLAN LEVEL 2 WEST

SCALE 1/8"=1'-0"



KEY PLAN

FP 693
EXP 12-31-11
GEORGE PROVENCHER
09/29/11

DRAWN BY:	NRL
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.02W

PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 2 WEST

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

NORTH

SPRINKLER HEAD LEGEND											ESCUTCHEON			
SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	2
TOTAL SPRINKLERS THIS SHEET														188

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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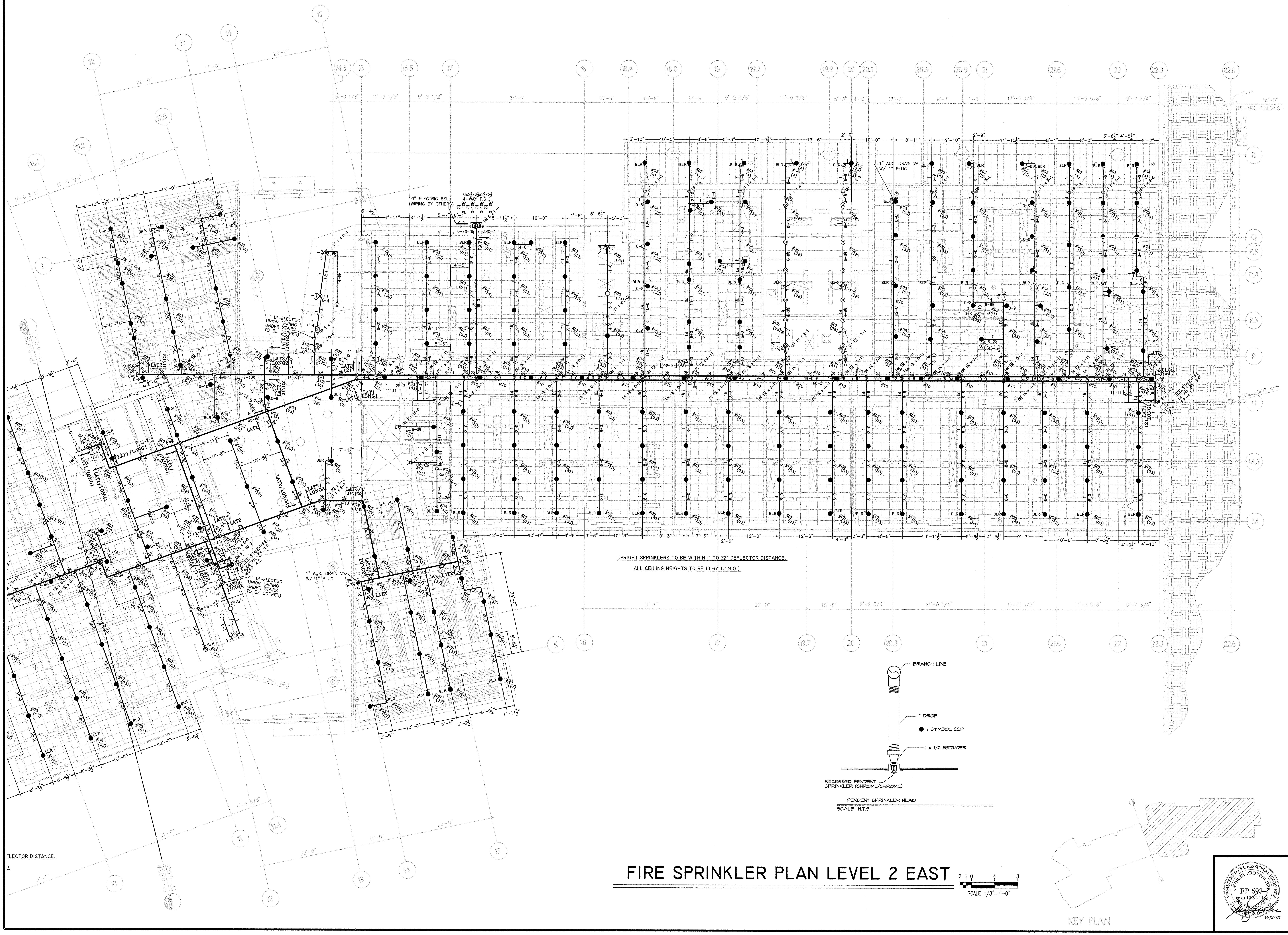
REVISIONS



FIRE SPRINKLER PLAN LEVEL 2 EAST

SPRINKLER HEAD LEGEND / ESCUTCHEON

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	186
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	2
TOTAL SPRINKLERS THIS SHEET														188

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

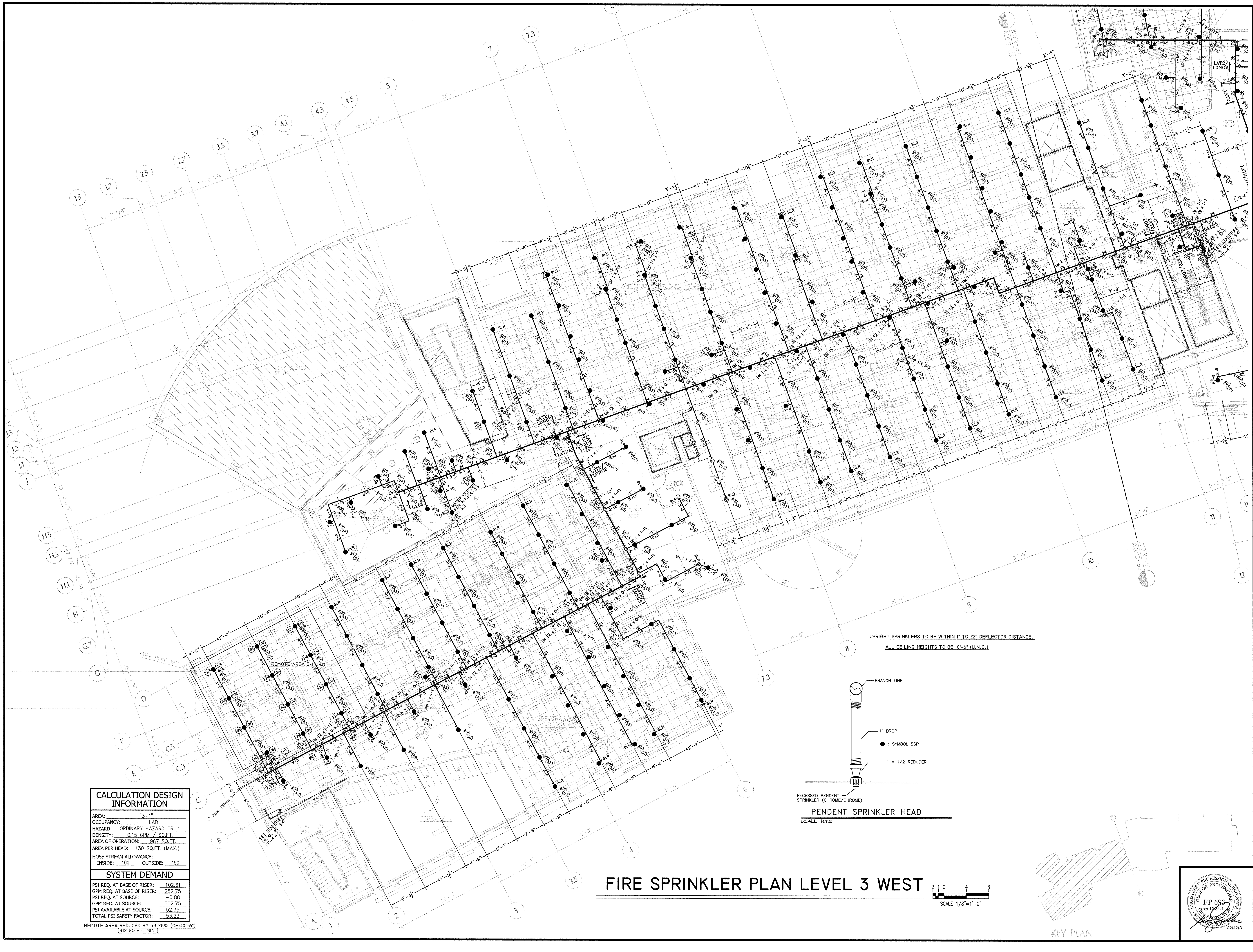
PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 2 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.02E

GEORGE PROVENCHER
FP 693
Exp 12-31-11
09/29/11



UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

CALCULATION DESIGN INFORMATION

AREA: "3-1"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 967 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	102.61
GPM REQ. AT BASE OF RISER:	252.75
PSI REQ. AT SOURCE:	-0.88
GPM REQ. AT SOURCE:	502.75
PSI AVAILABLE AT SOURCE:	52.35
TOTAL PSI SAFETY FACTOR:	53.23

REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

FIRE SPRINKLER PLAN LEVEL 3 WEST

SCALE 1/8"=1'-0"

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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REVISIONS

SPRINKLER HEAD LEGEND											ESCUTCHEON			
SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	204
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	-	-	-	4
TOTAL SPRINKLERS THIS SHEET														208

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

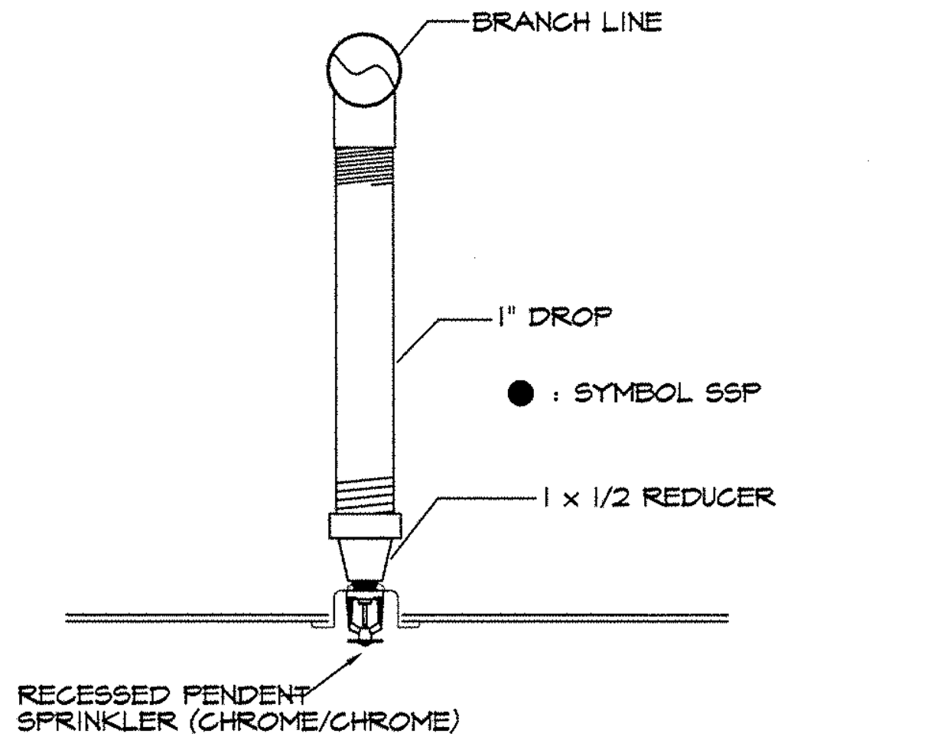
PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 3 WEST

REGISTERED PROFESSIONAL ENGINEER
GEORGE PROVENCHER
FP 693
exp 12-31-11
FIRE PROTECTION
STATE OF CALIFORNIA
09/29/11

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.03W

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)



PENDENT SPRINKLER HEAD

SCALE: N.T.S

CALCULATION DESIGN INFORMATION

AREA: "3-2"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 1135 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

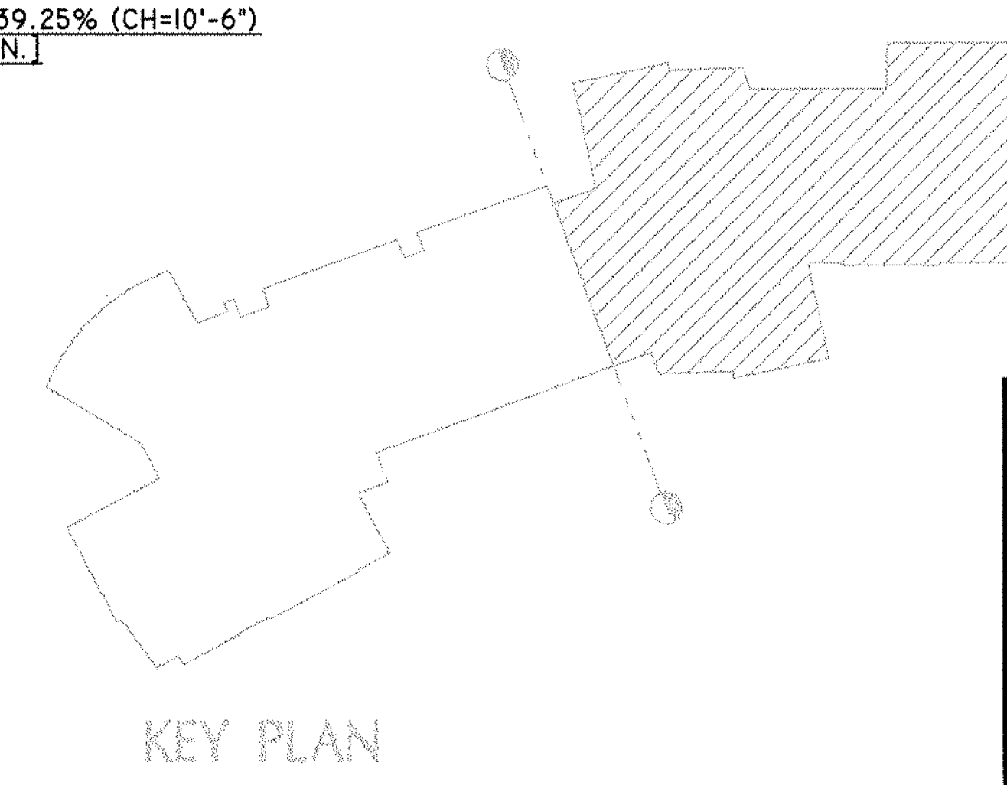
SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	107.33
GPM REQ. AT BASE OF RISER:	233.54
PSI REQ. AT SOURCE:	3.22
GPM REQ. AT SOURCE:	483.54
PSI AVAILABLE AT SOURCE:	52.45
TOTAL PSI SAFETY FACTOR:	49.23

REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

FIRE SPRINKLER PLAN LEVEL 3 EAST

2 1 0 4 8
SCALE 1/8"=1'-0"



FP 693
exp 12-31-11
GEORGE PROVENCHER
09/29/11

SPRINKLER HEAD LEGEND										ESCUTCHEON			
SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	224
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	2

TOTAL SPRINKLERS THIS SHEET 226

#	DATE	BY	DESCRIPTION
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△	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

REVISIONS

NORTH

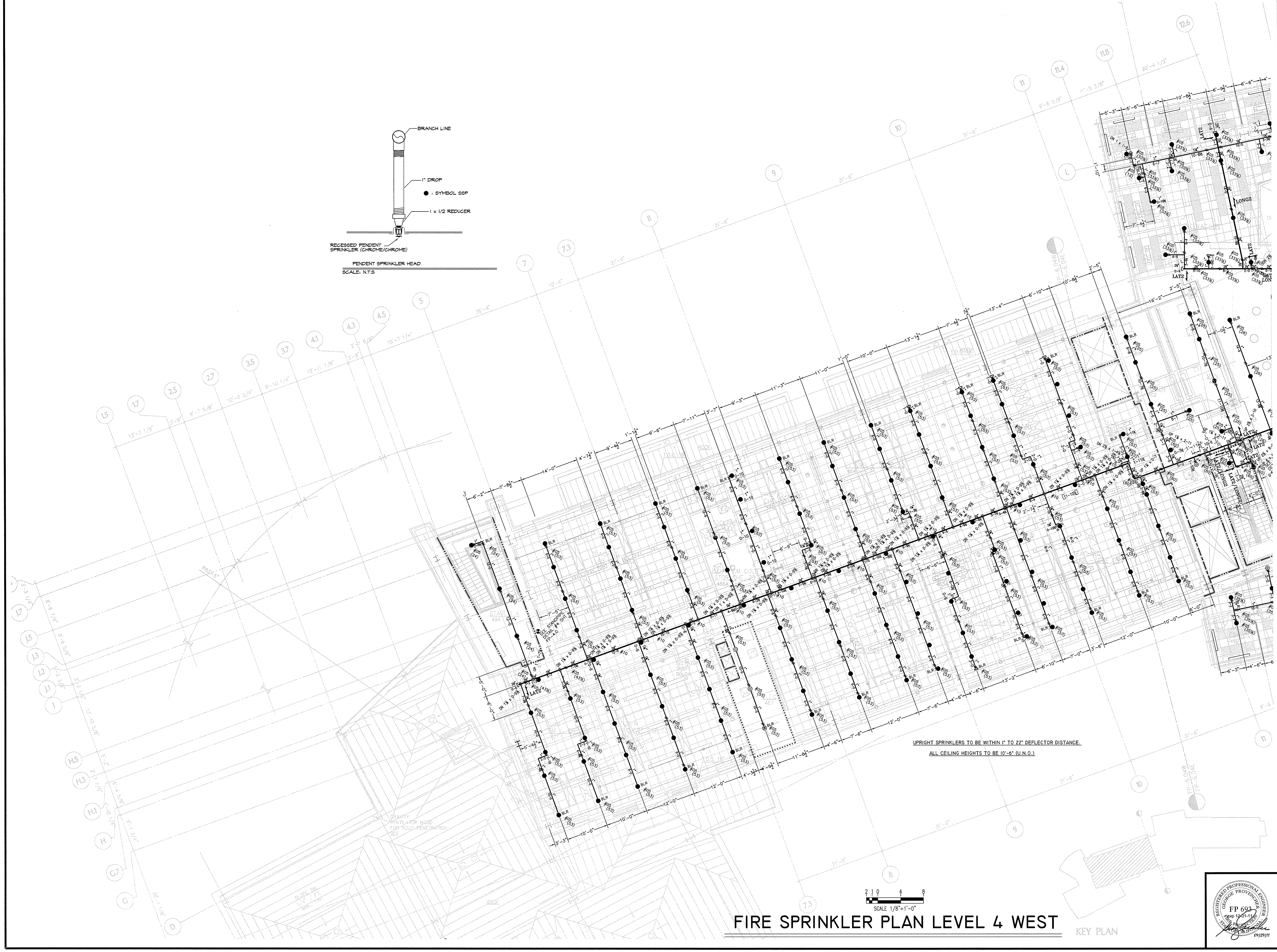
AERO
AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 3 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.03E



UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

FIRE SPRINKLER PLAN LEVEL 4 WEST

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	118
◎	TYCO	TY-FRB	TY3131	QR	UPR	BRASS	1/2"	1/2"	5.6	200	–	–	–	3
TOTAL SPRINKLERS THIS SHEET														121

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

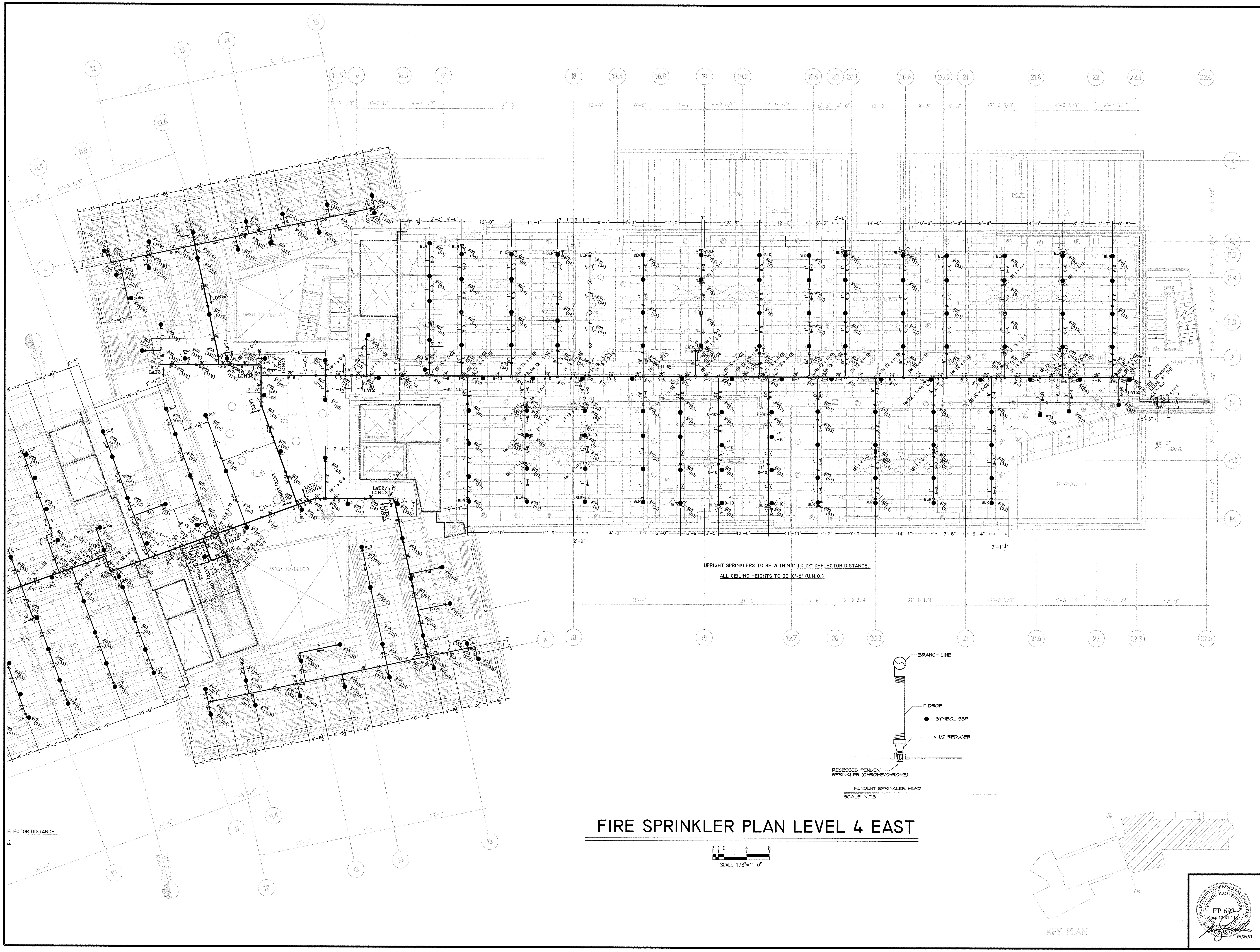
PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 4 WEST

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.04W



UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

FIRE SPRINKLER PLAN LEVEL 4 EAST

2 1 0 4 8

SCALE 1/8"=1'-0"

KEY PLAN

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	189
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	–	–	–	5
TOTAL SPRINKLERS THIS SHEET														194

REVISIONS

#	DATE	BY	DESCRIPTION
△	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
AZ-C16-234797
UT-8370-6690455-5501
CA-C16-901529
NV-C41-69370
NM-MS 12-354807

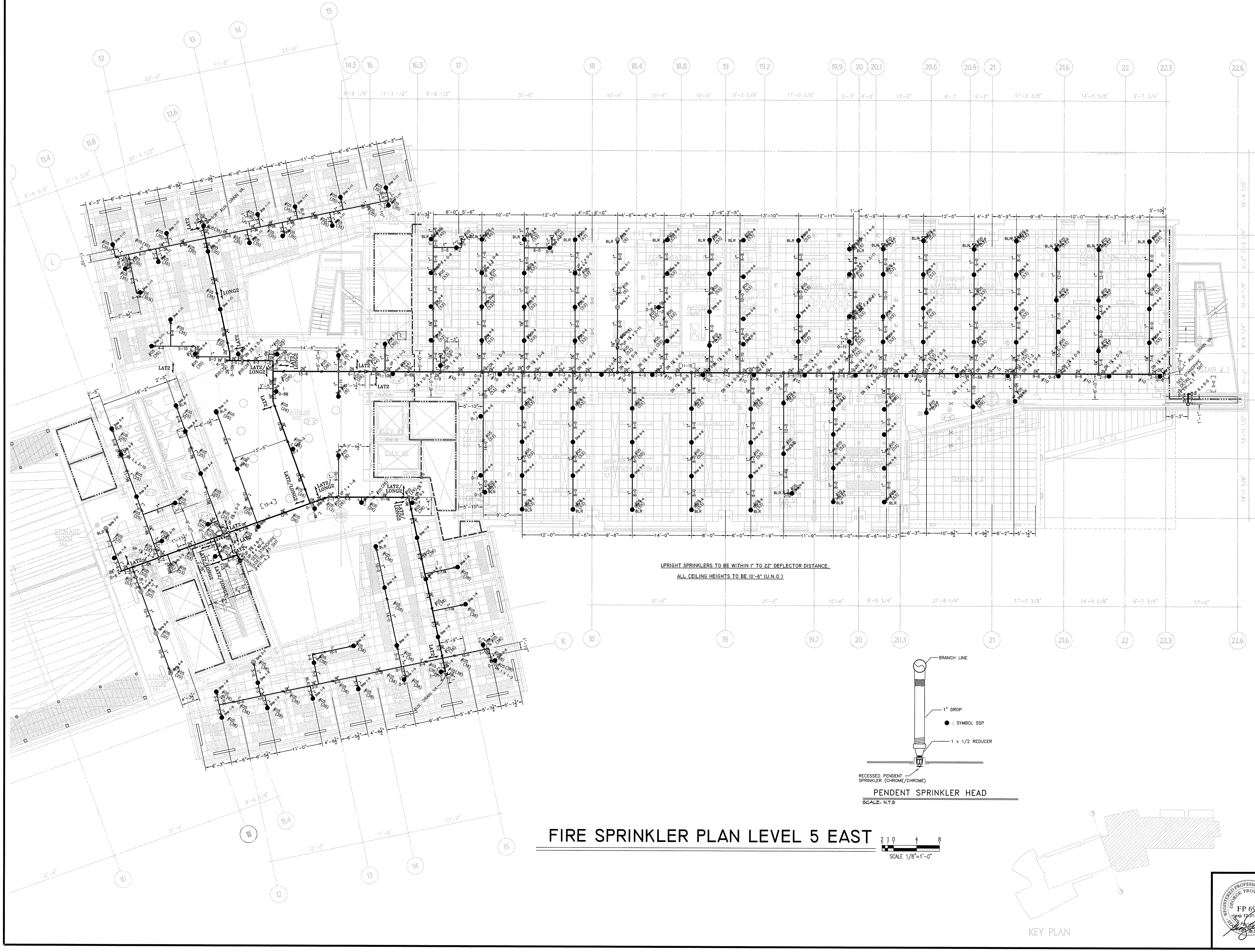
PROJECT:
CAL POLY
CENTER FOR SCIENCE
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 4 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.04E

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11



SPRINKLER HEAD LEGEND / **ESCUTCHEON**

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESC. TYPE	FINISH	TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	184
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	—	—	—	10

TOTAL SPRINKLERS THIS SHEET 194

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR

NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave. 623.580.7800
Phoenix, Arizona 85024 Fax 623.434.3154
AZ-L16-234798 CA-C16-901529
AZ-C16-234797 NV-C41-69370
UT-S370-6690455-5501 NM-MS 12-354807

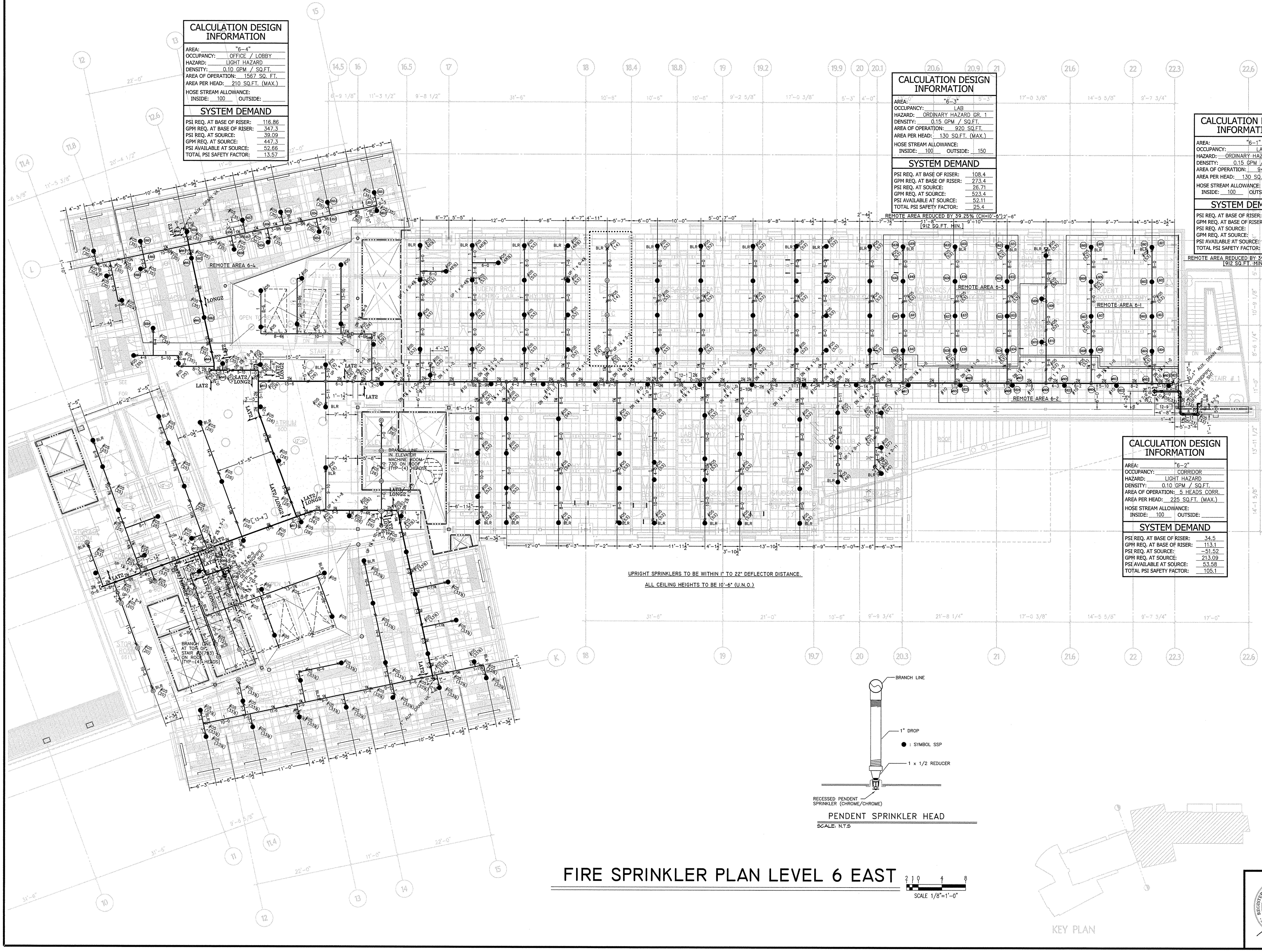
PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 5 EAST

DRAWN BY: NRL
SCALE: 1/8"=1'-0"
DATE: 8-15-2011
CONTRACT: 10034
SHEET: FP-6.05E

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11



REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

REMOTE AREA REDUCED BY 39.25% (CH=10'-6")
[912 SQ.FT. MIN.]

UPRIGHT SPRINKLERS TO BE WITHIN 1" TO 22" DEFLECTOR DISTANCE.

ALL CEILING HEIGHTS TO BE 10'-6" (U.N.O.)

PENDENT SPRINKLER HEAD

SCALE: N.T.S

CALCULATION DESIGN INFORMATION

AREA: "6-4"
OCCUPANCY: OFFICE / LOBBY
HAZARD: LIGHT HAZARD
DENSITY: 0.10 GPM / SQ.FT.
AREA OF OPERATION: 1567 SQ. FT.
AREA PER HEAD: 210 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: ______

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	116.86
GPM REQ. AT BASE OF RISER:	347.3
PSI REQ. AT SOURCE:	39.09
GPM REQ. AT SOURCE:	447.3
PSI AVAILABLE AT SOURCE:	52.66
TOTAL PSI SAFETY FACTOR:	13.57

CALCULATION DESIGN INFORMATION

AREA: "6-3"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 920 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	108.4
GPM REQ. AT BASE OF RISER:	273.4
PSI REQ. AT SOURCE:	26.71
GPM REQ. AT SOURCE:	523.4
PSI AVAILABLE AT SOURCE:	52.11
TOTAL PSI SAFETY FACTOR:	25.4

CALCULATION DESIGN INFORMATION

AREA: "6-1"
OCCUPANCY: LAB
HAZARD: ORDINARY HAZARD GR. 1
DENSITY: 0.15 GPM / SQ.FT.
AREA OF OPERATION: 940 SQ.FT.
AREA PER HEAD: 130 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: 150

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	95.47
GPM REQ. AT BASE OF RISER:	233.15
PSI REQ. AT SOURCE:	12.35
GPM REQ. AT SOURCE:	483.15
PSI AVAILABLE AT SOURCE:	53.35
TOTAL PSI SAFETY FACTOR:	40.1

CALCULATION DESIGN INFORMATION

AREA: "6-2"
OCCUPANCY: CORRIDOR
HAZARD: LIGHT HAZARD
DENSITY: 0.10 GPM / SQ.FT.
AREA OF OPERATION: 5 HEADS CORR.
AREA PER HEAD: 225 SQ.FT. (MAX.)
HOSE STREAM ALLOWANCE:
INSIDE: 100 OUTSIDE: ______

SYSTEM DEMAND

PSI REQ. AT BASE OF RISER:	34.5
GPM REQ. AT BASE OF RISER:	113.1
PSI REQ. AT SOURCE:	-51.52
GPM REQ. AT SOURCE:	213.09
PSI AVAILABLE AT SOURCE:	53.58
TOTAL PSI SAFETY FACTOR:	105.1

FIRE SPRINKLER PLAN LEVEL 6 EAST

SCALE 1/8"=1'-0"

SPRINKLER HEAD LEGEND

SYM.	MFG.	MODEL	SIN	RESP	STYLE	FINISH	N.P.T.	ORIFICE	K	TEMP.	ESCUTCHEON ESC. TYPE	ESCUTCHEON FINISH	ESCUTCHEON TEMP.	QTY.
●	TYCO	TY-FRB	TY3231	QR	PEND	CHRM	1/2"	1/2"	5.6	155	RECESSED	CHRM	N/A	193
◎	TYCO	TY-FRB	TY3131	QR	UPR	CHRM	1/2"	1/2"	5.6	200	N/A	N/A	N/A	20

TOTAL SPRINKLERS THIS SHEET 213

REVISIONS

#	DATE	BY	DESCRIPTION
1	9-28-2011	NRL	SUBMITTAL TO GENERAL CONTRACTOR
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NORTH

AERO AUTOMATIC SPRINKLER CO.
21605 North Central Ave.
Phoenix, Arizona 85024
623.580.7800
Fax 623.434.3154
AZ-L16-234798
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NV-C41-69370
NM-MS 12-354807

PROJECT:
CAL POLY
CENTER FOR SCIENCE
CALIFORNIA POLYTECHNIC STATE UNIVERSITY
SAN LUIS OBISPO, CA.

CONTRACT WITH:
GILBANE CONSTRUCTION
6265 GREENWICH DRIVE, SUITE 103
SAN DIEGO, CA. 92122

PLAN DESCRIPTION:
FIRE SPRINKLER PLAN LEVEL 6 EAST

DRAWN BY:	----
SCALE:	1/8"=1'-0"
DATE:	8-15-2011
CONTRACT:	10034
SHEET:	FP-6.06E

GEORGE PROVENCHER
FP 693
exp 12-31-11
09/29/11

APPENDIX E – WILKINS MODEL 350ADA

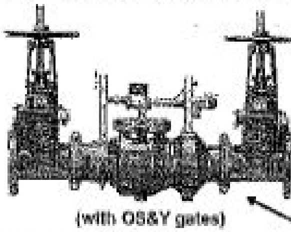
33 11 00 PART 2
2.01 E

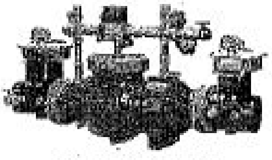
WILKINS
a ZURN company

Model 350ADA

Double Check Detector Assembly

SPECIFICATION SUBMITTAL SHEET


(with OS&Y gates)


(with BGVIC valves)

FEATURES

Sizes: ☐ 2 1/2"* ☐ 3"* ☐ 4" ☐ 6" ☒ 8" ☐ 10"

Maximum working water pressure	175 PSI
Maximum working water temperature	140°F
Hydrostatic test pressure	350 PSI
End connections (Grooved for steel pipe)	AWWA C606
(Flanged)	ANSI B16.1 Class 125

*2 1/2" & 3" sizes use 4" body & reducer couplings

OPTIONS

(Suffixes can be combined)

- ☐ - with flanged end OS & Y gate valves (standard)
- ☐ L - less shut-off valves (grooved body connections)
- ☐ LM - less water meter
- ☐ - with remote reading meter
- ☐ - with gpm meter (standard)
- ☐ - with cu ft/min meter
- ☐ G - with grooved end OS&Y gate valves
- ☐ FG - with flanged inlet gate connection and grooved outlet gate connection
- ☐ PI - with Post Indicator Gate Valves (4"-10")
- ☐BGVIC - with grooved end butterfly valves

ACCESSORIES

- ☐ Repair kit (rubber only)
- ☐ Thermal expansion tank (Model XT)
- ☐ OS & Y Gate valve tamper switch (OSY-40)
- ☐ Test Cock Lock (Model TCL24)

DIMENSIONS & WEIGHTS (do not include pkg.)

MODEL 350ADA SIZE		WEIGHT							
		WITHOUT GATES		WITH OS&Y GATES (GXF)		WITH OS&Y GATES (GXG)		WITH BUTTERFLY VALVES (GXG)	
in.	mm	lbs.	kg	lbs.	kg	lbs.	kg	lbs.	kg
~~2 1/2~~	~~65~~	~~105~~	~~47.5~~	~~207~~	~~94~~	~~199~~	~~90.3~~	~~123.6~~	~~56.2~~
~~3~~	~~80~~	~~104~~	~~47~~	~~224~~	~~101.5~~	~~214~~	~~97~~	~~124.4~~	~~56.5~~
~~4~~	~~100~~	~~91~~	~~41.3~~	~~245~~	~~111~~	~~219~~	~~99.4~~	~~123~~	~~55.8~~
~~6~~	~~150~~	~~141~~	~~64~~	~~377~~	~~171~~	~~347~~	~~158~~	~~183~~	[illegible]
8	200	302	137	778	353.2	754	342.3	410	186
~~10~~	~~250~~	~~355~~	~~161~~	~~1040~~	~~472.7~~	~~916~~	~~416.0~~	~~527~~	~~239.9~~

APPLICATION

Designed for installation on potable water lines connections in fire sprinkler systems to protect against both backsiphonage and backpressure of polluted water into the potable water supply. Model 350ADA shall provide protection where a potential health hazard does not exist. Incorporates metered by-pass to detect leaks and unauthorized water use.

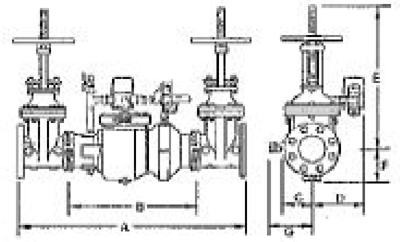
STANDARDS COMPLIANCE (HORIZONTAL & VERTICAL)

- ASSE® Listed 1048
- AWWA Compliant C510 (with gates only)
- CSA® Certified (4" - 8")
- UL® Classified
- C-UL® Classified
- FM® Approved
- Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California
- NYC MEA 221-04M-2 (2 1/2" - 8")

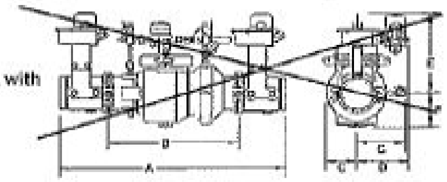
MATERIALS

Main valve body	Ductile Iron ASTM A 536 Grade 4
Access covers	Ductile Iron ASTM A 536 Grade 4
Coatings	FDA Approved electrostatic epoxy finish
Internals	Stainless steel, 300 Series NORYL™, NSF Listed
Fasteners & springs	Stainless Steel, 300 Series
Elastomers	EPDM (FDA approved) Buna Nitrile (FDA approved)
Polymers	NORYL™, NSF Listed

MODEL 350ADA with OS&Y option



MODEL 350ADA with BGVIC option

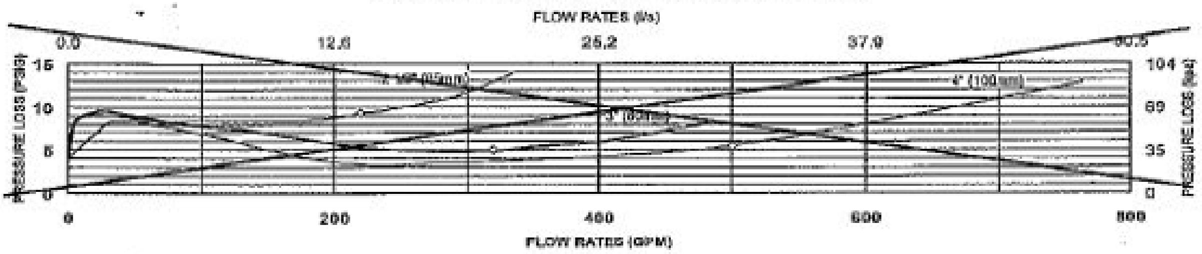


MODEL 350 ADA SIZE		DIMENSION (approximate)																			
		A		A WITH BUTTERFLY VALVES		B LESS GATE VALVES		C		D		E OS&Y OPEN		E OS&Y CLOSED		E WITH BUTTERFLY VALVES		F		G	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
~~2 1/2~~	~~65~~	~~35 1/8~~	~~892~~	~~32 1/8~~	~~816~~	~~20 1/8~~	~~511~~	~~4 1/2~~	~~114~~	~~9~~	~~229~~	~~16 3/8~~	~~416~~	~~13 7/8~~	~~352~~	~~8~~	~~203~~	~~6~~	~~152~~	~~7 1/4~~	~~184~~
~~3~~	~~80~~	~~36 1/8~~	~~918~~	~~33~~	~~838~~	~~20 1/8~~	~~511~~	~~4 1/2~~	~~114~~	~~9~~	~~229~~	~~18 7/8~~	~~479~~	~~15 5/8~~	~~397~~	~~8~~	~~203~~	~~6~~	~~152~~	~~7 1/4~~	~~184~~
~~4~~	~~100~~	~~38 1/4~~	~~972~~	~~33 1/4~~	~~845~~	~~19 7/8~~	~~505~~	~~4 1/2~~	~~114~~	~~9~~	~~229~~	~~22 3/4~~	~~578~~	~~16 1/4~~	~~404~~	~~9 1/8~~	~~232~~	~~6~~	~~152~~	~~8~~	~~203~~
~~6~~	~~150~~	~~47 1/4~~	~~1200~~	~~40 1/4~~	~~1022~~	~~25 7/8~~	~~657~~	~~5 1/2~~	~~140~~	~~10 1/2~~	~~267~~	~~30 1/8~~	~~765~~	~~23 3/4~~	~~603~~	~~10 1/8~~	~~257~~	~~7~~	~~178~~	~~10~~	~~254~~
8	200	62	1575	55	1397	38 1/2	978	10	254	12	305	37 3/4	959	29 1/4	743	11 15/16	303	8 1/2	216	11	279
~~10~~	~~250~~	~~64 5/8~~	~~1642~~	~~58 1/2~~	~~1486~~	~~38 1/2~~	~~978~~	~~10~~	~~254~~	~~12~~	~~305~~	~~45 3/4~~	~~1162~~	~~36 5/8~~	~~930~~	~~13 5/16~~	~~338~~	~~8 1/2~~	~~216~~	~~12~~	~~305~~

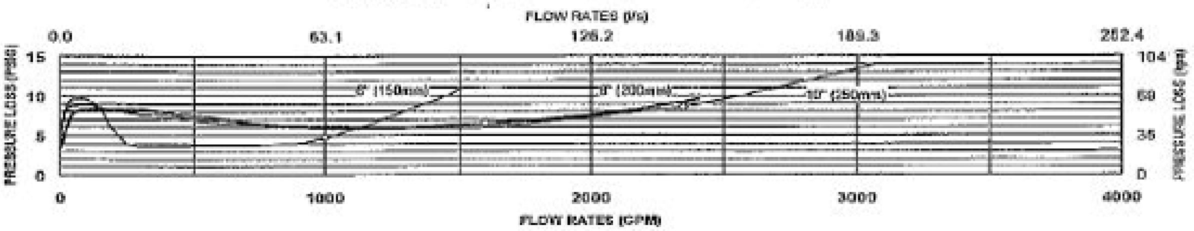
Attention: Model 350ADA (grooved body) and Model 350DA (flange body) have different lay lengths.

