Fire and Life Safety Analysis of the Bonderson Engineering Projects Center

Brian Sackett

California Polytechnic State University, San Luis Obispo

FPE Culminating Project

June 2014

Statement of Disclaimer

This project report is a result of a class assignment; it has been graded and accepted as fulfillment of the course requirements. Acceptance of this report in fulfillment of the course requirements does not imply technical accuracy or reliability. Any use of information in this report is done at the risk of the user. These risks may include, but may not be limited to, catastrophic failure of the device or infringement of patent or copyright laws. California Polytechnic State University at San Luis Obispo and its staff cannot be held liable for any use or misuse of the project.

Keywords

- Bonderson Engineering Projects Center
- Fire Protection Engineering
- Life Safety
- NFPA Code
- Performance-Based Design

1.0 Abstract

As part of the requirements for the Degree of Masters of Science in Fire Protection Engineering from California Polytechnic State University, San Luis Obispo, a prescriptive and performance based design analysis was conducted for the Bonderson Engineering Projects Center building (Cal Poly campus). The purpose of this analysis was to review the Bonderson Engineering Projects Center's compliance with applicable and recognized fire and building codes with regards to its fire protection systems and features.

The fire protection systems and features analyzed in this report include:

- Egress Systems
- Structural Fire Protection
- Fire Detection and Alarm Systems
- Fire Suppression Systems

Prescriptive analysis of the Bonderson Engineering Projects Center was performed in order to determine if the building adhered to standards set forth within applicable standards and codes. Analysis was based primarily upon both the International Building Code 2009 Edition and NFPA 101: Life Safety Code 2012 Edition. Where required, other NFPA codes and standards were utilized, including the 2010 Editions of NFPA 13: Standard for the Installation of Sprinkler Systems and NFPA 72: National Fire Alarm and Signaling Code. The egress systems in the building largely met prescriptive code requirements except for a few issues related to room 104 and its change in occupancy use (door swing direction, locks without panic hardware, etc). The structural system is a Type II-B classification and was found to meet prescriptive code requirements. Some shortcomings with the detection and alarm systems were discovered during the analysis, mainly with respect to spacing gaps. Several visible notification devices on the second floor did not meet prescriptive code due to gaps in required coverage. Additionally, it was determined that detailed measurements of the average ambient sound level should be taken in order to better analyze the audible notification systems. Lastly, the sprinkler system was found to meet prescriptive code requirements, both for water demand and bracing.

Performance based design analysis was performed in order to gain understanding on the ability of the building to safely egress occupants during various fire scenarios when built to the prescriptive approaches set forth in the codes and standards. This performance based design analysis was based upon standards set forth in Chapter 5 of the Life Safety Code. Fire Dynamics Simulator (FDS) and Pathfinder computer simulators were utilized to carry out the performance based design. ASET vs. RSET analysis solidified the code requirements which prohibit highly combustible materials from within atrium spaces.

Table of Contents

2.0 Project Scope

This project report is intended to detail the fire and life safety analysis that was completed for the Bonderson Engineering Projects Center (Building 197), which is located on the California Polytechnic State University campus in San Luis Obispo. This report includes prescriptive analysis per applicable codes and standards as well as performance based design analysis using primarily Fire Dynamics Simulator (FDS) software.

Applicable Codes and Standards

The Bonderson Engineering Projects Center was designed and built primarily under the following codes and standards:

- California Building Code, 2001
- California Code of Regulations, including Title 19 and Title 24
- Uniform Building Code, 1997
- Americans with Disabilities Act

The courses taught throughout the Cal Poly Fire Protection Engineering program mainly utilize both the International Building Code as well as NFPA 101: Life Safety Code. Although the Bonderson Engineering Projects Center was designed and constructed under the California Building Code, since this analysis is meant primarily as an academic exercise, this report will stay consistent with the program curriculum and utilize the International Building Code (in addition to the Life Safety Code). As such, the primary codes, standards, and references used throughout this report include the following:

- International Building Code, 2009
- NFPA 101: Life Safety Code, 2012
- NFPA 13: Standard for the Installation of Sprinkler Systems, 2010
- NFPA 72: National Fire Alarm and Signaling Code, 2010
- The SFPE Handbook of Fire Protection Engineering, 4th Edition
- The NFPA Fire Protection Handbook, 20th Edition

Prescriptive Analysis

The prescriptive approach uses existing codes and standards for the design of the various fire protection systems. These prescriptive codes have been developed over time, are written in mandatory language, and are assumed to offer the minimum acceptable level of safety based on current procedures and design practices. The prescriptive portion of this report is a review of the current state of the Bonderson Engineering Projects Center and its compliance with the prescriptive requirements set forth in the various codes and standards.

Performance Based Design

The performance based design analysis of the Bonderson Engineering Projects Center utilizes various threatening fire scenarios that were considered representative of realistic and possible fire events based upon current existing conditions throughout the building. The performance based design in this report primarily utilizes computer fire modeling software to analyze tenability and egress of occupants according to the Available Safe Egress Time (ASET) > Required Safe Egress Time (RSET) methodology.

3.0 Building Description

The Bonderson Engineering Projects Center is a building dedicated entirely towards housing and supporting mainly multidisciplinary, engineering student run projects, labs, and club meetings. Construction was completed in 2007 at an approximate cost of $8 million which was generously donated by Mr. Bonderson, Jr. and from which the building derives its name. The Bonderson Engineering Projects Center is located within the Engineering Plaza on the California Polytechnic State University, San Luis Obispo campus. The Bonderson Engineering Projects Center is surrounded by North Perimeter Road, H2 Parking Lot, Building 7 (Advanced Technology Labs), and Building 192 (Engineering IV). The general location can be seen in the figure below.

Figure 1: Bonderson Engineering Projects Center Location – Cal Poly Campus

Some of the student development, project, and lab areas within the Bonderson Engineering Projects Center include the Robotics Laboratory, Machine and Wood Shop, Chemistry Lab,

Computers Lab, and other various Dedicated Project areas. A general overview of the building characteristics is summarized below:

- Two story building
- Concrete and steel frame construction
- 18,575 ft^2 enclosed building space
- Mixed use occupancy
- Fully sprinklered (automatic wet-pipe system)
- Full building smoke detection and alarm notification

The main development parties associated with the construction of the Bonderson Engineering Projects Center are listed below:

- General Contractor – Maino Construction
- Architech – John Trautmann Architects
- Fire Sprinkler Contractor – S&M Fire Protection, Inc
- Fire Alarm Contractor – Alpha Fire

4.0 Prescriptive Analysis

4.1 Egress

4.1.0 Egress Overview

Safe and timely egress of a building during a fire scenario is of utmost importance in order to secure the life safety and well being of building occupants. Because of this, prescriptive approaches to building egress cover a wide variety of topics. For example, some of the factors governing egress include the type and number of people occupying a building, the use(s) of the building and its associated occupancy classification, the amount, layout, and ease of access to building exits, and travel distances as well as walkway dead end considerations.