FLOW CHARACTERISTICS

MODEL 350ADA 2 1/2", 3" & 4" (STANDARD & METRIC)



MODEL 350ADA 6", 8" & 10" (STANDARD & METRIC)

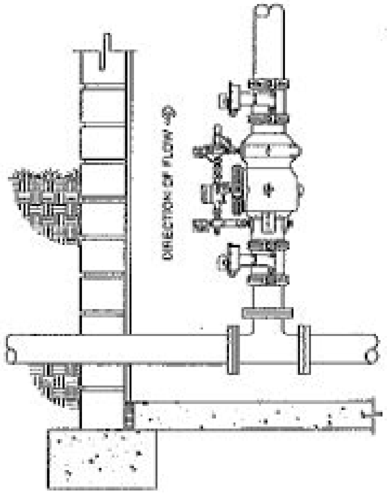


◇ Rated Flow (Established by approval agencies)

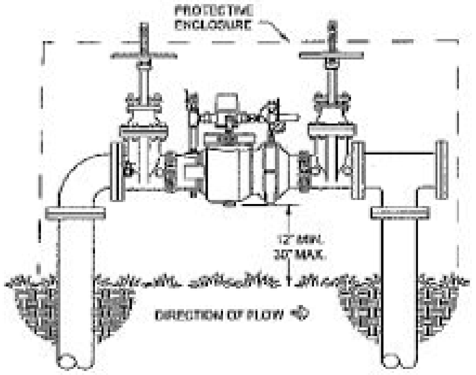
TYPICAL INSTALLATION

Local codes shall govern installation requirements. Unless otherwise specified, the assembly shall be mounted at a minimum of 12" (305mm) and a maximum of 30" (762mm) above adequate drains with sufficient side clearance for testing and maintenance. The installation shall be made so that no part of the unit can be submerged.

Capacity thru Schedule 40 Pipe (GPM)				
Pipe size	5 ft/sec	7.5 ft/sec	10ft/sec	15 ft/sec
~~2 1/2"~~	~~75~~	~~112~~	~~149~~	~~224~~
~~3"~~	~~115~~	~~173~~	~~230~~	~~346~~
~~4"~~	~~198~~	~~298~~	~~397~~	~~595~~
~~6"~~	~~450~~	~~675~~	~~900~~	~~1351~~
8"	780	1169	1559	2339
~~10"~~	~~1229~~	~~1843~~	~~2458~~	~~3687~~
~~12"~~	~~1763~~	~~2644~~	~~3525~~	~~5288~~



MODEL 350ADABGVIC (VERTICAL INSTALLATION)



MODEL 350ADA (OUTDOOR INSTALLATION)

SPECIFICATIONS

The Double Check Detector Backflow Prevention Assembly shall be ASSE® Listed 1048, and supplied with full port gate valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be Noryl™ (NSF Listed), the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second check valves shall be accessible for maintenance without removing the device from the line. The Double Check Detector Backflow Prevention Assembly shall be a WILKINS Model 350ADA.

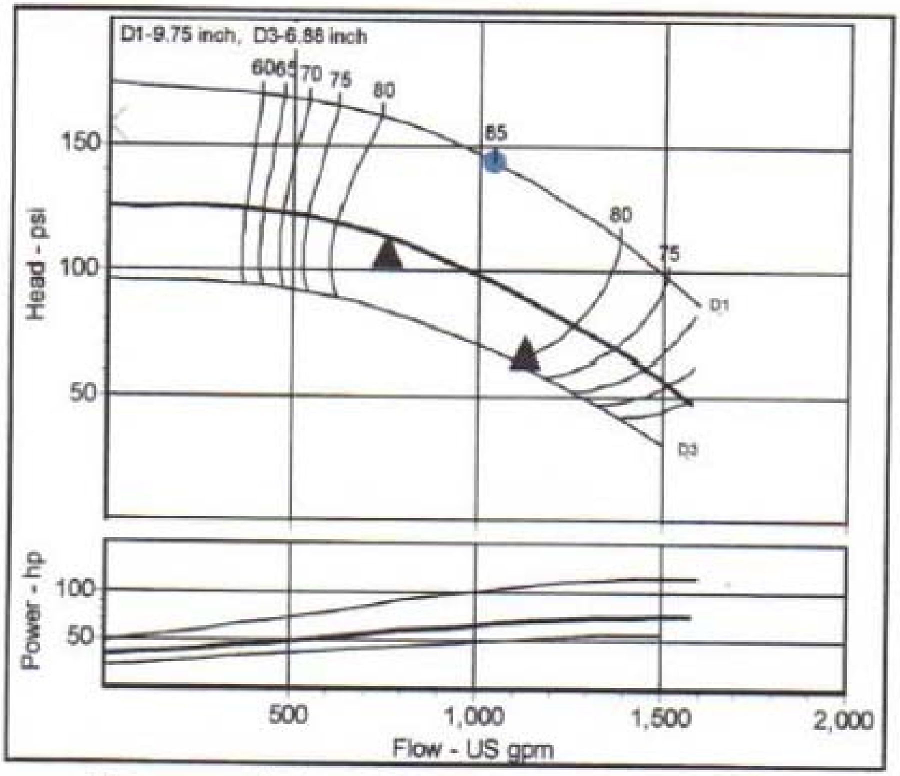
APPENDIX F – FIRE PUMP CURVE

PEERLESS PUMP
Reliability | When It Matters

Approved Fire Pumps
1151 N. Pomona Rd., Ste. B Corona, Ca 92882
Dena Mueller
Phone 951-738-9100
Fax 951-7389191

Project : Cal Poly Center for Science
Quote Ref. : UK-999999-1
Page No : 1
Date : Monday, February 28, 2011

Type:	**PG - In-Line Close Coupled Fire**	Item :	**1**
Pump Model:	**6PVF10**	Impeller No.:	2699332
Pump Op. Speed:	**3550 RPM, 60 Hz Electric**	Liquid:	**Water**
Impeller Dia.:	**8.24** inch	Temperature:	**59** °F
Curve No.:	**3116186**	Viscosity:	**1.14** cSt
Market :	**FM/UL/ULC Listed Fire Pump**	Sp. Gravity:	**1.00**
		Your Ref. :	



Rated Flow	**750** US gpm
Rated Head	**113** psi
Imp. Dia.	**8.24** inch
Rated Power Required	**58.1** hp
Rated Efficiency	**85.3** %

NFPA Limits:

140% Head at shutoff	**158.2** psi
65% Head at 150% flow	**73.4** psi
Flow at 150%	**1125** US gpm
Head at 150	**89** psi
Power Req. at 150%	**69.3** hp
Efficiency at 150%	**84.5** %
Peak Power	**75.4** hp
Closed Valve Pressure	**125.2** psi
Approval	UL

Comments

Performance curve represents typical performance. NPSH data is

Flow (US gpm)	Head (psi)	Pump Efficiency (%)	Power Required (hp)	NPSH Required (ft)
0.0	125.2	0.0	34.7	
197.6	125.2	38.6	39.5	
395.1	124.2	62.8	45.7	
592.7	119.6	78.8	52.6	
790.2	110.9	86.2	59.5	
987.8	98.9	87.0	65.7	
1185.3	84.4	82.8	70.7	
1382.9	67.9	74.2	74.0	
1580.4	48.2	59.1	75.4	

APPENDIX G – HYDRAULIC HAND CALCULATIONS

NODE	FLOW IN GPM		PIPE SIZE	PIPE FITTINGS AND DEVICES	EQUIV. PIPE LENGTH		FRICTION LOSS PSI/FT	PRESSURE SUMMARY		NOTES
S631	q	19.5		1T(5)	L	0.5		Pt	12.125	A=130ft^2 per sprinkler
			1.049		F	5	0.1242	Pe	-0.2165	D=0.15 gpm/ft^2
L631	Q	19.5			T	5.5		Pf	0.6831	H=-0.5ft, K=5.6
L631	q				L			Pt	12.592	Keq=19.5/sqrt(12.592)
					F			Pe		Keq=5.495
	Q	19.5			T			Pf		
L631	q				L	8		Pt	12.592	
			1.049		F		0.1242	Pe		
L632	Q	19.5			T	8		Pf	0.9936	
L632	q	20.25			L	8		Pt	13.586	Keq=5.495
			1.049		F		0.4637	Pe		Q=5.495*sqrt(13.586)
L633	Q	39.75			T	8		Pf	3.7096	Q=20.254 gpm
L633	q	22.85			L	8		Pt	17.2956	Keq=5.495
			1.049		F		1.074	Pe		Q=5.495*sqrt(17.2956)
L634	Q	62.6			T	8		Pf	8.592	Q=22.853 gpm
L634	q	27.96		1T(6)	L	7.5		Pt	25.8876	H=+1ft
			1.38	1E(3)	F	9	0.5595	Pe	-0.433	Q=5.495*sqrt(25.8876)
MN08	Q	90.56			T	16.5		Pf	9.232	Q=27.96 gpm
MN08	q				L			Pt	34.686	Branchline Keq
					F			Pe		Keq=90.56/sqrt(34.686)
	Q	90.56			T			Pf		Keq=15.38
MN08	q				L	10.75		Pt	34.686	
			2.635		F		0.024	Pe		
MN10	Q	90.56			T	10.75		Pf	0.2577	
MN10	q	90.92			L	10.75		Pt	34.944	Keq=15.38
			2.635		F		0.0868	Pe		Q=15.38*sqrt(34.944)
MN11	Q	181.48			T	10.75		Pf	0.9326	Q=90.916 gpm
MN11	q	92.12		1T(12)	L	149.5		Pt	35.877	H=+1.33 ft
			2.635	2E(6)	F	18	0.1854	Pe	-0.576	Q=15.38*sqrt(35.877)
MN12	Q	273.6			T	167.5		Pf	31.055	Q=92.122 gpm
MN12	q			1F(3)	L	32.8		Pt	66.356	
			2.635	1T(12)	F	15	0.1854	Pe		
MN13	Q	273.6			T	47.8		Pf	8.862	
MN13	q			2E(6)	L	26.452		Pt	75.22	H=-2.247 ft
			2.635	1T(12)	F	24	0.1854	Pe	0.973	
MN14	Q	273.6			T	50.452		Pf	9.3538	

NODE	FLOW IN GPM		PIPE SIZE	PIPE FITTINGS AND DEVICES	EQUIV. PIPE LENGTH		FRICTION LOSS PSI/FT	PRESSURE SUMMARY		NOTES
MN14	q			2E(6)	L	9.667		Pt	85.547	
			2.635		F	12	0.1854	Pe		
TOR6	Q	273.6			T	21.667		Pf	4.017	
TOR6	q			1C(11)	L	7.083		Pt	89.564	H=-7.083 ft
			2.635	1B(7)	F	24	0.1854	Pe	3.067	
BOR6	Q	273.6		1E(6)	T	31.083		Pf	5.763	
BOR6	q			1T(12)	L	1		Pt	98.394	H=+1 ft
			2.635		F	12	0.1854	Pe	-0.433	
SP36	Q	273.6			T	13		Pf	2.41	
SP36	q	100		1T(30)	L	32		Pt	100.37	H=-32 ft
			6.065		F	30	0.0057	Pe	13.856	
SP34	Q	373.6			T	62		Pf	0.3534	
SP34	q			1T(30)	L	23.833		Pt	114.58	H=-23.833 ft
			6.065		F	30	0.0057	Pe	10.32	
SP05	Q	373.6			T	53.833		Pf	0.307	
SP05	q			1T(30)	L	61.66		Pt	125.207	H=-1.084 ft
			6.065	1B(10)	F	110	0.0057	Pe	0.469	
SP04	Q	373.6		5E(14)	T	171.66		Pf	0.978	
SP04	q			2E(14)	L	79.33		Pt	126.654	H=-15.416 ft
			6.065		F	28	0.0057	Pe	6.68	
SPC1	Q	373.6			T	107.33		Pf	0.612	
SPC1	q			1T(30)	L	7.833		Pt	133.946	
			6.065		F	30	0.0057	Pe		
SPC2	Q	373.6			T	37.833		Pf	0.216	
SPC2	q			1B(12)	L	14.75		Pt	134.162	H=-10.83 ft
			7.981	1C(45)	F	75	0.0015	Pe	4.7	
PO	Q	373.6		1E(18)	T	89.75		Pf	0.1346	
PO	q				L			Pt	138.99	Pump Curve
					F			Pe		At 373.6 gpm
PI	Q	373.6			T			Pf	-125	P=125 psi
PI	q			1G(4)	L	13.29		Pt	14	H=+5 ft
			7.981	1E(18)	F	57	0.0015	Pe	-2.17	
POC	Q	373.6		1T(45)	T	70.29		Pf	0.105	
POC	q			1E(18)	L	41		Pt	13.885	H=+2.25 ft
			8.27		F	32.32	0.0008	Pe	-0.97	PVC pipe, C=150, 1.51
BF1a	Q	373.6			T	73.32		Pf	0.059	D=1.189, E=32.32

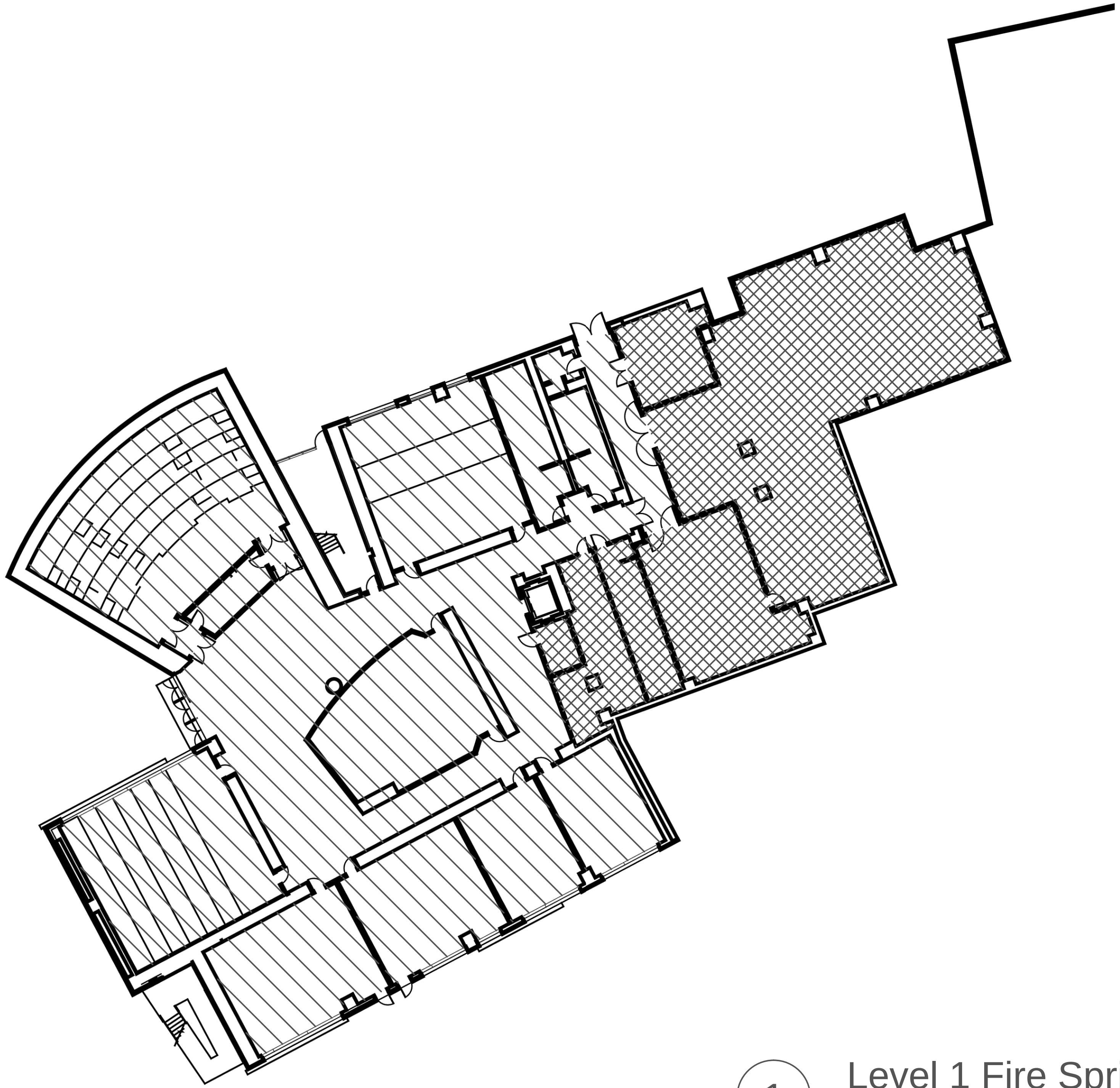
NODE	FLOW IN GPM		PIPE SIZE	PIPE FITTINGS AND DEVICES	EQUIV. PIPE LENGTH		FRICTION LOSS PSI/FT	PRESSURE SUMMARY		NOTES
BF1a	q			1E(18)	L	4		Pt	12.974	H=+4 ft
			7.981		F	18	0.0015	Pe	-1.73	
BF1	Q	373.6			T	22		Pf	0.033	
BF1	q			1Zic	L			Pt	11.277	Zurn spec sheet
			7.981		F			Pe		Fixed loss 8 psi
BF2	Q	373.6			T			Pf	8	
BF2	q			2E(18)	L	4		Pt	19.277	H=-4 ft
			7.981		F	36	0.0015	Pe	1.73	
BF2a	Q	373.6			T	40		Pf	0.06	
BF2a	q			1G(4)	L	42		Pt	21.07	PVC pipe, C=150, 1.51
			8.27	1T(35)	F	70.02	0.0008	Pe		D=1.189, E=32.32
SRC	Q	373.6			T	112.02		Pf	0.0896	(39)*(1.189)*(1.51)=70.02
SRC	q	150			L			Pt	21.16	Outside HSA=150gpm
					F			Pe		
	Q	523.6			T			Pf		

APPENDIX H – FIRE SPRINKLER HAZARD CLASSIFICATION FLOOR PLANS

Legend:

▨ Light Hazard

▩ Ordinary Hazard Group 2



① Level 1 Fire Sprinkler Hazard Classification

CAL POLY

Buiding 180 CSM
Level 1

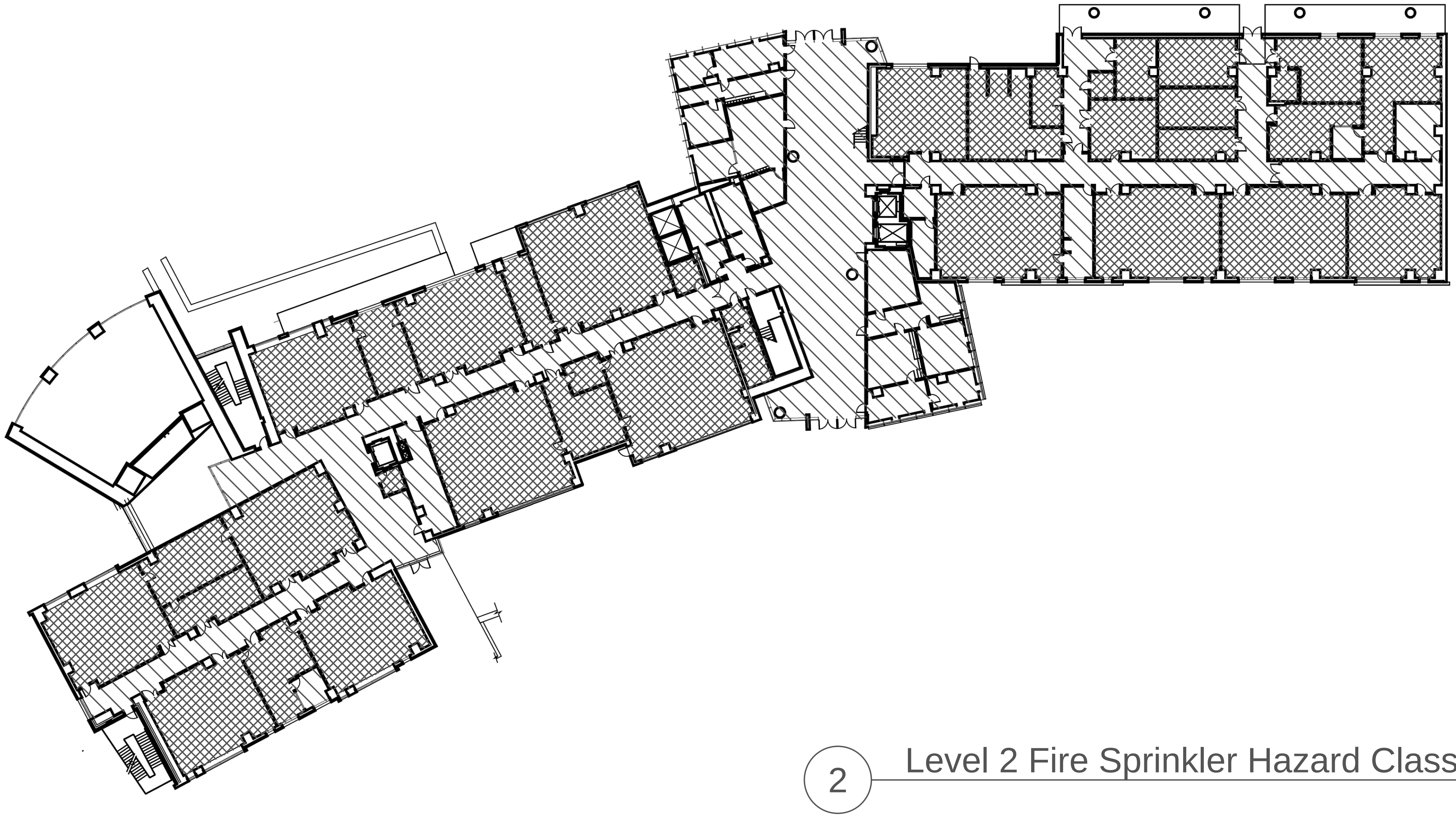
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
1
OF 6 SHEETS

Legend:

▨ Light Hazard

▦ Ordinary Hazard Group 2



② Level 2 Fire Sprinkler Hazard Classification

CALPOLY

Buiding 180 CSM
Level 2

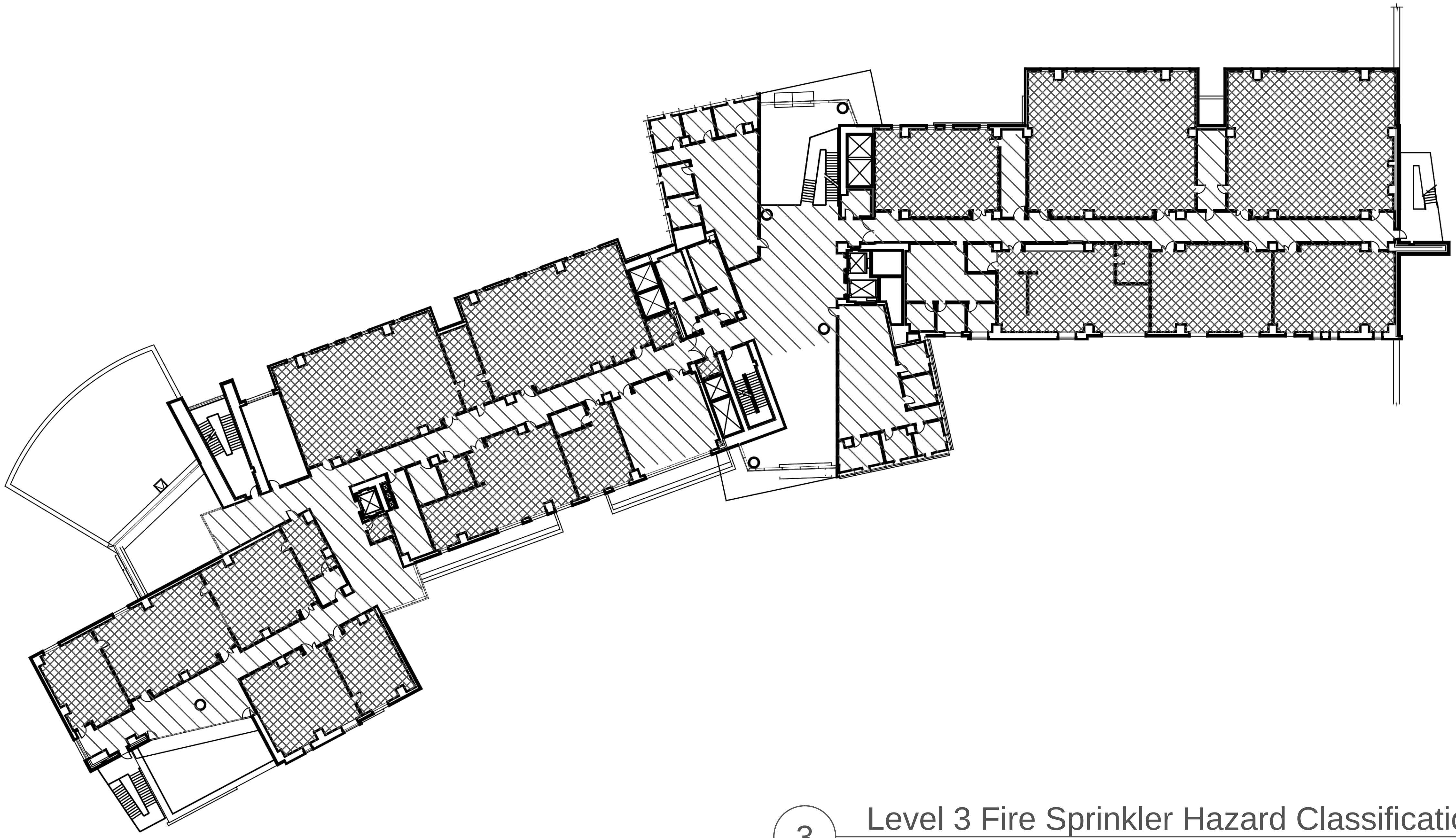
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
2
OF 6 SHEETS

Legend:

▨ Light Hazard

▩ Ordinary Hazard Group 2



3 Level 3 Fire Sprinkler Hazard Classification

CAL POLY

Buiding 180 CSM
Level 3

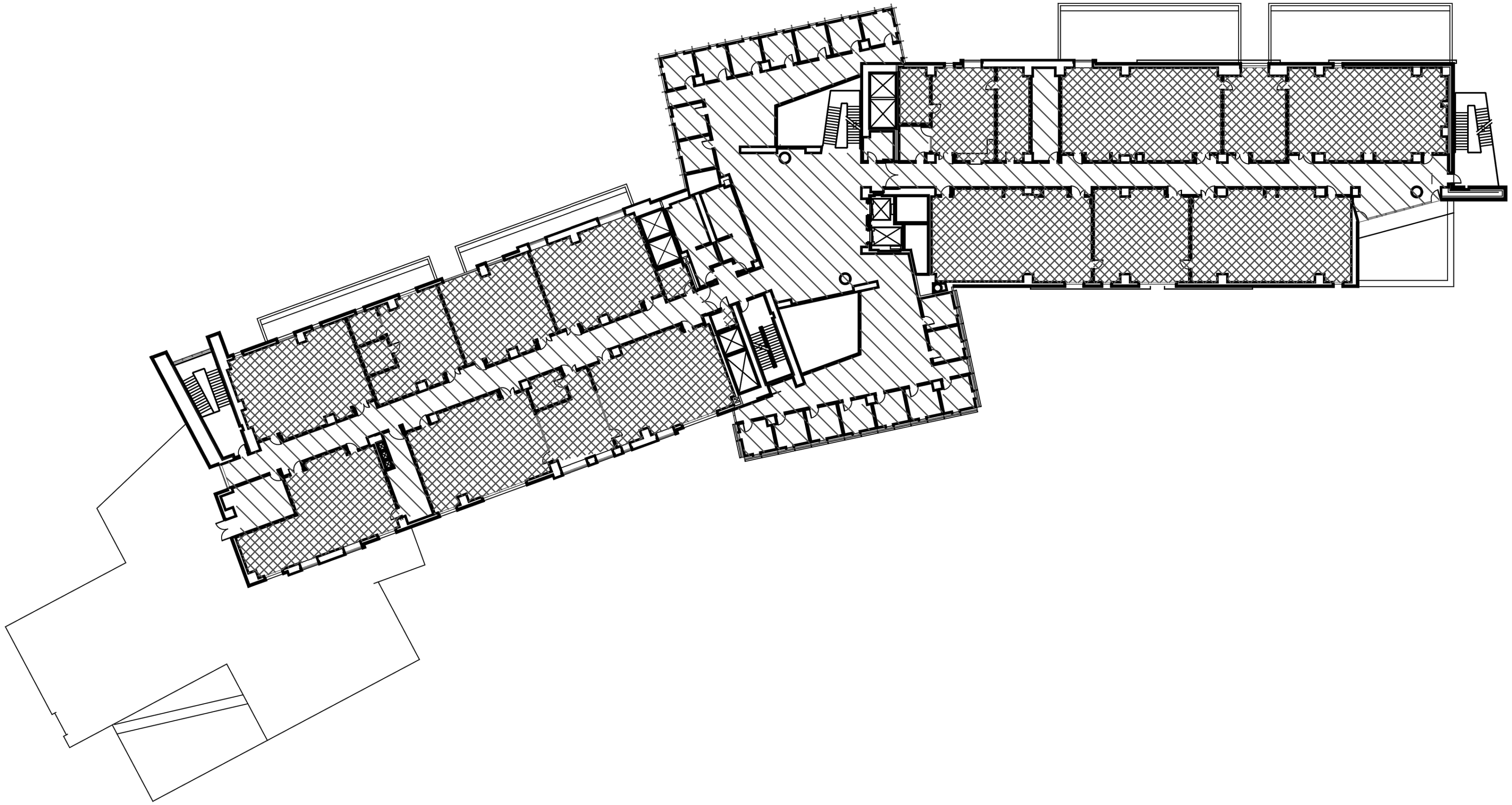
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
3
OF 6 SHEETS

Legend:

▨ Light Hazard

▩ Ordinary Hazard Group 2



④ Level 4 Fire Sprinkler Hazard Classification

CALPOLY

Buiding 180 CSM
Level 4

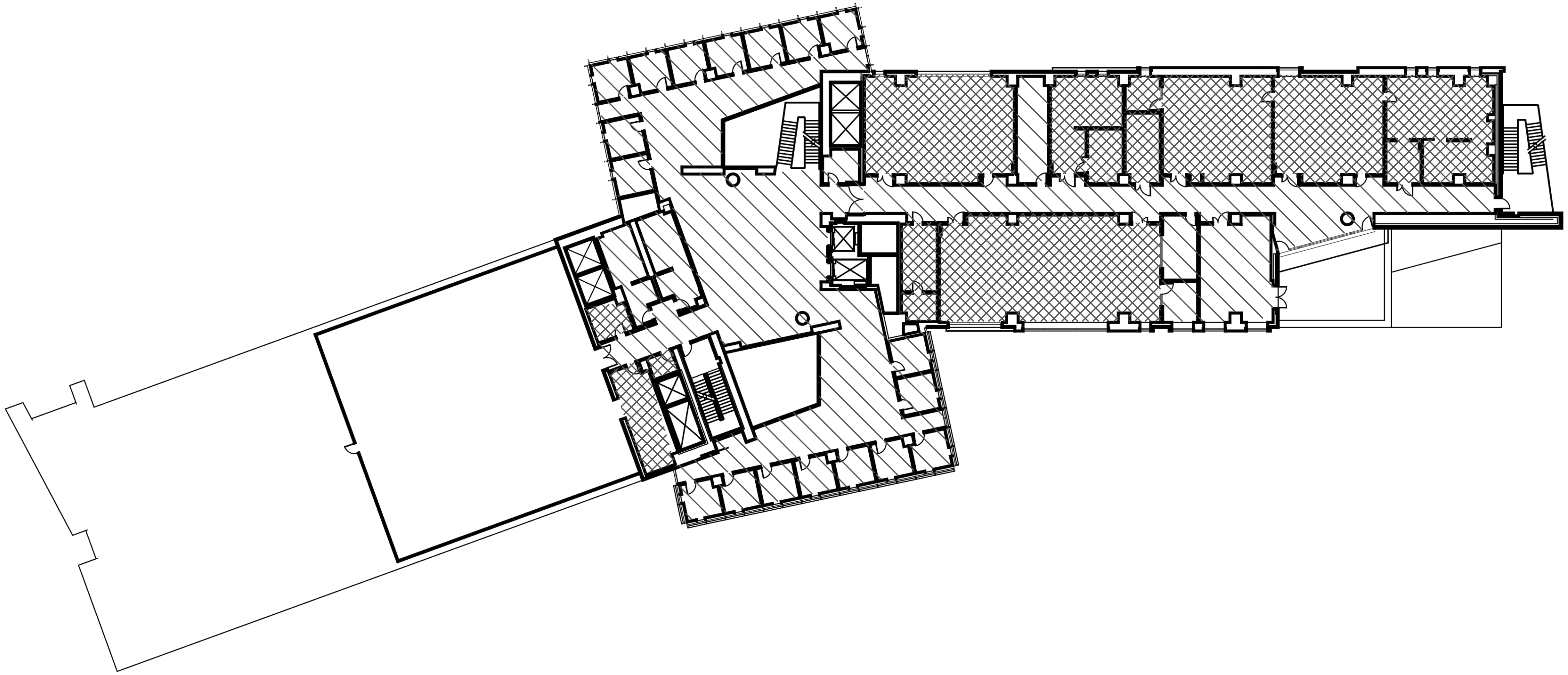
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
4
OF 6 SHEETS

Legend:

▨ Light Hazard

▦ Ordinary Hazard Group 2



5 Level 5 Fire Sprinkler Hazard Classification

CAL POLY

Buiding 180 CSM
Level 5

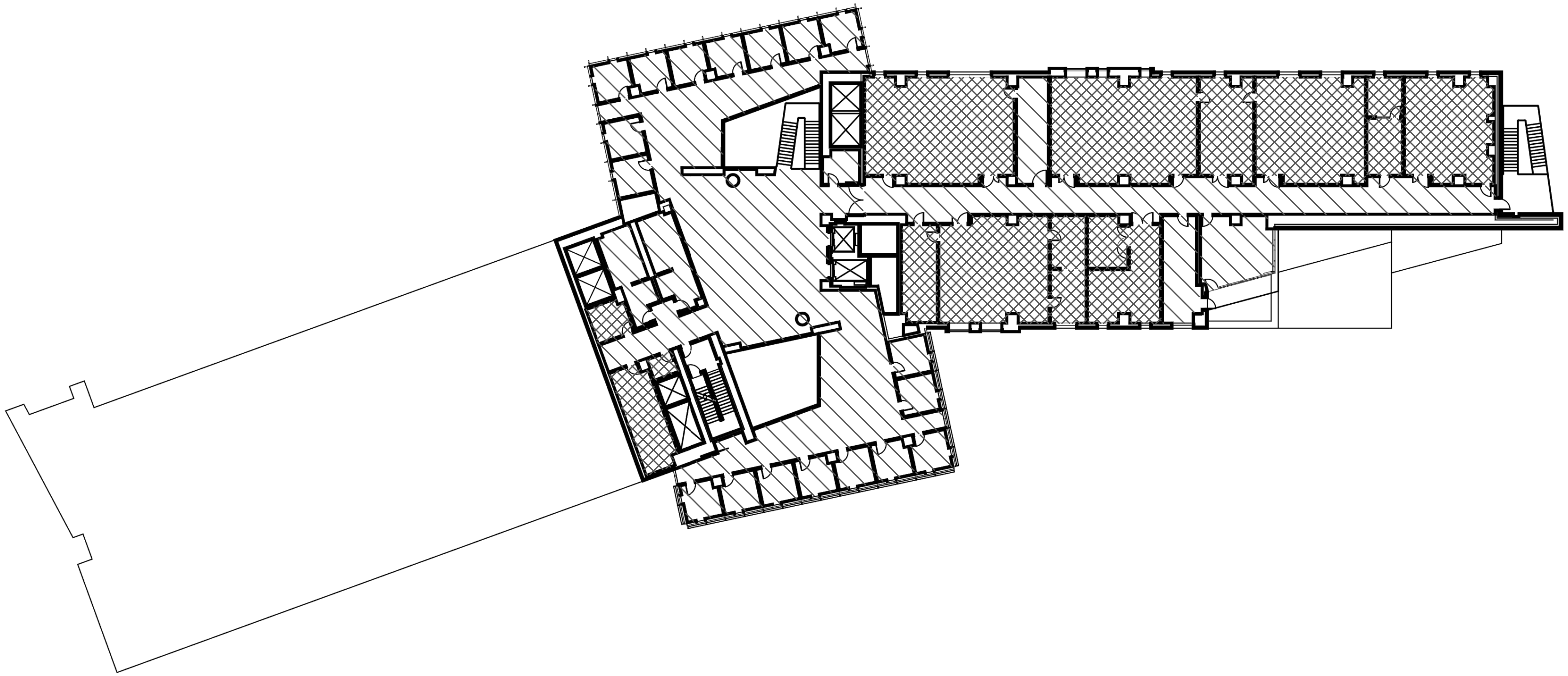
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
5
OF 6 SHEETS

Legend:

▨ Light Hazard

▩ Ordinary Hazard Group 2



6 Level 6 Fire Sprinkler Hazard Classification

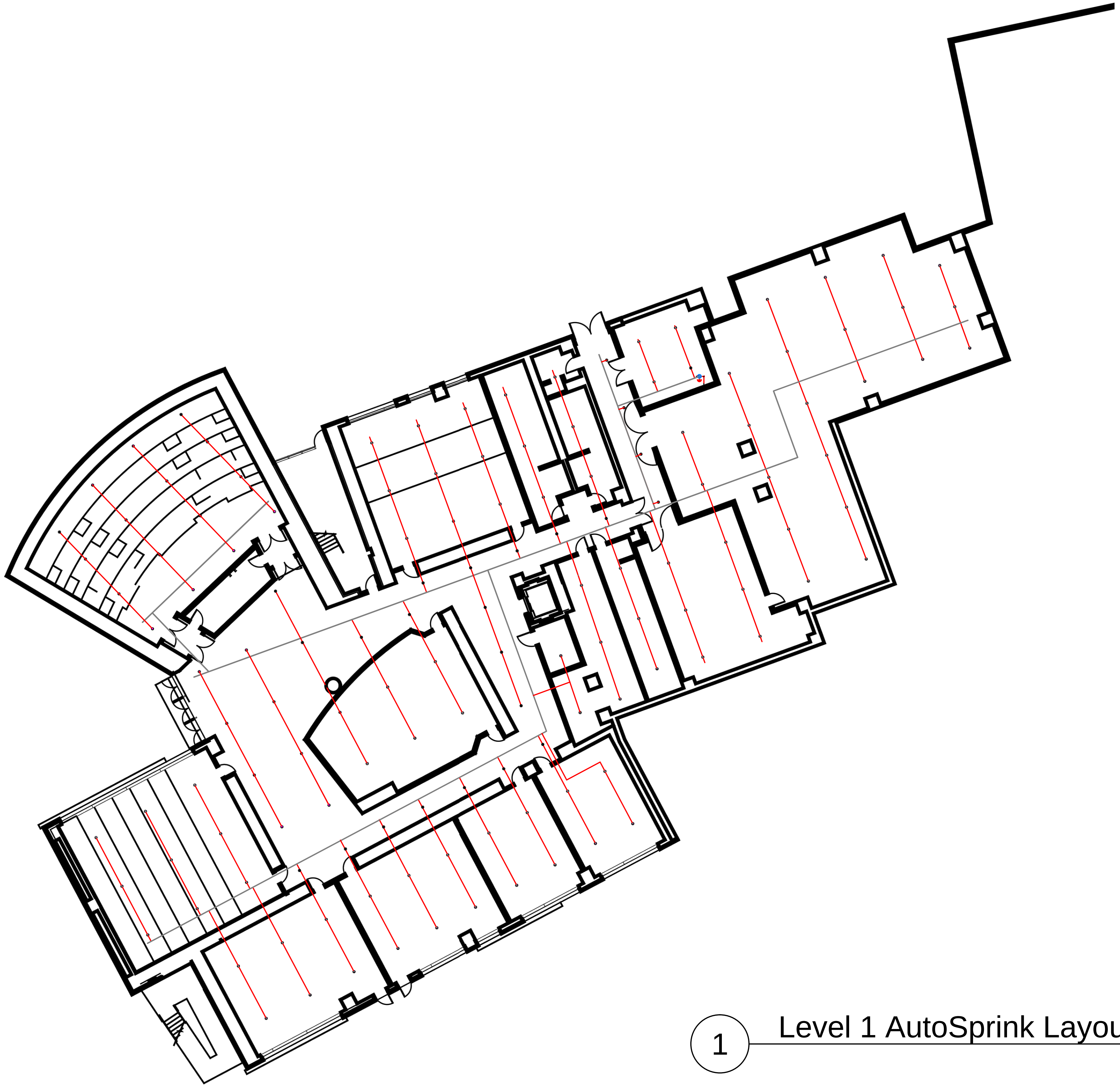
CAL POLY

Buiding 180 CSM
Level 6

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
6
OF 6 SHEETS

APPENDIX I – AUTOSPRINK FIRE SPRINKLER FLOOR PLANS



1 Level 1 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 1

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:
--

DRAWING NO.
1
OF 6 SHEETS

2 Level 2 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 2

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
2
OF 6 SHEETS

3 Level 3 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 3

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
3
OF 6 SHEETS

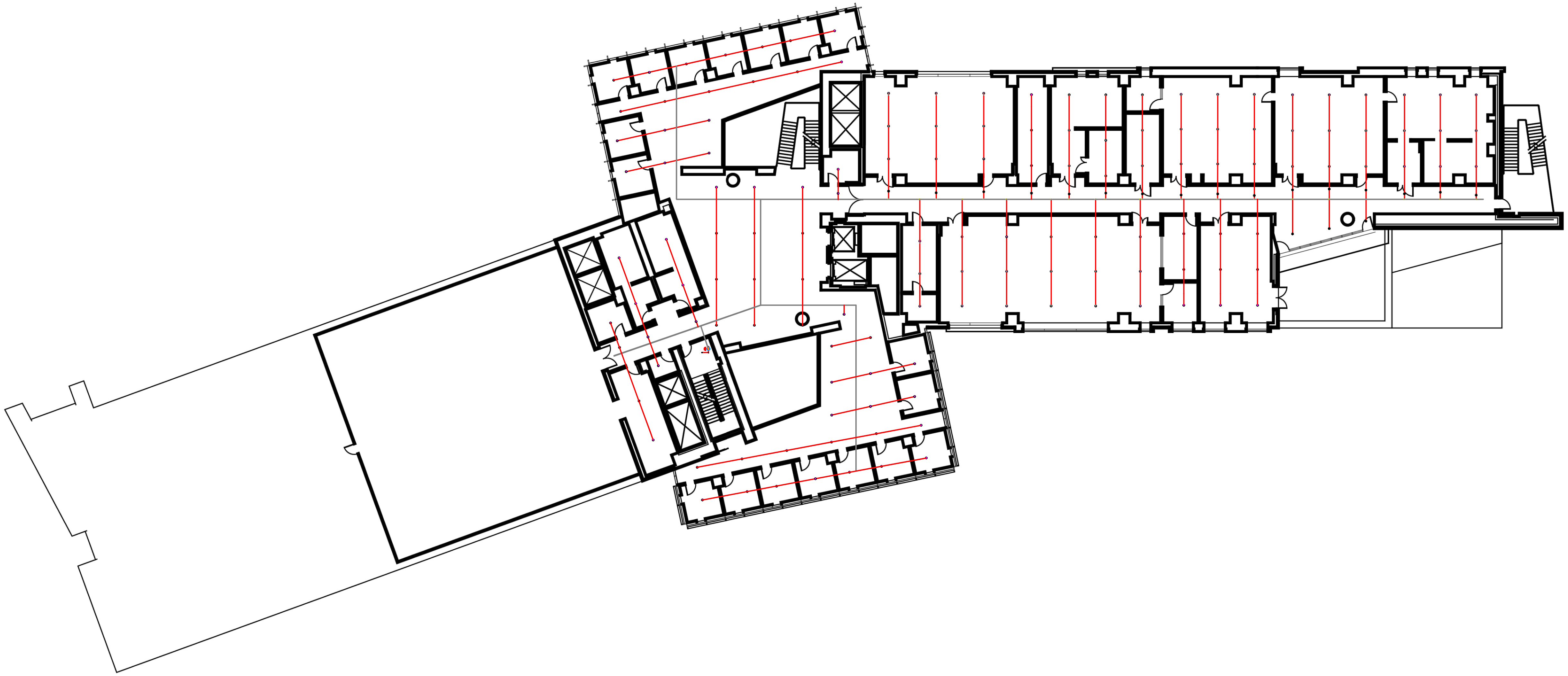
4 Level 4 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 4

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
4
OF 6 SHEETS



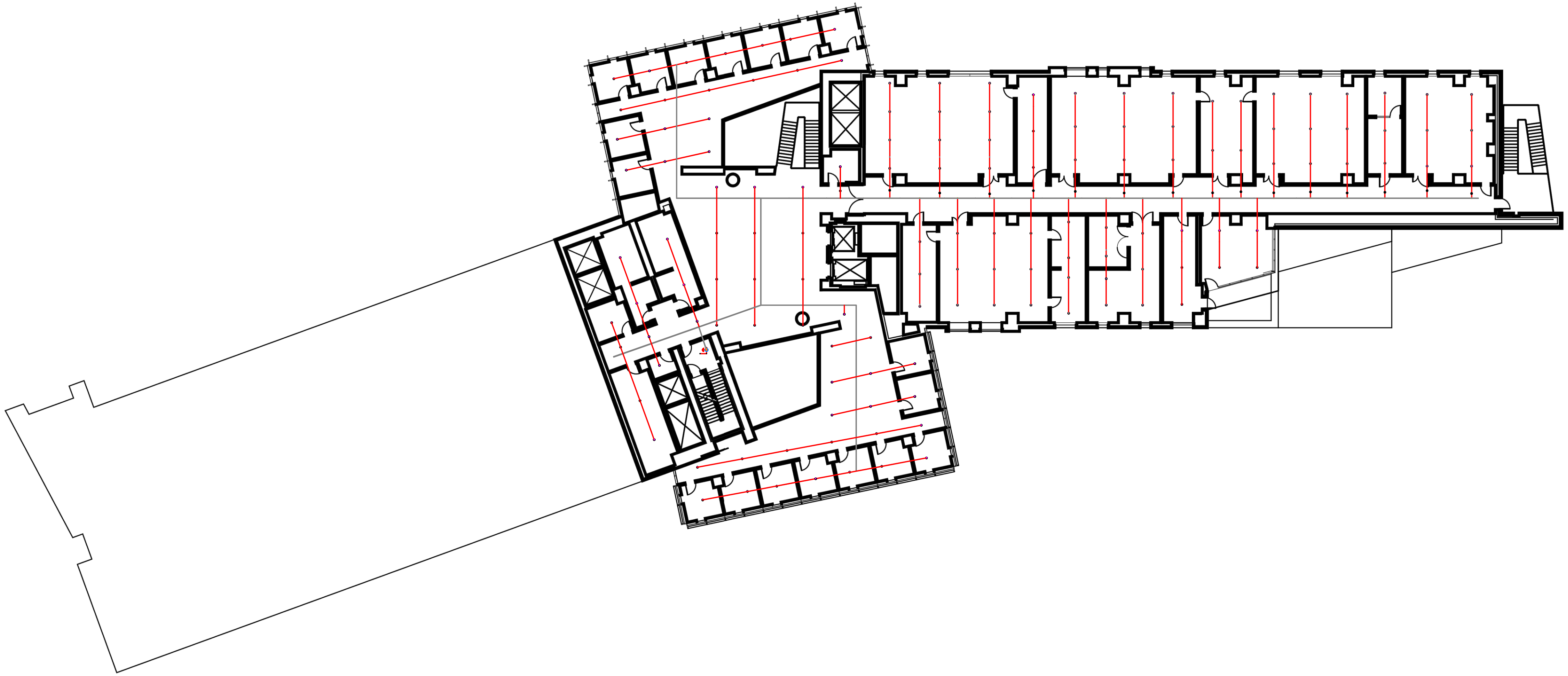
5 Level 5 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 5

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
5
OF 6 SHEETS



6 Level 6 AutoSprink Layout

CAL POLY

Buiding 180 CSM
Level 6

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
6
OF 6 SHEETS

APPENDIX J – AUTOSPRINK NODE ANALYSIS

Node Analysis

Job Number: 1
Report Description: Ordinary Group II

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
10	0'-0	S	82.394	248.02	
101	10'-6¼	Spr(-16.967)	16.967	23.07	
102	10'-6¼	Spr(-17.045)	17.045	23.12	
103	10'-6¼	Spr(-17.110)	17.110	23.16	
104	10'-6¼	Spr(-17.189)	17.189	23.22	
105	10'-6¼	Spr(-18.173)	18.173	23.87	
106	10'-6¼	Spr(-18.258)	18.258	23.93	
107	10'-6¼	Spr(-20.782)	20.782	25.53	
109	10'-6¼	Spr(-20.877)	20.877	25.59	
110	10'-6¼	Spr(-25.419)	25.419	28.23	
112	10'-6¼	Spr(-25.535)	25.535	28.30	
1	13'-0	T(5'-0)	17.158		
2	13'-0	T(5'-0)	18.448		
3	13'-0	T(5'-0)	21.235		
4	13'-0	T(5'-0)	26.185		
5	13'-0	E(3'-0)	46.893		
6	15'-0	PO(10'-0)	47.701		
7	15'-0	PO(10'-0)	47.919		
8	15'-0	T(20'-2)	62.126		
9	8'-0		77.162		
12	13'-0	T(5'-0)	17.242		
13	13'-0	T(5'-0)	18.538		
14	13'-0	T(5'-0)	21.337		
15	13'-0	T(5'-0)	26.308		
17	13'-0	E(3'-0)	47.104		
18	13'-0	E(2'-0)	16.798		
19	13'-0	E(2'-0)	16.881		

Hydraulic Analysis

Job Number: 1
Report Description: Ordinary Group II

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure	
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary	
Upstream							Total Length		
••••• Route 1 •••••									
DR	1.0490	23.07	8.56	120		0.169433	2'-5¾	Pf	1.268
101	10'-6¼	23.07	5.6	16.967		Sprinkler,	5'-0	Pe	-1.077
1	13'-0			17.158		T(5'-0)	7'-5¾	Pv	
BL	1.3800	46.23	9.92	120		0.161272	8'-0	Pf	1.290
1	13'-0	23.16		17.158		Flow (q) from Route 3		Pe	
2	13'-0			18.448			8'-0	Pv	
BL	1.3800	70.10	15.04	120		0.348385	8'-0	Pf	2.787
2	13'-0	23.87		18.448		Flow (q) from Route 5		Pe	
3	13'-0			21.235			8'-0	Pv	
BL	1.3800	95.63	20.51	120		0.618815	8'-0	Pf	4.951
3	13'-0	25.53		21.235		Flow (q) from Route 7		Pe	
4	13'-0			26.185			8'-0	Pv	
BL	1.3800	123.87	26.57	120		0.998630	17'-8¾	Pf	20.707
4	13'-0	28.23		26.185		Flow (q) from Route 9	3'-0	Pe	
5	13'-0			46.893		E(3'-0)	20'-8¾	Pv	
RN	2.0670	123.87	11.84	120		0.139607	2'-0	Pf	1.675
5	13'-0			46.893			10'-0	Pe	-0.867
6	15'-0			47.701		PO(10'-0)	12'-0	Pv	
CM	3.2600	123.87	4.76	120		0.015179	14'-4¾	Pf	0.218
6	15'-0			47.701				Pe	
7	15'-0			47.919			14'-4¾	Pv	
CM	3.2600	248.02	9.53	120		0.054837	218'-9	Pf	14.206
7	15'-0	124.15		47.919		Flow (q) from Route 2	40'-3¾	Pe	
8	15'-0			62.126		2T(20'-2)	259'-0¾	Pv	
CM	2.6350	248.02	14.59	120		0.154612	35'-0¾	Pf	12.001
8	15'-0			62.126			42'-6¾	Pe	3.036
9	8'-0			77.162		Ee2(4'-1½), PO(16'-5¾),	77'-7½	Pv	
						C(16'-5¾), LtE(5'-6)			
FR	2.4690	248.02	16.62	120		0.212260	7'-3¾	Pf	1.765
9	8'-0			77.162			1'-0	Pe	3.467
10	0'-0			82.394		f(-0.000), ALV, GV(1'-0), S	8'-3¾	Pv	
		0.00				Hose Allowance At Source			
10		248.02							
••••• Route 2 •••••									
DR	1.0490	23.12	8.58	120		0.170162	2'-5¾	Pf	1.274
102	10'-6¼	23.12	5.6	17.045		Sprinkler,	5'-0	Pe	-1.077
12	13'-0			17.242		T(5'-0)	7'-5¾	Pv	
BL	1.3800	46.34	9.94	120		0.161965	8'-0	Pf	1.296
12	13'-0	23.22		17.242		Flow (q) from Route 4		Pe	
13	13'-0			18.538			8'-0	Pv	
BL	1.3800	70.27	15.07	120		0.349881	8'-0	Pf	2.799
13	13'-0	23.93		18.538		Flow (q) from Route 6		Pe	
14	13'-0			21.337			8'-0	Pv	
BL	1.3800	95.85	20.56	120		0.621464	8'-0	Pf	4.972
14	13'-0	25.59		21.337		Flow (q) from Route 8		Pe	
15	13'-0			26.308			8'-0	Pv	
BL	1.3800	124.15	26.63	120		1.002885	17'-8¾	Pf	20.796
15	13'-0	28.30		26.308		Flow (q) from Route 10	3'-0	Pe	
17	13'-0			47.104		E(3'-0)	20'-8¾	Pv	
RN	2.0670	124.15	11.87	120		0.140202	2'-0	Pf	1.682
17	13'-0			47.104			10'-0	Pe	-0.867
7	15'-0			47.919		PO(10'-0)	12'-0	Pv	
••••• Route 3 •••••									
DR	1.0490	23.16	8.60	120		0.170755	2'-5¾	Pf	0.766
103	10'-6¼	23.16	5.6	17.110		Sprinkler,	2'-0	Pe	-1.077
18	13'-0			16.798		E(2'-0)	4'-5¾	Pv	
BL	1.3800	23.16	4.97	120		0.044909	8'-0	Pf	0.359
18	13'-0			16.798				Pe	
1	13'-0			17.158			8'-0	Pv	
••••• Route 4 •••••									
DR	1.0490	23.22	8.62	120		0.171489	2'-5¾	Pf	0.769
104	10'-6¼	23.22	5.6	17.189		Sprinkler,	2'-0	Pe	-1.077
19	13'-0			16.881		E(2'-0)	4'-5¾	Pv	
BL	1.3800	23.22	4.98	120		0.045103	8'-0	Pf	0.361
19	13'-0			16.881				Pe	
12	13'-0			17.242			8'-0	Pv	
••••• Route 5 •••••									
DR	1.0490	23.87	8.86	120		0.180553	2'-5¾	Pf	1.351
105	10'-6¼	23.87	5.6	18.173		Sprinkler,	5'-0	Pe	-1.077
2	13'-0			18.448		T(5'-0)	7'-5¾	Pv	
••••• Route 6 •••••									

Pipe Type Downstream Upstream	Diameter Elevation	Flow Discharge	Velocity K-Factor	HWC Pt	Pn	Friction Loss Fittings	Length Eq. Length Total Length	Pressure Summary
DR	1.0490	23.93	8.88	120		0.181326	2'-5¾	**Pf** 1.357
106	10'-6¼	23.93	5.6	18.258		Sprinkler,	5'-0	**Pe** -1.077
13	13'-0			18.538		T(5'-0)	7'-5¾	**Pv**
• • • • • **Route 7** • • • • •								
DR	1.0490	25.53	9.48	120		0.204403	2'-5¾	**Pf** 1.530
107	10'-6¼	25.53	5.6	20.782		Sprinkler,	5'-0	**Pe** -1.077
3	13'-0			21.235		T(5'-0)	7'-5¾	**Pv**
• • • • • **Route 8** • • • • •								
DR	1.0490	25.59	9.50	120		0.205270	2'-5¾	**Pf** 1.536
109	10'-6¼	25.59	5.6	20.877		Sprinkler,	5'-0	**Pe** -1.077
14	13'-0			21.337		T(5'-0)	7'-5¾	**Pv**
• • • • • **Route 9** • • • • •								
DR	1.0490	28.23	10.48	120		0.246264	2'-5¾	**Pf** 1.843
110	10'-6¼	28.23	5.6	25.419		Sprinkler,	5'-0	**Pe** -1.077
4	13'-0			26.185		T(5'-0)	7'-5¾	**Pv**
• • • • • **Route 10** • • • • •								
DR	1.0490	28.30	10.50	120		0.247297	2'-5¾	**Pf** 1.851
112	10'-6¼	28.30	5.6	25.535		Sprinkler,	5'-0	**Pe** -1.077
15	13'-0			26.308		T(5'-0)	7'-5¾	**Pv**

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend

AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PRV	Pressure Reducing Valve
PrV	Pressure Relief Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap

APPENDIX K – FIRE ALARM AS-BUILTS

GENERAL NOTES

1. NOTIFICATION DEVICES CANNOT BE T-TAPPED. ADDRESSABLE (IDC) DEVICES CAN BE T-TAPPED. ALL FIRE ALARM CABLING SHALL SHALL BE RUN FROM DEVICE TO DEVICE, WITH NO SPLICES. ANY REQUIRED TERMINATIONS MUST BE MADE IN APPROVED BOX.

2. ALL INTERIOR INITIATING DEVICES, NOTIFICATION DEVICES, AND MODULES REQUIRE 4"SQUARE SPECIAL DEEP BACK BOXES U.O.N.

3. PANEL BACK BOXES AND OTHER LISTED BACK BOXES SHALL BE PROVIDED TO THE EC BY DBI. ALL CONTROL PANELS, POWER SUPPLIES, AND BATTERY BOXES SHALL UTILIZE ONLY FACTORY KNOCKOUTS NEAR THE TOP OF THE CAN TO ALLOW PLACEMENT OF BATTERIES.

4. ALL FIRE ALARM CONDUIT TO BE ¾" EMT MINIMUM U.O.N. FIRE ALARM CONDUIT SHALL BE SEPARATE FROM CONDUIT SYSTEM FOR SECURITY ALARM CABLING AND OTHER SYSTEMS.

5. WALL MOUNT AUDIO/VISUAL DEVICES SHALL BE MOUNTED 80" AFF TO BOTTOM OF THE STROBE LENS.

6. MANUAL PULL STATIONS SHALL BE MOUNTED 48" AFF TO CENTERLINE OF BOX. MPS SHALL BE DOUBLE ACTION AND KEYED THE SAME AS THE FACP.

7. DEDICATED 120 VAC CIRCUIT WITH LOCKOUT @ BREAKER TO BE PROVIDED BY OTHERS AT LOCATION OF PANELS AND POWER SUPPLIES.

8. KNOX BOX, PIV, SUPERVISORY SWITCHES, FLOW SWITCHES, SOLENOIDS, AND SPRINKLER BELLS SHALL BE PROVIDED BY OTHERS.

9. SMOKE DETECTORS SHALL NOT BE PLACED WITHIN 3' OF ANY SUPPLY AIR REGISTER OR WHERE THE AIR MOVEMENT EXCEEDS THE MANUFACTURER'S LISTING.

10. FIRE FIGHTER TELEPHONE RISER IS CLASS A, STYLE Z

11. VOLTAGE DROP CALCULATIONS FOR NOTIFICATION DEVICES ARE BASED ON THE LAYOUT SHOWN. DEVIATION FROM THESE PLANS COULD RESULT IN ADDITIONAL CONDUIT WORK, REENGINEERING, UPSIZED CABLE AND/OR ADDITIONAL POWER REQUIREMENTS.

12. PAINT ALL FIRE ALARM JUNCTION BOXES AND COVERS RED IN UNFINISHED AREAS (IE ABOVE CEILINGS, MECHANICAL ROOMS ETC.) IN FINISHED AREAS CONDUIT AND JUNCTION BOXES CAN BE PAINTED TO MATCH THE ROOM FINISH, THE INSIDE COVER IF THE JUNCTION BOX MUST BE IDENTIFIED AS "FIRE ALARM" AND THE CONDUIT MUST HAVE PAINTED RED BANDS ¾" WIDE AT 10' CENTERS AND AT EACH SIDE OF A FLOOR, WALL, OR CEILING PENETRATION.

13. UPON COMPLETION OF INSTALLATION OF THE FIRE ALARM SYSTEM A SATISFACTORY TEST OF THE ENTIRE SYSTEM SHALL BE MADE IN THE PRESENCE OF THE AUTHORITY HAVING JURISDICTION (AHJ).

14. ALL NOTIFICATION DEVICES SHALL BE SYNCHRONIZED.

15. A STAMPED SET OF APPROVED FIRE ALARM PLANS SHALL BE AT THE JOBSITE AND USED FOR INSTALLATION.

16. SIGNALING LINE CIRCUIT IS CLASS B, STYLE 4

17. NOTIFICATION APPLIANCE CIRCUIT IS CLASS B, STYLE Y

5

18. ALL SMOKE DETECTORS SHALL BE INSTALLED AT LEAST 1'-0" FROM FLUORESCENT LIGHT FIXTURES TO AVOID UNWANTED ALARMS AND SHALL BE INSTALLED IN AREAS THAT DO NOT EXCEED THE MANUFACTURE'S OPERATING TEMPERATURE RANGE BETWEEN 32°F AND 120°F.

CODE REGULATIONS

CALIFORNIA CODE REGULATIONS

APPLICABLE CODES

2007	BUILDING STANDARDS ADMINISTRATIVE CODE	TITLE 24 PART 1
2007	CALIFORNIA BUILDING CODE (CBC)	TITLE 24 PART 2
2007	CALIFORNIA ELECTRICAL CODE (CEC)	TITLE 24 PART 3
2007	CALIFORNIA MECHANICAL CODE (CMC)	TITLE 24 PART 4
2007	CALIFORNIA PLUMBING CODE (CPC)	TITLE 24 PART 5
2007	CALIFORNIA ENERGY CODE	TITLE 24 PART 6
2007	CALIFORNIA ELEVATOR SAFETY CONSTRUCTION CODE	TITLE 24 PART 7
2007	CALIFORNIA HISTORICAL BUILDING CODE	TITLE 24 PART 8
2007	CALIFORNIA FIRE CODE (CFC)	TITLE 24 PART 9
2007	CALIFORNIA REFERENCED STANDARDS CODE	TITLE 24 PART 12

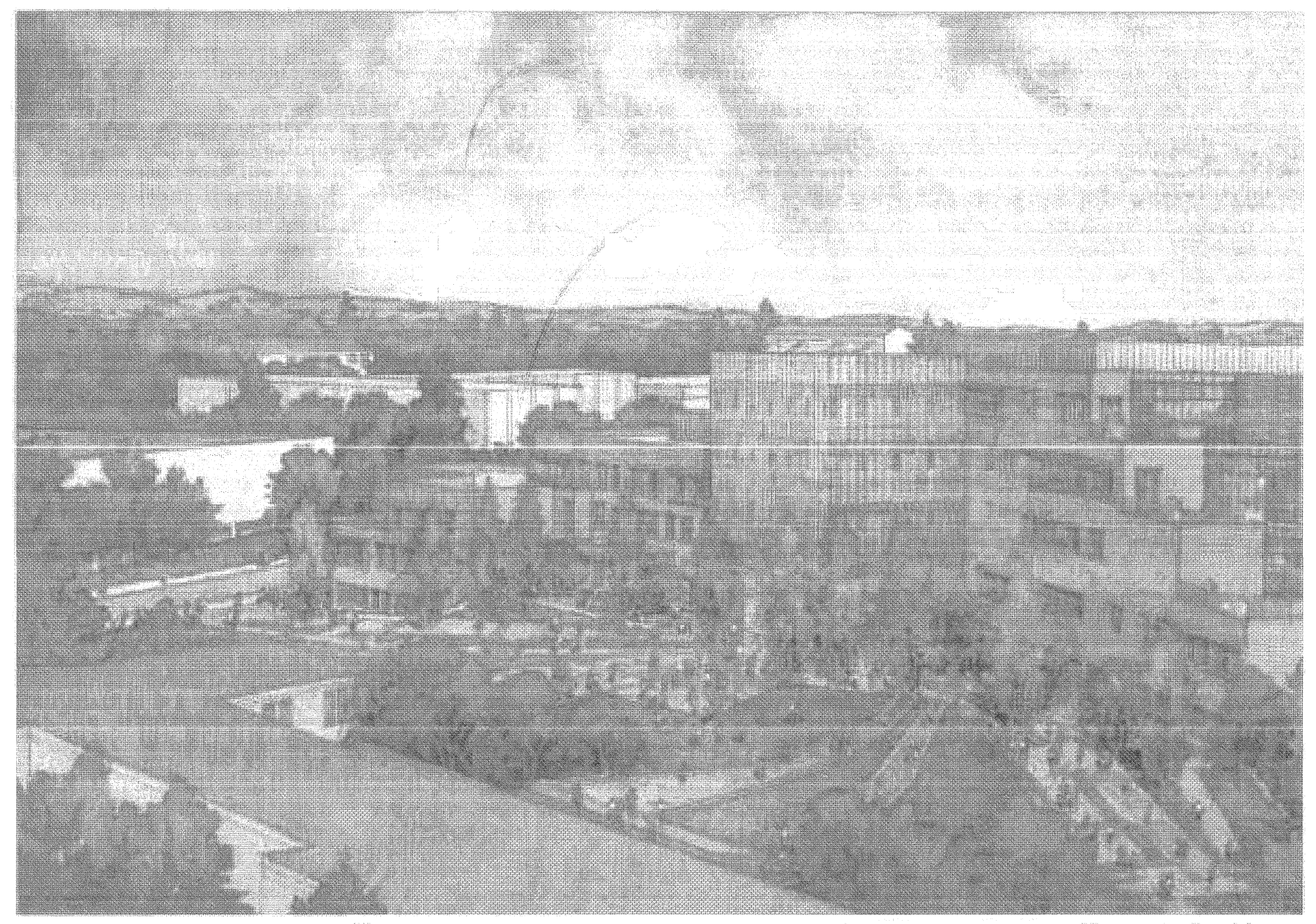
APPLICABLE STANDARDS & GUIDELINES

2007	AUTOMATIC SRINKLER SYSTEMS	NFPA 13
2007	STATIONARY PUMPS	NFPA 20
2007	NATIONAL FIRE ALARM CODES (CALIFORNIA AMENDED)	NFPA 72
2007	STANDARD FOR INSTALLATION OF AIR-CONDITIONING	NFPA90A
2007	STANDARD FOR INSTALLATION OF WARN AIR HEATING	NFPA 90B
2006	STANDARD FOR SMOKE-CONTROL SYSTEMS UTILIZING BARRIERS AND PRESSURE DIFFERENCES	NFPA 92A
2005	STANDARD FOR SMOKE MANAGEMENT SYSTEMS IN MALLS, ATRIA, AND LARGE SPACES	NFPA 92B

4

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CALIFORNIA 93407
FIRE ALARM & EMERGENCY COMMUNICATION SYSTEM

SITE PLAN



CENTER FOR SCIENCE

PROJECT DESCRIPTION

1. OCCUPANCY TYPE: A, B, AND H3
2. SYSTEM TYPE: CLASS B, ADDRESSABLE, MANUAL
3. METHOD OF COMMUNICATION: TELEPHONE
4. SCOPE OF WORK: FIRE ALARM & VOICE EVACUATION SYSTEMS

SEQUENCE OF OPERATIONS MATRIX

ACTION

EVENT	SUPERVISORY CONDITION AT FACU	TROUBLE CONDITION AT FACU	ALARM CONDITION AT FACU	ACTIVATE FIRE ALARM AUDIO/VISUAL DEVICES AND VOICE ALARM COMMUNICATION	DISPLAY TEXT ON LCD ANNUNCIATOR	ACTIVATE SHUNT TRIP RELAY	SHUTDOWN AIR HANDLER UNIT	ACTIVATE ELEVATOR RECALL	SHUTDOWN INDIVIDUAL ASSOCIATED DAMPERS	DEACTIVATE MAGNETIC DOOR HOLDERS	ACTIVATE SUPERVISORY SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE TROUBLE SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	ACTIVATE ALARM DIALER SIGNAL TO RECEIVING STATION (CAMPUS POLICE)	BYPASS ALL ALARM OUTPUTS (NOTIFICATION, SHUNTS, RELAY OUTPUTS) FOR TESTING	OPEN ATRUIM DOORS WITH MOTORIZED DOOR OPERATORS	ACTIVATE ATRIUM PASSIVE SMOKE EVACUATION SYSTEM
FIRE ALARM CONTROL UNIT																
PANEL SUPERVISORY CONDITION (TEST BYBASS) ON ACM-24 AT	X				X						X			X		
PANEL TROUBLE CONDITION (AC POWER FAIL, LOW BATTERY, OPEN CIRCUIT, GROUND FAULT, ETC.)		X			X							X				
PANEL ALARM CONDITION			X	X	X		X			X			X			
MANUAL PULL STATION ACTIVATION			X	X	X					X			X			
SPOT SMOKE DETECTOR ACTIVATION			X	X	X					X			X			
DUCT SMOKE DETECTOR ACTIVATION			X	X	X				X	X			X			
AIR HANDLING UNIT DUCT SMOKE DETECTOR ACTIVATION			X	X	X		X						X			
SPRINKLER TAMPER SWITCH	X				X						X		X			
SPRINKLER WATER FLOW ACTIVATION			X	X	X					X			X			
FIRE PUMP RUNNING			X	X	X					X			X			
FIRE PUMP LOSS OF PH ASE	X				X						X					
FIRE PUMP PHASE REVERSAL	X				X						X		X			
HEAT DETECTOR ACTIVATION (ELEVATOR EQUIPMENT)			X	X	X	X				X			X			
ELEVATOR LOBBY/ EMR SMOKE / ELEVATOR HOISTWAYS			X	X	X			X		X			X			
SHUNT TRIP POWER SUPERVISION	X				X						X					
GENERAL ALARM (ANYWHERE WITHIN THE BUILDING)			X	X	X		X			X			X			
ATRIUM SMOKE CONTORL SYSTEM ALARM			X	X	X					X			X		X	X
BEAM SMOKE DETECTION WITHIN ATRIUM			X	X	X					X			X		X	X
PULL STATION WITHIN ATRIUM			X	X	X					X			X		X	X
SPRINKLER WATER FLOW WITHIN ATRIUM			X	X	X					X			X		X	X

2 3 4

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
6	31	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F	STROBE ONLY	SW	7320-1653:201
	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
5 2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

DRAWING INDEX

1	COVER SHEET	FA 0.0
2	RISER DIAGRAM	FA 1.0
3	FIRST FLOOR WEST	FA 3.01W
4	SECOND FLOOR EAST	FA 3.02E
5	SECOND FLOOR WEST	FA 3.02W
6	THIRD FLOOR EAST	FA 3.03E
7	THIRD FLOOR WEST	FA 3.03W
8	FOURTH FLOOR EAST	FA 3.04E
9	FOURTH FLOOR WEST	FA 3.04W
10	FIFTH FLOOR EAST	FA 3.05E
11	FIFTH FLOOR WEST	FA 3.05W
12	SIXTH FLOOR EAST	FA 3.06E
13	SEVENTH FLOOR EAST	FA 3.07E
14	CALCULATIONS	FA 4.0
15	DETAILS	FA 5.0

AS-BUILT

SET COVER SHEET

Deep Blue Integration

Consulting - Design - Installation
Service - Monitoring
Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

Revisions

SYMBOL	DESCRIPTION	DATE	APPR.
1	REVIEW COMMENTS	6/14/2011	
2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID
FA-0
SHEET 1 OF 15

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
6	31	F MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F STROBE ONLY	SW	7320-1653:201
	165	F SPEAKER/STROBE	SPWS	7320-1653:201
	6	F SPEAKER ONLY	SPW	7320-1653:201
	7	WP F SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H HEAT DETECTOR	FST-851	7270-0028:196
5	18	S SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM RELAY MODULE	FRM-1	7300-0028:219
	16	WFS WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
4	1	XP10-M TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

GENERAL NOTES:

1. The Notification Appliance Circuits vary between 14 AWG and 12 AWG, see ~~voltage drops for correct sizing.~~

5 2. All smoke detectors shall be placed at least 1'-0" from fluorescent light fixtures to avoid unwanted alarms and in areas that will not exceed manufacture's specified operating temperature 32°F to 120°F.

SHEET NOTES:

1 The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

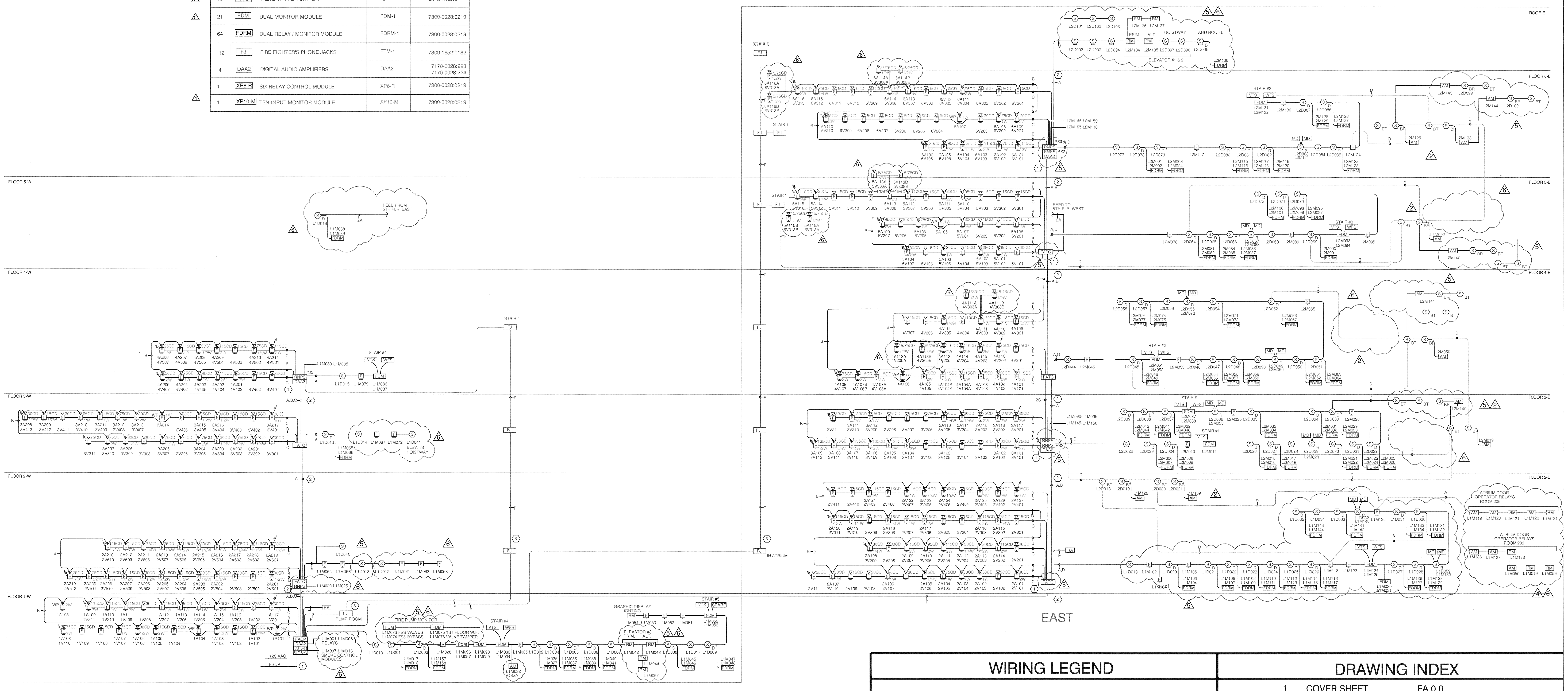
2 The riser going between floors will be in 2" conduit or larger.

3 6.10.1.16* All circuits necessary for the operation of two-way telephone communication systems shall be installed using one of the following methods:

- (1) A 2-hour fire rated circuit integrity (CI) cable
- (2) A 2-hour fire rated cable system (electrical circuit protective system)
- (3) A 2-hour fire rated enclosure
- (4) Performance alternatives approved by the authority having jurisdiction
- (5) Buildings fully protected by an automatic sprinkler system installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, with the wiring or cables installed in metal raceways and in accordance with Article 760 of NFPA 70

A.6.10.1.16 One or more of the following means might be considered acceptable to provide a level of survivability consistent with the intent of this requirement:

- (1) Routing two-way telephone circuits separately
- (2) Using short-circuit fault tolerant circuits



FIRE ALARM RISER DIAGRAM
NTS

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
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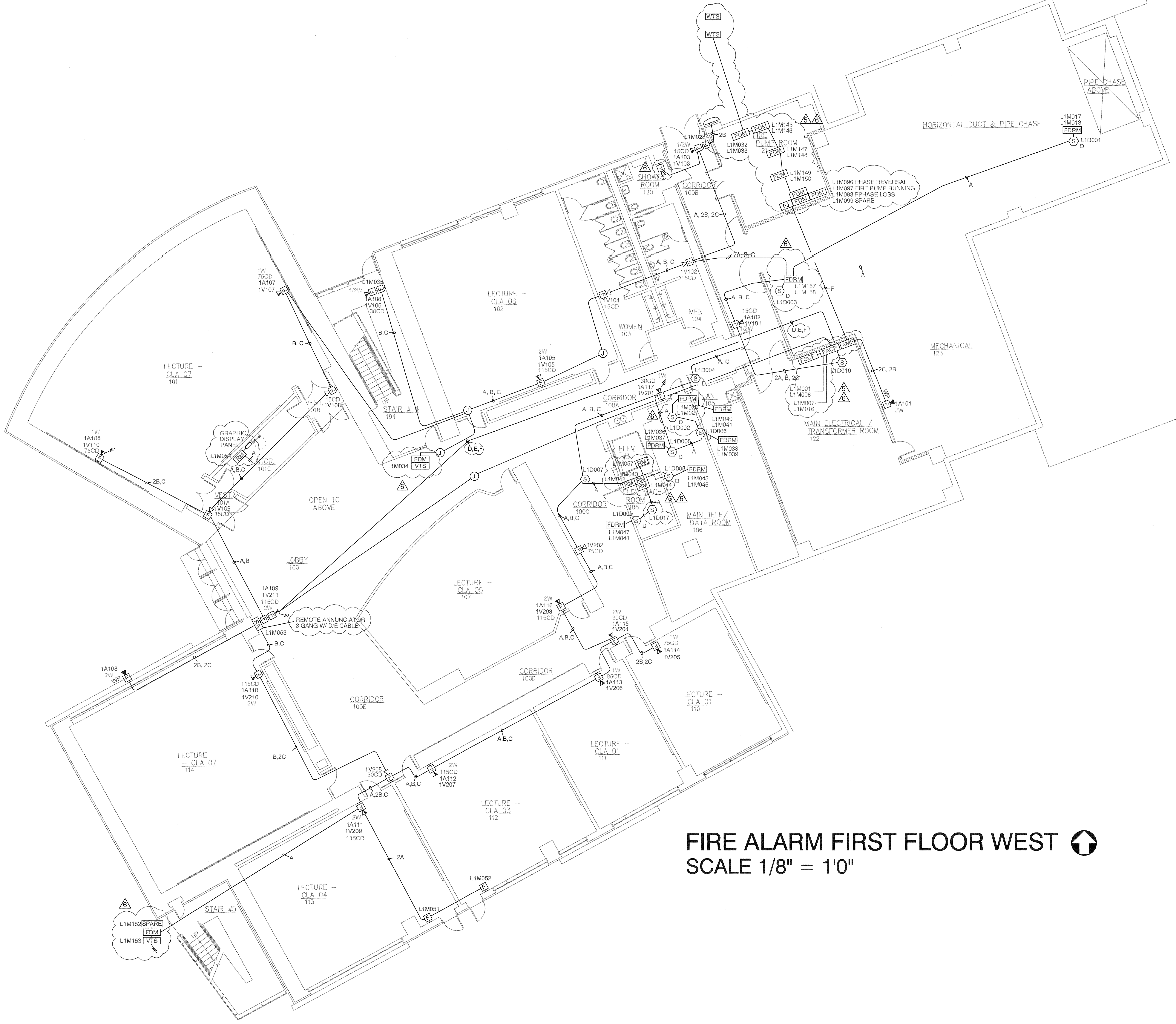
SHEET ID
FA 1.0
SHEET 2 OF 15



FIRE ALARM FIRST FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

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5	~~0~~	H	~~HEAT DETECTOR~~	~~FST-851~~	~~7270-0028:196~~
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
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	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
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B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

DRAWING INDEX

1	COVER SHEET	FA 0.0
2	RISER DIAGRAM	FA 1.0
3	FIRST FLOOR WEST	FA 3.01W
4	SECOND FLOOR EAST	FA 3.02E
5	SECOND FLOOR WEST	FA 3.02W
6	THIRD FLOOR EAST	FA 3.03E
7	THIRD FLOOR WEST	FA 3.03W
8	FOURTH FLOOR EAST	FA 3.04E
9	FOURTH FLOOR WEST	FA 3.04W
10	FIFTH FLOOR EAST	FA 3.05E
11	FIFTH FLOOR WEST	FA 3.05W
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14	CALCULATIONS	FA 4.0
15	DETAILS	FA 5.0

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5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
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DESIGNED BY: Curtis Streeter
DATE: 08/23/2013
DRAWN BY: Derek Richardson
SCALE:
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
DRAWING CODE: FA ALL DRAWINGS CPCFS
PROJECT ENGINEER: Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID
FA 3.01W
SHEET 3 OF 15

FIRE ALARM SECOND FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
△6	31	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F	STROBE ONLY	SW	7320-1653:201
	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
△5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
△5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
△5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
△2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
△6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
△6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
△6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
△6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
△5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
△4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
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DESIGNED BY:
Curtis Streeter

DRAWN BY:
Derek Richardson

CHECKED BY:
CURTIS STREETER, SET
NICET IV #102672

PROJECT ENGINEER:
Integral Design Associates INC.