The Bonderson Engineering Projects Center's primary means of egress for occupants is a main corridor on each floor which runs the general length of the building. The corridor on the ground level has primary exits at both ends which discharge occupants out of the building and into the public way. The corridor on the second floor leads to an exterior stairway on the Eastern end of the building which discharges occupants towards the H2 parking lot, and an interior stairway which discharges into the first floors exit corridor on the Western end (towards the Engineering Plaza). There are also three exits leading from the covered work area into the public way in addition to the three main exits.

The exit locations can be seen in Appendix A.

4.1.1 Occupancy Classification

The Bonderson Engineering Projects Center, like most buildings, is comprised of rooms which are intended for different uses. According to Chapter 6 of the Life Safety Code, the Bonderson Engineering Projects Center is a Multiple Occupancy building (LSC 6.1.14.1), featuring Assembly, Business, Industrial, and Storage (incidental to main occupancies) occupancies. Multiple Occupancy buildings need to be categorized as either Mixed Occupancy (strictest requirements of any occupancy apply to all occupancies) or Separated Occupancies (differing occupancies are separated by fire resistive walls). Bonderson Engineering Projects Center is categorized as a Mixed Occupancy building because although it meets Separated Occupancy requirements set forth in the IBC, it does not meet Separated Occupancy requirements set forth in the LSC. Since it is classified as a Mixed Use building as per LSC (6.1.14.3.2), the building will need to adhere to the most restrictive requirements of the occupancies involved, throughout the entire building, as set forth under the Mixed Occupancies standards of 6.1.14.3. The Life Safety Code description of the various occupancies can be found below:

> **Assembly**: An occupancy (1) used for a gathering of 50 or more persons for deliberation, worship, entertainment, eating, drinking, amusement, awaiting transportation, or similar uses; or (2) used as a special amusement building, regardless of occupant load.
>
> **Business**: An occupancy used for the transaction of business other than mercantile.
>
> **Industrial:** An occupancy in which products are manufactured or in which processing, assembling, mixing, packaging, finishing, decorating, or repair operations are conducted.

There are storage use spaces throughout the building for custodial supplies and other contents, but as per Life Safety Code 6.1.14.1.3, these are considered as incidental to the above occupancies, and are allowed to be considered part of the predominant occupancy and subject to those provisions.

An example of an assembly usage within the building is given by Room 104, which is used as meeting space for presentations, club meetings, or other general assembly purposes. Room 104 was originally designed as a Business Occupancy, but over time its use has changed and come more in line with an Assembly Occupancy. The business occupancy portions of the building include the facility office on the ground floor which houses management for the industrial shops as well as tool checkout, the robotics room on the first floor, and the laboratory spaces on the second floor which include the chemistry lab, electronics repair, computer cluster, and device control labs. The chemistry lab, due to having less than 2 gal/100

ft^2 of Class I, II, or IIIA liquids, is classified as a Class D lab (per NFPA 45), and as such is a business occupancy. Industrial occupancies within the building are primarily seen in the machine shop, woodworking shop, the various dedicated project and integrated project areas, as well as the covered work space flanking the southern and eastern parts of the building perimeter. Finally, as mentioned above, a handful of small storage rooms exist which house custodial equipment or are used for the purpose of building support. The color coded ground level and second story floor plans based on occupancy classification can be seen in Appendix A.

4.1.2 Occupant Loading

The building's occupancy load was calculated using Table 7.3.1.2 of the Life Safety Code and the occupancy classification of each individual room or space. Occupant load factors were taken from the table, and the room occupant load was then calculated by dividing the area of the room by the Occupant Load Factor associated with that room, as seen below:

$$\text{Room Occupant Load} = \frac{Room\ Area\ (ft^2)}{Occupant\ Load\ Factor\ (\frac{ft^2}{person})}$$

The total building occupant load is then found by summing the occupant loads for all of the rooms. The loading factors that were utilized for the Bonderson Engineering Projects Center are shown in the Table 1 summary below:

Table 1: Life Safety Code Occupant Load Factors

LSC Occupancy Use Classification	LSC Occupant Load Factors (ft^2/Pers)
Assembly Use - Less Concentrated Use, Without Fixed Seating	15 Net
Business Use	100 Gross
Industrial Use - General Industrial Occupancy	100 Gross
Storage Use - Ordinary Hazard Contents	500 Gross
Shops, Laboratories, or Vocational Rooms	50 Net

Details on the room number, room description, room area, the Life Safety Code occupancy category, the Life Safety Code occupancy usage, the occupant load factor, and the final occupant load per room or area within the Bonderson Engineering Projects Center for the first and second floor can be seen in Appendix A.

It is important to note that the occupancy use and occupancy classification are not the same, and that occupancy use (and associated occupant load factor) is based on the closest matching use of the room or area rather than a direct correlation to occupancy classification. For example, the Robotics Laboratory has a Business occupancy classification, but uses an Occupant Load Factor of 50 ft^2/person for the Vocational Room usage (subset of Educational Occupancy)

rather than a Business Occupant Load Factor of 100 ft^2/person. A summary of the first floor, second floor, and total building occupant load can be seen in Table 2 below.

Table 2: Calculated Occupant Loads

Occupant Load (Persons)	
First Floor	285
Second Floor	98
Building Total	383

4.1.3 Exit Capacity

The capacity for individual exits located throughout the building was determined through section 7.3.3.1 of the Life Safety Code by using the Exit Capacity Factors found in Table 7.3.3.1, *Capacity Factors,* of the Life Safety Code. The exit capacity factors are different for stairway exits and exits located on level components (building floors) or ramps. The exit capacity factors within the building fall under the "All Others" category of Table 7.3.3.1 and are summarized below:

- Stairways (width per person): 0.3 inches
- Level Components and Ramps (width per person): 0.2 inches

The room number, room description, doorway exit width, exit capacity factor, calculated capacity, and actual required capacity based upon occupant load can be seen in Appendix A. A summary of the main building exit capacity per floor leading to the public way can be seen in Table 3 below. The exit locations can be identified in Appendix A.

Table 3: Exit capacity Summary for First and Second Floor

Location	Occupant Load	Exit Width	Exit Capacity	Meets Req.
Second Floor / Vertical Exits	98			
Stair 1		48"	160	Yes
Stair 2		48"	160	Yes
First Floor (Public Way Exits)	285			
Exit 1		72"	360	Yes
Exit 2		72"	360	Yes
Exit 3		72"	360	Yes
Exit 4		36"	180	Yes
Exit 5		36"	180	Yes
Exit 6		36"	180	Yes

4.1.4 Exit Arrangement, Location, and Remoteness

The Bonderson Engineering Projects Center building meets code requirements set forth in the Life Safety Code concerning the arrangement of exits. All individual rooms, as well as the building as a whole, meet requirements for arrangement and location of exits, including:

- LSC Section 7.5.1.1: Exits are readily accessible
- LSC Section 7.5.1.3.1: Exits are remote from each other
- LSC Section 7.5.1.3.2: Exit separation > 1/3 room or building diagonal

Two means of egress are required, as a minimum, in every section where size, occupancy, and arrangement endanger occupants attempting to use a single exit that is blocked by fire or smoke. Additionally, two exits are also required in spaces with an occupant load greater than 50 people. Generally, these exits are required to be separated by no less than one-half of the overall diagonal of the building or room area served by the exits. This requirement can be lowered to 1/3 of the diagonal when an approved, automatic sprinkler system is installed. Room 104 (assembly occupancy) and the outside covered work area (industrial) are the only spaces within the building with an occupant load greater than 50 people (actual occupant loads are 120 and 82, respectively). Since two exits are required, and an automatic sprinkler system is installed, the two available exits need to be at least 1/3 of the room's diagonal distance away from each other. The diagonal distance for Room 104 is 91 feet and the exit separation length is 40 feet, which is greater than the 1/3 diagonal distance of 30.3 feet. This can be seen in Figure 2 below. The overall diagonals of the exits for the covered work area, as well as the first and second floor, follow this same procedure and are adequate to the Life Safety Code standards. The IBC has the same requirements regarding exit separation and diagonal length and as such, is also satisfied. Additionally, when there are more than two exits available, only two need to be separated by the minimum diagonal length (IBC 1015.2.2). This allows the two lobby exits to be so close while still satisfying code requirements.

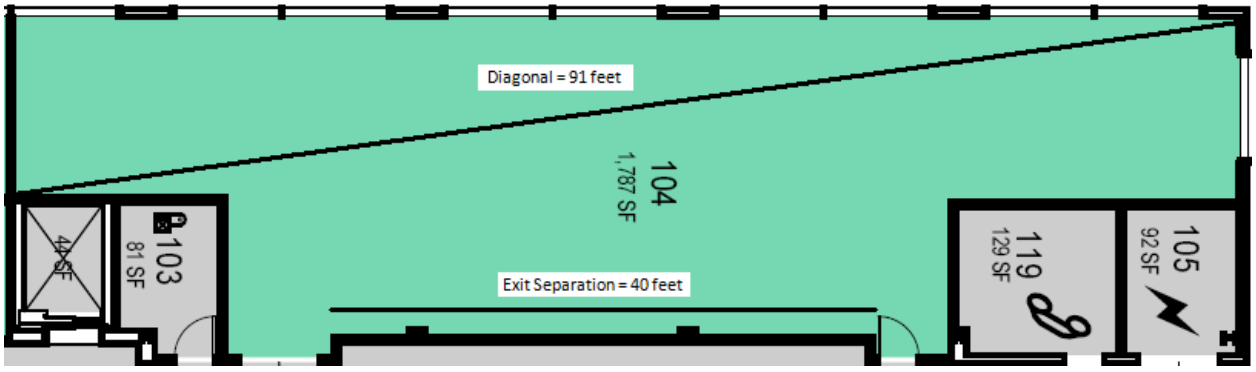


Figure 2: Exit Remoteness for Room 104

Although room 104 does meet standards for exit remoteness, its 36” exit does not meet code in regards to door swing direction, and both exits do not meet the code regarding panic hardware. Section 7.2.1.4.2 of the LSC requires door leaves of the side-hinged type shall swing in the direction of egress travel. The 36” exit swings into the room, as can be seen in Figure 3 below.

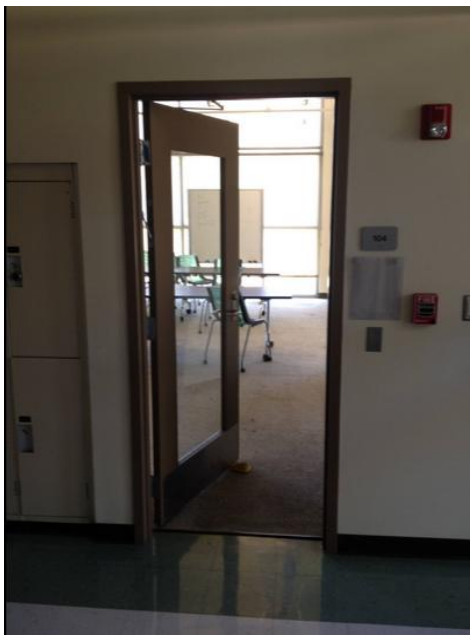


Figure 3: Room 104 Exit Violating Door Leaf Swing Direction

Furthermore, 12.2.2.2.3 requires that “any door in a required means of egress from an area having an occupant load of 100 or more persons shall be permitted to be provided with a latch or lock only if the latch or lock is panic hardware or fire-exit hardware complying.” Both exits have locks but do not include panic hardware.

These code violations most likely came about as the use for room 104 evolved. As described previously, the room was initially classified as a Business occupancy in the original construction drawings. But, an Assembly Occupancy is more in line with its current use as a meeting and assembly space. As such, these code violations should be fixed.

4.1.5 Number of Means of Egress

The number of required exits for the building as a whole is based on Section 7.4.1. The number of required exits per story shall not be less than two (unless permitted in other various LSC chapters), but is increased as the occupant load is increased. The general required number of exits per story can be seen in Table 4 below.

Table 4: Required Number of Exits Per Story Based Upon Occupant Load

Floor Occupant Load	Required Number of Exits
≤ 500	2
501 -> 1000	3
≥ 1001	4

Since both floors have an occupant load of less than 500 people, each floor is only required to have two exits. Both floors of the building meet this requirement.

The required number of means of egress from individual rooms follow the same standard guidelines. In addition, the IBC requires that rooms with an occupant load of 50 or more for Assembly, Business, and Factory (Industrial) have two exits. This requirement is satisfied, and a large number of rooms have two exits even with an occupant load of less than 50 people. This would allow these rooms to change in use in the future and still meet prescriptive requirements.

4.1.6 Travel Distance and Dead End Requirements

Maximum travel distances and dead end requirements that occupants are allowed to be subjected to in order to reach one of the required exits is covered in 7.6 of the Life Safety Code and Section 1016.1 of the IBC. Requirements vary based upon occupancy classification and if sprinklers are installed. Since the Bonderson Engineering Projects Center is a Mixed Use Occupancy, an analysis was performed to check that each individual occupancy adhered to the strictest standards. A summary of the travel distance and dead end limits per occupancy classification can be seen in Table 5 below.

Table 5: Maximum Travel Distances and Dead End Limits

Occupancy (Existing)	Travel Distance Limit (ft)	Dead End Limit (ft)	Common Travel
Assembly	250	20	20/75
Business	300	50	100
Industrial	250	50	100

The most restrictive criteria is 250 feet for the maximum travel distance, 20 feet for the maximum dead end limit, and 20 or 70 feet for the common path, depending on occupant load. Examination of floor plans and full building walk-through's reveal that the Bonderson Engineering Projects Center meets these code requirements. for maximum travel distance and dead end limits.