DATE: 08/23/2013
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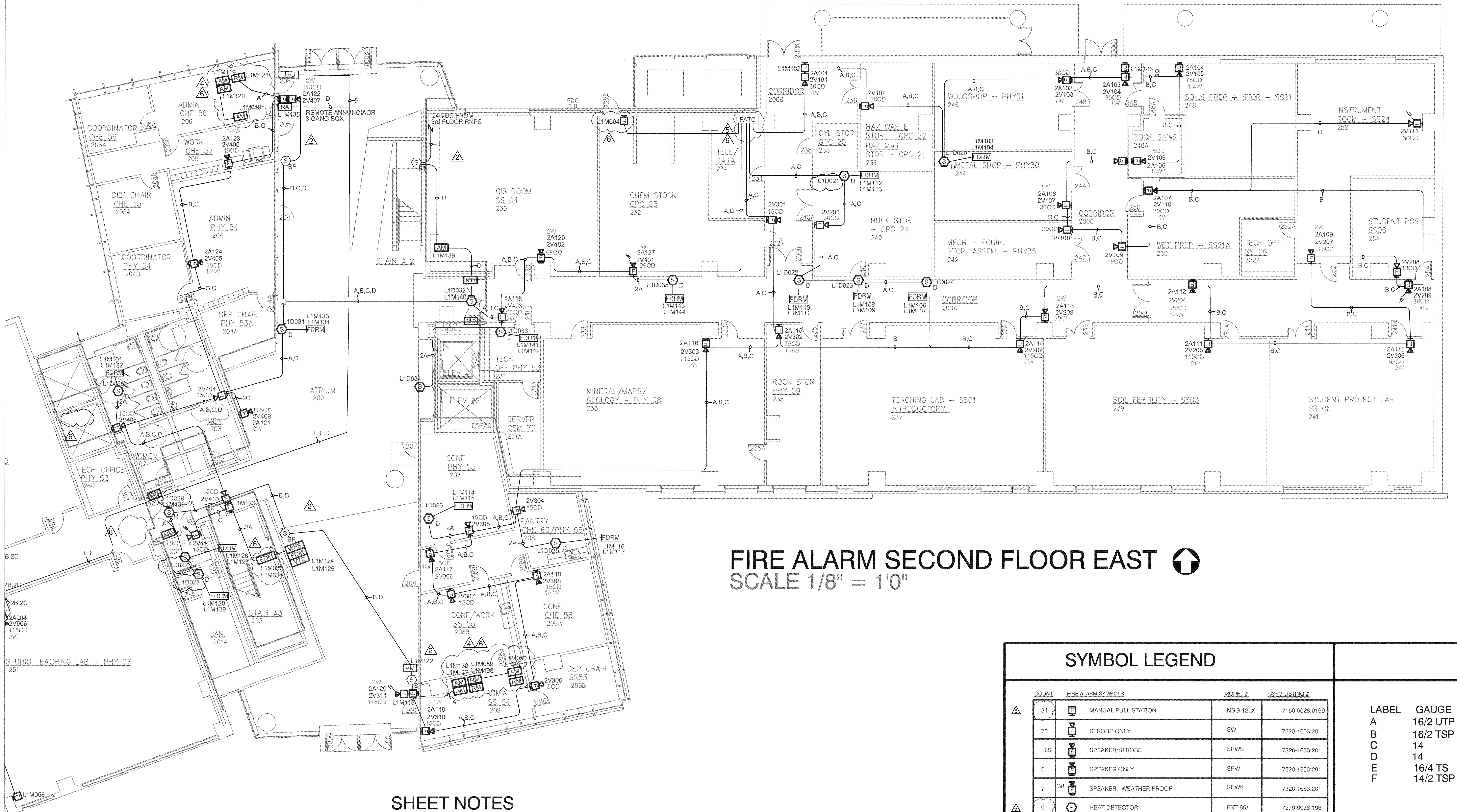
CSFM #18-40-03-0001

SHEET ID
FA 3.02W
SHEET 4 OF 15



FIRE ALARM SECOND FLOOR EAST

SCALE 1/8" = 1'0"

SHEET NOTES

1 PROVIDE FIRE ALARM BEAM DETECTORS TRANSMITTER AND RECEIVER. INTERLOCK WITH SMOKE EVACUATION SYSTEM SUCH THAT WHEN BEAM DETECTOR IS ACTIVATED, SMOKE EVACUATION SYSTEM IS ACTIVATED. REFER TO DETAIL 4 & 5/FA5.0.

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△5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
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△2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
△6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
△6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
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△5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
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	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
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SHEET ID
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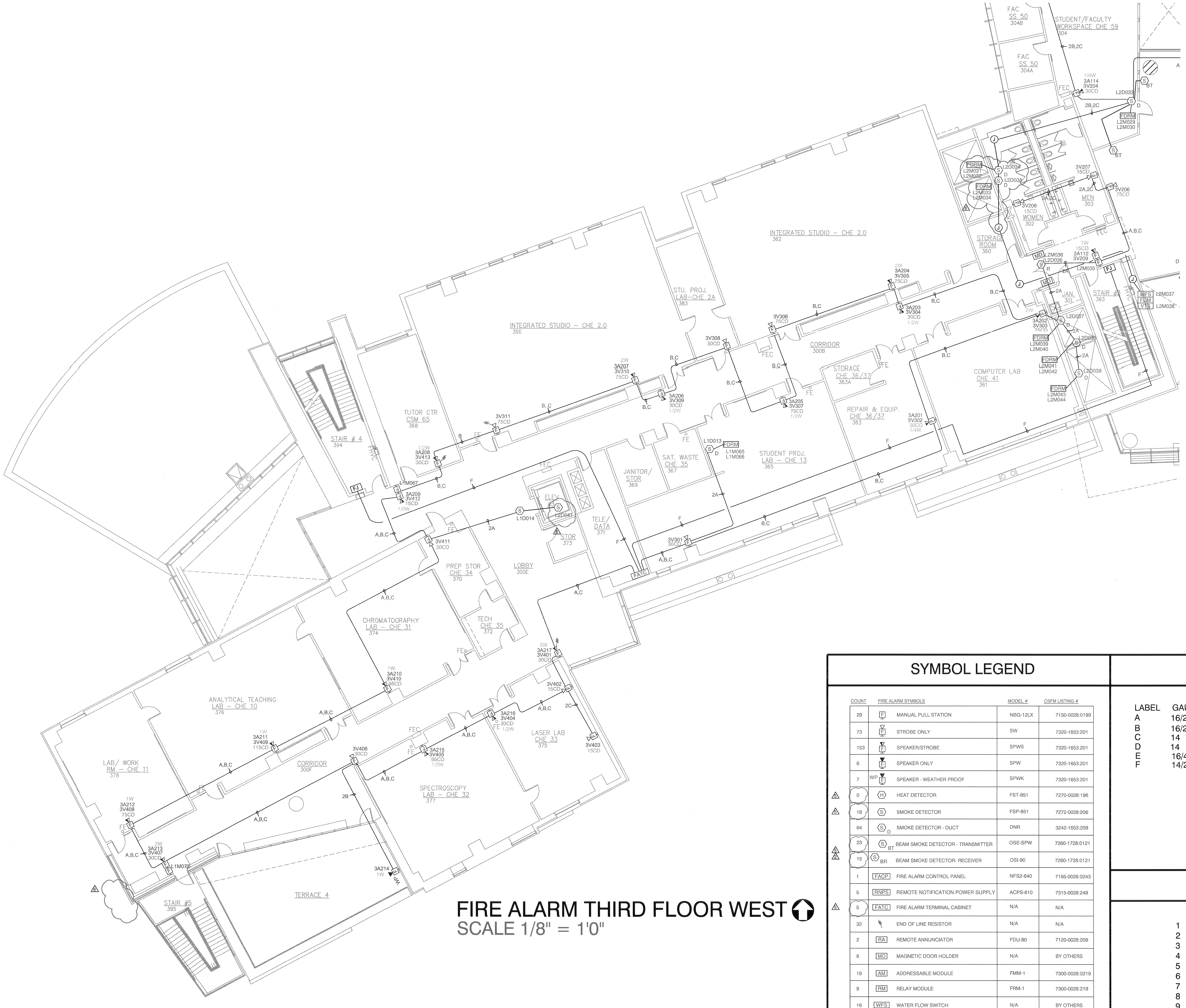

FIRE ALARM THIRD FLOOR WEST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
	29	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
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	153	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
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	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
	19	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
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	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
△5	22	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
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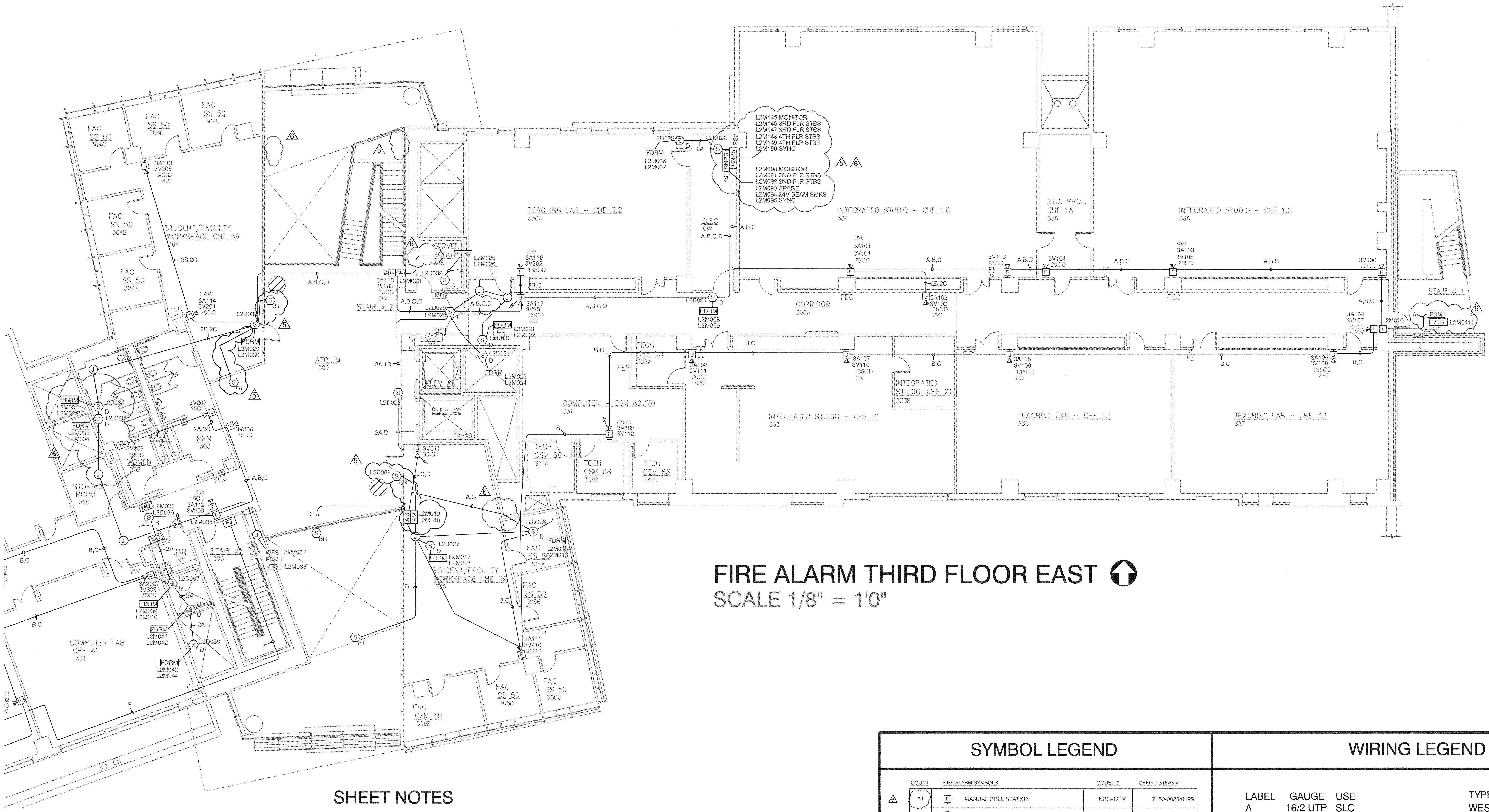

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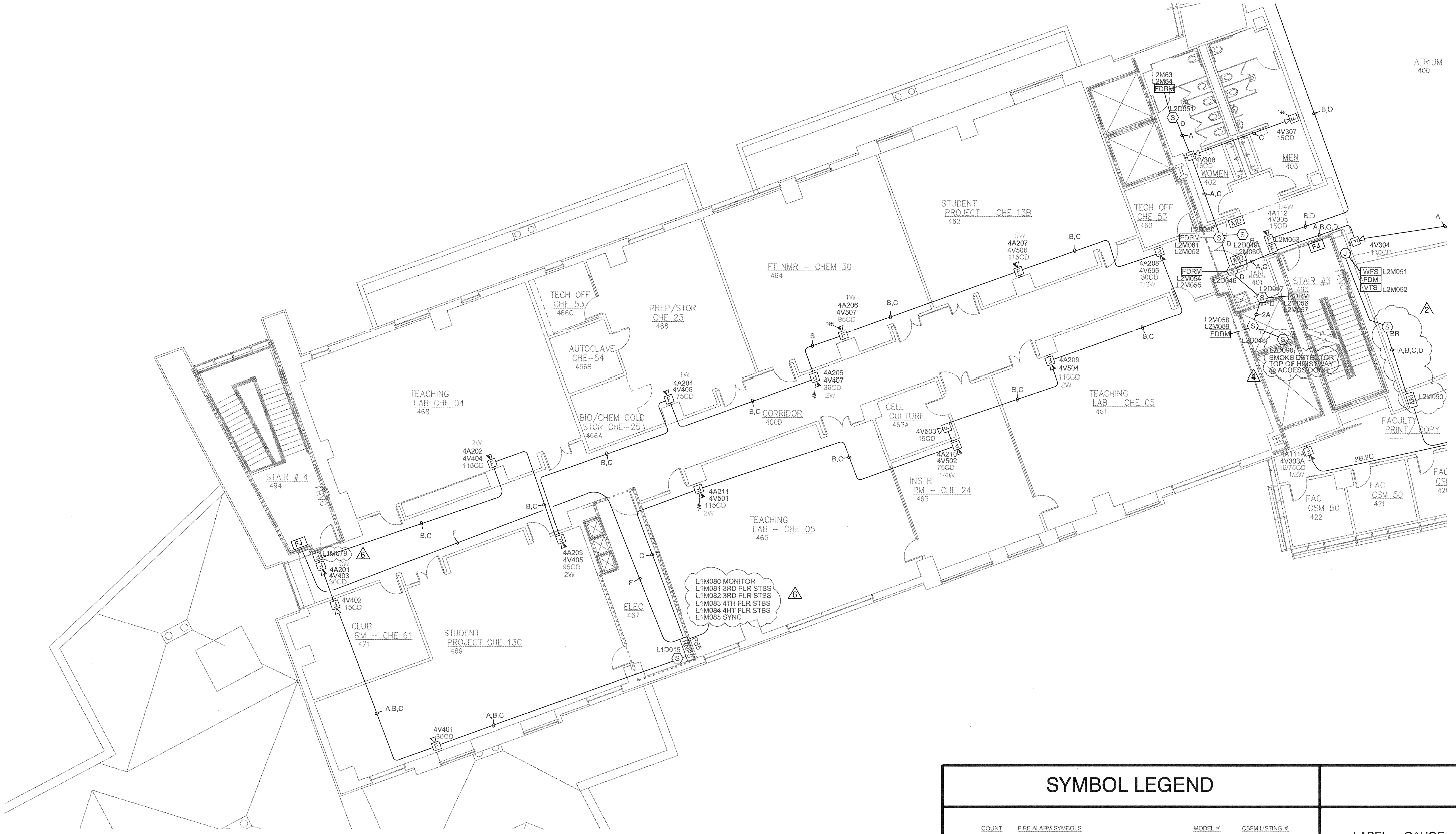

FIRE ALARM FOURTH FLOOR WEST

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	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
△5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
△5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
△5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
△2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
△6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
△6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
△6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
△6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
△5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
△4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

DRAWING INDEX

1	COVER SHEET	FA 0.0
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3	FIRST FLOOR WEST	FA 3.01W
4	SECOND FLOOR EAST	FA 3.02E
5	SECOND FLOOR WEST	FA 3.02W
6	THIRD FLOOR EAST	FA 3.03E
7	THIRD FLOOR WEST	FA 3.03W
8	FOURTH FLOOR EAST	FA 3.04E
9	FOURTH FLOOR WEST	FA 3.04W
10	FIFTH FLOOR EAST	FA 3.05E
11	FIFTH FLOOR WEST	FA 3.05W
12	SIXTH FLOOR EAST	FA 3.06E
13	SEVENTH FLOOR EAST	FA 3.07E
14	CALCULATIONS	FA 4.0
15	DETAILS	FA 5.0

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△5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
△6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY:
Curtis Streeter

DRAWN BY:
Derek Richardson

CHECKED BY:
CURTIS STREETER, SET
NICET IV #102672

PROJECT ENGINEER:
Integral Design Associates INC.

DATE: 08/23/2013

SCALE:

DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY

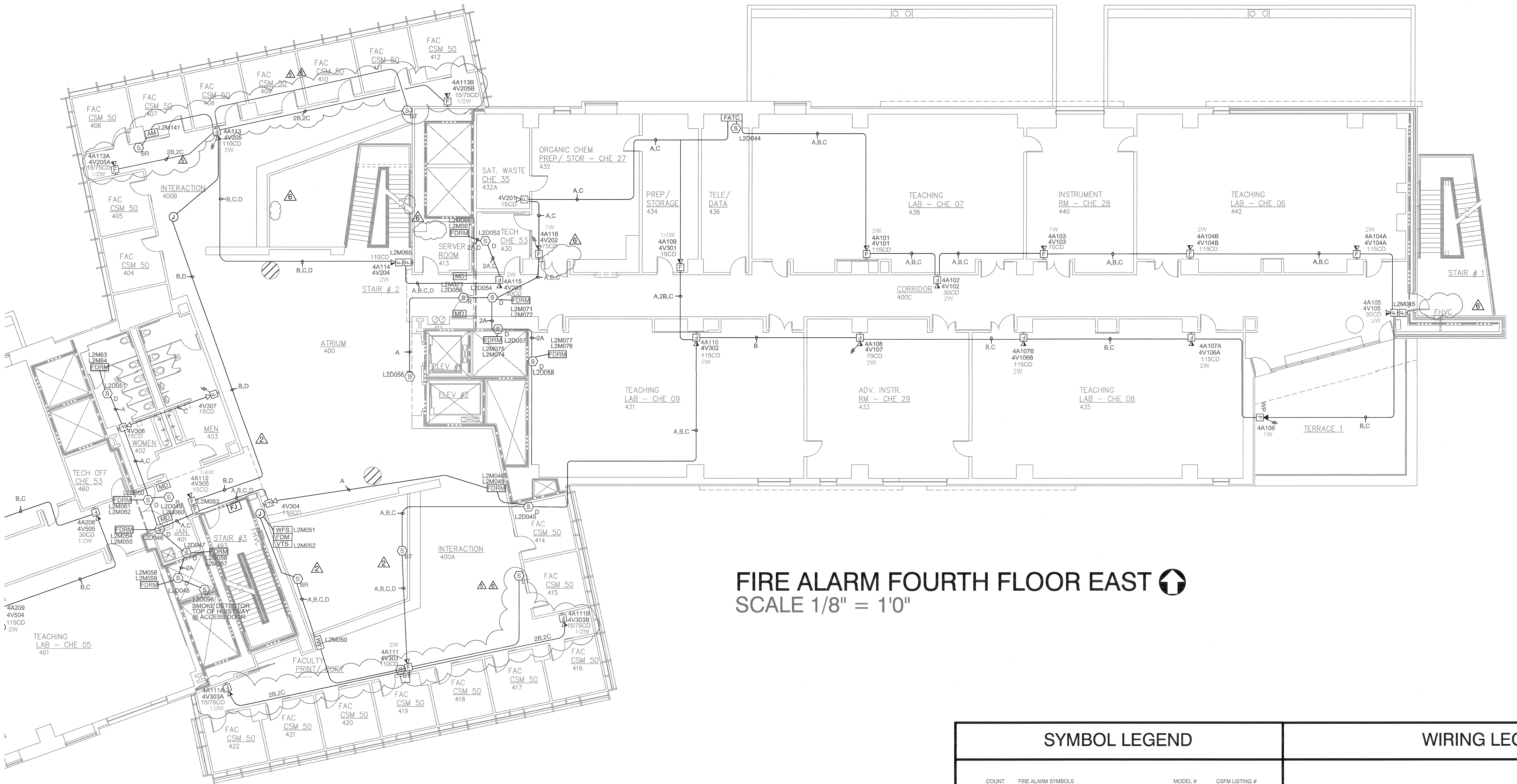
SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID

FA 3.04W

SHEET 8 OF 15



FIRE ALARM FOURTH FLOOR EAST

SCALE 1/8" = 1'0"

SHEET NOTES

1. PROVIDE FIRE ALARM BEAM DETECTORS TRANSMITTER AND RECEIVER. INTERLOCK WITH SMOKE EVACUATION SYSTEM SUCH THAT WHEN BEAM DETECTOR IS ACTIVATED, SMOKE EVACUATION SYSTEM IS ACTIVATED. REFER TO DETAIL 4 & 5/FA5.0.
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SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS	MODEL #	CSFM LISTING #
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	73	F STROBE ONLY	SW	7320-1653:201
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	6	F SPEAKER ONLY	SPW	7320-1653:201
	7	WP F SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
△5	0	H HEAT DETECTOR	FST-851	7270-0028:196
△5	18	S SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D SMOKE DETECTOR - DUCT	DNR	3242-1653:209
△5	23	S BT BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
△2	15	S BR BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
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	5	RNPS REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
△6	4	FATC FIRE ALARM TERMINAL CABINET	N/A	N/A
	32	END OF LINE RESISTOR	N/A	N/A
	2	RA REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD MAGNETIC DOOR HOLDER	N/A	BY OTHERS
△6	21	AM ADDRESSABLE MODULE	FMM-1	7300-0028:0219
△6	12	RM RELAY MODULE	FRM-1	7300-0028:219
	16	WFS WATER FLOW SWITCH	N/A	BY OTHERS
△6	10	VTS VALVE TAMPER SWITCH	N/A	BY OTHERS
△5	21	FDM DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2 DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
△4	1	XP10-M TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
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D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

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DESIGNED BY: Curtis Streeter

DATE: 08/23/2013

DRAWN BY: Derek Richardson

SCALE:

CHECKED BY: CURTIS STREETER, SET NICET IV #102672

DRAWING CODE: FA ALL DRAWINGS CPCFS

PROJECT ENGINEER: Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY

SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID

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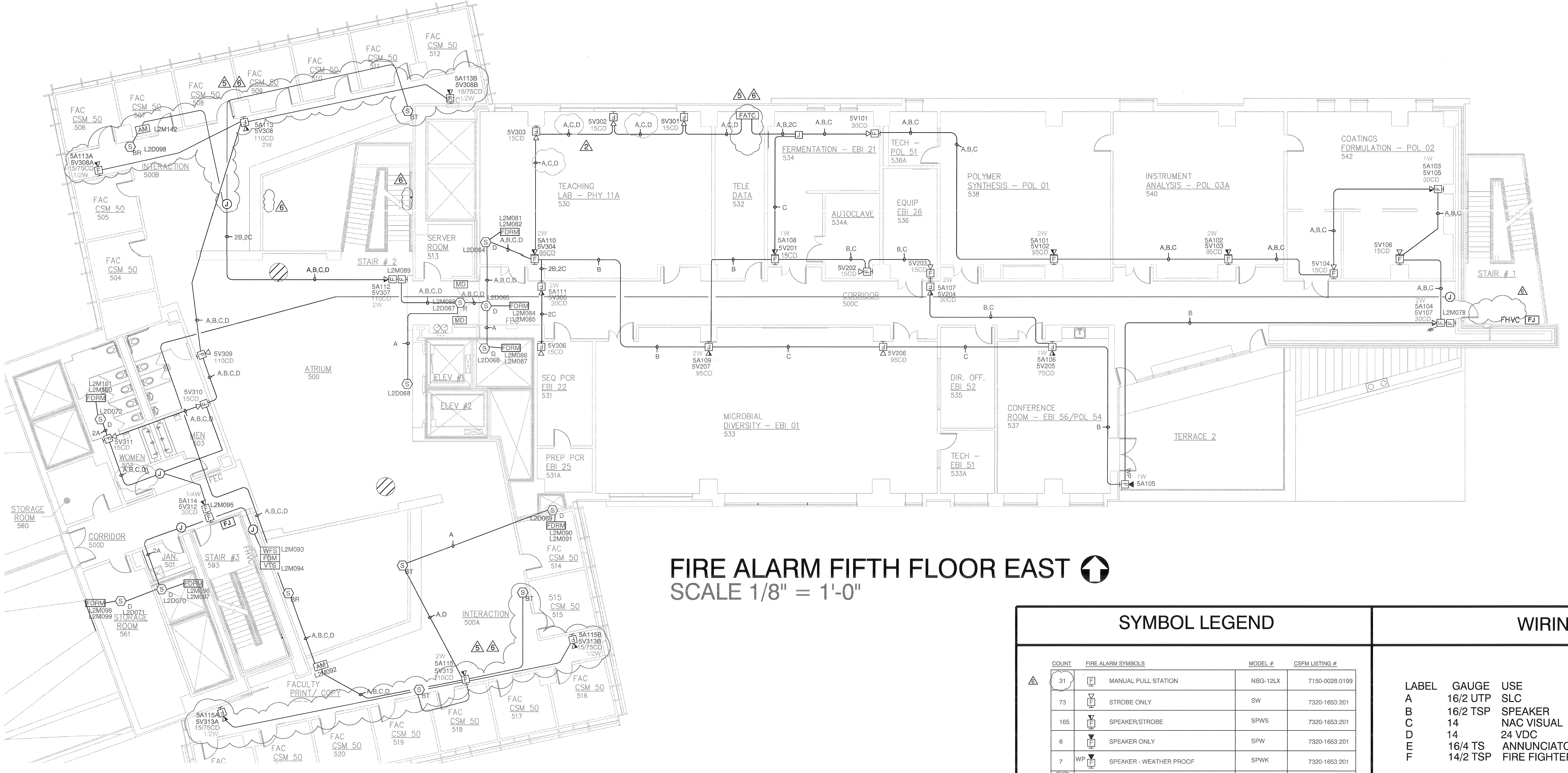
SHEET 9 OF 15



FIRE ALARM FIFTH FLOOR EAST

SCALE 1/8" = 1'-0"

SHEET NOTES

1. PROVIDE FIRE ALARM BEAM DETECTORS TRANSMITTER AND RECEIVER. INTERLOCK WITH SMOKE EVACUATION SYSTEM SUCH THAT WHEN BEAM DETECTOR IS ACTIVATED, SMOKE EVACUATION SYSTEM IS ACTIVATED. REFER TO DETAIL 4 & 5/FA5.0.
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SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
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	73	F	STROBE ONLY	SW	7320-1653:201
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6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
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5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
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DATE: 08/23/2013
SCALE:
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DESIGNED BY: Curtis Streeter
DRAWN BY: Derek Richardson
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
PROJECT ENGINEER: Integral Design Associates INC.

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SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

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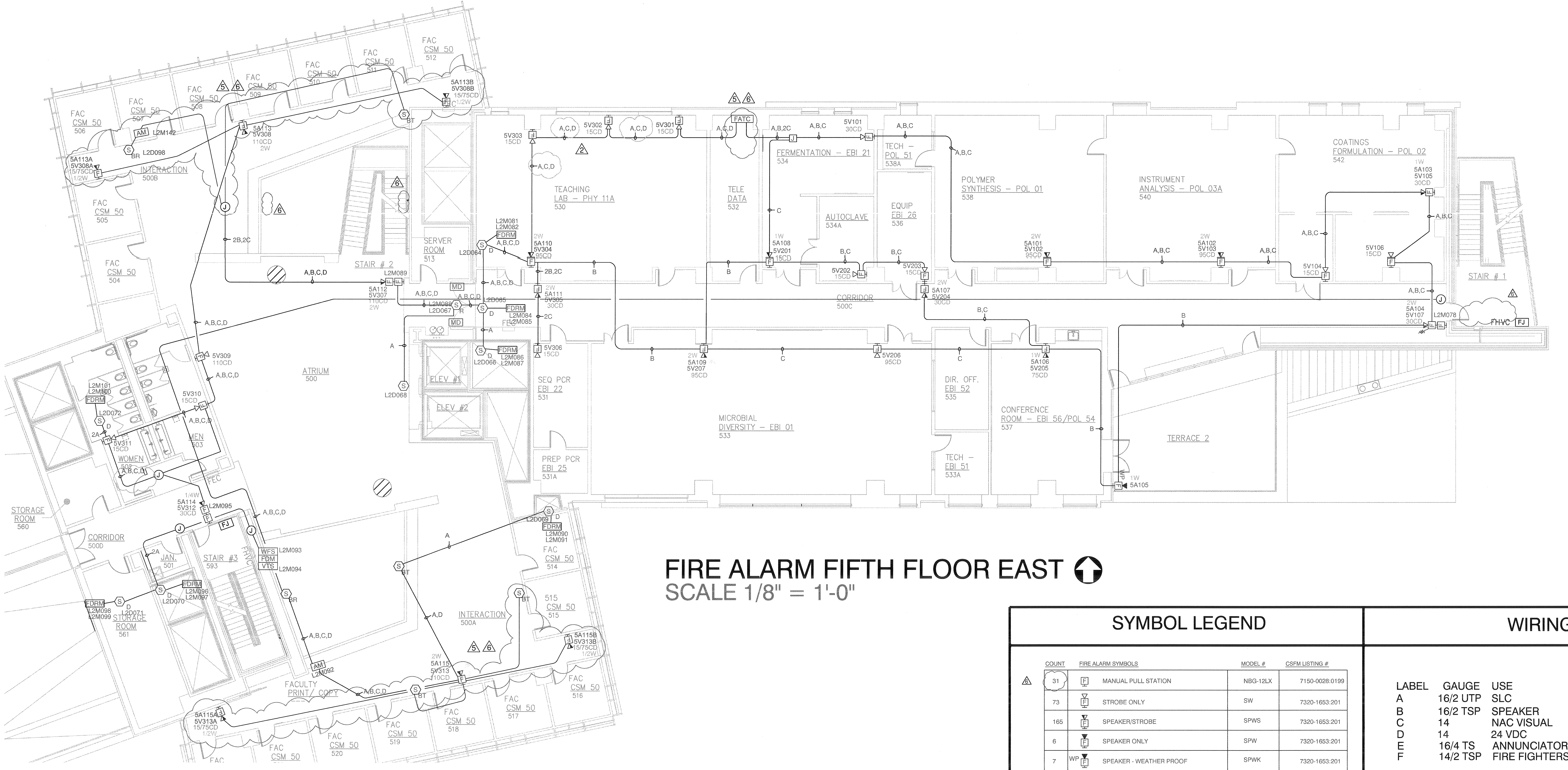
SHEET 11 OF 15



FIRE ALARM FIFTH FLOOR EAST

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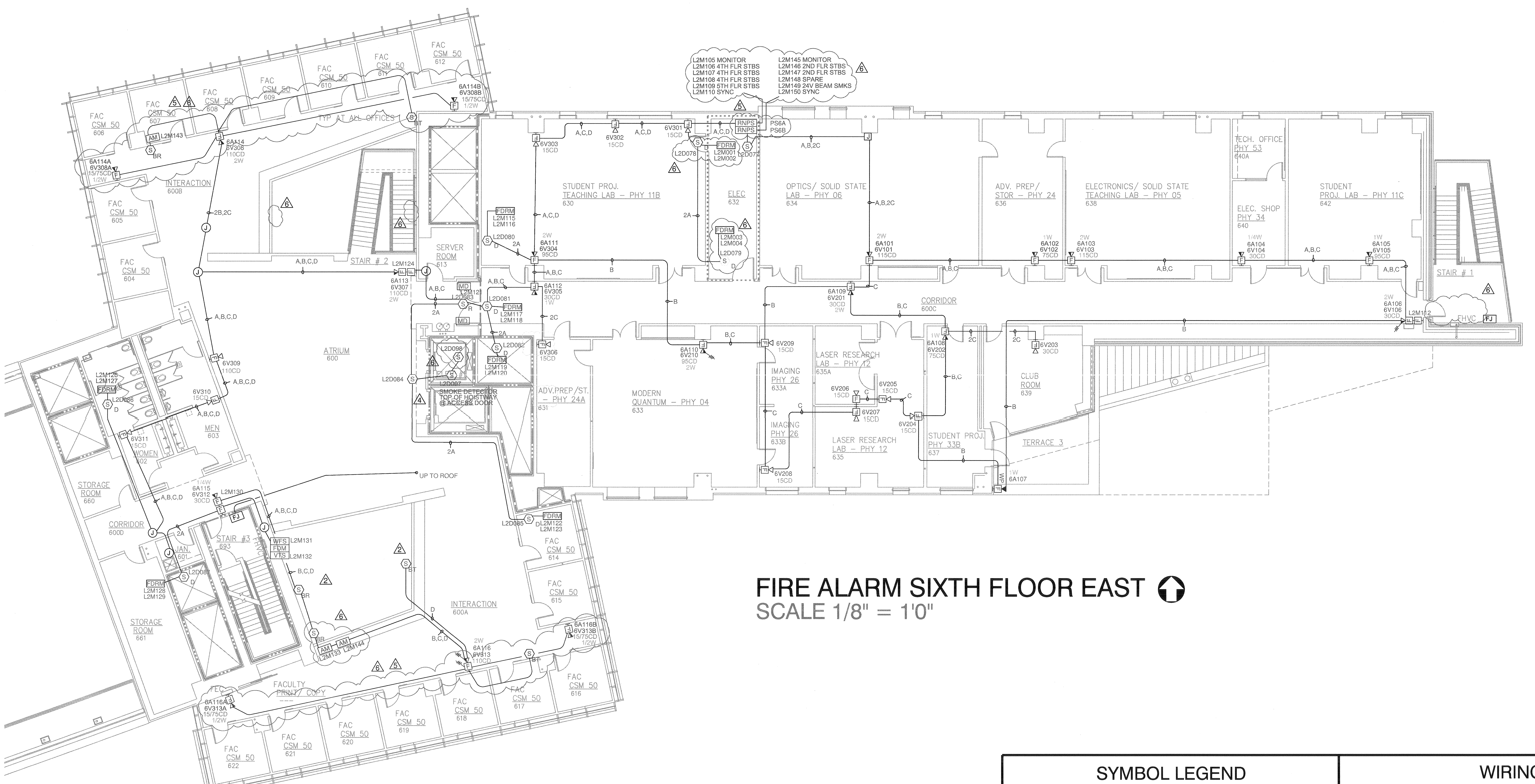

FIRE ALARM SIXTH FLOOR EAST

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	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
△6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
△6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
△6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
△5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
	1	XP6-R	SIX RELAY CONTROL MODULE	XP6-R	7300-0028:0219
△4	1	XP10-M	TEN-INPUT MONITOR MODULE	XP10-M	7300-0028:0219

WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
A	16/2 UTP	SLC	WEST PENN D990
B	16/2 TSP	SPEAKER	WEST PENN D991
C	14	NAC VISUAL	THHN
D	14	24 VDC	THHN
E	16/4 TS	ANNUNCIATOR	WEST PENN 993
F	14/2 TSP	FIRE FIGHTERS PHONE	WEST PENN D995

DRAWING INDEX

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4	SECOND FLOOR EAST	FA 3.02E
5	SECOND FLOOR WEST	FA 3.02W
6	THIRD FLOOR EAST	FA 3.03E
7	THIRD FLOOR WEST	FA 3.03W
8	FOURTH FLOOR EAST	FA 3.04E
9	FOURTH FLOOR WEST	FA 3.04W
10	FIFTH FLOOR EAST	FA 3.05E
11	FIFTH FLOOR WEST	FA 3.05W
12	SIXTH FLOOR EAST	FA 3.06E
13	SEVENTH FLOOR EAST	FA 3.07E
14	CALCULATIONS	FA 4.0
15	DETAILS	FA 5.0

Deep Blue Integration

Consulting - Design - Installation
Service - Monitoring

Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

Revisions

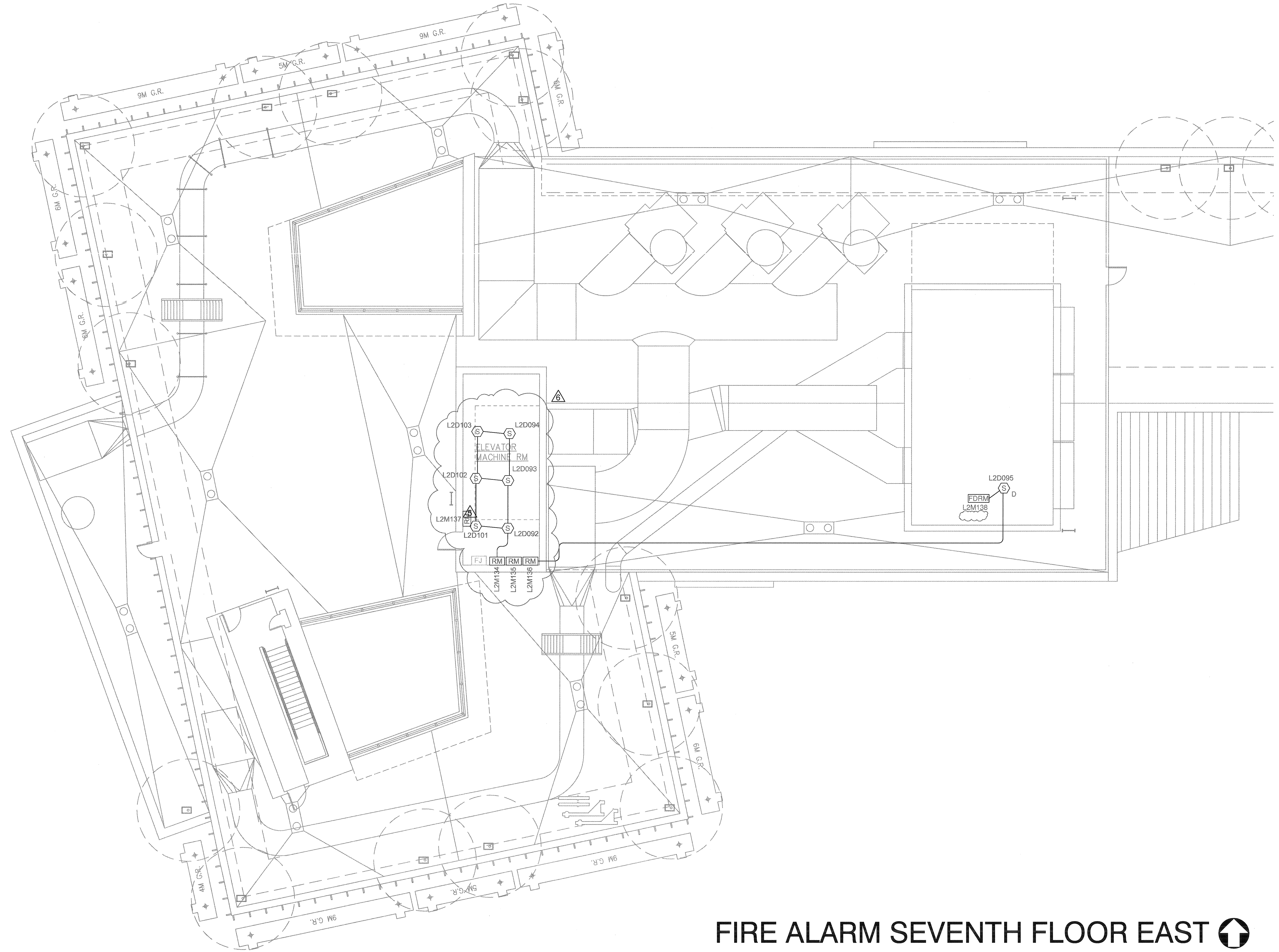
SYMBOL	DESCRIPTION	DATE	APPR.
△1	REVIEW COMMENTS	6/14/2011	
△2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
△3	SFM REVIEW COMMENTS	8/20/2012	
△4	CRB 93.2	1/15/2013	
△5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
△6	AS-BUILT DRAWINGS	8/23/2013	

DATE: 08/23/2013
SCALE:
DRAWING CODE: FA ALL DRAWINGS CPCFS

DESIGNED BY:
Curtis Streeter
DRAWN BY:
Derek Richardson
CHECKED BY:
CURTIS STREETER, SET
NICET IV #102672
PROJECT ENGINEER:
Integral Design Associates INC.