4.1.7 Exit Signage and Illumination

Section A.7.10.1.2.1 of the Life Safety Code states, “where a main entrance also serves as an exit, it will usually be sufficiently obvious to occupants so that no exit sign is needed. The character of the occupancy has a practical effect on the need for signs. In any assembly occupancy, hotel, department store, or other building subject to transient occupancy, the need for signs will be greater than in a building subject to permanent or semi-permanent occupancy by the same people, such as an apartment house where the residents are presumed to be familiar with exit facilities by reason of regular use thereof. Even in a permanent residence–type building, however, there is a need for signs to identify exit facilities such as outside stairs that are not subject to regular use during the normal occupancy of the building. There are many types of situations where the actual need for signs is debatable. In cases of doubt, however, it is desirable to be on the safe side by providing signs, particularly because posting signs does not ordinarily involve any material expense or inconvenience. The requirement for the locations of exit signs visible from any direction of exit access is illustrated in Figure 4 below.

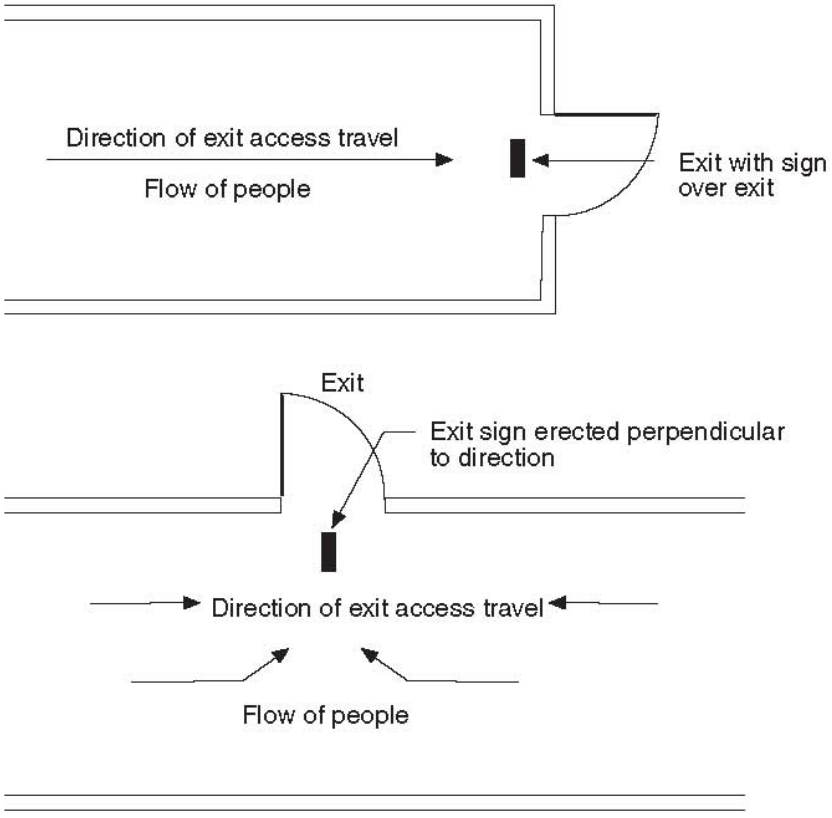


Figure 4: Proper Exit Sign Placement as per Life Safety Code

The building seems to meet requirements in regards to the location and placement of Exit Signs. The layout of Exit Signs can be seen in Appendix A.

Illumination of the means of egress is another important factor to consider. IBC Section 1006.1 requires that the means of egress, including the exit discharge, be illuminated at all times when the building space served by the means of egress is occupied and at not less than 1 foot-candle at the walking surface. Additionally, Section 1006.3 requires that in the event of a power failure, an emergency system should automatically illuminate

- Aisles and unenclosed egress stairways
- Corridors, exit enclosures, and exit passageways
- Exterior egress components at other than their levels of exit discharge.

The Bonderson Engineering Projects Center is supplied with in line night lights to provide illumination of the egress pathway at night, as well as emergency battery pack lights which activate to supply illumination to the means of egress should power fail. The locations of these emergency lights can be seen in Appendix A.

4.1.8 Interior Finishes

Interior finish requirements for exits, corridors, and other spaces within a building are regulated by Section 10.2.2 of the Life Safety Code. The requirements pertaining to interior finishes are intended to restrict the spread of fire over the continuous surface forming the interior portions of a building. Interior finish classifications are based upon the materials flame spread index and smoke development rates. Class A finishes have the lowest flame spread rates while Class C finishes have the highest. Interior finishes within the Bonderson Engineering Projects Center are minimal. A majority of the building is comprised of exposed structural members and concrete flooring. While finishes such as fiber cement panels, vinyl tiles, painted gypsum, and carpet tiles do exist within the building, the overall level of combustible finishes is quite low. A summary of Table A.10.2, *Interior Finish Classification Limitations,* is shown in Table 6 below:

Table 6: Interior Finish Classification Limitations (LSC)

Occupancy	Exits	Exit Access Corridors	Other Spaces
Assembly - Existing, ≤ 300	A	A or B	A or B
Business - Existing	A or B	A or B	A, B, or C
Industrial	A or B	A, B, or C	A, B, or C

Class A finishes used throughout the building include the concrete floors and the painted, exposed structural members. Interior finishes for the corridors include 4” vinyl base floor coverings and LRV 82 “Arizona White” paint frazee on the walls and ceiling.

4.2 Structural Fire Protection

4.2.0 Structural Fire Protection Overview

This section reviews the structural fire protection requirements and features present within the Bonderson Engineering Projects Center. The requirements are based upon the standards put forth within the International Building Code, and cover subjects such as the building construction, allowable areas, heights, and stories, as well as the required fire resistance ratings of various structural members and elements.

4.2.1 Building Construction and Type

The Bonderson Engineering Projects Center is a concrete and steel frame building of Type II-B construction, which is known as an unprotected, non-combustible building. The total building occupies approximately 18,575 ft^2, with 12,240 ft^2 located on the first floor, and 6,335 ft^2 located on the second floor. The total building height is 29' – 0" with the second floor starting at 14' – 1".

Table 7: Allowable Area, Heights, and Stories

TABLE 503
ALLOWABLE BUILDING HEIGHTS AND AREAS[a]
Building height limitations shown in feet above grade plane. Story limitations shown as stories above grade plane.
Building area limitations shown in square feet, as determined by the definition of "Area, building," per story

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
	HEIGHT(feet)	UL	160	65	55	65	55	65	50	40
GROUP		STORIES(S) AREA (A)								
A-1	S	UL	5	3	2	3	2	3	2	1
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
A-2	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-4	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-5	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	S	UL	11	5	3	5	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
E	S	UL	5	3	2	3	2	3	1	1
	A	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
F-1	S	UL	11	4	2	3	2	4	2	1
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
F-2	S	UL	11	5	3	4	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	18,000	50,500	21,000	13,000

Table 503 (Table 7, above), *Allowable Building Heights and Areas,* of Chapter 5 – General Building Heights and Areas of the International Building Code specifies the maximum building height, maximum building area, and maximum stories allowed for various construction types and building occupancies. Table 503 specifies that a building of Type II-B construction can have a maximum height of 55 feet, a maximum floor area of 9,500 ft^2, and a maximum amount of 2

stories for a Group A-3 (Assembly) Occupancy, a maximum height of 55 feet, a maximum floor area of 23,000 ft^2, and a maximum amount of 3 stories for a Group B (Business) Occupancy, and a maximum height of 55 feet, a maximum floor area of 15,500 ft^2, and a maximum amount of 2 stories for a Group F-1 (Industrial) Occupancy. A summarized view of the allowable characteristics per Occupancy Group (A, B, and F-1) and the actual building characteristics can be seen in Table 8 below:

Table 8: Summarized Allowable Area, Height, and Stories

Occupancy Group	Max. Allowable Area (ft^2)	Max. Allowable Heights (ft)	Max. Allowable Stories
A-3	9,500	55	2
B	23,000	55	3
F-1	15,500	55	2
Actual	20,350	29	2

When analyzing the building as a Mixed Occupancy building, the most restrictive characteristics apply. In this case, the Assembly Group 3 occupancy is the most restrictive. The actual building characteristics meet all of the requirements except for the maximum allowable floor area. Group A-3 allows a maximum floor area of 9,500 ft^2, whereas the actual maximum floor area (first floor) is 20,350 ft^2 when counting the covered work area as floor area since it falls under the above roof/floor horizontal projection.

4.2.2 Allowable Increases

Increases to the allowable area, height, and maximum number of stories allowed per Table 503 exist (IBC Section 504.2, 506.2, and 506.3) based upon installation of an approved, automatic sprinkler system as well as public way or open space frontage around the perimeter of the building. Section 504.2 allows for a 20 foot maximum height increase and one additional story to be allotted for buildings protected by an approved, automatic sprinkler system. Since the building already meets the most restrictive height and story requirements, taking advantage of this increase is not needed. Section 506.2 allows for an increase in the maximum floor area (from Table 503) based on frontage increases. This takes into account the portion of a building that fronts on a pubic way or an open space of 20 feet or greater, as well as the width of the public way spacing. Furthermore, Section 506.3 allows for a 200% maximum area increase (from Table 503) based upon installation of an approved, automatic sprinkler system for buildings with more than one story above grade plane. A summary of the allowed percentage of area increases can be seen in Table 9 below:

Table 9: Allowed Percentage of Area Increase

Base Area	100%
Frontage Increase	50%
Sprinkler Increase	200%
Area After Increase	250%

Taking this into account, the new allowable maximum area for the most restrictive occupancy, Group A-3, is 23,750 ft^2. This is above the actual first floor area of 20,350 ft^2, which includes the 8,110 ft^2 Covered Work Area as part of the IBC's "area, building" definition, and so the building meets IBC standards.

4.2.3 Fire Resistance Ratings

Table 601 (Table 10), *Fire-Resistance Rating Requirements For Building Elements (hours),* of Chapter 6 – Types of Construction, of the International Building Code, sets forth the minimum needed fire resistance ratings of various building elements for specific construction types.

Table 10: Fire Resistance Rating Requirements for Building Elements (IBC)

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

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

The following fire resistance ratings per building element are required for a Type II-B building:

- **Primary Structural Frame:** 0 hours
- **Bearing Walls**
  - **Exterior:** 0 hours
  - **Interior:** 0 hours
- **Interior Nonbearing Walls:** 0 hours

- **Interior Nonbearing Partitions:** 0 hours
- **Floor Construction/Secondary Members:** 0 hours
- **Roof Construction/Secondary Members:** 0 hours

The fire resistance rating of exterior nonbearing walls and partitions can be found in Table 602 (Table 11), *Fire Resistance Rating Requirements For Exterior Walls Based On Fire Separation Distance,* of the International Building Code.

Table 11: Fire Resistance Rating Requirements for Exterior Walls Based on Fire Separation (IBC)

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, e]

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

The fire resistance rating requirements for these structural members are based upon the fire separation distance measured from the exterior wall of the building to the exterior wall of the closest adjacent building or the middle of a public road/public way. The minimum fire separation distance for the Bonderson Engineering Projects Center conservatively falls within the 10 ≤ X ≤ 30 feet range for the most challenging building side. With this, it can be seen that the fire resistance rating for exterior walls for either Group A, B, or F-1 Occupancies is 0 hours.

4.2.4 Structural Elements and Member Specifics

Exterior Walls

Various exterior wall assemblies are used throughout the Bonderson Engineering Projects Center building. Exterior wall assemblies include the following:

- Glass curtain wall
- Reinforced (steel) concrete
- Gypsum lined steel studs with exterior fastened 5/16th inch cement board

The exterior walls for the Bonderson Engineering Projects Center building are non-load bearing. Large parts of the North side wall are plain glass sections. Other exterior sections feature 5/16 inch cement board on the exterior face which is held in place by 18 gauge galvanized 1 ½ inch Z-Channel spacers. A vapor permeable air barrier membrane butts up against 5/8 inch thick glass

mat sheathing. Approximately four inches of acoustic and thermal insulation comprises the middle section of the wall and the interior face is comprised of 5/8 inch thick Type X gypsum board. Construction drawings of the various wall assembly sections can be seen in Appendix B.

Interior Walls

Various interior wall assemblies are used throughout the Bonderson Engineering Projects Center building. The interior walls of the Bonderson building are non-load bearing, but at some sections may cosmetically cover up load bearing columns. The typical interior wall / partition features a minimum 25 gauge ceiling runner with 3" flanges which hold in place 5/8 inch Type X gypsum board, which is fastened to MTL studs and the floor and ceiling track with 1" Type S BUGLE head screws at 8 inches on center along the edges and 12 inches on center in the field of the board. Acoustic insulation is added in the center as necessary. Construction drawings of the various wall assembly sections can be seen in Appendix B.

Roof Assembly

The roof assembly is constructed out of 20-gauge steel decking with an insulation layer and outer membrane layer. Construction drawings of the roof assembly can be seen in Appendix B.

First Floor Construction

The Bonderson Engineering Projects Center building is built on top of a concrete reinforced foundation and is situated on grade. Four foot by four foot spread footings support the columns at their designated locations. The foundation slab itself is a 2 foot thick concrete mat with steel reinforcement. The steel reinforcement runs both ways and are #7 bars located on center at 12 inches. Construction drawings of the floor/slab construction can be seen in Appendix B.

Second Story Floor Construction

The second story floor of the Bonderson building is comprised of VERCO W3 20 gauge composite metal decking overlain with a light weight concrete fill giving a total thickness of 7 ¼ inches. Steel welded wire mesh fabric reinforcement runs throughout the slab with 6x6 W1.4 x W1.4 reinforcement at the center of the slab.

The roof decking is comprised of VERCO N24 20 gauge side lap BCP at 12 inches on center with 4 welds per sheet to support its load.

Both the floor and roof assemblies are not rated for fire resistance as the Type II-B construction standards do not require a fire resistance for those assemblies.

Construction drawings of the second story floor section can be seen in Appendix B.

Columns

The most common column assembly uses a W12x45 steel member which is either unprotected and exposed, or lined with a 5/8 inch gypsum board covering. Columns are attached to the ground level base-mat described above. Figure 5 below shows pictures of a typical unprotected column assembly.

Figure 5: Unprotected/Exposed Structural Columns – 0 hr Fire Resistance Rating

Construction drawings of the column spacing and locations can be seen in Appendix B.