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID
FA 3.06E
SHEET 12 OF 15



FIRE ALARM SEVENTH FLOOR EAST

SCALE 1/8" = 1'0"

SYMBOL LEGEND

	COUNT	FIRE ALARM SYMBOLS		MODEL #	CSFM LISTING #
6	31	F	MANUAL PULL STATION	NBG-12LX	7150-0028:0199
	73	F	STROBE ONLY	SW	7320-1653:201
	165	F	SPEAKER/STROBE	SPWS	7320-1653:201
	6	F	SPEAKER ONLY	SPW	7320-1653:201
	7	WP F	SPEAKER - WEATHER PROOF	SPWK	7320-1653:201
5	0	H	HEAT DETECTOR	FST-851	7270-0028:196
5	18	S	SMOKE DETECTOR	FSP-851	7272-0028:206
	64	S D	SMOKE DETECTOR - DUCT	DNR	3242-1653:209
5	23	S BT	BEAM SMOKE DETECTOR - TRANSMITTER	OSE-SPW	7260-1728:0121
2	15	S BR	BEAM SMOKE DETECTOR- RECEIVER	OSI-90	7260-1728:0121
	1	FACP	FIRE ALARM CONTROL PANEL	NFS2-640	7165-0028:0243
	5	RNPS	REMOTE NOTIFICATION POWER SUPPLY	ACPS-610	7315-0028:248
6	4	FATC	FIRE ALARM TERMINAL CABINET	N/A	N/A
	32		END OF LINE RESISTOR	N/A	N/A
	2	RA	REMOTE ANNUNCIATOR	FDU-80	7120-0028:209
	8	MD	MAGNETIC DOOR HOLDER	N/A	BY OTHERS
6	21	AM	ADDRESSABLE MODULE	FMM-1	7300-0028:0219
6	12	RM	RELAY MODULE	FRM-1	7300-0028:219
	16	WFS	WATER FLOW SWITCH	N/A	BY OTHERS
6	10	VTS	VALVE TAMPER SWITCH	N/A	BY OTHERS
5	21	FDM	DUAL MONITOR MODULE	FDM-1	7300-0028:0219
	64	FDRM	DUAL RELAY / MONITOR MODULE	FDRM-1	7300-0028:0219
	12	FJ	FIRE FIGHTER'S PHONE JACKS	FTM-1	7300-1652:0182
	4	DAA2	DIGITAL AUDIO AMPLIFIERS	DAA2	7170-0028:223 7170-0028:224
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WIRING LEGEND

LABEL	GAUGE	USE	TYPE (OR EQUIVALENT)
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D	14	24 VDC	THHN
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SAN LUIS OBISPO, CA

CSFM #18-40-03-0001

SHEET ID

FA 3.07E

SHEET 13 OF 15

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS5- Circuit 4V4		
Area Covered	4th Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.897	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	50	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
4V401	50	23.72	0.275	1.15%	0.094	System Sensor	SCR	ST	30
4V402	40	23.53	0.473	1.97%	0.066	System Sensor	SCR	ST	15
4V403	10	23.48	0.518	2.16%	0.094	System Sensor	SCR	ST	30
4V404	40	23.32	0.676	2.82%	0.210	System Sensor	SCR	ST	115
4V405	20	23.27	0.729	3.04%	0.181	System Sensor	SCR	ST	95
4V406	45	23.20	0.799	3.33%	0.158	System Sensor	SCR	ST	75
4V407	30	23.18	0.816	3.40%	0.094	System Sensor	SCR	ST	30
END	0	23.18	0.816	3.40%	0.000				
END	0	23.18	0.816	3.40%	0.000				
END	0	23.18	0.816	3.40%	0.000				
END	0	23.18	0.816	3.40%	0.000				
END	0	23.18	0.816	3.40%	0.000				
END	0	23.18	0.816	3.40%	0.000				
Totals	235	End of Line Voltage		23.18	0.897				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.897	235	0.82
End of Line Voltage		23.18
Percent Drop		3.40%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS5- Circuit 4V5		
Area Covered	4th Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.129	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	37	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
4V501	37	23.74	0.256	1.07%	0.210	System Sensor	SCR	ST	115
4V502	50	23.46	0.539	2.24%	0.158	System Sensor	SCR	ST	75
4V503	7	23.43	0.571	2.38%	0.066	System Sensor	SCR	ST	15
4V504	25	23.32	0.678	2.83%	0.210	System Sensor	SCR	ST	115
4V505	40	23.20	0.797	3.32%	0.094	System Sensor	SCR	ST	30
4V506	30	23.13	0.869	3.62%	0.210	System Sensor	SCR	ST	115
4V507	35	23.09	0.908	3.78%	0.181	System Sensor	SCR	ST	95
END	0	23.09	0.908	3.78%	0.000				
END	0	23.09	0.908	3.78%	0.000				
END	0	23.09	0.908	3.78%	0.000				
END	0	23.09	0.908	3.78%	0.000				
END	0	23.09	0.908	3.78%	0.000				
END	0	23.09	0.908	3.78%	0.000				
Totals	224	End of Line Voltage		23.09	1.129				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.129	224	0.91
End of Line Voltage		23.09
Percent Drop		3.78%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS5- Circuit 3V3		
Area Covered	3rd Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.418	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	17	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
3V301	17	23.85	0.148	0.62%	0.094	System Sensor	SCR	ST	30
3V302	65	23.32	0.676	2.82%	0.094	System Sensor	SCR	ST	30
3V303	50	22.95	1.054	4.39%	0.158	System Sensor	SCR	ST	75
3V304	20	22.81	1.186	4.94%	0.094	System Sensor	SCR	ST	30
3V305	30	22.63	1.366	5.69%	0.158	System Sensor	SCR	ST	75
3V306	30	22.48	1.517	6.32%	0.158	System Sensor	SCR	ST	75
3V307	20	22.40	1.598	6.66%	0.158	System Sensor	SCR	ST	75
3V308	30	22.31	1.691	7.05%	0.094	System Sensor	SCR	ST	30
3V309	25	22.25	1.754	7.31%	0.094	System Sensor	SCR	ST	30
3V310	15	22.22	1.783	7.43%	0.158	System Sensor	SCR	ST	75
3V311	35	22.18	1.817	7.57%	0.158	System Sensor	SCR	ST	75
END		22.18	1.817	7.57%	0.000				
END		22.18	1.817	7.57%	0.000				
Totals	337	End of Line Voltage		22.18	1.418				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.418	337	1.82
End of Line Voltage		22.18
Percent Drop		7.57%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS5- Circuit 3V4		
Area Covered	3rd Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.492	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	40	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
3V401	40	23.63	0.366	1.53%	0.094	System Sensor	SCR	ST	30
3V402	12	23.53	0.469	1.96%	0.066	System Sensor	SCR	ST	15
3V403	12	23.43	0.568	2.36%	0.066	System Sensor	SCR	ST	15
3V404	40	23.12	0.879	3.66%	0.094	System Sensor	SCR	ST	30
3V405	20	22.98	1.022	4.26%	0.181	System Sensor	SCR	ST	95
3V406	25	22.83	1.175	4.89%	0.094	System Sensor	SCR	ST	30
3V407	50	22.55	1.450	6.04%	0.094	System Sensor	SCR	ST	30
3V408	15	22.48	1.524	6.35%	0.158	System Sensor	SCR	ST	75
3V409	40	22.32	1.682	7.01%	0.210	System Sensor	SCR	ST	115
3V410	30	22.24	1.762	7.34%	0.181	System Sensor	SCR	ST	95
3V411	50	22.16	1.840	7.67%	0.094	System Sensor	SCR	ST	30
3V412	20	22.14	1.860	7.75%	0.066	System Sensor	SCR	ST	15
3V413	20	22.13	1.872	7.80%	0.094	System Sensor	SCR	ST	30
Totals	374	End of Line Voltage		22.13	1.492				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.492	374	1.87
End of Line Voltage		22.13
Percent Drop		7.80%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier FACP- Circuit 2V5		
Area Covered	2nd Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.808	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	60	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V501	60	23.33	0.666	2.78%	0.094	System Sensor	SCR	ST	30
2V502	23	23.09	0.908	3.78%	0.066	System Sensor	SCR	ST	15
2V503	25	22.84	1.161	4.84%	0.094	System Sensor	SCR	ST	30
2V504	30	22.55	1.447	6.03%	0.210	System Sensor	SCR	ST	115
2V505	13	22.45	1.547	6.45%	0.094	System Sensor	SCR	ST	30
2V506	8	22.40	1.598	6.66%	0.210	System Sensor	SCR	ST	115
2V507	68	22.06	1.945	8.10%	0.210	System Sensor	SCR	ST	115
2V508	11	22.01	1.994	8.31%	0.094	System Sensor	SCR	ST	30
2V509	46	21.86	2.143	8.93%	0.210	System Sensor	SCR	ST	115
2V510	48	21.76	2.236	9.32%	0.210	System Sensor	SCR	ST	115
2V511	20	21.74	2.256	9.40%	0.158	System Sensor	SCR	ST	75
2V512	60	21.74	2.256	9.40%	0.158	System Sensor	SCR	ST	75
END		21.74	2.256	9.40%					
Totals	412	End of Line Voltage		21.74	1.808				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.808	412	2.26
End of Line Voltage		21.74
Percent Drop		9.40%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier FACP- Circuit 2V6		
Area Covered	2nd Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.712	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	40	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V601	40	23.58	0.420	1.75%	0.094	System Sensor	SCR	ST	30
2V602	30	23.28	0.719	2.99%	0.210	System Sensor	SCR	ST	115
2V603	30	23.02	0.978	4.07%	0.158	System Sensor	SCR	ST	75
2V604	25	22.83	1.170	4.87%	0.210	System Sensor	SCR	ST	115
2V605	30	22.64	1.361	5.67%	0.094	System Sensor	SCR	ST	30
2V606	20	22.52	1.477	6.16%	0.210	System Sensor	SCR	ST	115
2V607	60	22.25	1.749	7.29%	0.158	System Sensor	SCR	ST	75
2V608	40	22.11	1.891	7.88%	0.158	System Sensor	SCR	ST	75
2V609	50	21.98	2.020	8.41%	0.210	System Sensor	SCR	ST	115
2V610	25	21.95	2.052	8.55%	0.210	System Sensor	SCR	ST	115
END		21.95	2.052	8.55%	0.000				
END		21.95	2.052	8.55%	0.000				
END		21.95	2.052	8.55%	0.000				
Totals	350	End of Line Voltage		21.95	1.712				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.712	350	2.05
End of Line Voltage		21.95
Percent Drop		8.55%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier FACP- Circuit 1V1		
Area Covered	1st Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.016	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	30	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
1V101	30	23.81	0.187	0.78%	0.066	System Sensor	SCR	ST	15
1V102	20	23.70	0.304	1.27%	0.066	System Sensor	SCR	ST	15
1V103	30	23.53	0.467	1.94%	0.066	System Sensor	SCR	ST	15
1V104	50	23.28	0.718	2.99%	0.066	System Sensor	SCR	ST	15
1V105	50	23.05	0.949	3.95%	0.210	System Sensor	SCR	ST	115
1V106	35	22.93	1.065	4.44%	0.094	System Sensor	SCR	ST	30
1V107	30	22.85	1.148	4.78%	0.158	System Sensor	SCR	ST	75
1V108	35	22.79	1.210	5.04%	0.066	System Sensor	SCR	ST	15
1V109	40	22.74	1.265	5.27%	0.066	System Sensor	SCR	ST	15
1V110	35	22.70	1.299	5.41%	0.158	System Sensor	SCR	ST	75
END		22.70	1.299	5.41%	0.000				
END		22.70	1.299	5.41%	0.000				
END		22.70	1.299	5.41%	0.000				
Totals	355	End of Line Voltage		22.70	1.016				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.016	355	1.30
End of Line Voltage		22.70
Percent Drop		5.41%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier FACP- Circuit 1V2		
Area Covered	1st Floor West		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.829	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	40	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
1V201	40	23.55	0.449	1.87%	0.094	System Sensor	SCR	ST	30
1V202	45	23.07	0.929	3.87%	0.158	System Sensor	SCR	ST	75
1V203	15	22.93	1.074	4.47%	0.210	System Sensor	SCR	ST	115
1V204	15	22.80	1.200	5.00%	0.094	System Sensor	SCR	ST	30
1V205	15	22.68	1.317	5.49%	0.158	System Sensor	SCR	ST	75
1V206	15	22.58	1.420	5.92%	0.181	System Sensor	SCR	ST	95
1V207	40	22.35	1.649	6.87%	0.210	System Sensor	SCR	ST	115
1V208	10	22.31	1.694	7.06%	0.094	System Sensor	SCR	ST	30
1V209	10	22.27	1.732	7.22%	0.210	System Sensor	SCR	ST	115
1V210	35	22.18	1.822	7.59%	0.210	System Sensor	SCR	ST	115
1V211	15	22.16	1.842	7.67%	0.210	System Sensor	SCR	ST	115
END		22.16	1.842	7.67%	0.000				
END		22.16	1.842	7.67%	0.000				
Totals	255	End of Line Voltage		22.16	1.829				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.829	255	1.84
End of Line Voltage		22.16
Percent Drop		7.67%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

WEST

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS4- Circuit 6V1		
Area Covered	6th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.947	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	50	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
6V101	50	23.71	0.291	1.21%	0.210	System Sensor	SCR	ST	115
6V102	32	23.56	0.436	1.81%	0.158	System Sensor	SCR	ST	75
6V103	10	23.53	0.471	1.96%	0.210	System Sensor	SCR	ST	115
6V104	32	23.46	0.544	2.26%	0.094	System Sensor	SCR	ST	30
6V105	25	23.41	0.586	2.44%	0.181	System Sensor	SCR	ST	95
6V106	20	23.40	0.597	2.49%	0.094	System Sensor	SCR	ST	30
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
END		23.40	0.597	2.49%					
Totals	169	End of Line Voltage		23.40	0.947				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.947	169	0.60
End of Line Voltage		23.40
Percent Drop		2.49%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS4- Circuit 6V2		
Area Covered	6th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.923	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	62	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
6V201	62	23.65	0.351	1.46%	0.094	System Sensor	SCR	ST	30
6V202	30	23.50	0.504	2.10%	0.158	System Sensor	SCR	ST	75
6V203	20	23.41	0.586	2.44%	0.094	System Sensor	SCR	ST	30
6V204	45	23.25	0.746	3.11%	0.066	System Sensor	SCR	ST	15
6V205	10	23.22	0.777	3.24%	0.066	System Sensor	SCR	ST	15
6V206	10	23.20	0.805	3.35%	0.066	System Sensor	SCR	ST	15
6V207	5	23.18	0.816	3.40%	0.066	System Sensor	SCR	ST	15
6V208	30	23.13	0.874	3.64%	0.066	System Sensor	SCR	ST	15
6V209	30	23.08	0.919	3.83%	0.066	System Sensor	SCR	ST	15
6V210	15	23.06	0.936	3.90%	0.181	System Sensor	SCR	ST	95
END		23.06	0.936	3.90%					
END		23.06	0.936	3.90%					
END		23.06	0.936	3.90%					
Totals	257	End of Line Voltage		23.06	0.923				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.923	257	0.94
End of Line Voltage		23.06
Percent Drop		3.90%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS4- Circuit 6V3		
Area Covered	6th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.573	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	12	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
6V301	12	23.88	0.116	0.48%	0.066	System Sensor	SCR	ST	15
6V302	12	23.77	0.227	0.95%	0.066	System Sensor	SCR	ST	15
6V303	12	23.67	0.333	1.39%	0.066	System Sensor	SCR	ST	15
6V304	20	23.50	0.502	2.09%	0.181	System Sensor	SCR	ST	95
6V305	10	23.42	0.575	2.40%	0.094	System Sensor	SCR	ST	30
6V306	10	23.36	0.643	2.68%	0.066	System Sensor	SCR	ST	15
6V307	25	23.20	0.802	3.34%	0.202	System Sensor	SCR	ST	110
6V308	75	22.82	1.185	4.94%	0.202	System Sensor	SCR	ST	110
6V309	50	22.62	1.378	5.74%	0.202	System Sensor	SCR	ST	110
6V310	15	22.58	1.417	5.91%	0.066	System Sensor	SCR	ST	15
6V311	20	22.54	1.462	6.09%	0.066	System Sensor	SCR	ST	15
6V312	25	22.49	1.507	6.28%	0.094	System Sensor	SCR	ST	30
6V313	80	22.39	1.607	6.69%	0.202	System Sensor	SCR	ST	110
Totals	366	End of Line Voltage		22.39	1.573				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.573	366	1.61
End of Line Voltage		22.39
Percent Drop		6.69%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS3- Circuit 5V1		
Area Covered	5th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.776	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	48	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
5V101	28	23.87	0.133	0.56%	0.094	System Sensor	SCR	ST	30
5V102	64	23.60	0.401	1.67%	0.181	System Sensor	SCR	ST	95
5V103	32	23.50	0.500	2.08%	0.181	System Sensor	SCR	ST	95
5V104	25	23.45	0.549	2.29%	0.066	System Sensor	SCR	ST	15
5V105	14	23.43	0.571	2.38%	0.094	System Sensor	SCR	ST	30
5V106	18	23.41	0.588	2.45%	0.066	System Sensor	SCR	ST	15
5V107	18	23.40	0.599	2.50%	0.094	System Sensor	SCR	ST	30
END		23.40	0.599	2.50%	0.000				
END		23.40	0.599	2.50%	0.000				
END		23.40	0.599	2.50%	0.000				
END		23.40	0.599	2.50%	0.000				
END		23.40	0.599	2.50%	0.000				
END		23.40	0.599	2.50%	0.000				
Totals	219	End of Line Voltage		23.40	0.776				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.776	219	0.60
End of Line Voltage		23.40
Percent Drop		2.50%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS3- Circuit 5V2		
Area Covered	5th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.812	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	35	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
5V201	35	23.83	0.174	0.73%	0.066	System Sensor	SCR	ST	15
5V202	20	23.73	0.266	1.11%	0.066	System Sensor	SCR	ST	15
5V203	15	23.67	0.329	1.37%	0.066	System Sensor	SCR	ST	15
5V204	5	23.65	0.348	1.45%	0.094	System Sensor	SCR	ST	30
5V205	20	23.59	0.411	1.71%	0.158	System Sensor	SCR	ST	75
5V206	33	23.52	0.485	2.02%	0.181	System Sensor	SCR	ST	95
5V207	33	23.48	0.521	2.17%	0.181	System Sensor	SCR	ST	95
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
Totals	161	End of Line Voltage		23.48	0.812				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.812	161	0.52
End of Line Voltage		23.48
Percent Drop		2.17%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS3- Circuit 5V3		
Area Covered	5th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.573	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	15	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
5V301	15	23.86	0.145	0.60%	0.066	System Sensor	SCR	ST	15
5V302	15	23.72	0.284	1.18%	0.066	System Sensor	SCR	ST	15
5V303	15	23.58	0.416	1.73%	0.066	System Sensor	SCR	ST	15
5V304	25	23.37	0.627	2.61%	0.181	System Sensor	SCR	ST	95
5V305	8	23.31	0.686	2.86%	0.094	System Sensor	SCR	ST	30
5V306	15	23.21	0.787	3.28%	0.066	System Sensor	SCR	ST	15
5V307	60	22.83	1.168	4.87%	0.202	System Sensor	SCR	ST	110
5V308	70	22.47	1.526	6.36%	0.202	System Sensor	SCR	ST	110
5V309	45	22.30	1.700	7.08%	0.202	System Sensor	SCR	ST	110
5V310	10	22.27	1.726	7.19%	0.066	System Sensor	SCR	ST	15
5V311	20	22.23	1.771	7.38%	0.066	System Sensor	SCR	ST	15
5V312	30	22.17	1.825	7.61%	0.094	System Sensor	SCR	ST	30
5V313	80	22.08	1.924	8.02%	0.202	System Sensor	SCR	ST	110
Totals	408	End of Line Voltage		22.08	1.573				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.573	408	1.92
End of Line Voltage		22.08
Percent Drop		8.02%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS2- Circuit 4V1		
Area Covered	4th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.250	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	50	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
4V101	50	23.62	0.384	1.60%	0.210	System Sensor	SCR	ST	115
4V102	20	23.49	0.511	2.13%	0.094	System Sensor	SCR	ST	30
4V103	25	23.34	0.657	2.74%	0.158	System Sensor	SCR	ST	75
4V104	46	23.12	0.879	3.66%	0.210	System Sensor	SCR	ST	115
4V105	41	22.98	1.025	4.27%	0.210	System Sensor	SCR	ST	115
4V106	120	22.70	1.296	5.40%	0.210	System Sensor	SCR	ST	115
4V107	53	22.65	1.347	5.61%	0.158	System Sensor	SCR	ST	75
END		22.65	1.347	5.61%	0.000				
END		22.65	1.347	5.61%	0.000				
END		22.65	1.347	5.61%	0.000				
END		22.65	1.347	5.61%	0.000				
END		22.65	1.347	5.61%	0.000				
END		22.65	1.347	5.61%	0.000				
Totals	355	End of Line Voltage		22.65	1.250				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.250	355	1.35
End of Line Voltage		22.65
Percent Drop		5.61%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS2- Circuit 4V2		
Area Covered	4th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.722	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	60	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
4V201	60	23.73	0.266	1.11%	0.066	System Sensor	SCR	ST	15
4V202	15	23.67	0.326	1.36%	0.158	System Sensor	SCR	ST	75
4V203	15	23.63	0.372	1.55%	0.094	System Sensor	SCR	ST	30
4V204	25	23.57	0.434	1.81%	0.202	System Sensor	SCR	ST	110
4V205	70	23.48	0.521	2.17%	0.202	System Sensor	SCR	ST	110
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
END		23.48	0.521	2.17%	0.000				
Totals	185	End of Line Voltage		23.48	0.722				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.722	185	0.52
End of Line Voltage		23.48
Percent Drop		2.17%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS3- Circuit 4V3		
Area Covered	4th Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	0.878	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	37	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
4V301	37	23.80	0.199	0.83%	0.066	System Sensor	SCR	ST	15
4V302	17	23.72	0.284	1.18%	0.210	System Sensor	SCR	ST	115
4V303	104	23.33	0.669	2.79%	0.202	System Sensor	SCR	ST	110
4V304	70	23.16	0.841	3.50%	0.202	System Sensor	SCR	ST	110
4V305	20	23.14	0.865	3.60%	0.066	System Sensor	SCR	ST	15
4V306	30	23.11	0.889	3.70%	0.066	System Sensor	SCR	ST	15
4V307	20	23.10	0.897	3.74%	0.066	System Sensor	SCR	ST	15
END		23.10	0.897	3.74%	0.000				
END		23.10	0.897	3.74%	0.000				
END		23.10	0.897	3.74%	0.000				
END		23.10	0.897	3.74%	0.000				
END		23.10	0.897	3.74%	0.000				
END		23.10	0.897	3.74%	0.000				
Totals	298	End of Line Voltage		23.10	0.878				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
0.878	298	0.90
End of Line Voltage		23.10
Percent Drop		3.74%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS2- Circuit 3V1		
Area Covered	3rd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.920	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	48	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
3V101	48	23.43	0.566	2.36%	0.158	System Sensor	SCR	ST	75
3V102	8	23.35	0.652	2.72%	0.094	System Sensor	SCR	ST	30
3V103	38	22.96	1.042	4.34%	0.158	System Sensor	SCR	ST	75
3V104	8	22.88	1.116	4.65%	0.094	System Sensor	SCR	ST	30
3V105	25	22.67	1.333	5.55%	0.158	System Sensor	SCR	ST	75
3V106	40	22.36	1.642	6.84%	0.158	System Sensor	SCR	ST	75
3V107	11	22.28	1.716	7.15%	0.094	System Sensor	SCR	ST	30
3V108	15	22.19	1.809	7.54%	0.228	System Sensor	SCRH	ST	135
3V109	65	21.88	2.120	8.83%	0.228	System Sensor	SCRH	ST	135
3V110	33	21.77	2.231	9.30%	0.228	System Sensor	SCRH	ST	135
3V111	30	21.71	2.290	9.54%	0.094	System Sensor	SCR	ST	30
3V112	33	21.66	2.336	9.74%	0.228	System Sensor	SCRH	ST	135
END		21.66	2.336	9.74%	0.000				
Totals	354	End of Line Voltage		21.66	1.920				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.920	354	2.34
End of Line Voltage		21.66
Percent Drop		9.74%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS2- Circuit 3V2		
Area Covered	3rd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.212	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	80	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
3V201	80	23.40	0.595	2.48%	0.094	System Sensor	SCR	ST	30
3V202	10	23.34	0.664	2.77%	0.228	System Sensor	SCRH	ST	135
3V203	40	23.12	0.883	3.68%	0.158	System Sensor	SCR	ST	75
3V204	50	22.89	1.107	4.61%	0.094	System Sensor	SCR	ST	30
3V205	32	22.77	1.233	5.14%	0.094	System Sensor	SCR	ST	30
3V206	65	22.55	1.450	6.04%	0.158	System Sensor	SCR	ST	75
3V207	8	22.53	1.469	6.12%	0.066	System Sensor	SCR	ST	15
3V208	20	22.49	1.508	6.28%	0.066	System Sensor	SCR	ST	15
3V209	40	22.43	1.570	6.54%	0.066	System Sensor	SCR	ST	15
3V210	75	22.34	1.657	6.90%	0.094	System Sensor	SCR	ST	30
3V211	65	22.31	1.694	7.06%	0.094	System Sensor	SCR	ST	30
END		22.31	1.694	7.06%					
END		22.31	1.694	7.06%	0.000				
Totals	485	End of Line Voltage		22.31	1.212				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.212	485	1.69
End of Line Voltage		22.31
Percent Drop		7.06%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS1- Circuit 2V1		
Area Covered	2nd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.042	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	20	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V101	20	23.87	0.128	0.53%	0.094	System Sensor	SCR	ST	30
2V102	20	23.76	0.244	1.02%	0.094	System Sensor	SCR	ST	30
2V103	45	23.52	0.480	2.00%	0.094	System Sensor	SCR	ST	30
2V104	12	23.46	0.536	2.23%	0.094	System Sensor	SCR	ST	30
2V105	12	23.41	0.585	2.44%	0.066	System Sensor	SCR	ST	15
2V106	25	23.32	0.677	2.82%	0.158	System Sensor	SCR	ST	75
2V107	20	23.27	0.732	3.05%	0.094	System Sensor	SCR	ST	30
2V108	5	23.26	0.742	3.09%	0.094	System Sensor	SCR	ST	30
2V109	15	23.23	0.766	3.19%	0.066	System Sensor	SCR	ST	15
2V110	15	23.22	0.783	3.26%	0.094	System Sensor	SCR	ST	30
2V111	70	23.18	0.824	3.43%	0.094	System Sensor	SCR	ST	30
END		23.18	0.824	3.43%	0.000				
END		23.18	0.824	3.43%	0.000				
Totals	259	End of Line Voltage		23.18	1.042				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.042	259	0.82
End of Line Voltage		23.18
Percent Drop		3.43%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS1- Circuit 2V2		
Area Covered	2nd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.137	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	35	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V201	35	23.76	0.244	1.02%	0.094	System Sensor	SCR	ST	30
2V202	60	23.37	0.629	2.62%	0.210	System Sensor	SCR	ST	115
2V203	15	23.29	0.705	2.94%	0.094	System Sensor	SCR	ST	30
2V204	40	23.11	0.887	3.70%	0.094	System Sensor	SCR	ST	30
2V205	15	23.05	0.946	3.94%	0.210	System Sensor	SCR	ST	115
2V206	40	22.95	1.053	4.39%	0.181	System Sensor	SCR	ST	95
2V207	33	22.90	1.105	4.60%	0.066	System Sensor	SCR	ST	15
2V208	20	22.87	1.128	4.70%	0.094	System Sensor	SCR	ST	30
2V209	5	22.87	1.130	4.71%	0.094	System Sensor	SCR	ST	30
END		22.87	1.130	4.71%	0.000				
END		22.87	1.130	4.71%	0.000				
END		22.87	1.130	4.71%	0.000				
END		22.87	1.130	4.71%	0.000				
Totals	263	End of Line Voltage		22.87	1.137				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.137	263	1.13
End of Line Voltage		22.87
Percent Drop		4.71%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS1- Circuit 2V3		
Area Covered	2nd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.106	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	22	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V301	22	23.85	0.149	0.62%	0.066	System Sensor	SCR	ST	15
2V302	22	23.71	0.290	1.21%	0.158	System Sensor	SCR	ST	75
2V303	15	23.63	0.371	1.55%	0.210	System Sensor	SCR	ST	115
2V304	55	23.40	0.598	2.49%	0.066	System Sensor	SCR	ST	15
2V305	10	23.36	0.635	2.65%	0.066	System Sensor	SCR	ST	15
2V306	10	23.33	0.668	2.79%	0.066	System Sensor	SCR	ST	15
2V307	10	23.30	0.698	2.91%	0.066	System Sensor	SCR	ST	15
2V308	17	23.26	0.740	3.08%	0.066	System Sensor	SCR	ST	15
2V309	25	23.21	0.793	3.30%	0.066	System Sensor	SCR	ST	15
2V310	30	23.16	0.843	3.51%	0.066	System Sensor	SCR	ST	15
2V311	5	23.15	0.850	3.54%	0.210	System Sensor	SCR	ST	115
END		23.15	0.850	3.54%	0.000				
END		23.15	0.850	3.54%	0.000				
Totals	221	End of Line Voltage		23.15	1.106				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

Totals		Voltage Drop
Current	Distance	
1.106	221	0.85
End of Line Voltage		23.15
Percent Drop		3.54%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Fire Alarm Voltage Drop Calculations

Project Name	Cal Poly Building 52: Computer Math and Science		
Panel / Circuit #	Notifier RNPS, PS1- Circuit 2V4		
Area Covered	2nd Floor East		
Nominal System Voltage	24		
Minimum Device Voltage	20		
Total Circuit Current	1.300	Wire Gauge	Ohm's Per 1000
Distance from source to 1st device	22	14	3.07
Wire Gauge for balance of circuit		14	3.07

Device Number	Distance from previous device	Voltage			Current in amps.	Device Model #		Device Type	Candela Rating
		At Device	Drop from source	Percent Drop					
2V401	22	23.82	0.176	0.73%	0.181	System Sensor	SCR	ST	95
2V402	22	23.67	0.327	1.36%	0.181	System Sensor	SCR	ST	95
2V403	15	23.59	0.413	1.72%	0.094	System Sensor	SCR	ST	30
2V404	55	23.30	0.698	2.91%	0.066	System Sensor	SCR	ST	15
2V405	10	23.25	0.746	3.11%	0.094	System Sensor	SCR	ST	30
2V406	10	23.21	0.788	3.28%	0.066	System Sensor	SCR	ST	15
2V407	10	23.17	0.826	3.44%	0.210	System Sensor	SCR	ST	115
2V408	17	23.13	0.868	3.62%	0.066	System Sensor	SCR	ST	15
2V409	25	23.08	0.921	3.84%	0.210	System Sensor	SCR	ST	115
2V410	30	23.05	0.945	3.94%	0.066	System Sensor	SCR	ST	15
2V411	5	23.05	0.947	3.95%	0.066	System Sensor	SCR	ST	15
END		23.05	0.947	3.95%	0.000				
END		23.05	0.947	3.95%	0.000				
Totals	221	End of Line Voltage		23.05	1.300				

Point to Point Method

CIRCUIT IS WITHIN LIMITS

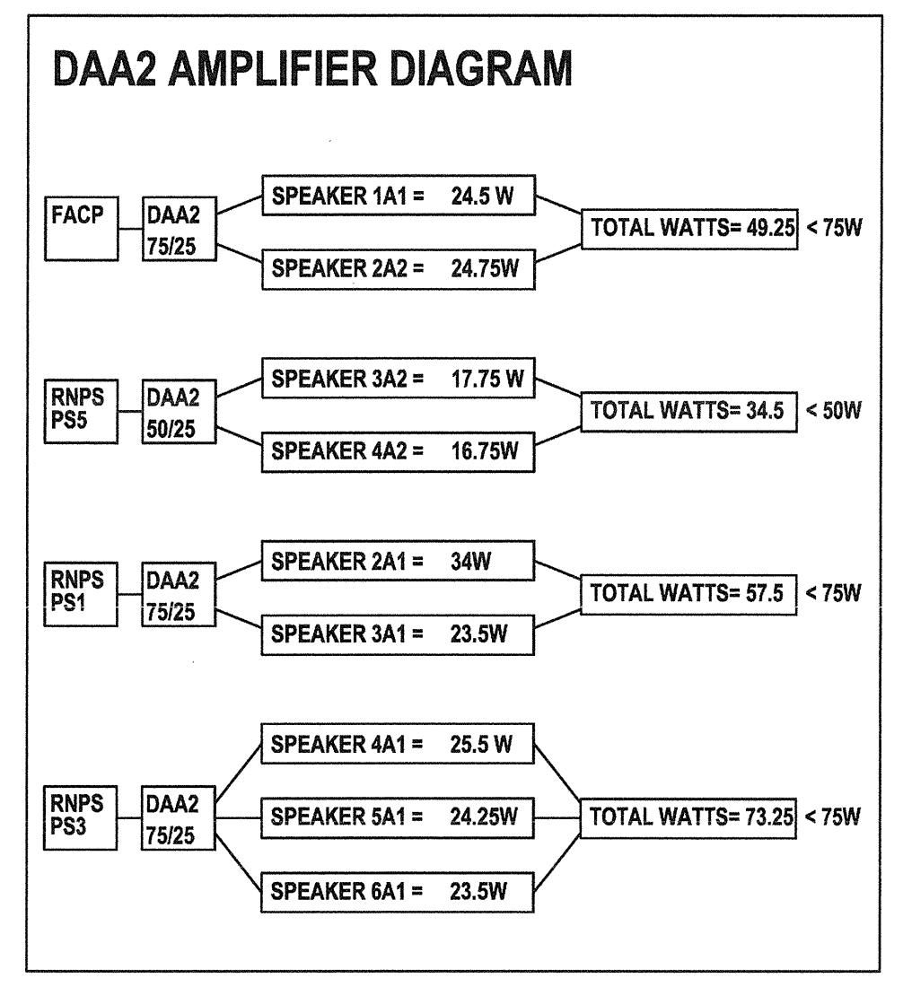
Totals		Voltage Drop
Current	Distance	
1.300	221	0.95
End of Line Voltage		23.05
Percent Drop		3.95%

Standard Wire Resistance in Ohms per 1000 feet.
18=7.77 16=4.89 14=3.07 12=1.98 10=1.24
18-14 Awg = Solid Conductors 12-10 Awg = Stranded Conductors

Notes:
Wire resistance is doubled in the calculations for two wires (Positive and Negative)
The voltage calculated to the last device must not be lower than
the manufactures listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

VOLTAGE DROP CALCULATIONS

EAST



SPEAKER CALCULATIONS

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	FACP Notifier NFS-640	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
FACP	Fire Alarm Control Unit	0.2850	X	1	=	0.2850	0.2850	X	1	=	0.2850
UDACT	Universal Dialer	0.0400	X	1	=	0.0400	0.1000	X	1	=	0.1000
FDU-80	Remote Annunciator	0.0643	X	2	=	0.1286	0.0643	X	2	=	0.1286
APS-6	Power Supply Amp	0.0000	X	1	=	0.0000	0.0250	X	1	=	0.0250
OSE-SPV	Beam Smoke Emitter	0.0035	X	10	=	0.0350	0.0035	X	10	=	0.0350
OSI-90	Beam Smoke Imager	0.0310	X	10	=	0.3100	0.0310	X	10	=	0.3100
PULL	Manual Pull (addressable)	0.0004	X	29	=	0.0116	0.0004	X	29	=	0.0116
FRM-1	Relay Module	0.0017	X	9	=	0.0153	0.0022	X	9	=	0.0198
FSP-851	Smoke Detector	0.0003	X	16	=	0.0048	0.0003	X	16	=	0.0048
FDM-1	Dual Monitor Module	0.0008	X	18	=	0.0144	0.0064	X	18	=	0.1152
SPK	Speaker Only	0.0000	X	3	=	0.0000	0.0008	X	3	=	0.0024
SR	Strobe Only 15CD	0.0000	X	7	=	0.0000	0.0660	X	7	=	0.4620
SR	Strobe Only 30CD	0.0000	X	6	=	0.0000	0.0940	X	6	=	0.5640
SR	Strobe Only 75CD	0.0000	X	2	=	0.0000	0.1580	X	2	=	0.3160
FTM-1	Fire Fighter Phone Jack	0.0075	X	12	=	0.0900	0.0075	X	12	=	0.0900
XP6-R	Six Relay Control Module	0.0015	X	1	=	0.0015	0.0320	X	1	=	0.0320
XP10-M	10-Input Monitor Module	0.0035	X	1	=	0.0035	0.0550	X	1	=	0.0550
SPSR	Speaker Strobes 15CD	0.0000	X	3	=	0.0000	0.0710	X	3	=	0.2130
SPSR	Speaker Strobes 30CD	0.0000	X	14	=	0.0000	0.0960	X	14	=	1.3440
SPSR	Speaker Strobes 75CD	0.0000	X	14	=	0.0000	0.1530	X	14	=	2.1420
SPSR	Speaker Strobes 95CD	0.0000	X	3	=	0.0000	0.1760	X	3	=	0.5280
SPSR	Speaker Strobes 115CD	0.0000	X	16	=	0.0000	0.2050	X	16	=	3.2800
FST-851	Heat Detector (addressable)	0.0004	X	4	=	0.0016	0.0004	X	4	=	0.0016
FMM-1	Monitor Module	0.0037	X	19	=	0.0703	0.0037	X	19	=	0.0703
FDRM-1	Dual Relay/Monitor Module	0.0013	X	64	=	0.0832	0.0240	X	64	=	1.5360
DNR	Duct Smoke Detectors	0.0003	X	64	=	0.0192	0.0003	X	64	=	0.0192
TOTAL SYSTEM STANDBY CURRENT (AMPS)						1.1140	TOTAL SYSTEM ALARM CURRENT (AMPS)				11.6905

REQUIRED STANDBY TIME (HRS)		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS)		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	1.1140	=	26.7348	0.250	X	11.6905	=	2.9226

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
26.73	+	2.9226	=	29.6574	29.6574	+	20%	=	35.6

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	RNPS 3- 5TH FLOOR EAST	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
RNPS	Remote Power Supply	0.1300	X	1	=	0.1300	0.1300	X	1	=	0.1300
SPK	Speaker Only	0.0000	X	1	=	0.0000	0.0008	X	1	=	0.0008
SR	Strobe Only 15CD	0.0000	X	15	=	0.0000	0.0660	X	15	=	0.9900
SR	Strobe Only 30CD	0.0000	X	6	=	0.0000	0.0940	X	6	=	0.5640
SR	Strobe Only 75CD	0.0000	X	1	=	0.0000	0.1580	X	1	=	0.1580
SR	Strobe Only 95CD	0.0000	X	5	=	0.0000	0.1810	X	1	=	0.1810
SR	Strobe Only 110CD	0.0000	X	6	=	0.0000	0.2020	X	6	=	1.2120
SR	Strobe Only 115CD	0.0000	X	1	=	0.0000	0.2100	X	1	=	0.2100
SRH	Strobe Only 135CD	0.0000	X	0	=	0.0000	0.2280	X	0	=	0.0000
TOTAL SYSTEM STANDBY CURRENT (AMPS)						0.1300	TOTAL SYSTEM ALARM CURRENT (AMPS)				3.4458

REQUIRED STANDBY TIME (HRS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	0.1300	=	3.1200	0.250	X	3.4458	=	0.8615

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
3.12	+	0.8615	=	3.9815	3.9815	+	20%	=	4.8

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	RNPS 1- 2ND FLOOR EAST	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
RNPS	Remote Power Supply	0.1300	X	1	=	0.1300	0.1300	X	1	=	0.1300
SPK	Speaker Only	0.0000	X	0	=	0.0000	0.0008	X	0	=	0.0000
SR	Strobe Only 15CD	0.0000	X	16	=	0.0000	0.0660	X	16	=	1.0560
SR	Strobe Only 30CD	0.0000	X	16	=	0.0000	0.0940	X	16	=	1.5040
SR	Strobe Only 75CD	0.0000	X	2	=	0.0000	0.1580	X	2	=	0.3160
SR	Strobe Only 95CD	0.0000	X	3	=	0.0000	0.1810	X	1	=	0.1810
SR	Strobe Only 115CD	0.0000	X	6	=	0.0000	0.2100	X	6	=	1.2600
TOTAL SYSTEM STANDBY CURRENT (AMPS)						0.1300	TOTAL SYSTEM ALARM CURRENT (AMPS)				4.4470

REQUIRED STANDBY TIME (HRS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	0.1300	=	3.1200	0.250	X	4.4470	=	1.1118

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
3.12	+	1.1118	=	4.2318	4.2318	+	20%	=	5.1

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	RNPS 4- 6TH FLOOR EAST	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
RNPS	Remote Power Supply	0.1300	X	1	=	0.1300	0.1300	X	1	=	0.1300
SPK	Speaker Only	0.0000	X	1	=	0.0000	0.0008	X	1	=	0.0008
SR	Strobe Only 15CD	0.0000	X	12	=	0.0000	0.0660	X	12	=	0.7920
SR	Strobe Only 30CD	0.0000	X	6	=	0.0000	0.0940	X	6	=	0.5640
SR	Strobe Only 75CD	0.0000	X	2	=	0.0000	0.1580	X	2	=	0.3160
SR	Strobe Only 95CD	0.0000	X	3	=	0.0000	0.1810	X	1	=	0.1810
SR	Strobe Only 110CD	0.0000	X	4	=	0.0000	0.2020	X	4	=	0.8080
SR	Strobe Only 115CD	0.0000	X	2	=	0.0000	0.2100	X	2	=	0.4200
SRH	Strobe Only 135CD	0.0000	X	0	=	0.0000	0.2280	X	0	=	0.0000
TOTAL SYSTEM STANDBY CURRENT (AMPS)						0.1300	TOTAL SYSTEM ALARM CURRENT (AMPS)				3.2118

REQUIRED STANDBY TIME (HRS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	0.1300	=	3.1200	0.250	X	3.2118	=	0.8030

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
3.12	+	0.8030	=	3.9230	3.9230	+	20%	=	4.7