Beams

Beam assemblies are constructed using wide flange I-Beam steel members which range in size depending upon location and load bearing requirements. Beams within the building range from W12x14 to W21x50, including W18x35, W16x36, and W16x26. As with columns, and depending upon location, structural beam members are either unprotected and exposed or are covered with 5/8th inch gypsum wallboard for appearance and sectioning purposes. Construction drawings of the beam spacing and locations be seen in Appendix B.

Joints and Penetrations

Where through penetrations exist in fire rated walls, the penetrations need to comply with Section 713.3.1 of the International Building Code. Section 713.3.1.1 states that penetrations

shall be installed as tested in an approved fire-resistance rated assembly. Section 713.3.1.2 states that through penetrations of fire-resistance rated walls shall be protected by an approved penetration fire stop system installed as tested in accordance with either ASTM or UL standards. Figure 6 below shows a typical fire penetration stop.

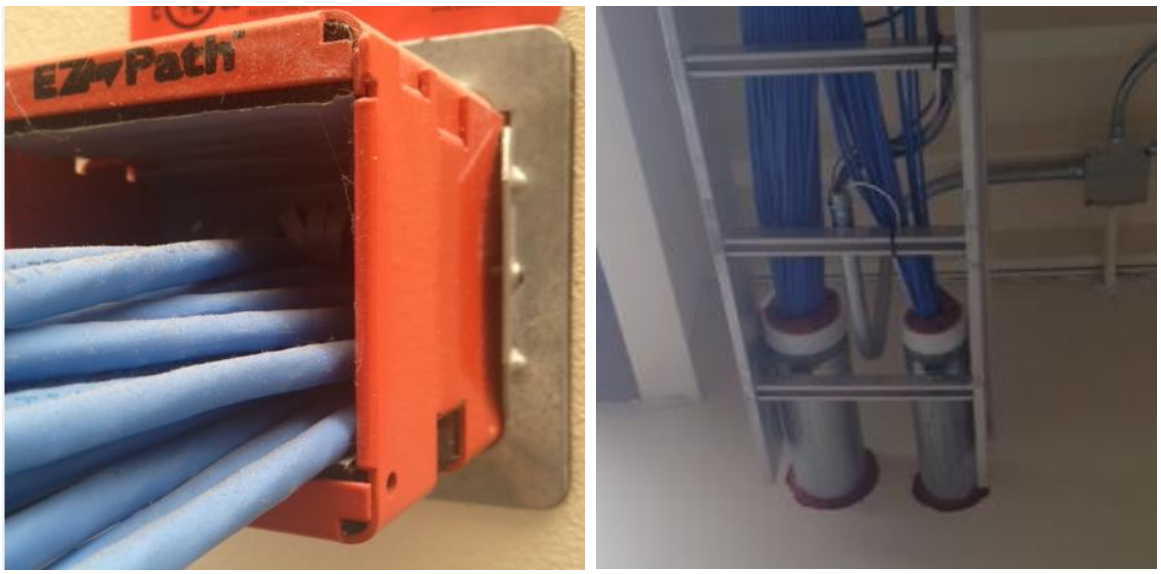


Figure 6: Typical Fire Penetrations

4.2.5 Fire Rated Separation

As mention previously, the Bonderson Engineering Projects Center does not meet the classification requirements for a Separated Occupancy building since the Business and Industrial occupancies on the first floor are not separated. Requirements for rated separation of occupancies can be found in Table 12 below, and are based off of IBC Table 508.4 and LSC Table 6.1.14.4.1(b).

Table 12: Required Fire Rated Separation of Occupancies for Rated Separation Occupancy Requirements

Adjacent Occupancies	IBC Required Separation	LSC Required Separation
Assembly from Business	1 hour (sprinklered)	Not Required
Business from Industrial / Factory - Moderate	Not Required	1 hour (Sprinklered)
Assembly from Industrial / Factory - Moderate	Not Required	1 hour (Sprinklered)

The building was constructed with fire rated separation due to code requirements at the time of design. The 2001 CBC, Section 304.2.2.1, required that laboratories and vocational shops

under a Business Occupancy used for education be separated from each other and other portions of the building by not less than a one-hour fire resistive separation. The Bonderson Engineering Projects Center was built to meet this code requirement with 1-hour separation around all of the designated labs and vocational rooms. For example, 1-hour rated walls are provided for the separation of spaces such as the machine shop, wood shop, and laboratory spaces on the first and second floors. This 1-hour fire rated separation is constructed using two layers of 5/8" Type X gypsum wall board on each wall face, with fire stop sealant with backer rod where the section head meets the ceiling and where the section base meets the floor. These rated spaces also have fire rated doors (60 minute), fire dampers in the HVAC system, and rated penetrations (discussed previously) as required. Activation of the smoke alarm system will also cause automatic closing of the tool checkout window in order to ensure rated separation of that area occurs. The building would not meet LSC requirements to classify as a Separated Occupancy because room 117 (Business occupancy) and room 114 (Industrial occupancy) are not separated by a 1 hour rated separation.

Section 7.1.3.1, Exit Access Corridors, of the Life Safety Code, requires corridors used as exit access and serving an occupant load of more than 30 people to have a 1-hour fire rated separation from other parts of the building unless otherwise permitted in applicable individual occupancy chapters. Chapter 12, Section 12.3.6 (Assembly Occupancies), Chapter 38, Section 38.3.6 (Business Occupancies), and Chapter 40, Section 40.3.6 (Industrial Occupancies) all state that corridors do not need to be fire rated if the building is protected throughout by an approved, automatic sprinkler system.

Section 38.3.2.2 states that high hazard content areas shall be separated from other parts of the building by fire barriers having a minimum 1-hour fire resistance rating, with all openings therein protected by self-closing fire door assemblies having a minimum ¾ hour fire protection rating, as well as being protected by an automatic extinguishing system. Original fire rated separation construction throughout the building separates the high hazard areas, mainly laboratories, workshops, and vocational shops, including the machine shop and wood working shop, from other areas. The fire rated separation around room 107 and 102 also satisfies IBC Section 404.6, which requires that atrium spaces be separated from adjacent spaces by a 1-hour fire barrier. Locations of the fire rated separation can be seen in Appendix B.

4.3 Fire Detection and Alarm Systems

4.3.0 Detection and Alarm Overview

Prompt detection and notification of fire scenarios is important in ensuring occupant safety. If there are no detectors in the room or area of fire origin, the fire could grow to exceed design objectives before being detected and the start of evacuation. Furthermore, inadequate detector response, delayed occupant notification, and/or incorrect response for the disposition of alarms or signals can greatly increase the probability of occupant fatalities.

In order to maximize the probability of quick detection and occupant notification, as well as to satisfy code requirements for the presence of an alarm system, the Bonderson Engineering Projects Center is equipped with a number of various detection, initiation, and notification systems and appliances. The primary system includes a full coverage, building wide ionization smoke detection system. Additional detection and initiation is achieved through a combination of heat detectors (non sprinkler), sprinklers, manual pull stations, and a water flow switch. Notification is achieved through a combination of strobe and horn/strobe appliances. The detection and alarm systems are connected to a Fire Alarm Annunciator in the main lobby as well as a Fire Alarm Control Panel in Room 105. The Cal Poly campus features a campus wide fire alarm and security system which is routed through a Proprietary Supervising Station. The requirements upon receipt of an Alarm, Supervisory, or Trouble signal are described below as per NFPA 72, Chapter 26:

Alarm Signal – Section 26.3.8.1.2
Upon receipt of an alarm signal, the central station shall perform the following actions:
(1) Retransmit the alarm to the communications center (fire department/emergency dispatch, etc).
(2) Dispatch a runner or technician to the protected premises to arrive within 2 hours after receipt of a signal if equipment needs to be manually reset by the prime contractor. Depending upon specific AHJ instructions, the runner can be recalled prior to arrival at the premises if a qualified representative of the subscriber at the premises can provide the necessary resetting of the equipment and is able to place the system back in operating condition.
(3) Immediately notify the subscriber.
(4) Provide notice to the subscriber or authority having jurisdiction, or both, if required.

Supervisory Signal – Section 26.3.8.3
Upon receipt of a supervisory signal, the central station shall perform the following actions:
(1) Communicate immediately with the persons designated by the subscriber and notify

the fire department or law enforcement agency, or both, if required.
(2) Dispatch a runner or maintenance person to arrive within 2 hours to investigate unless the supervisory signal is cleared in accordance with a scheduled procedure.
(3) Notify the AHJ when the sprinkler system or other fire suppression systems or equipment have been wholly or partially out of service for 8 hours.
(4) When service has been restored, provide notice, if required, to the subscriber or the AHJ, or both, as to the nature of the signal, the time of occurrence, and the restoration of service when equipment has been out of service for 8 hours or more.

Trouble Signal – Section 26.3.8.4
Upon receipt of trouble signals or other signals pertaining solely to matters of equipment maintenance of the alarm systems, the central station shall perform the following actions:
(1) Communicate immediately with the persons designated by the subscriber.
(2) Dispatch personnel to arrive within 4 hours to initiate maintenance, if necessary.
(3) When the interruption is more than 8 hours, provide notice to the subscriber and the fire department if so required by the AHJ as to the nature of the interruption, the time of occurrence, and the restoration of service.

4.3.1 Detection Devices

As discussed earlier, the detection and initiation systems and devices installed throughout the Bonderson Engineering Projects Center include:

- Building wide ionization smoke detection system
- Heat detectors
- Manual pull stations
- Water flow switch

Smoke Detection

Smoke detection within the Bonderson Engineering Projects Center is carried out through the use of ionization smoke detectors. Three types of detectors are in use throughout the building. There are 16 Notifier FSP-851 smoke detectors and 10 Notifier FSH-751 HARSH smoke detectors on the first floor and 20 Notifier FSP-851 smoke detectors and 2 Notifier FSH-751 HARSH smoke detectors on the second floor, which are shown in Figure 7 below.

Figure 7: Notifier FSP-851 Smoke Detector, Notifier FSH-751 HARSH Smoke Detector, and Notifier Intelligent Duct Smoke Detectors (FSD-751RP)

The standard (FSP-851) detectors are used in normal use areas such as the assembly and business occupancies. The HARSH (FSH-751) detectors are used in areas of greater hazard, such as the machine and wood shops, where the standard detectors might be prone to nuisance alarms. Finally, two Notifier Intelligent Duct Smoke Detectors (FSD-751RP) are located within the building's HVAC system. Sequence of Operation coding within the fire alarm system allows for the HVAC system to be shut down upon receipt of an alarm signal from either of the duct detectors. The specific layout and locations of the various devices, as well as the appliance specification sheets, can be seen in Appendix C.

Detector spacing is based upon prescriptive standards set forth in NFPA 72, where a maximum 30 foot spacing is allowed for detectors on smooth ceilings or under solid joist construction with joist depth being less than 0.1*H (Section 17.7.3.2.3.1).

Heat Detection

Two Notifier (FST-851) (Figure 8) heat detectors supplement the building wide ionization smoke detection system with regards to fire detection. A single heat detector is located on each floor, with the first detector (ground level) located in the elevator equipment room (Room 103) while the second heat detector is located at the top of the elevator shaft on the second story (near the roof level). The specific layout and locations of the various devices, as well as the appliance specification sheet, can be seen in Appendix C.

Figure 8: Notifier (FST-851) Heat Detector

Manual Pull Stations

There are four manual pull station (Notifier NBG-12LX) (Figure 9) appliances located throughout the building. Three are located on the first floor near building exits while the fourth is located on the second story near the Eastern facing exterior stairway exit. The manual pull stations meet the NFPA 72 requirements set forth in Chapter 17 for:

- Are conspicuous, unobstructed, and accessible (17.14.8.2).
- Are red in color (17.14.8.3).
- Are located within 5 feet of each exit doorway on each floor (17.14.8.4).
- Are provided such that travel distance between stations does not exceed 200 feet (17.14.8.5).

Figure 9: Notifier NBG-12LX Manual Pull Station

The specific layout and locations of the various devices, as well as the appliance specification sheet, can be seen in Appendix C.

The total amount of the various detection and initiation devices located on each floor can be seen in Table 13 below:

Table 13: First and Second Floor Initiating Device Counts

First Floor	Second Floor
Ionization Det. - 16	Ionization Det. - 20
HARSH Ionization Det. - 10	HARSH Ionization Det. - 2
Manual Pull Station - 3	Duct Smoke Detector - 2
Heat Det. - 1	Heat Det. - 1
Water Flow - 1	Pull Station - 1

4.3.2 Notification Devices

As discussed earlier, the notification systems and devices installed throughout the Bonderson Engineering Projects Center include:

- Wall mounted horn/strobe appliances
- Ceiling mounted strobe appliances
- Water bell

Horn/Strobe Appliance

There are 11 wall mounted horn/strobe notification appliances located throughout the ground floor and 5 located on the second floor of the Bonderson Engineering Projects Center (Figure 10). These specific devices are SpectrAlert Notification Devices made by System Sensor. The specific layout and locations of the devices, as well as the appliance specification sheet, can be seen in Appendix C.

Figure 10: Wall Mounted System Sensor Horn/Strobe Device

Strobe Appliance

There are 11 strobe appliances (Figure 11) located throughout the ground floor and 8 located on the second floor of the Bonderson Engineering Projects Center. Like the horn/strobe devices, these appliances are made by System Sensor. The specific layout and locations of the devices, as well as the appliance specification sheet, can be seen in Appendix C.

Figure 11: Ceiling Mounted System Sensor Strobe Alarm

4.3.3 NFPA 72 Code Compliance

Smoke Detectors

Chapter 17 of NFPA 72 deals with the performance, selection, use, and location requirements for automatic fire detection devices. As per 17.1.1, "The performance, selection, use, and location of automatic fire detection devices, sprinkler water flow detectors, manually activated alarm stations and supervisory signal-initiating devices must comply with minimum requirements of Chapter 17 of NFPA 72." The fire detection devices installed within the Bonderson Engineering Project Center discussed in previous sections must conform to these requirements, which are discussed below.