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	RNPS 2- 3RD & 4TH FLOOR EAST	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
RNPS	Remote Power Supply	0.1300	X	1	=	0.1300	0.1300	X	1	=	0.1300
SPK	Speaker Only	0.0000	X	1	=	0.0000	0.0008	X	1	=	0.0008
SR	Strobe Only 15CD	0.0000	X	4	=	0.0000	0.0660	X	4	=	0.2640
SR	Strobe Only 30CD	0.0000	X	12	=	0.0000	0.0940	X	12	=	1.1280
SR	Strobe Only 75CD	0.0000	X	9	=	0.0000	0.1580	X	9	=	1.4220
SR	Strobe Only 95CD	0.0000	X	0	=	0.0000	0.1810	X	1	=	0.1810
SR	Strobe Only 110CD	0.0000	X	2	=	0.0000	0.2020	X	2	=	0.4040
SR	Strobe Only 115CD	0.0000	X	5	=	0.0000	0.2100	X	5	=	1.0500
SRH	Strobe Only 135CD	0.0000	X	5	=	0.0000	0.2280	X	5	=	1.1400
TOTAL SYSTEM STANDBY CURRENT (AMPS)						0.1300	TOTAL SYSTEM ALARM CURRENT (AMPS)				5.7198

REQUIRED STANDBY TIME (HRS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	0.1300	=	3.1200	0.250	X	5.7198	=	1.4300

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
3.12	+	1.4300	=	4.5500	4.5500	+	20%	=	5.5

Fire Alarm Control Panel Battery Calculation

Battery Calculations for:	RNPS 5- 4TH FLOOR WEST	Project:	Cal Poly Building 52

ITEM	DESCRIPTION	STANDBY CURRENT PER UNIT (AMPS)		QTY		TOTAL STANDBY CURRENT PER ITEM	ALARM CURRENT PER UNIT (AMPS)		QTY		TOTAL ALARM CURRENT PER ITEM
RNPS	Remote Power Supply	0.1300	X	1	=	0.1300	0.1300	X	1	=	0.1300
SPK	Speaker Only	0.0000	X	1	=	0.0000	0.0008	X	1	=	0.0008
SR	Strobe Only 15CD	0.0000	X	5	=	0.0000	0.0660	X	5	=	0.3300
SR	Strobe Only 30CD	0.0000	X	16	=	0.0000	0.0940	X	16	=	1.5040
SR	Strobe Only 75CD	0.0000	X	8	=	0.0000	0.1580	X	8	=	1.2640
SR	Strobe Only 95CD	0.0000	X	4	=	0.0000	0.1810	X	1	=	0.1810
SR	Strobe Only 110CD	0.0000	X	0	=	0.0000	0.2020	X	0	=	0.0000
SR	Strobe Only 115CD	0.0000	X	5	=	0.0000	0.2100	X	5	=	1.0500
SRH	Strobe Only 135CD	0.0000	X	0	=	0.0000	0.2280	X	0	=	0.0000
TOTAL SYSTEM STANDBY CURRENT (AMPS)						0.1300	TOTAL SYSTEM ALARM CURRENT (AMPS)				4.4598

REQUIRED STANDBY TIME (HRS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM STANDBY CURRENT (AMPS)		REQUIRED STANDBY CAPACITY (AMP-HOURS)	REQUIRED ALARM TIME (HOURS) UFC 4-021-01 & UFC3-600-10N		TOTAL SYSTEM ALARM CURRENT (AMPS)		REQUIRED ALARM CAPACITY (AMP-HOURS)
24	X	0.1300	=	3.1200	0.250	X	4.4598	=	1.1150

REQUIRED STANDBY CAPACITY (AMP-HOURS)		REQUIRED ALARM CAPACITY (AMP-HOURS)		TOTAL CAPACITY (AMP-HOURS)	TOTAL CAPACITY (AMP-HOURS)		SAFETY FACTOR (%)		ADJUSTED BATTERY CAPACITY (AMP-HOURS)
3.12	+	1.1150	=	4.2350	4.2350	+	20%	=	5.1

BATTERY CALCULATIONS

DRAWING INDEX

1	COVER SHEET	FA 0.0
2	RISER DIAGRAM	FA 1.0
3	FIRST FLOOR WEST	FA 3.01W
4	SECOND FLOOR EAST	FA 3.02E
5	SECOND FLOOR WEST	FA 3.02W
6	THIRD FLOOR EAST	FA 3.03E
7	THIRD FLOOR WEST	FA 3.03W
8	FOURTH FLOOR EAST	FA 3.04E
9	FOURTH FLOOR WEST	FA 3.04W
10	FIFTH FLOOR EAST	FA 3.05E
11	FIFTH FLOOR WEST	FA 3.05W
12	SIXTH FLOOR EAST	FA 3.06E
13	SEVENTH FLOOR EAST	FA 3.07E
14	CALCULATIONS	FA 4.0
15	DETAILS	FA 5.0

CALCULATIONS

Deep Blue Integration

Consulting - Design - Installation
Service - Monitoring

Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

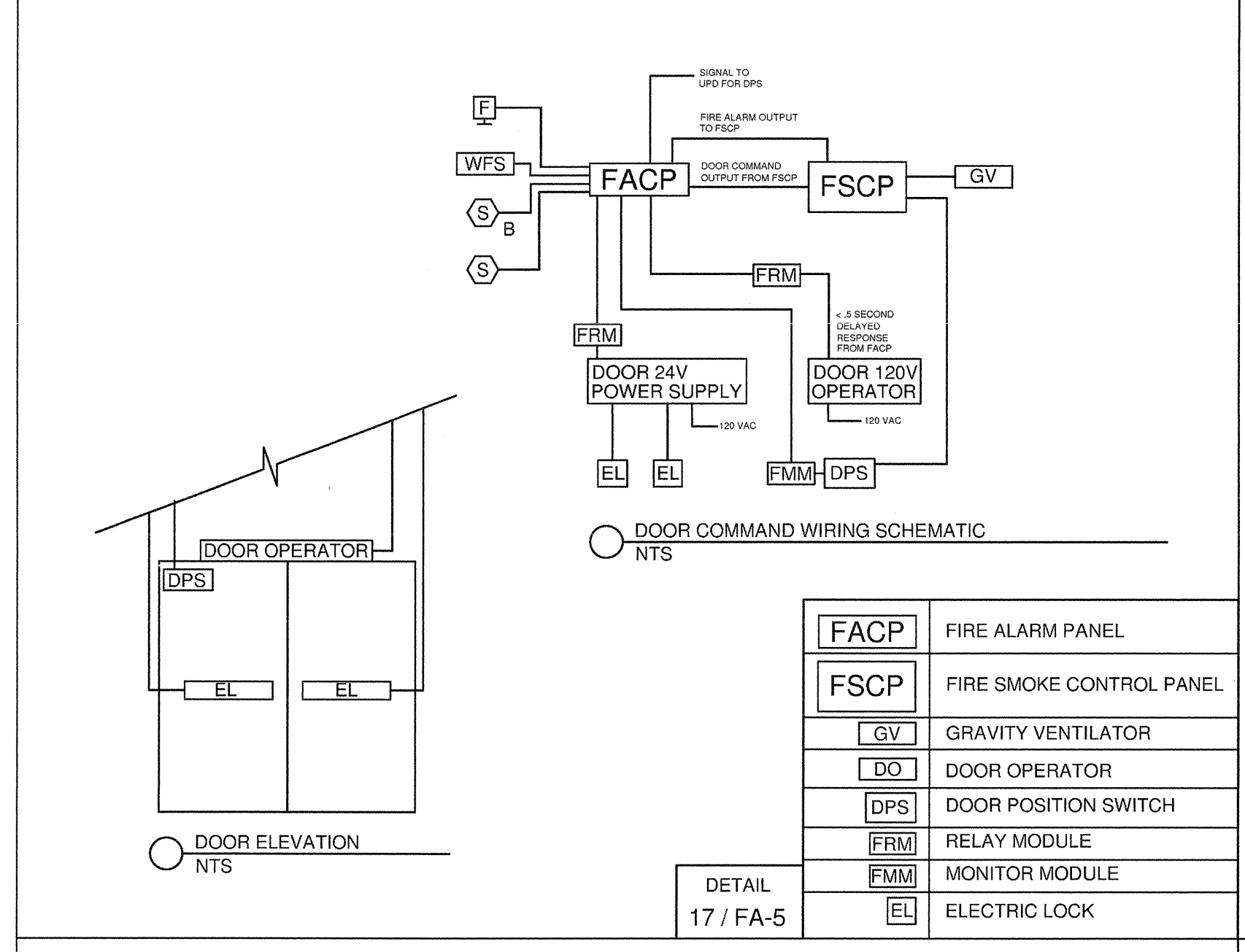
Revisions

SYMBOL	DESCRIPTION	DATE	APPR.
1	REVIEW COMMENTS	6/14/2011	
2	CRB # 093.1 & FI 99	5/18/2012 4/11/2012	
3	SFM REVIEW COMMENTS	8/20/2012	
4	CRB 93.2	1/15/2013	
5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY: Curtis Streeter
DATE: 08/23/2013
DRAWN BY: Derek Richardson
SCALE:
CHECKED BY: CURTIS STREETER, SET NICET IV #102672
DRAWING CODE: FA ALL DRAWINGS CPCFS
PROJECT ENGINEER: Integral Design Associates INC.

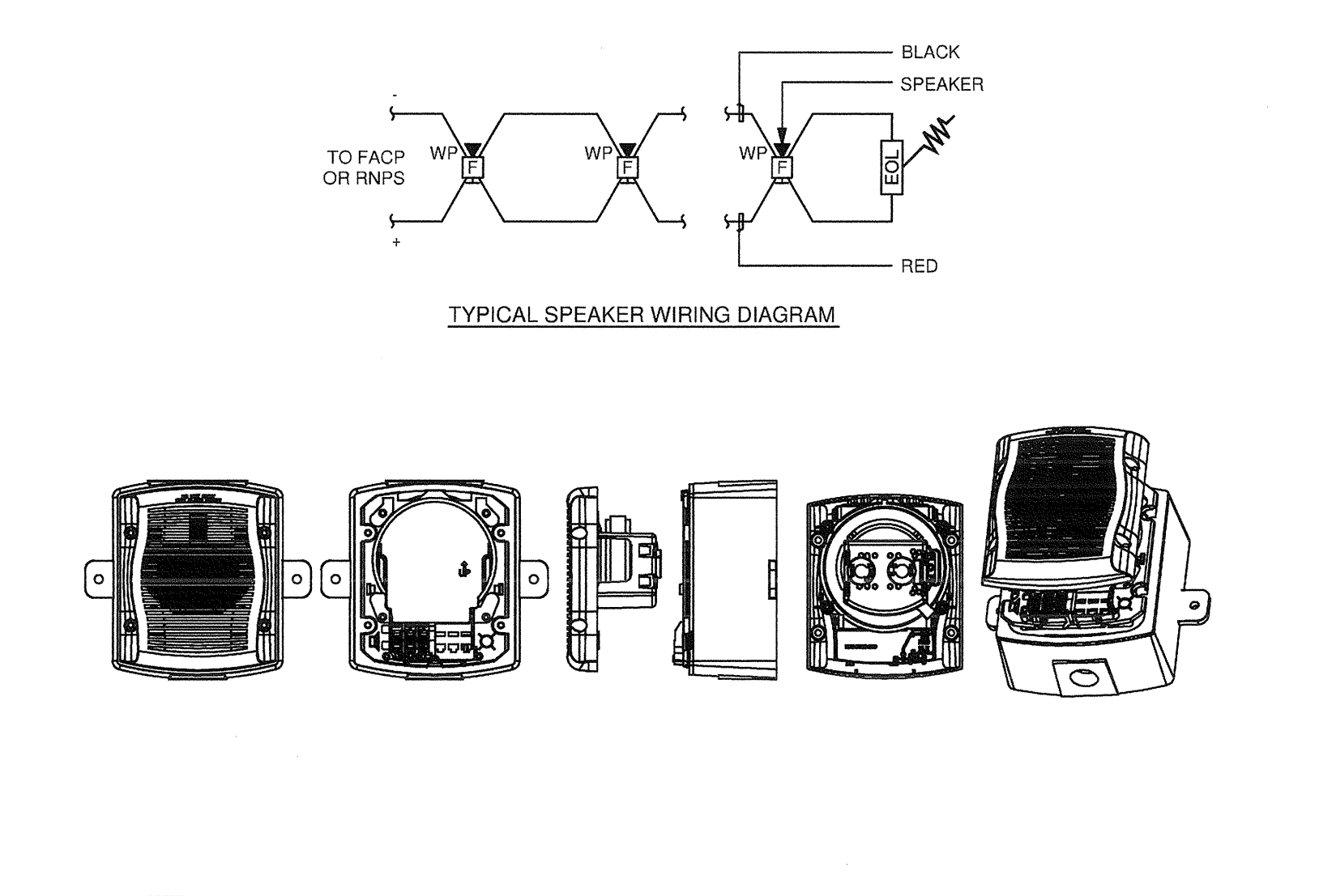
CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID
FA 4.0
SHEET 14 OF 15

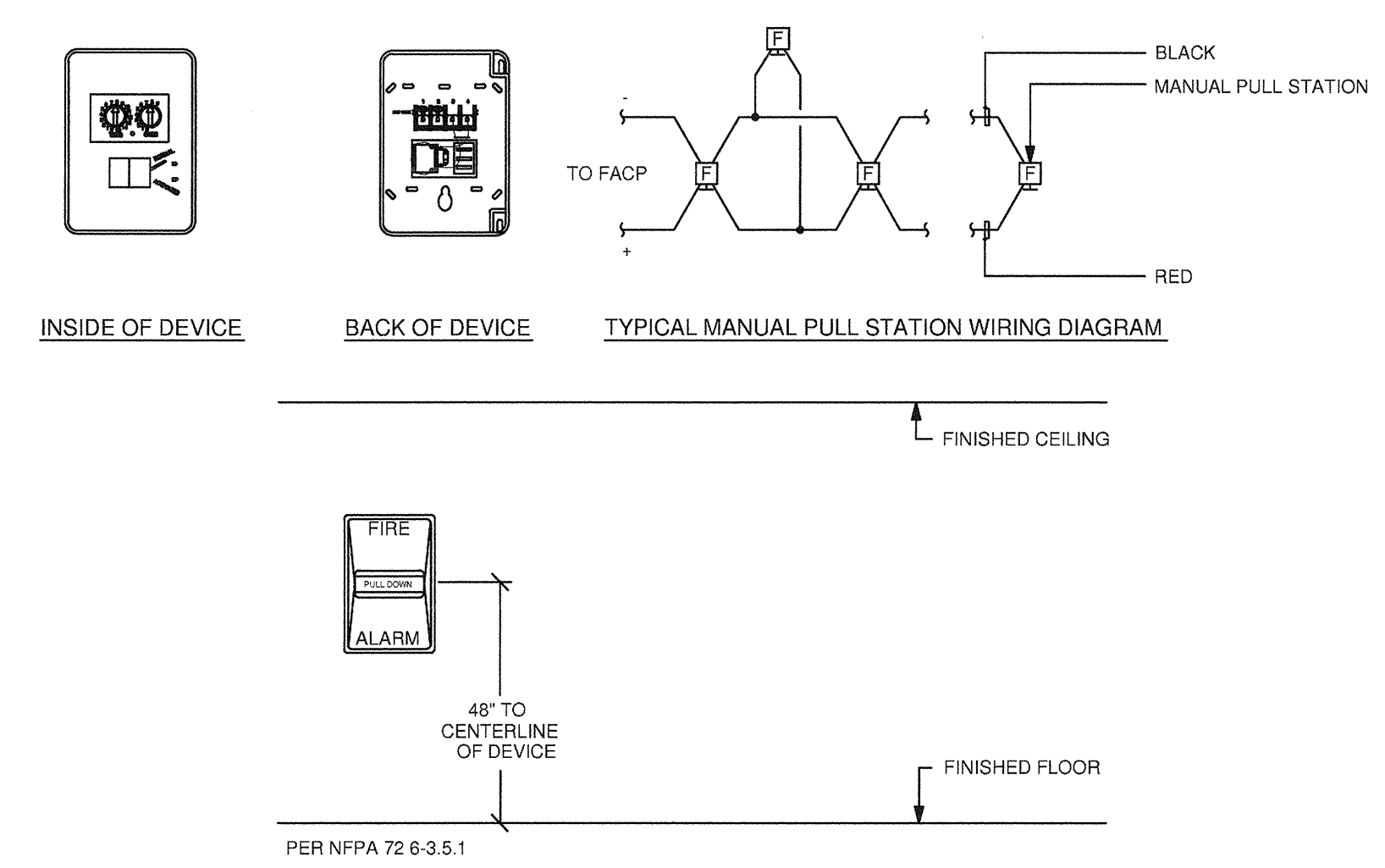


FACP	FIRE ALARM PANEL
FSCP	FIRE SMOKE CONTROL PANEL
GV	GRAVITY VENTILATOR
DO	DOOR OPERATOR
DPS	DOOR POSITION SWITCH
FRM	RELAY MODULE
FMM	MONITOR MODULE
EL	ELECTRIC LOCK

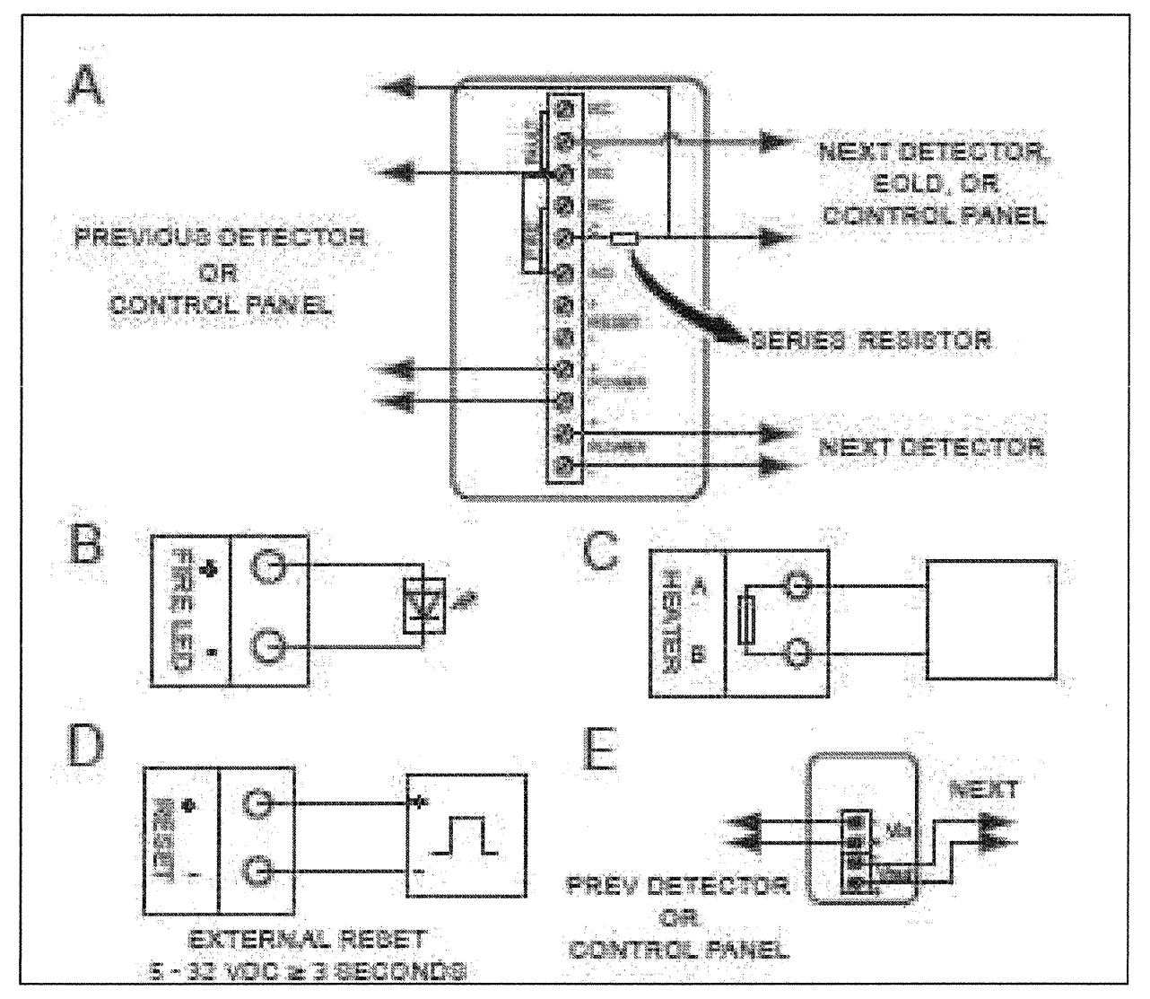
DETAIL 17 / FA-5



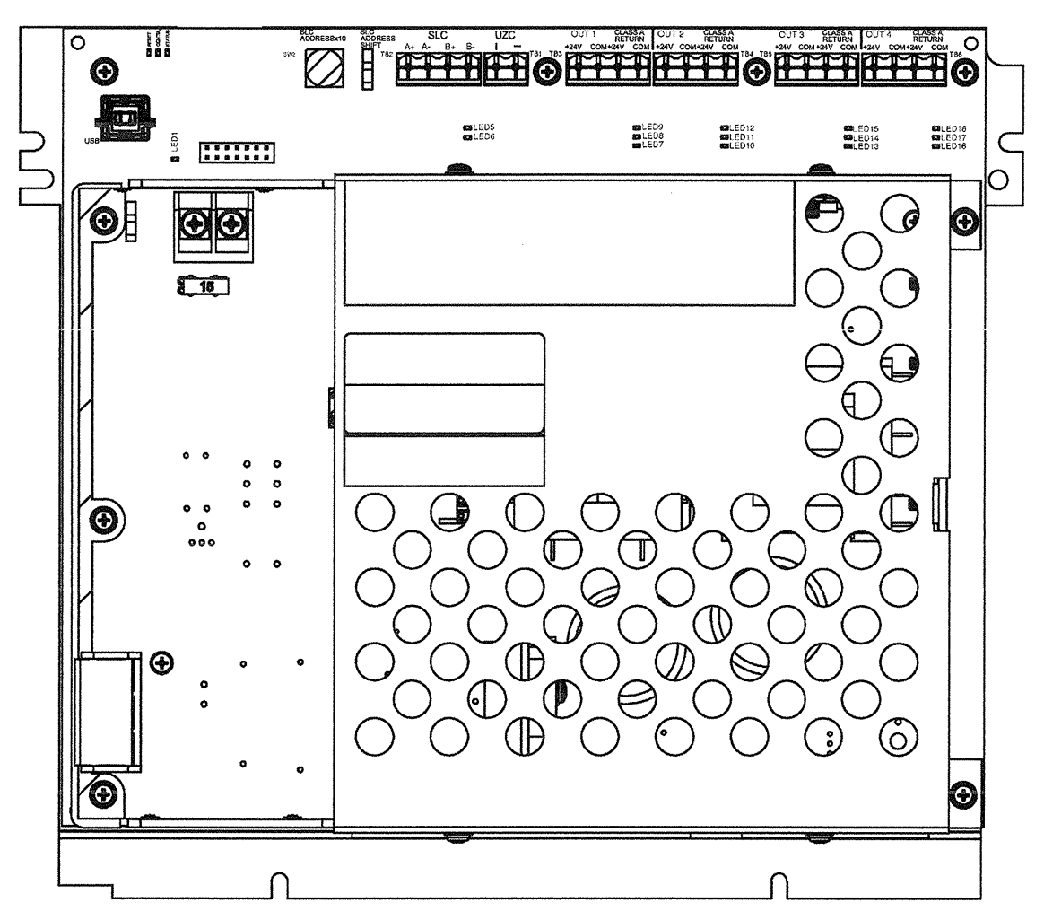
WP F 13 **WALL SPEAKER OUTDOOR**
SCALE 1:2



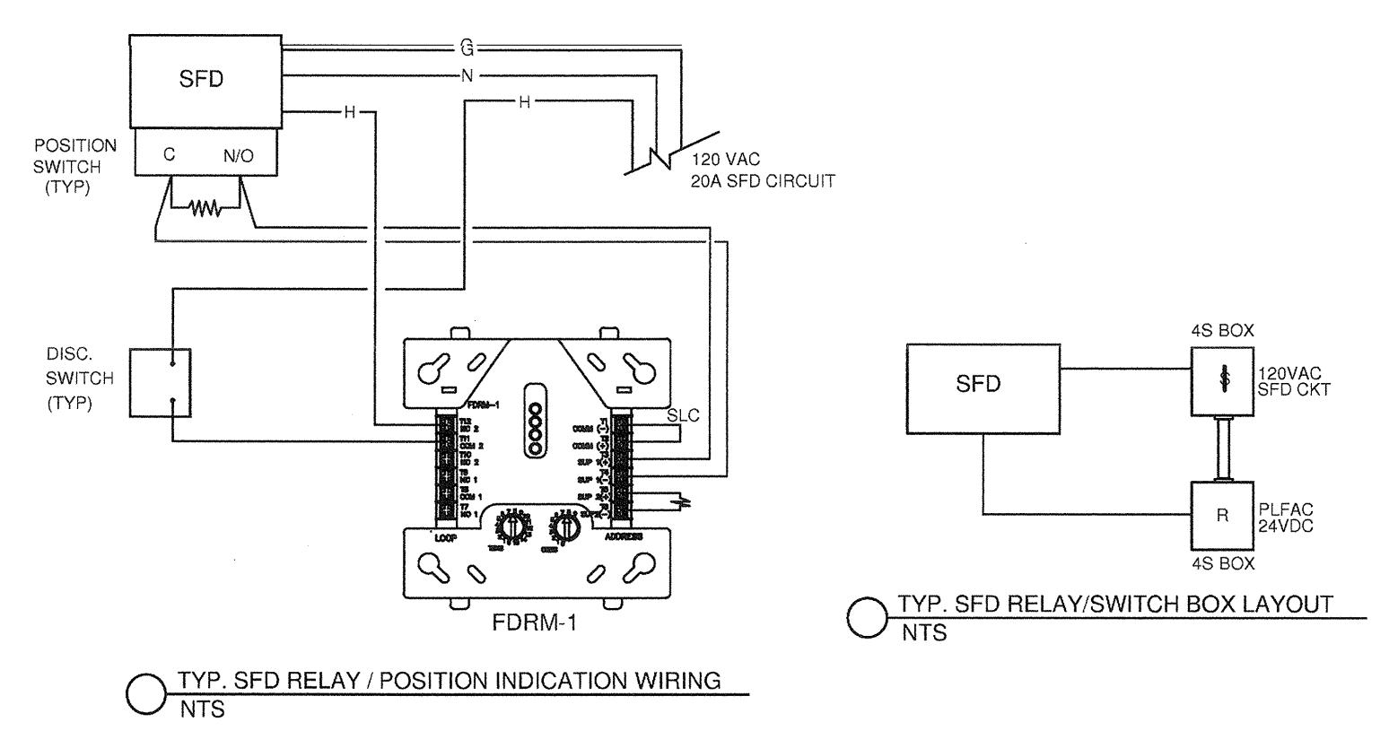
F 9 **ADDRESSABLE MANUAL PULL STATION INSTALLATION**
NOT TO SCALE



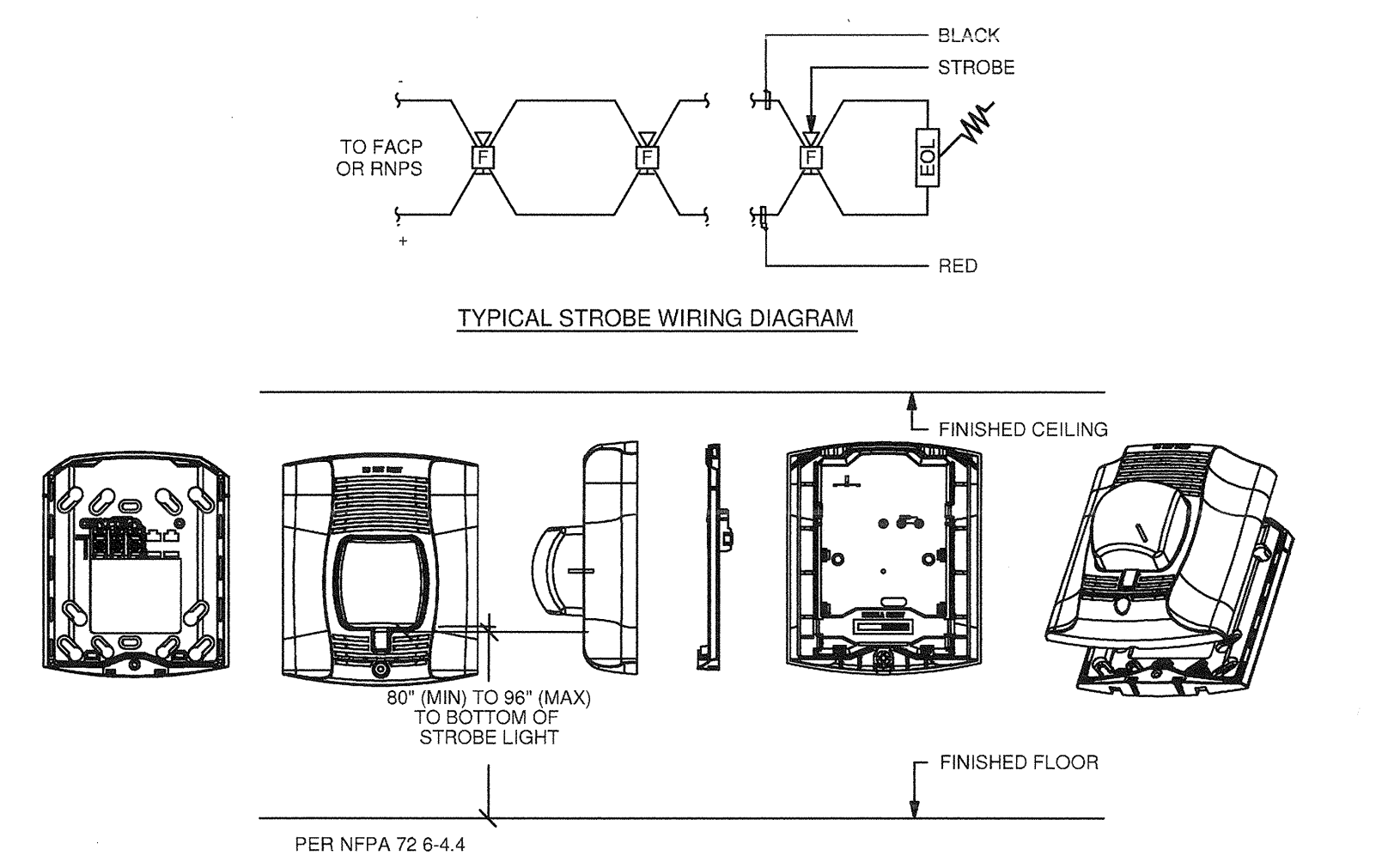
5 **BEAM SMOKE DETECTOR WIRING**
NOT TO SCALE



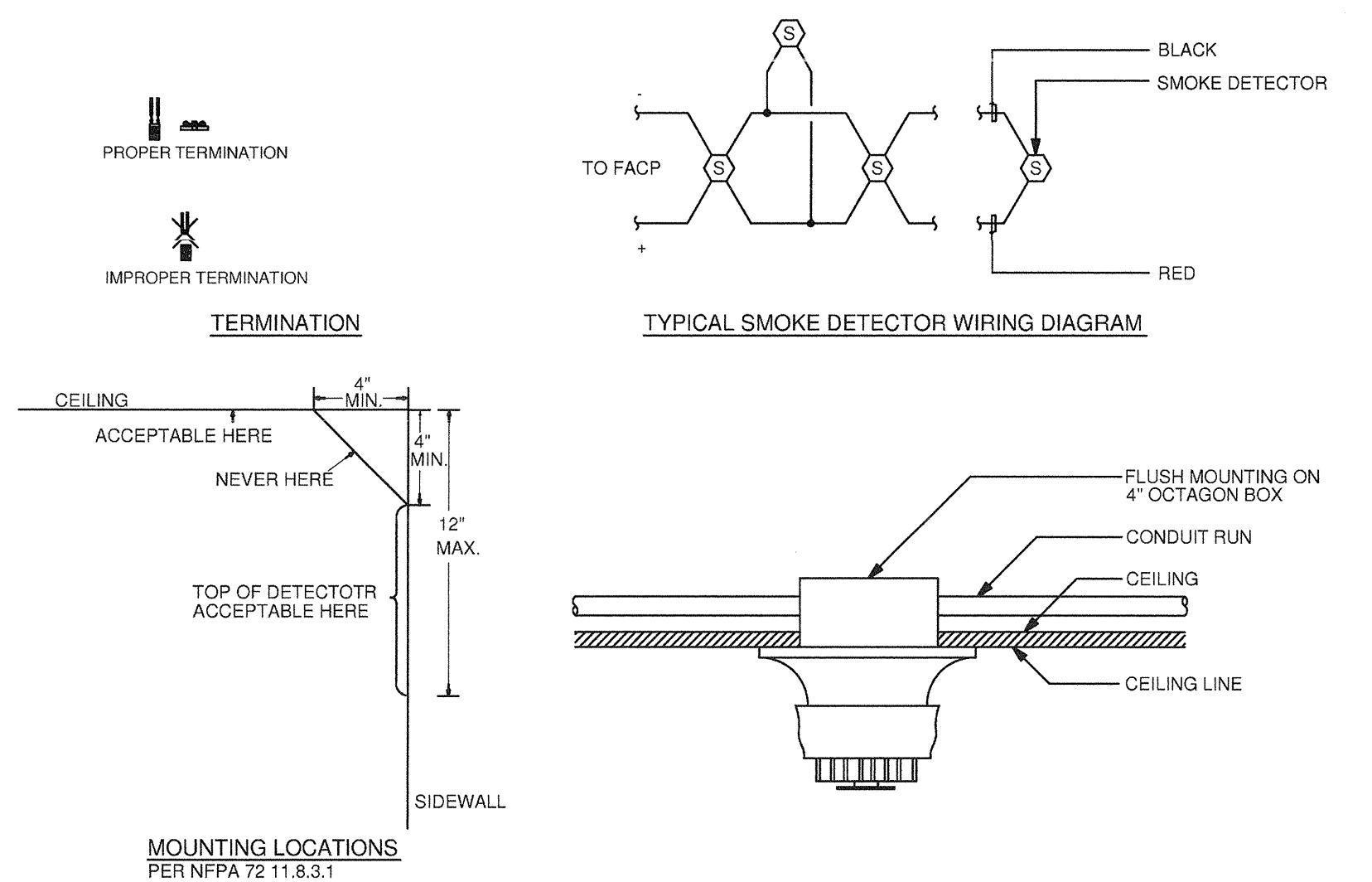
RNPS 0 **ACPS-610 POWER SUPPLY**
NOT TO SCALE



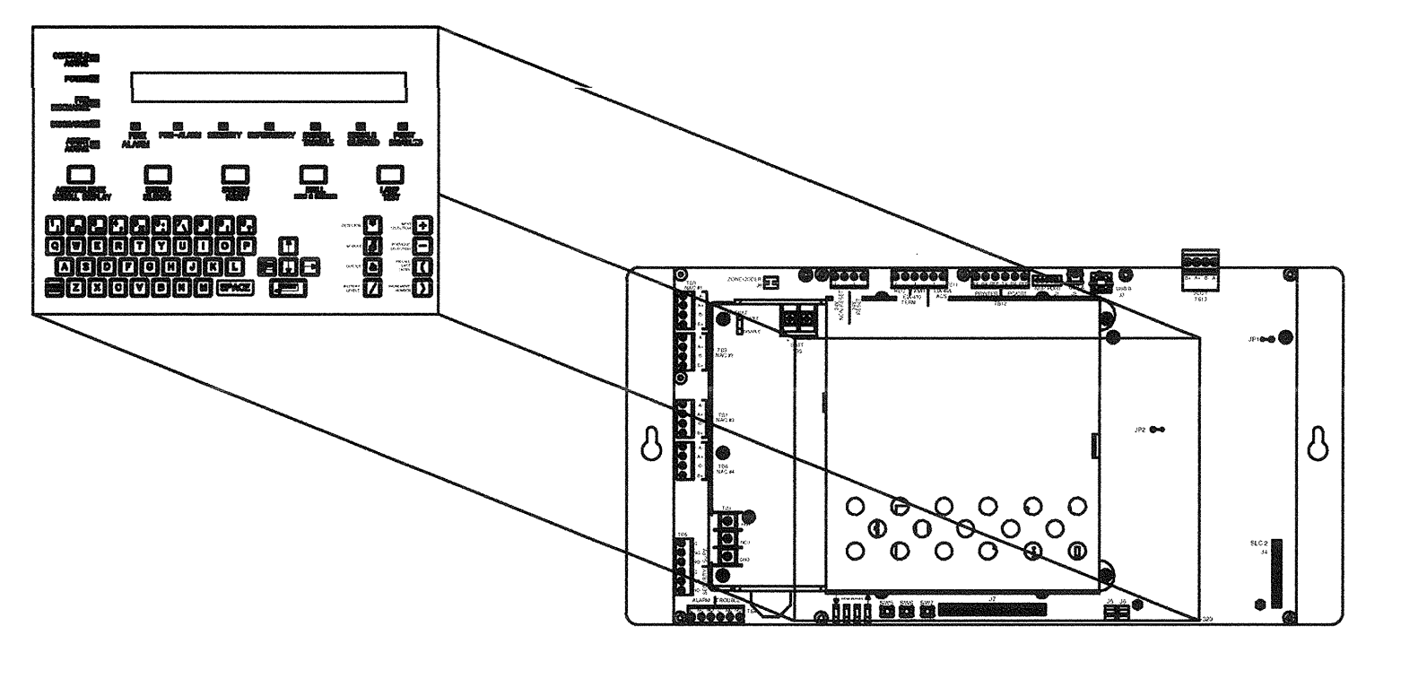
DETAIL	CAL POLY CENTER FOR SCIENCE BLDG 52
18 / FA-5	SMOKE FIRE DAMPER RELAY DETAIL



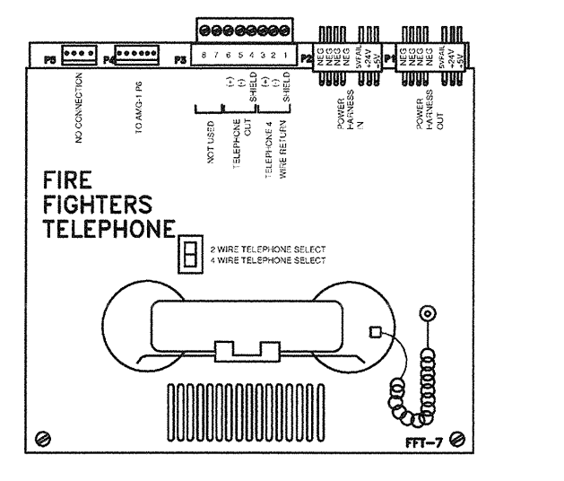
F 14 **WALL STROBE INSTALLATION**
NOT TO SCALE



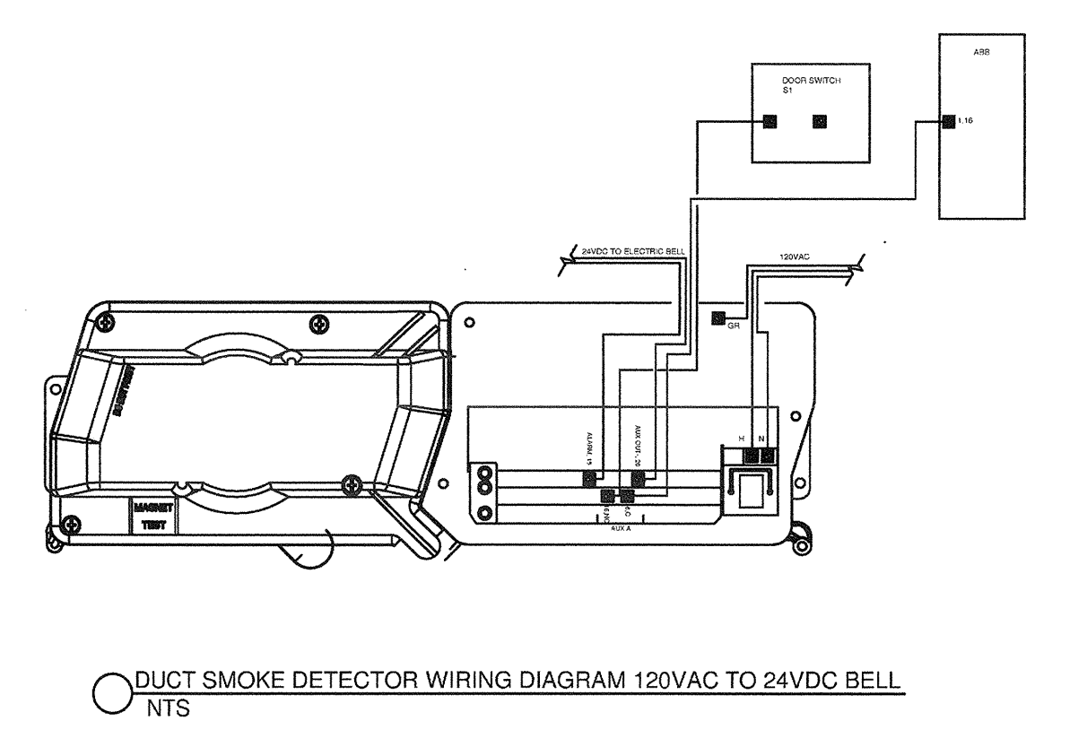
S 10 **ADDRESSABLE SMOKE DETECTOR INSTALLATION**
NOT TO SCALE



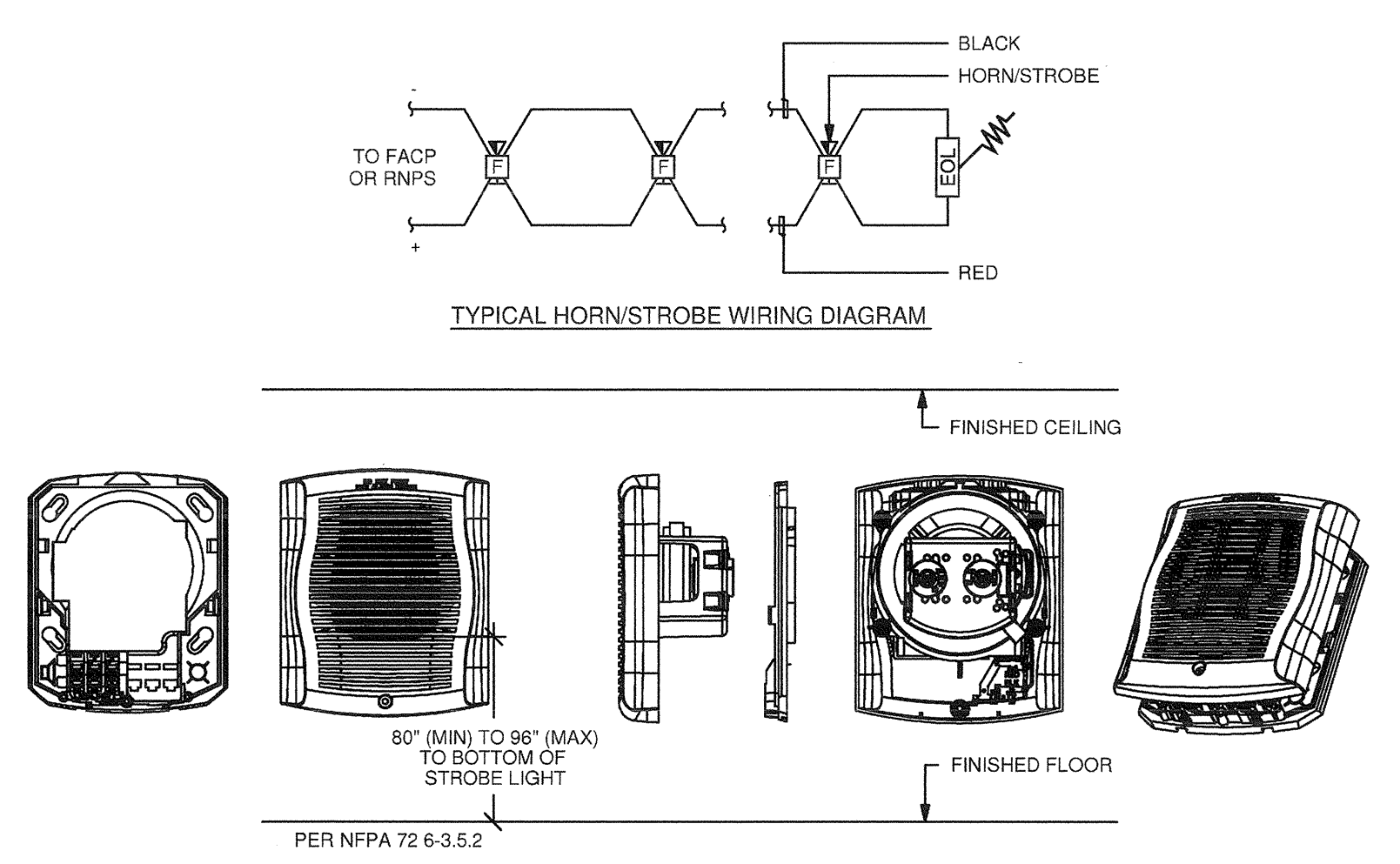
6 **NFS2-640 PANEL**
NOT TO SCALE



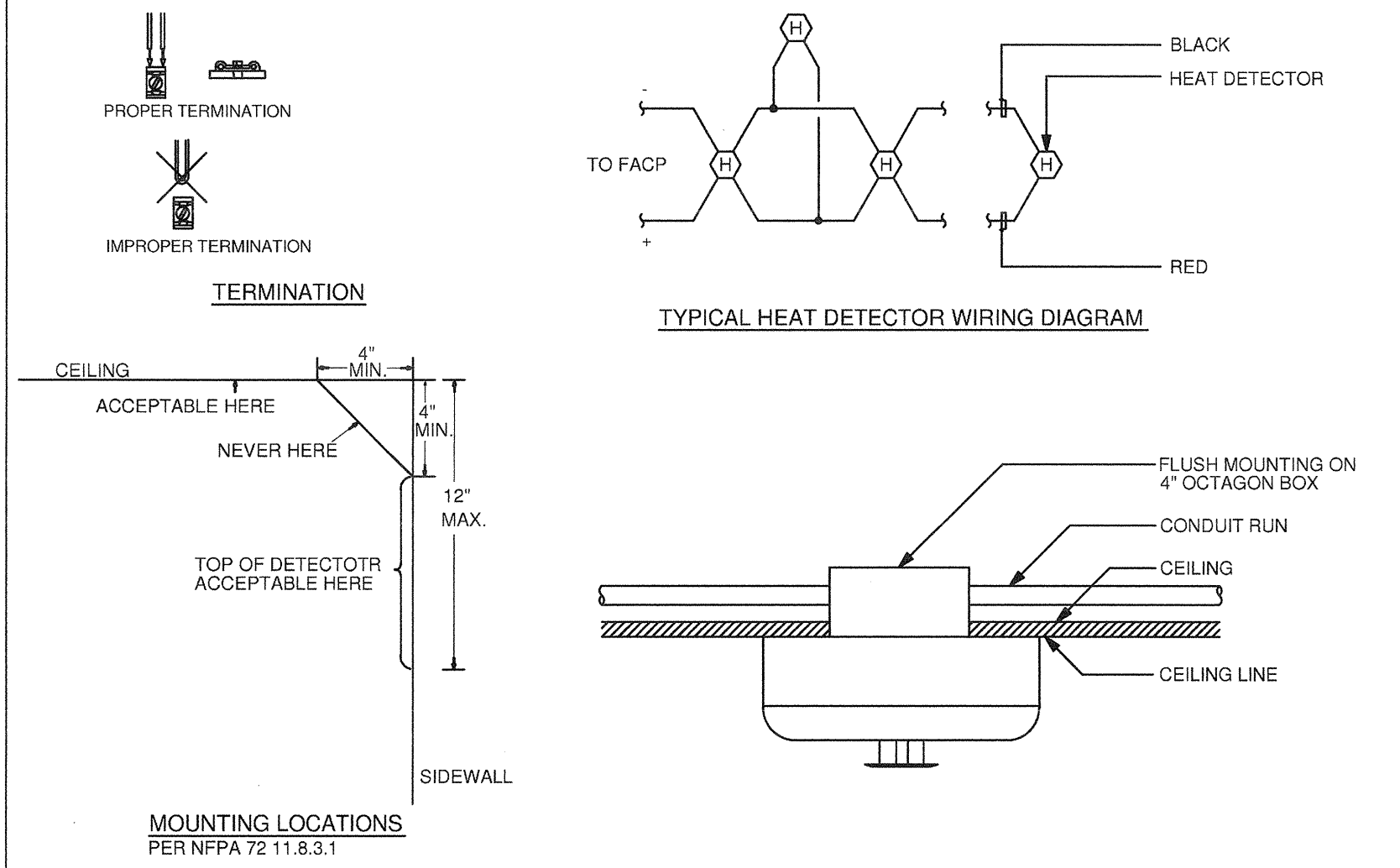
FJ 2 **FFT-7 FIRE FIGHTER TELEPHONE**
NOT TO SCALE



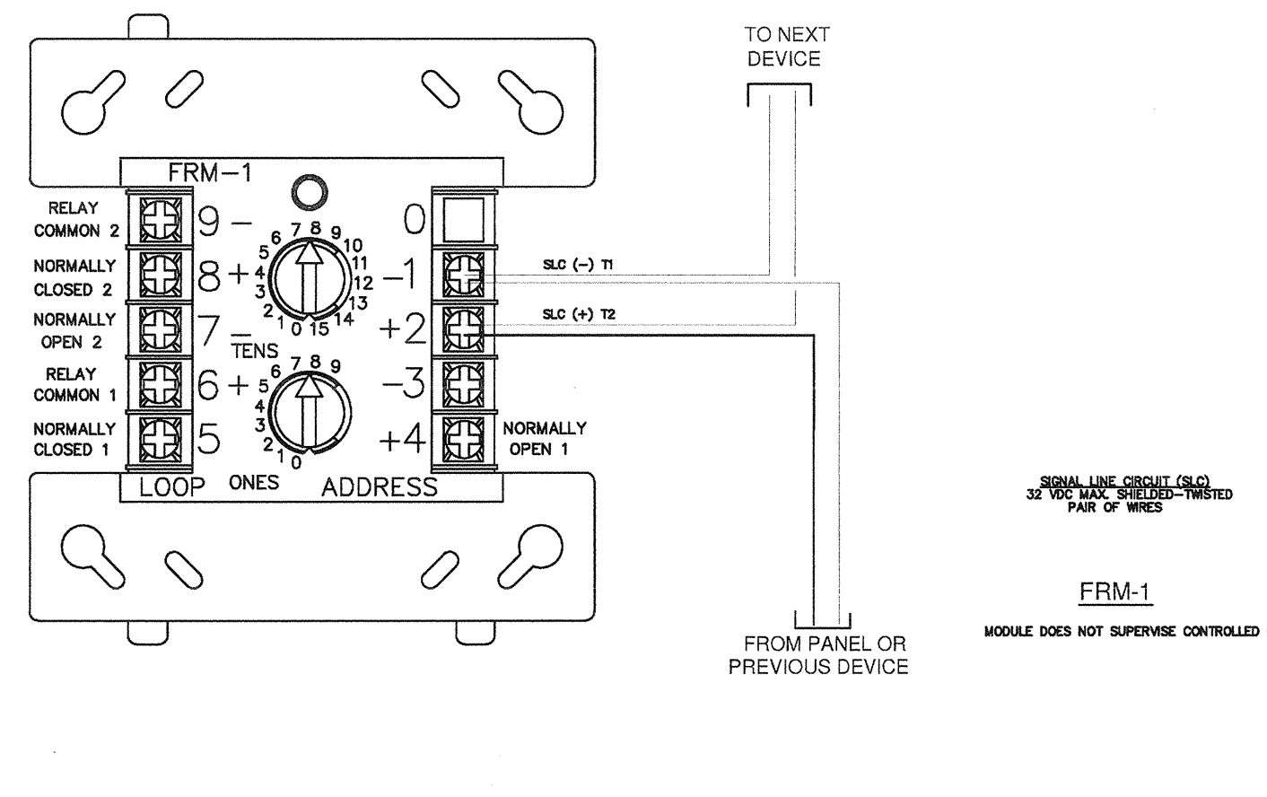
DETAIL	REF.	CAL POLY CENTER FOR SCIENCE BLDG 52
19 / FA-5	CWA 465	HVAC UNIT TEMP. DUCT DETECTOR SHUNT



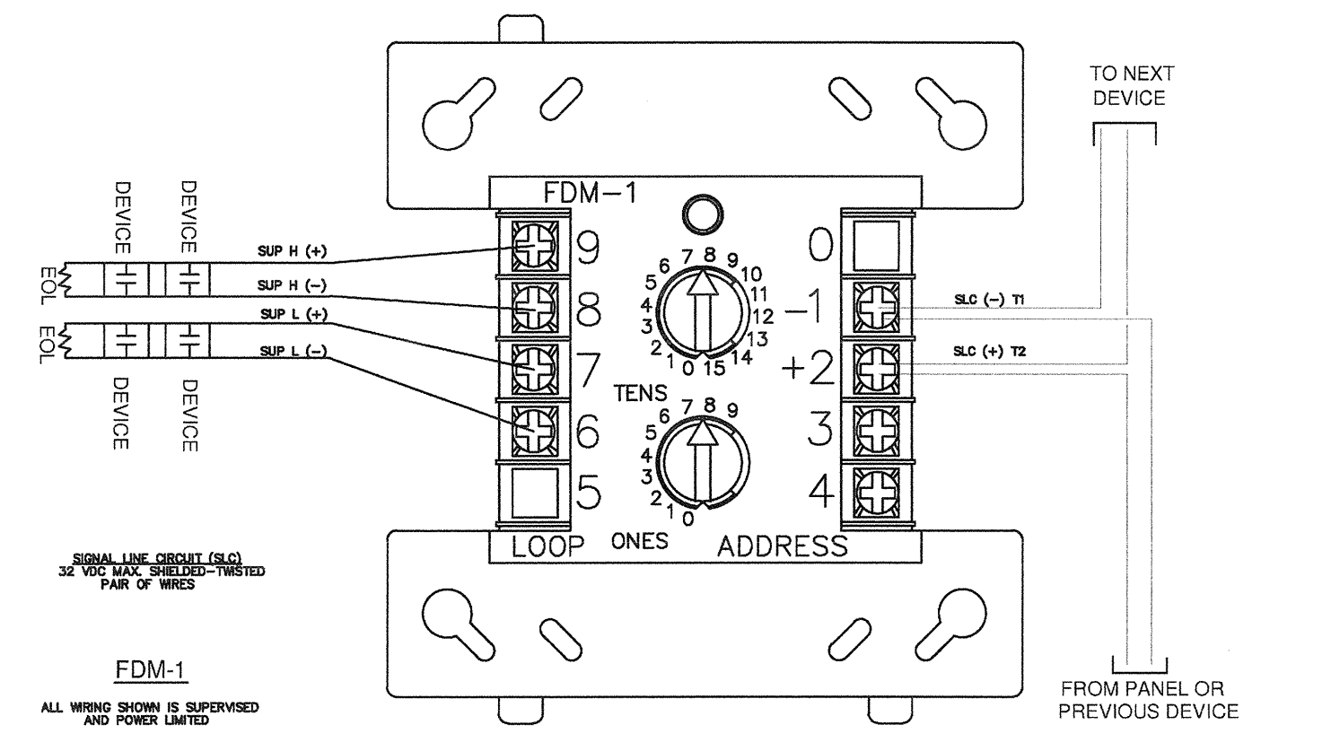
F 15 **WALL SPEAKER STROBE INSTALLATION**
SCALE 1:2



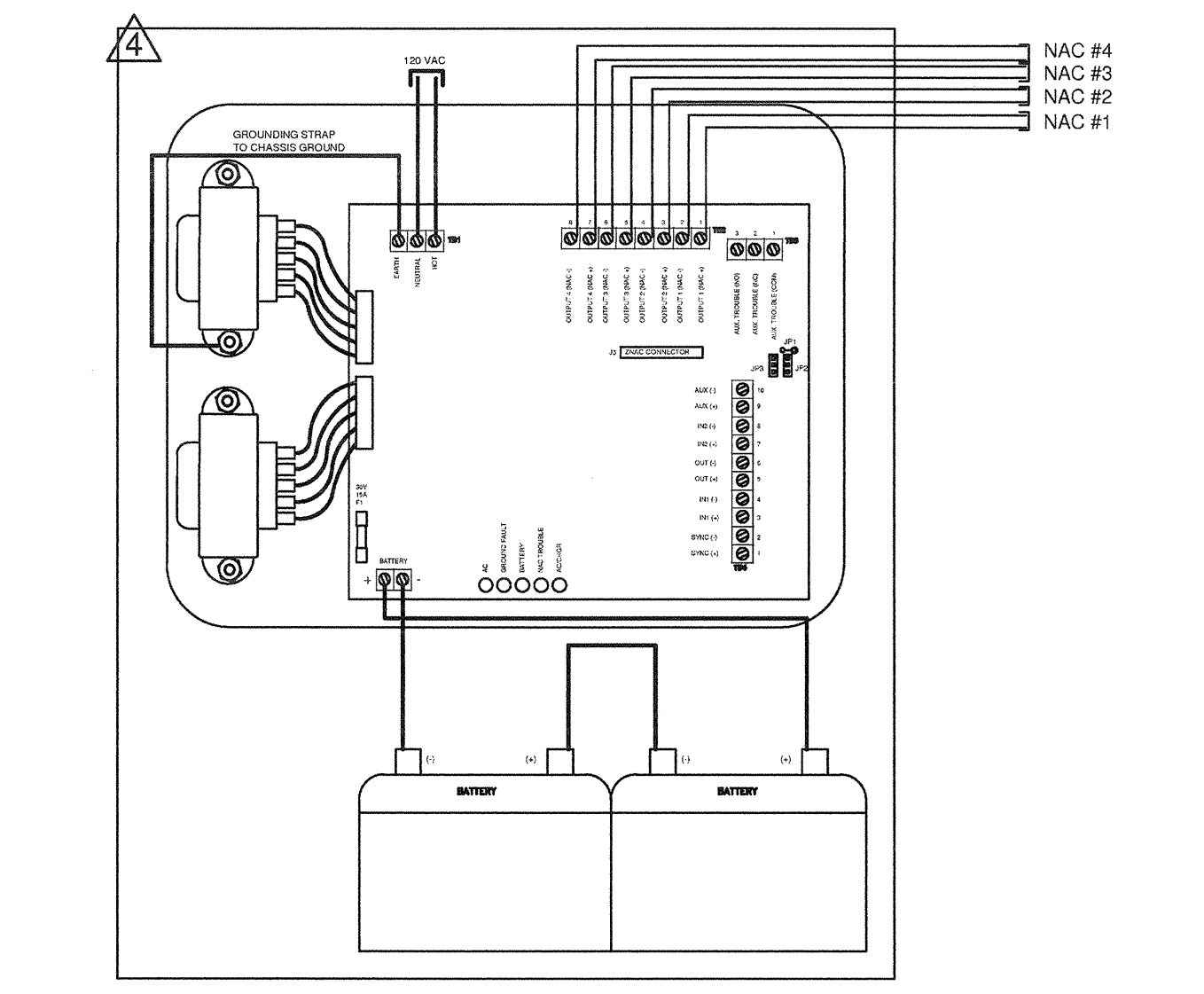
H 11 **ADDRESSABLE HEAT DETECTOR INSTALLATION**
NOT TO SCALE



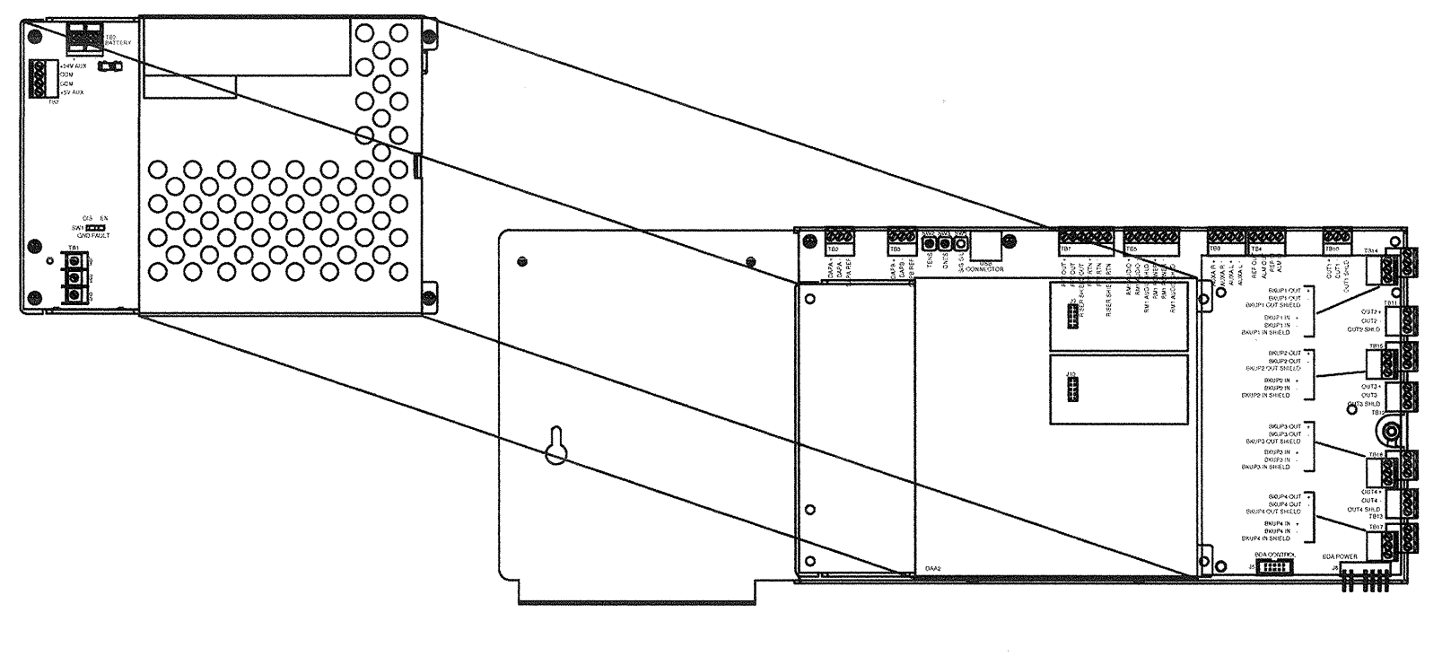
RM 7 **FRM-1 MODULE**
NOT TO SCALE



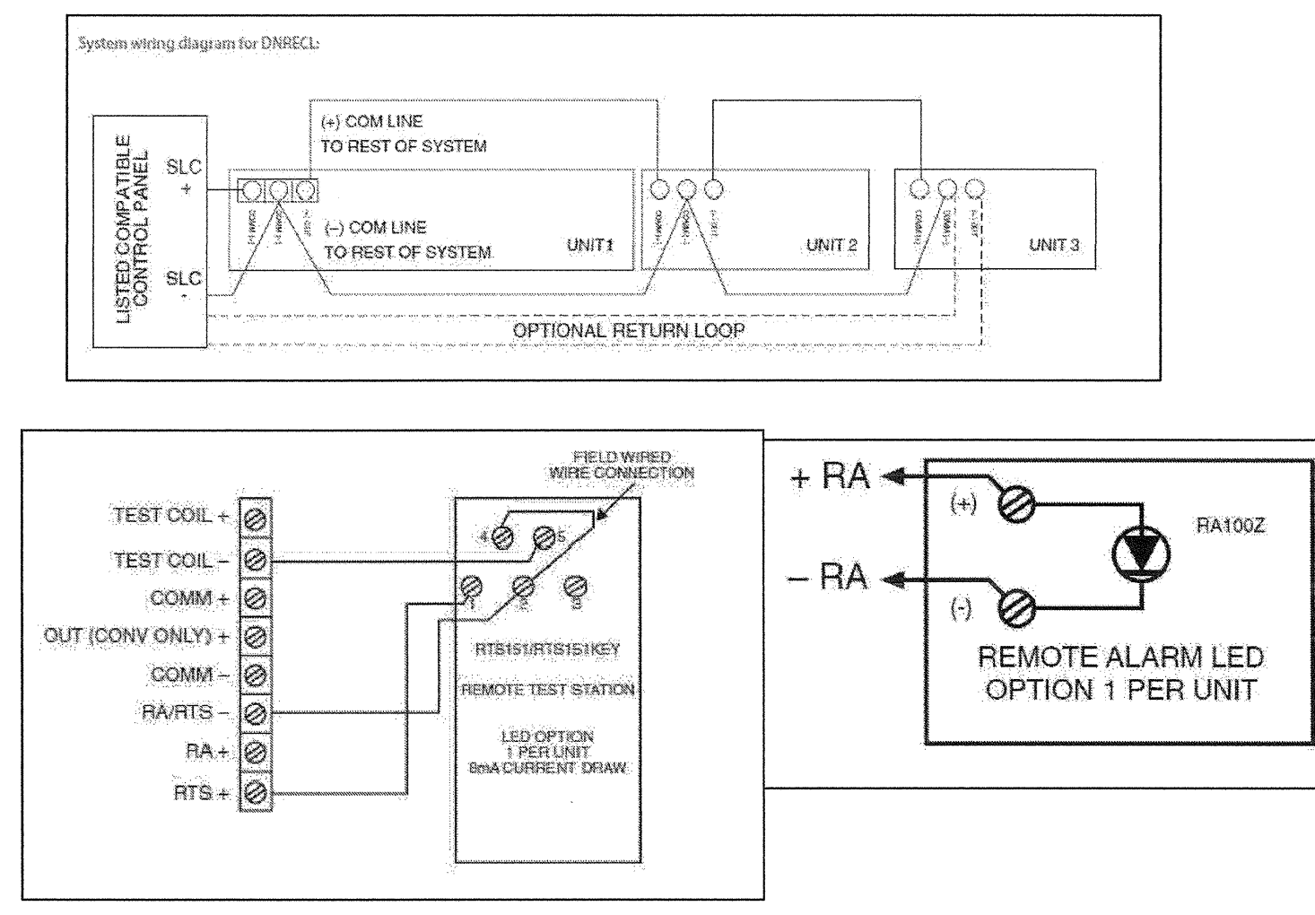
FDM 3 **FDM-1 MODULE**
NOT TO SCALE



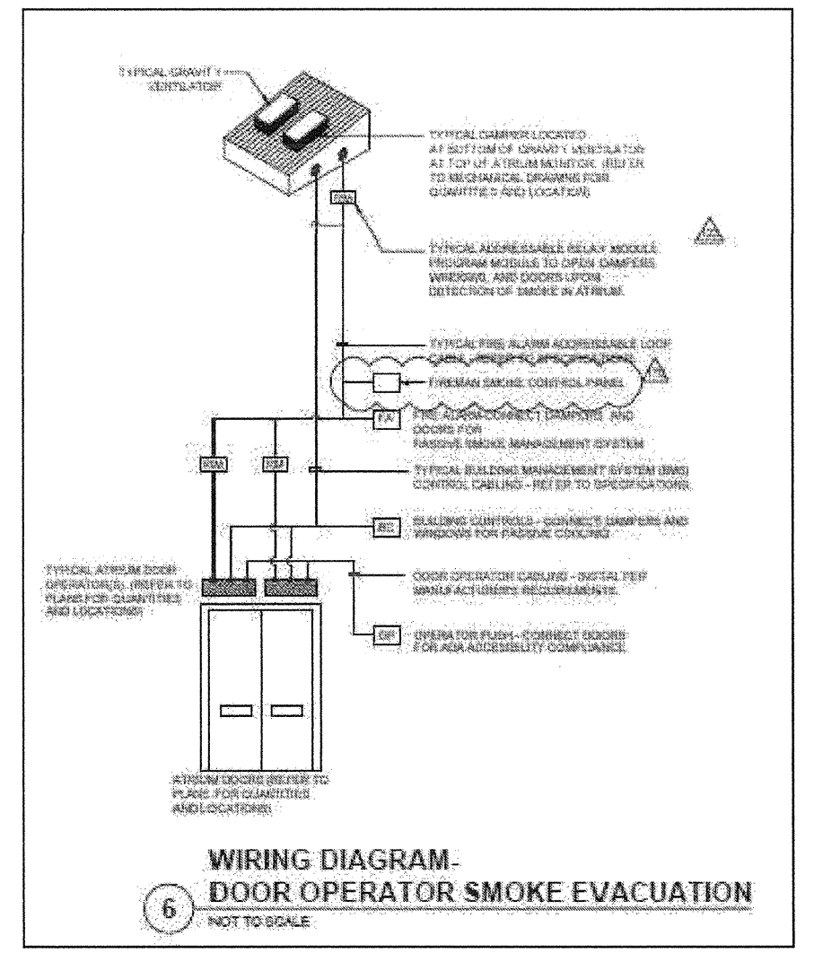
RNPS 20 **REMOTE POWER SUPPLY**
NOT TO SCALE



DAA2 16 **DAA2 SERIES AUDIO AMPLIFIER**
NOT TO SCALE

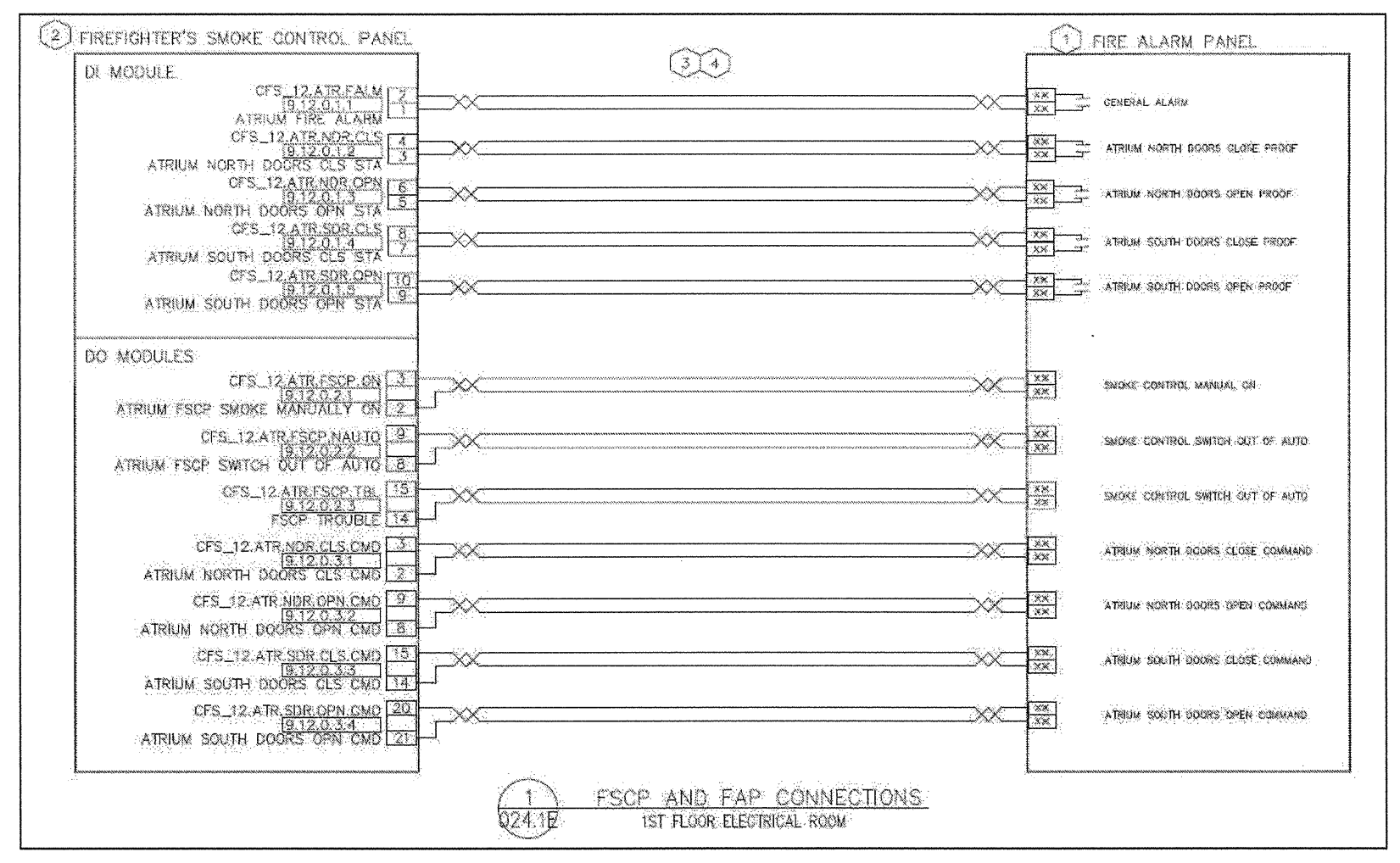


S D 12 **DUCT DETECTOR WIRING**
NOT TO SCALE



6 WIRING DIAGRAM- DOOR OPERATOR SMOKE EVACUATION
NOT TO SCALE

8 **PASSIVE SMOKE CONTROL SYSTEM DETAILS**
NOT TO SCALE



4 **PASSIVE SMOKE CONTROL SYSTEM DETAILS**
NOT TO SCALE

DETAILS

Deep Blue Integration
Consulting - Design - Installation
Service - Monitoring

Deep Blue Integration, Inc
3442 Empresa Drive Suite C
San Luis Obispo, CA 93401
C-10, C-16 #943465 ACO#6864
Toll Free: 888◆6000◆DBI FAX: 805◆791◆2037
www.deepblueintegration.com

Revisions

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5	FA & SMOKE CONTROL SFM COMMENTS	4/3/2013	
6	AS-BUILT DRAWINGS	8/23/2013	

DESIGNED BY:
Curtis Streeter

DRAWN BY:
Derek Richardson

CHECKED BY:
CURTIS STREETER, SET
NICET IV #102672

PROJECT ENGINEER:
Integral Design Associates INC.

DATE: 08/23/2013

SCALE:

DRAWING CODE: FA ALL DRAWINGS CPCFS

CENTER FOR SCIENCE AND MATHEMATICS
CALIFORNIA STATE POLYTECHNIC UNIVERSITY
SAN LUIS OBISPO, CA
CSFM #18-40-03-0001

SHEET ID
FA 5.0
SHEET 15 OF 15

APPENDIX L – NOTIFIER FSP-851(A)

FSP-851(A) Series

Intelligent Plug-In Photoelectric Smoke Detectors with FlashScan®

NOTIFIER®
by Honeywell

Intelligent/Addressable Devices

General

Notifier FSP-851(A) Series intelligent plug-in smoke detectors with integral communication provide features that surpass conventional detectors. Detector sensitivity can be programmed in the control panel software. Sensitivity is continuously monitored and reported to the panel. Point ID capability allows each detector's address to be set with rotary, decimal address switches, providing exact detector location for selective maintenance when chamber contamination reaches an unacceptable level. The FSP-851(A) photoelectric detector's unique optical sensing chamber is engineered to sense smoke produced by a wide range of combustion sources. Dual electronic thermistors add 135°F (57°C) fixed-temperature thermal sensing on the FSP-851T(A). The FSP-851R(A) is a remote test capable detector for use with DNR(A)/DNRW duct detector housings. FSP-851(A) series detectors are compatible with Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by Notifier that greatly increases the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices in the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

Features

- Sleek, low-profile design.
- Addressable-analog communication.
- Stable communication technique with noise immunity.
- Low standby current.
- Two-wire SLC connection.
- Compatible with FlashScan® and CLIP protocol systems.
- Rotary, decimal addressing (1-99 on CLIP systems, 1-159 on FlashScan systems).
- Optional remote, single-gang LED accessory.
- Dual LED design provides 360° viewing angle.
- Visible bi-color LEDs blink green every time the detector is addressed, and illuminate steady red on alarm *(FlashScan systems only)*.
- Remote test feature from the panel.
- Walk test with address display (an address on 121 will blink the detector LED: 12-[pause]-1 *(FlashScan systems only)*.
- Built-in functional test switch activated by external magnet.
- Built-in tamper-resistant feature.
- Sealed against back pressure.
- Constructed of off-white fire-resistant plastic, designed to commercial standards, and offers an attractive appearance.
- 94-5V plastic flammability rating.
- SEMS screws for wiring of the separate base.
- Optional relay, isolator, and sounder bases.

Specifications

Sensitivity: 0.5% to 2.35% per foot obscuration

Size: 2.1" (5.3 cm) high; base determines diameter.

- **B210LP(A):** 6.1" (15.5 cm) diameter.
- **B501(A):** 4.1" (10.4 cm) diameter.
- **B200S(A):** 6.875" (17.46 cm) diameter.
- **B200SR(A):** 6.875" (17.46 cm) diameter.
- **B224RB(A):** 6.2" (15.748 cm) diameter.
- **B224BI(A):** 6.2" (15.748 cm) diameter.

Shipping Weight: 5.2oz. (147g).

Operating Temperature range: FSP-851(A), 0°C to 49°C (32°F to 120°F). FSP-851T(A), 0°C to 38°C (32°F to 100°F). Low temperature signal for FSP-851T(A) at 45°F +/- 10°F (7.22°C +/- 5.54°C). FSP-851R(A) installed in a DNR(A)/DNRW, -20°C to 70°C (-4°F to 158°F).

UL/ULC Listed Velocity Range: 0-4000 ft/min. (1219.2 m/min.), suitable for installation in ducts.

Relative Humidity: 10%-93% noncondensing.

Thermal Ratings: Fixed-temperature setpoint 135°F (57°C).

FSP-851(A) in B210LP(A) Base

DETECTOR SPACING AND APPLICATIONS

Notifier recommends spacing detectors in compliance with NFPA 72. In low airflow applications with smooth ceiling, space detectors 30 feet (9.144m) for ceiling heights 10 feet (3.148m) and higher. For specific information regarding detector spacing, placement, and special applications refer to NFPA 72. *System Smoke Detector Application Guide*, document A05-1003, is available at systemsensor.com

ELECTRICAL SPECIFICATIONS

Voltage Range: 15-32 volts DC peak.

Standby Current (max. avg.): 300μA @ 24VDC (one communication every five seconds with LED enabled).

LED Current (max.): 6.5mA @ 24 VDC ("ON").

Installation

FSP-851(A) plug-in detectors use a separate base to simplify installation, service, and maintenance. A special tool allows maintenance personnel to plug in and remove detectors without using a ladder.

Mount base (all base types) on an electrical backbox which is at least 1.5" (3.81 cm) deep. For a chart of compatible junction boxes, see *DN-60054.*

NOTE: *1) Because of inherent supervision provided by the SLC loop, end-of-line resistors are not required. Wiring "T-taps" or branches are permitted for Style 4 (Class "B") wiring. 2) When using relay or sounder bases, consult the ISO-X(A) installation* *sheet I56-1380 for device limitations between isolator modules and isolator bases.*

Agency Listings and Approvals

These listings and approvals apply to the modules specified in this document. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. *Consult factory for latest listing status.*

- **UL Listed:** S1115.
- **ULC Listed:** S1115 (FSP-851A, FSP-851RA, FSP-851TA).
- **MEA Listed:** 225-02-E .
- **FM Approved.**
- **CSFM:** 7272-0028:0206 .
- **Maryland State Fire Marshal:** Permit # 2122 **.**
- **BSMI:** CI313066760036.
- **CCCF:** Certif. # 2004081801000017 (FSP-851T)
  Certif. # 2004081801000016 (FSP-851).
- **U.S. Coast Guard:** 161.002/42/1 (NFS-640); 161.002/50/0 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).
- **Lloyd's Register:** 11/600013 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).

Product Line Information

***NOTE:** "A" suffix indicates ULC Listed model.*

FSP-851: Low-profile intelligent photoelectric sensor. Must be mounted to one of the bases listed below.

FSP-851A: Same as FSP-851 but with ULC listing.

FSP-851T: Same as FSP-851 but includes a built-in 135°F (57°C) fixed-temperature thermal device.

FSP-851TA: Same as FSP-851T but with ULC listing.

FSP-851R: Low-profile intelligent photoelectric sensor, remote test capable. For use with DNRA/DNRW.

FSP-851RA: Same as FSP-851R but with ULC listing. For use with DNRA.

INTELLIGENT BASES

***NOTE:** "A" suffix indicates ULC Listed model.*

***NOTE:** For details on intelligent bases, see DN-60054.*

B210LP(A): Standard U.S. flanged low-profile mounting base.

B210LPBP: Bulk pack of B210LP; package contains 10.

B501(A): Standard European flangeless mounting base.

B501BP: Bulk pack of B501; package contains 10.

B200S(A): Intelligent, programmable sounder base capable of producing sound output in high or low volume with ANSI Temporal 3, ANSI Temporal 4, continuous tone, marching tone, and custom tone.

B200SR(A): Intelligent sounder base capable of producing sound output with ANSI Temporal 3 or continuous tone. Replaces B501BH series bases in retrofit applications.

B224RB(A): Plug-in System Sensor **relay** base. Screw terminals: up to 14 AWG (2.0 mm^2). Relay type: Form-C. Rating: 2.0 A @ 30 VDC resistive; 0.3 A @ 110 VDC inductive; 1.0 A @ 30 VDC inductive.

B224BI(A): Plug-in System Sensor ***isolator*** detector base. Maximum 25 devices between isolator bases .

ACCESSORIES

F110: Retrofit flange to convert B210LP(A) to match the B710LP(A) profile, or to convert older high-profile bases to low-profile.

F110BP: Bulk pack of F110; package contains 15.

F210: Replacement flange for B210LP(A) base.

RA100Z(A): Remote LED annunciator. 3 – 32 VDC. Mounts to a U.S. single-gang electrical box. For use with B501(A) and B210LP(A) bases only.

SMB600: Surface mounting kit

M02-04-00: Test magnet.

M02-09-00: Test magnet with telescoping handle.

XR2B: Detector removal tool. Allows installation and/or removal of detector heads from bases in high ceiling applications.

XP-4: Extension pole for XR2B. Comes in three 5-foot (1.524 m) sections.

T55-127-010: Detector removal tool without pole.

BCK-200B: Black detector covers for use with FSP-851(A) only; box of 10.

WCK-200B: White detector covers for use with FSP-851(A) only; box of 10.

ISO 9001
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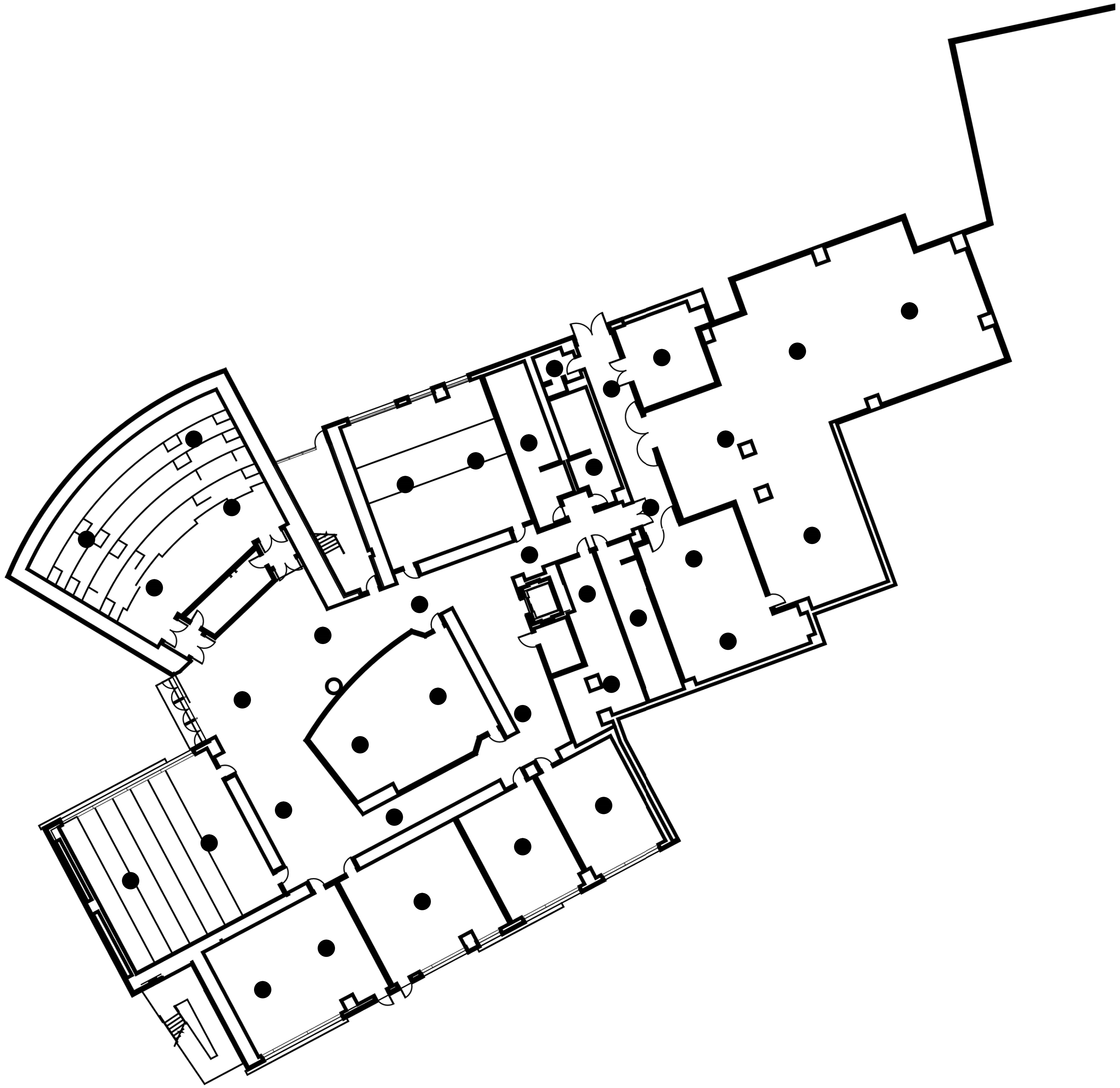
APPENDIX M – COMPLETE SMOKE DETECTOR COVERAGE FLOOR PLANS

Legend:

● Smoke Detector



1 Level 1 Smoke Detector Layout

CAL POLY

Buiding 180 CSM
Level 1

NAME:
Aric Carracino

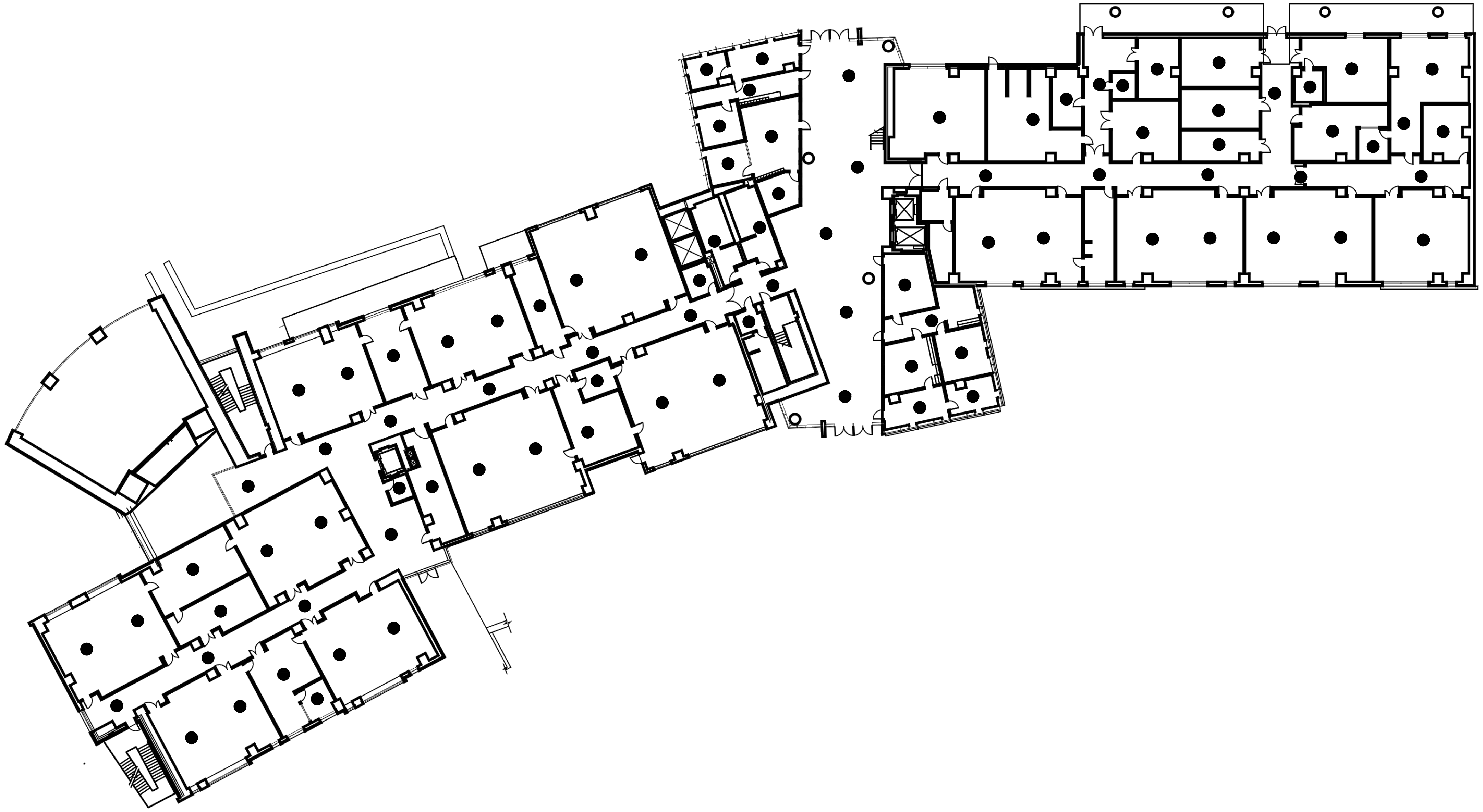
DATE:
Spring 2015

SCALE:
--

DRAWING NO.
1
OF 6 SHEETS

Legend:

● Smoke Detector



2 Level 2 Smoke Detector Layout

CAL POLY

Buiding 180 CSM
Level 2

NAME:
Aric Carracino

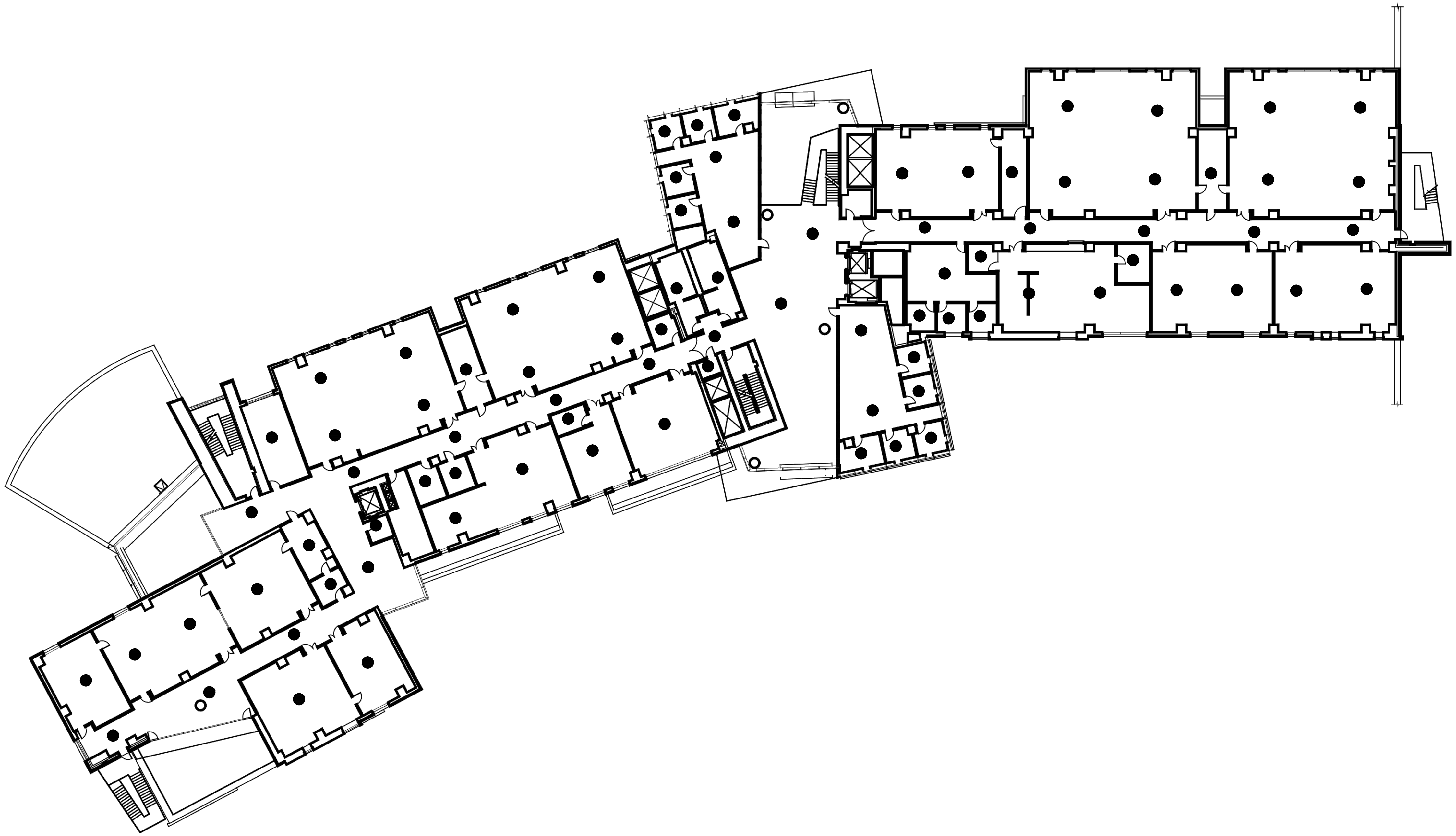
DATE:
Spring 2015

SCALE:

DRAWING NO.
2
OF 6 SHEETS

Legend:

● Smoke Detector



③ Level 3 Smoke Detector Layout

CAL POLY

Buiding 180 CSM
Level 3

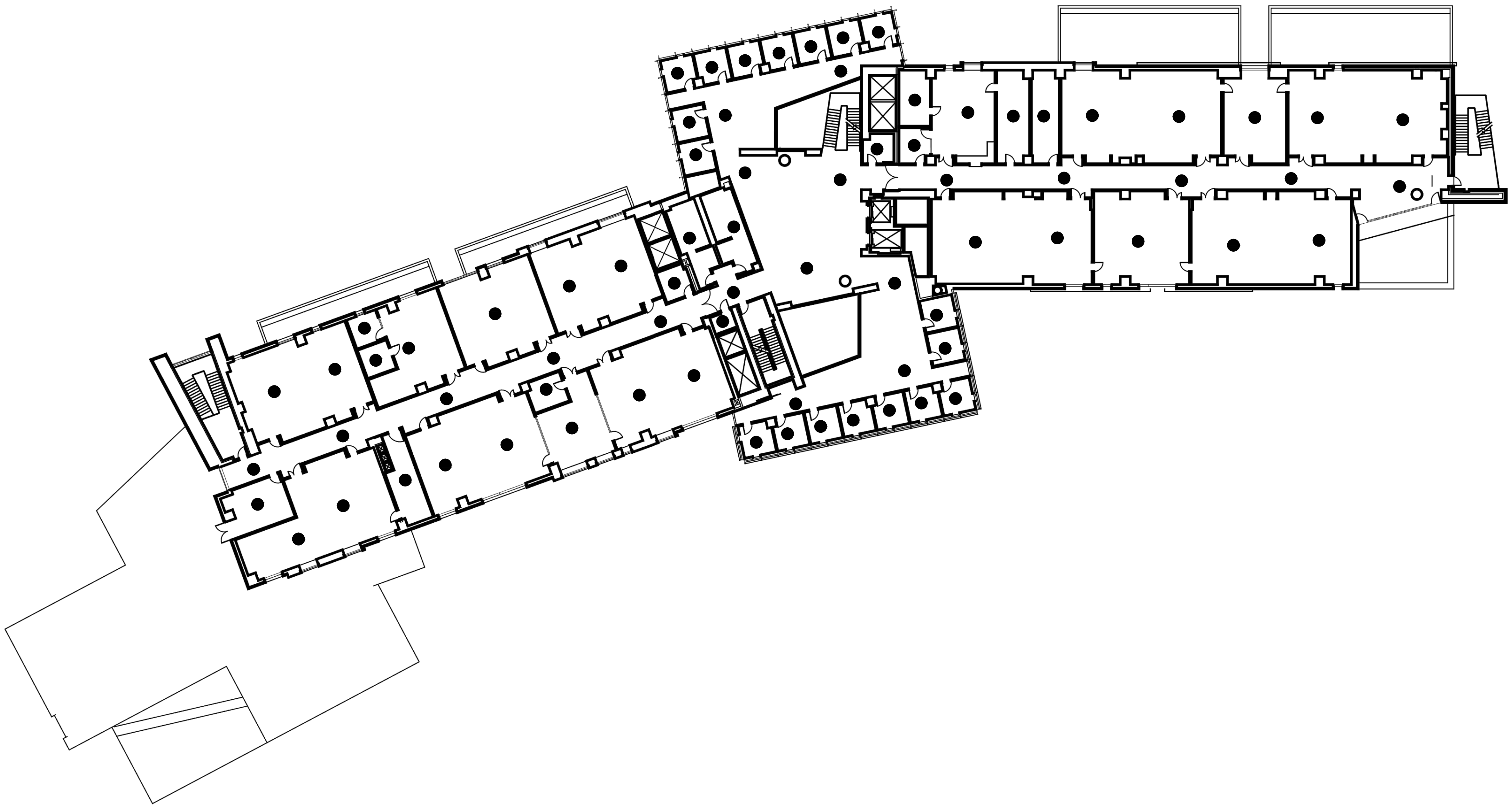
NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

--

DRAWING NO.
3
OF 6 SHEETS

Legend:

● Smoke Detector



4 Level 4 Smoke Detector Layout

CAL POLY

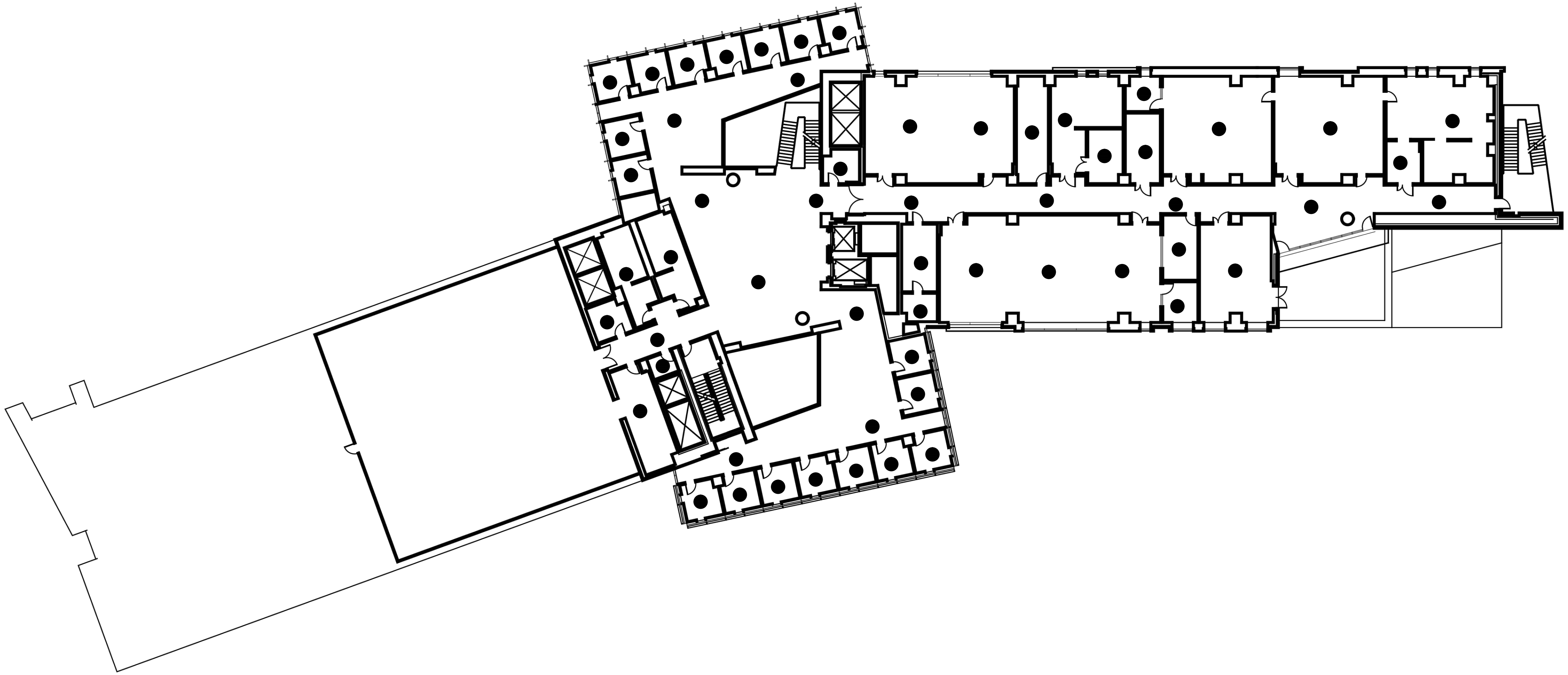
Buiding 180 CSM
Level 4

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:
--

DRAWING NO.
4
OF 6 SHEETS

Legend:

● Smoke Detector



5 Level 5 Smoke Detector Layout

CAL POLY

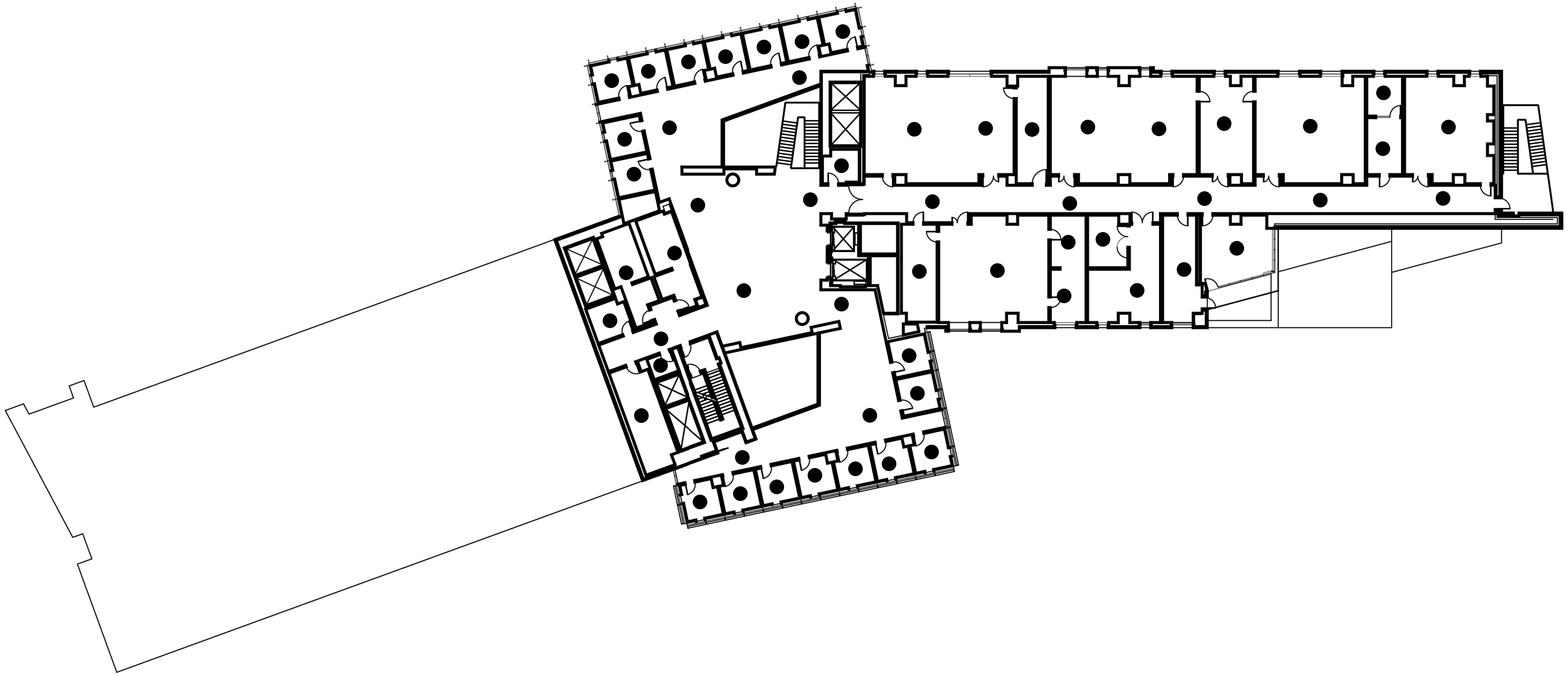
Buiding 180 CSM
Level 5

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
5
OF 6 SHEETS

Legend:

● Smoke Detector



6 Level 6 Smoke Detector Layout

CAL POLY

Buiding 180 CSM
Level 6

NAME:
Aric Carracino
DATE:
Spring 2015
SCALE:

DRAWING NO.
6
OF 6 SHEETS

APPENDIX N – OSID BY XTRALIS

OSID Smoke Detection

Open-area Smoke Imaging Detection (OSID) by Xtralis is a new innovation in projected beam smoke detection technology. By using advanced dual wavelength projected beams and optical imaging technology for early warning smoke detection, OSID provides a low-cost, reliable and easy-to-install solution that overcomes typical beam detection issues such as false alarm incidents and alignment difficulties.

Unique Detection Technology

The OSID system measures the level of smoke entering beams of light projected over an area of protection. A single OSID Imager can detect up to seven Emitters to provide a wide coverage area. Two innovations in smoke detection technology have been developed for the revolutionary OSID smoke detector:

Dual Wavelength Particle Detection

The beam projected from each Emitter contains a unique sequence of ultraviolet (UV) and infrared (IR) pulses that are synchronised with the Imager and enable the rejection of any unwanted light sources.

By using two wavelengths of light to detect particles, the system is able to distinguish between particle sizes. The shorter UV wavelength interacts strongly with both small and large particles while the longer IR wavelength is affected only by larger particles. Dual wavelength path loss measurements therefore enable the detector to provide repeatable smoke obscuration measurements, while rejecting the presence of dust particles or solid intruding objects.

Optical Imaging with a CMOS Imaging Chip

An optical imaging array in the OSID Imager provides the detector with a wide viewing angle to locate and track multiple Emitters. Consequently, the system can tolerate a much less precise installation and can compensate for the drift caused by natural shifts in building structures.

Optical filtering, high-speed image acquisition and intelligent software algorithms also enable the OSID system to provide new levels of stability and sensitivity with greater immunity to high level lighting variability.

Operation

Status information (Fire Alarm, Trouble and Power) is communicated through the Imager via Status LEDs, dedicated Trouble and Alarm relays, and the Remote Indicator interface. Specific Trouble (Fault) conditions are identified through coded flashes of the Trouble LED.

An internal heating option is also provided on the Imager to prevent condensation on the optical surface, and a reset input enables an external signal to reset the device.

Simple Installation and Maintenance

The OSID system consists of up to seven Emitters, for the 45° and 90° Imager units, located along the perimeter of the protected area, and an Imager mounted opposite. Each component can be mounted directly to the surface or can be secured with the supplied mounting brackets. Battery powered Emitters with up to five years battery life are also available to reduce installation time and cost.

Features

- Maximum detection range of 150 m (492 ft) for the OSI-10
- Status LEDs for Fire, Trouble and Power
- High false alarm immunity
- Dust and intrusive solid object rejection
- Easy alignment with large adjustment and viewing angles
- No need for precise alignment
- Tolerant of alignment drift
- Automatic commisioning in under ten minutes
- Simple DIP switch configuration
- Dual wavelength LED-based smoke detection
- Simple and easy maintenance requirements
- Conventional alarm interface for straightforward fire system integration
- Three selectable alarm thresholds

Listings/Approvals

- UL
- ULC
- FM
- AFNOR
- CE Mark
- VdS
- ActivFire
- BOSEC
- Major Agency Approvals pending

OSID by xtralis®

OSID Smoke Detection

On the Imager, a termination card provides all field wiring terminals, and DIP switches enable the user to configure the detector for particular applications.

Alignment of the Emitter is simply achieved using a laser alignment tool to rotate the optical spheres until the laser beam projected from the alignment tool is close to the Imager.

The Imager is aligned in a similar way so that its Field of View (FOV) encompasses all Emitters. A Trouble or Fault will be indicated if an Emitter is missing or outside the Imager field of view.

The OSID system is highly tolerant to dust and dirt and requires little maintenance in practice. Preventative maintenance is limited to occasionally cleaning the optical faces of the detector components.

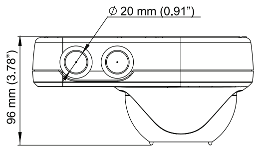
Configuration Options

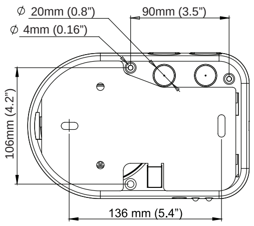
OSID systems may be configured to suit a range of detection spaces by selecting the number of Emitters and type of Imager. Each type of Imager differs by the lens used in the unit, which determines the field of view and range of the system.

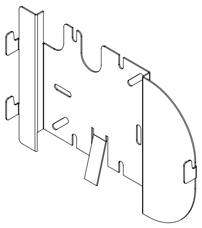
Imager	Field of View		Detection Range				Max. Number of Emitters
	Horizontal	Vertical	Standard Power		High Power		
			Min	Max	Min	Max	
10°	7°	4°	30 m (98 ft)	150 m (492 ft)	- -	- -	1
45°	38°	19°	15 m (49 ft)	60 m (197 ft)	30 m (98 ft)	120 m (393 ft)	7
90°	80°	48°	6 m (20 ft)	**34 m (111 ft)	12 m (39 ft)	**68 m (223 ft)	7

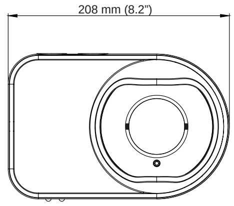
** Maximum Distances measured for the Center Field of View of the Imager. For more details on distances for the Imager, see the OSID Product Guide.

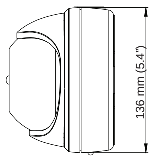
Emitter / Imager Dimensions











Ordering Codes

OSI-10	Imager - 7º coverage
OSI-45	Imager - 38º coverage
OSI-90	Imager - 80º coverage
OSE-SP-01	Emitter - Alkaline Battery
OSE-SPW	Emitter - Standard Power, Wired
OSID-EHE	Emitter environmental housing IP66
OSID-EHI	Imager environmental housing IP66
OSE-ACF	Anti-condensation film for Emitters
OSEH-ACF	Anti-condensation film for OSID-EHE and OSID-EHI environmental housings

OSE-HPW	Emitter - High Power, Wired
OSID-INST	OSID Installation Kit
OSP-001	FTDI Cable 1.5m
OSP-002	Laser Alignment tool
OSID-WG	Wire Guard
OSE-RBA	Spare alkaline battery pack for Emitter units
OSE-RBL	Replacement Lithium Ion Kit

Specifications

Supply Voltage

20 to 30 VDC (24 VDC nominal)

Imager Current Consumption

Nominal (at 24 VDC):
8mA (1 Emitter)
10mA (7 Emitters)
Peak (at 24 VDC) during training mode:
31mA

Emitter Current Consumption

Wired Version (at 24 VDC):
350µA Std Power, 800µA High Power
Battery Version (1.9 - 3.2 VDC):
Built-in 5 Year Replaceable Battery

Field Wiring

Cable Guage
0.2 - 4mm² (26-12 AWG)

Alarm Threshold Levels:

Low - Highest sensitivity / earliest alarm:
20% (0.97 dB)
Medium - Medium sensitivity:
35% (1.87 dB)
High - Lowest sensitivity / maximum immunity to nuisance smoke conditions:
50% (3.01 dB)

Adjustment Angle

±60° (horizontal)
±15° (vertical)

Maximum Misalignment Angle

±2°

Dimensions (WHD)

Emitter / Imager:
208 mm x 136 mm x 96 mm
(8.19 in. x 5.35 in. x 3.78 in.)

Operating Conditions*

Temperature:
-10 °C to 55 °C (14 °F to 131 °F)*
Humidity:
10 to 95% RH (non-condensing)

Please consult your Xtralis office for operation outside these parameters.

IP Rating

IP 44 for Electronics
IP 66 for Optics Enclosure

Status LEDs

Fire Alarm (Red)
Trouble / Power (Bi-color Yellow / Green)

Event log

10,000 events

Approvals Compliance

Please refer to the Product Guide for details regarding compliant design, installation and commissioning.

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* Product UL listed for use from 0°C to 39°C (32°F to 103°F)

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Middle East +962 6 588 5622 **Asia** +86 21 5240 0077 **Australia and New Zealand** +61 3 9936 7000

OPEN-AREA SMOKE IMAGING DETECTION (OSID) REFERENCE GUIDE

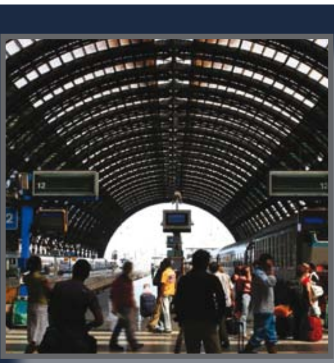
OSID (Open-area Smoke Imaging Detector) combines dual wavelength (IR and UV) beams with CMOS imaging detection. This technology features high tolerance to vibration and structural movement and OSID differentiates better between smoke and environmental conditions than traditional beam detectors.. OSID operates in both pitch dark as well as bright sunlight.

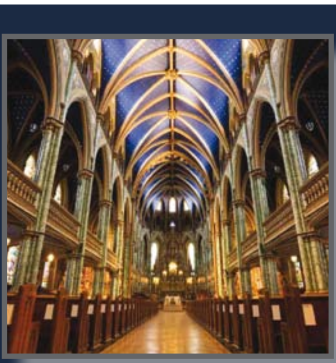
One Imager (receiver) can have up to 7 Emitters and provides easy 3D coverage for atria etc.

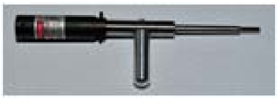
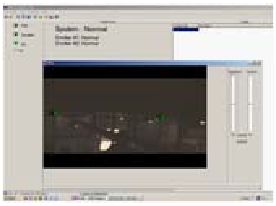
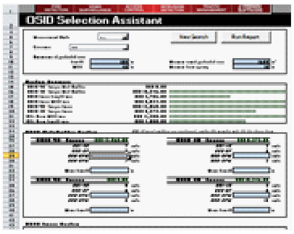
Fast and easy installation and commissioning is achieved through the flexible ball & socket arrangement and the use of the laser alignment tool. Trouble shooting is simple thanks to the on-board memory and the OSID Diagnostic SW package, both unique for this industry.

Below is an overview of this award winning OSID range.

OSI-10	**Imager 8° FOV** Distance 30-150 m with OSE-SP/W. This configuration is for a 1 on 1 system. The OSI-10 is not suited to work with High Powered Emitters.	
OSI-45	**Imager 38° FOV** Distance 12-60 m with OSE-SP/W Distance 24-120 m with OSE-HPW The OSI-45 can operate with up to 7 Emitters.	
OSI-90	**Imager 80° FOV** Distance 6-34 m with OSE-SP/W Distance 12-68 m with OSE-HPW The OSI-45 can operate with up to 7 Emitters.	
OSE-SP-01	**Emitter battery powered-alkaline battery** Using battery powered Emitters, with a guaranteed 5 year life, drastically reduce the wiring and installation costs.	
OSE-HP-01	**Emitter High Power battery powered-alkaline battery** Using battery powered Emitters, with a guaranteed 3 year life, drastically reduce the wiring and installation costs.	
OSE-SPW	**Emitter Wired 24 Vdc** A preferred solution when 24 Vdc is close by.	
OSE-HPW	**Emitter High Power Wired 24 Vdc** Allows to double the detection ranges of the OSI-45 and OSI- 90.	
OSID-INST	**OSID Installation Kit** Kit including laser alignment tool, test filter, PC cable, cleaning cloth, reflectors and manual.	





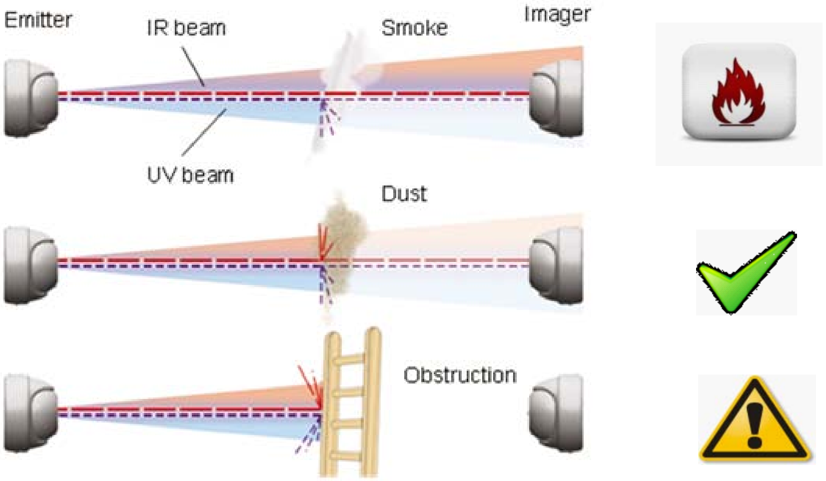
VKT-301	**OSID Demo kit** Kit consisting of 2 X OSE-SP-01, 1 X OSI-90, 1 X OSID-INST and mounting plates, fitted in a rugged carry case.	
OSP-001	**FTDI Cable 1.5m** Allows to connect a PC and hence OSID Diagnostic SW to the Imager. The FTDI cable can be extended with another 20 m using cable with an active USB amplifier.	
OSP-002	**Laser Alignment tool** A unique alignment tool for fast alignment. Aligns and locks the eyeball. Does also activate Emitters when locked.	
OSID-WG	**Wire Guard** A steel cage to protect OSID Imagers and Emitters from vandalism and accidental damage.	
OSID-EHI	**Imager Environmental Housing** Custom designed IP 66, NEMA 4-4X protective and environmental housings protect OSID Imagers from dust and water ingress in industrial environments.	
OSID-EHE	**Emitter Environmental Housing** Custom designed IP 66, NEMA 4-4X protective and environmental housings protect OSID Emitters from dust and water ingress in industrial environments.	
OSE-ACF	**Anti-condensation film for Emitters** An easy applicable film that provide long time resistance to condensation on the acrylic Emitter lens.	
OSEH-ACF	**Anti-condensation film for OSID-EH housings** An easy applicable film that provide long time resistance to condensation on the glass fronts	
OSID Diagnostic Tool	**Diagnostic software package** A unique software program that allows visualisation of the Imager's view, quality of alignment and IR/UV real time graphs. The program also features real time logging capability for trouble shooting and site evaluation purposes.	
OSID Selection Assistant	**System selection tool** The program is an intuitive Excel based program that for a given area will calculate 90°, 45°and 10° OSID solutions as well offer a price comparison with traditional beams. It also gives the exact location to point the alignment laser tool for optimal FOV for the Imagers in multi-Emitter solutions.	
OSE-RBL	**Emitter replacement battery Lithium**	
OSE-RBA	**Emitter replacement battery Alkaline**	

Available Fields of View and Detection Ranges

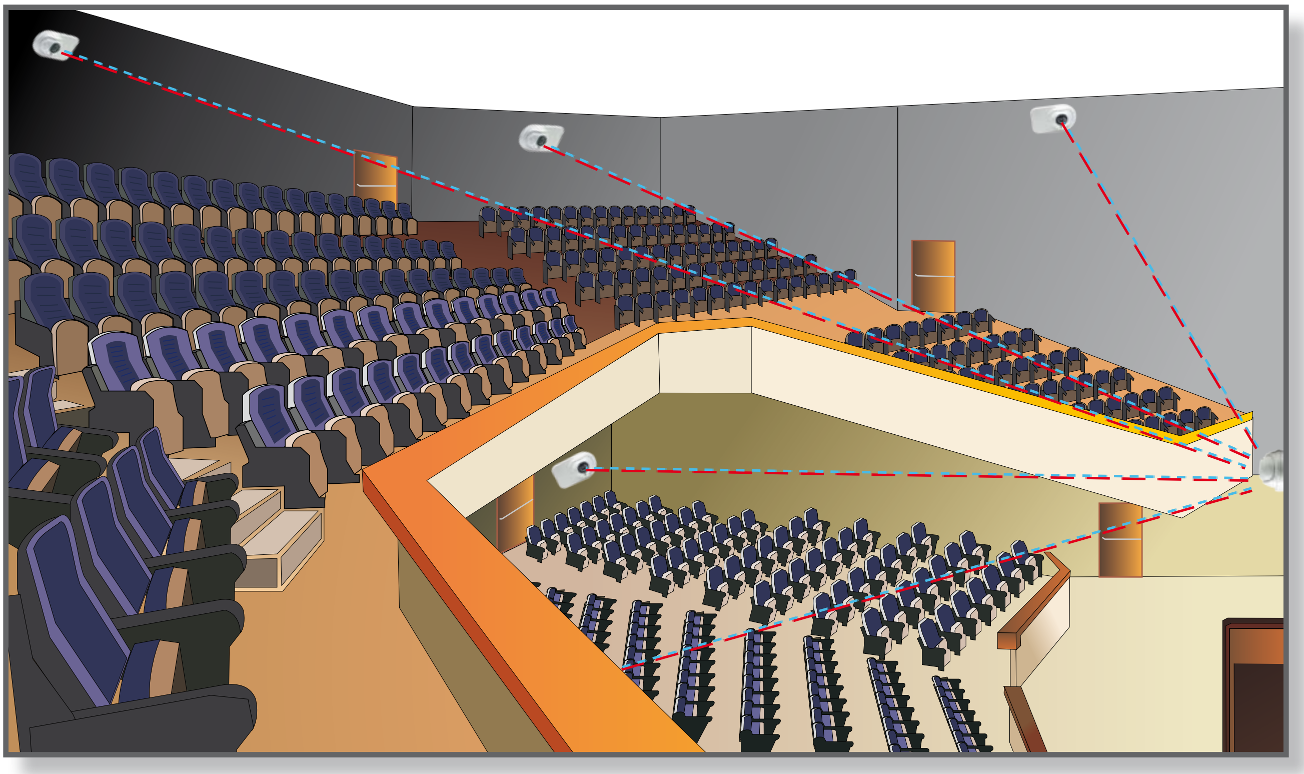
Image Lens Type	Usable Field of View		Detection Range				Max. Number of Emitters
	Horizontal	Vertical	Standard Power		High Power		
			Min	Max	Min	Max	
10º	7º	4º	30 m (98 ft)	150 m (492 ft)	-	-	1
45º	38º	19º	15 m (49 ft)	60 m (197 ft)	30m (98 ft)	120 m (393 ft)/ 100 m (328 ft) *	7
50º	80º	48º	6m (20 ft)	34 m (111 ft)	12m (39 ft)	68 m (223 ft)/ 50 m (164 ft) *	7

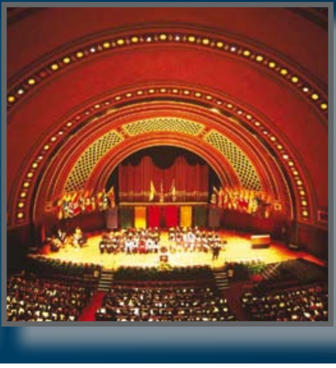
** Range with OSE-HP-01*

One-on-one application and theory of operation



Typical Multi-Emitter application





PRODUCT SPECIFICATIONS

General	
Alarm Thresholds (Configurable)	Low - Highest sensitivity / earliest alarm: 20% (0.97 dB) Medium - Medium sensitivity: 35% (1.87 dB) High - Lowest sensitivity / maximum immunity to nuisance smoke conditions: 50% (3.01 dB)
Alarm Latching (Configurable)	Latching / Non-latching configured via DIP switch
Status LEDs (Imager)	Red: Fire Alarm; Bi-color Yellow/Green: Trouble or Normal
IP Rating	IP 44 for Electronics; IP 66 for Optics Enclosure
DIP Switch Configuration (Termination Card)	Configuration for alarm thresholds, number of Emitters and alarm latching/non latching.
Electrical	
Imager Supply voltage	20-30 VDC (24 VDC nominal)
Imager Current Consumption	Typical at 24 VDC: 8 mA (one Emitter), 10 mA (seven Emitters)
Emitter Current Consumption	Externally powered Emitter (at 24 VDC): 350 µA Standard Power, 800 µA High Power Battery-powered Emitter: Built-in 5 Year Replacement Alkaline Battery,3 Year Replacement with OSE-HP-01
Cable Gauge	0.2 - 4 mm^2 (26-12 AWG)
Trouble/Fault Relay	2 A @ 30 VDC, NO-C-NC Dry Relay Contacts
Fire Alarm Relay	2 A @ 30 VDC, NO-C-NC Dry Relay Contacts
Heater Input Power	24 VDC, 16 mA (400 mW)
Environmental	
Operating Temperature	-10ºC to 55ºC (14ºF to 131ºF)
Humidity	10 to 95% RH Non-condensing
Mechanical	
Dimensions (WHD)	208 mm x 136 mm x 96 mm (8.2 in x 5.4 in x 3.8 in)
Weight	Imager: 610 g; Emitter (battery powered): 1.2 kg Emitter (wired): 535 g
Adjustment Angle	Horizontal: ±60º; Vertical: ±15º
Maximum Misalignment Angle	±2º

OSID AWARDS

LES TROPHÉES expoprotection 2012

ZŁOTY MEDAL 2012

FIRE EXCELLENCE AWARDS 2011 WINNER

NPS NEW PRODUCT SHOWCASE

ASIS 11 accolades Security's Best Winner

OSID WEBSITE

Visit the OSID website at

WWW.XTRALIS.COM

and discover application flyers, application notes, software, brochures and much more.

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Middle East +962 6 588 5622 **Asia** +86 21 5240 0077 **Australia and New Zealand** +61 3 9936 7000

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