- Section 17.4.2 requires that initiating devices must not be installed in inaccessible areas.
- Section 17.4.3 requires that initiating devices must be protected where subject to mechanical damage.
- Section 17.4.4 requires that initiating devices must be supported independently of attachment to circuit conductors.
- Section 17.4.6 requires that initiating devices must be installed in all areas where required by other NFPA codes/standards or by other governing laws, codes, or standards.
- Section 17.5.1 requires that detectors cannot be recessed into mounting surface unless listed for such mounting.
- Section 17.5.2 requires that spaces separated by parturitions must be considered as separate rooms where partitions extend to within 15% of the ceiling height. From walkthroughs of the building, there are not spaces separated by partitions that extend to within 15% of the ceiling, and so this section does not apply.

- Section 17.7.1.8 states that unless specifically designed and listed for expected conditions, smoke detectors cannot be installed if any of the following ambient conditions exist: Temperatures below 32F or above 100F, RH above 93%, or air velocity > 300 ft/min. None of these conditions exist and so this section is not applicable.
- Section 17.7.3.2 states that spot-type smoke detectors must be located on the ceiling, or, if on a sidewall, between the ceiling and 12 inches down from the ceiling to the top of the detector.
- Section 17.7.3.1.2 states that the design must account for the contribution of the following factors in predicting detector response to the anticipated fires to which the system is intended to respond:
    - Ceiling shape and surface
    - Ceiling height
    - Configuration of contents in the protected area
    - Combustion characteristics
    - Compartment ventilation
    - Ambient temperature, pressure altitude, and humidity

Also stated in NFPA 72, in the absence of specific performance based design criteria, maximum smooth ceiling smoke detector spacing must be a nominal 30 feet (+/- 18 inches).

From observations, walkthroughs of the building, and plan sheet overviews, the smoke detection system within the building appears to be a total (complete) coverage system. This means that detectors are installed in all accessible compartments or spaces including all rooms, halls, storage areas, and other subdivisions and accessible spaces. The installed smoke detection system appears to meet all of the requirements except for coverage. Small coverage gaps do exist within the building, mainly where the edge of coverage per detector (0.7*Listed Spacing) comes close to ceiling corners. Overall though, the coverage within the building is quite good.

Notification Devices (Horns)

Chapter 18 of NFPA 72 sets forth requirements pertaining to notification appliances. The devices used throughout the building conform to NFPA 72, 18.3.1 *Listing* in that all notification appliances installed shall be listed for the purpose for which they are used. The purpose of the notification devices is set forth in Section 18.2, in that, notification appliances shall provide stimuli for initiating emergency action and provide information to users, emergency response personnel, and occupants.

Maximum sound level limits are set forth in LSC 18.4.1.2 such that the sound pressure level produced by combining the ambient sound pressure level with all audible notification

appliances operating does not exceed 110 dBA at the minimum hearing distance. Average ambient sound level is determined by Table A.18.4.3, *Average Ambient Sound Level According to Location*, from Chapter 18 of the Life Safety Code (Table 14):

Table 14: Average Ambient Sound Level According to Location (NFPA 72)

TABLE A.18.4.3 *Average Ambient Sound Level According to Location*

Location	*Average Ambient Sound Level (dBA)*
Business occupancies	55
Educational occupancies	45
Industrial occupancies	80
Institutional occupancies	50
Mercantile occupancies	40
Mechanical rooms	85
Piers and water-surrounded structures	40
Places of assembly	55
Residential occupancies	35
Storage occupancies	30
Thoroughfares, high-density urban	70
Thoroughfares, medium-density urban	55
Thoroughfares, rural and suburban	40
Tower occupancies	35
Underground structures and windowless buildings	40
Vehicles and vessels	50

The average ambient sound level of applicable occupancies is summarized in Table 15 below:

Table 15: Applicable Occupancy Average Ambient Sound Level

Occupancy Location	Average Ambient Sound Level (dBA)
Assembly	55
Business	55
Industrial	80

Section 18.4.3.1 states that notification appliances must maintain a sound level at least 15 dB above the average ambient sound level or 5 dB above the maximum sound level, whichever is greater. The 6dBA Rule of Thumb Method (6dBA drop every time the distance from the alarm source is doubled) can be used to check sound level compliance above average ambient level. From the manufacturers specification sheet (Table 16) (full version in Appendix C), at the highest selectable setting of a high volume, non-temporal tone at 3000 Hz interrupted, for a 24 V circuit, the horn puts out a decibel level of 86 dBA at 10 feet from its base.

Table 16: Manufacturer Specification Sheet Showing Selectable Decibel Levels

SpectrAlert Horn Sound Measurements (dBA)

Selectable Horn Tones			8-17.5V	16-33V
Temporal	Low Volume	Electromechanical	67	75
		3000 Hz Interrupted	68	75
	High Volume	Electromechanical	71	80
		3000 Hz Interrupted	72	81
Non-Temporal	Low Volume	Electromechanical	71	79
		3000 Hz Interrupted	72	79
	High Volume	Electromechanical	76	84
		3000 Hz Interrupted	77	86

Using the 6 dBA drop off of SPL rule-of-thumb method (NFPA 72 Figure 14.3.1), the drop off in dBA level can be calculated, as seen in Figure 12 below:

86 dBA @ 10 ft (from wall mount) 86 dBA – 6 dBA = 80 dBA

80 dBA @ 20 ft (from wall mount) 80 dBA – 6 dBA = 74 dBA

74 dBA @ 40 ft (from wall mount) 74 dBA – 6 dBA = 68 dBA

68 dBA @ 80 ft (from wall mount)

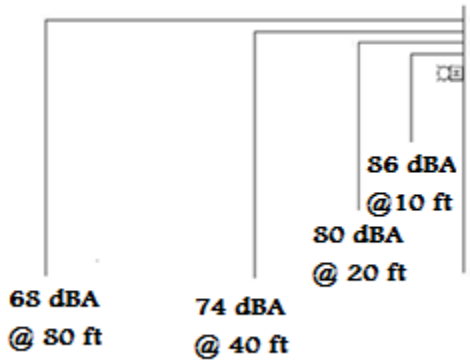


Figure 12: Decibel Level Drop Off for Horn/Strobe Notification Appliance

The minimum dBA level allowed per code (15 dBA above ambient) is shown below for the various occupancies throughout the Bonderson building.

- Assembly: 70 dBA
- Business: 70 dBA

- Industrial: 95 dBA

As can be seen from the device location plans in the Appendix and the calculations from above, the minimum sound level required by the code would not be met in some areas. The industrial occupancy room 107, for example, requires a minimum sound level higher than what is available. Fortunately, the code requirements are met when a more realistic average ambient sound level is utilized. After performing multiple walk-through's over the course of several days, and varying hours, it was apparent that the Bonderson Engineering Projects Center is actually a very quite building (other than the occasional machine shop milling which doesn't last exceptionally long). From the walk-through's, a lower average ambient sound level seems more appropriate, with something around the range of 45 dBA (educational) seeming correct. If an average ambient sound level of 45 dBA is utilized, then a minimum sound level of 60 dBA is required. The strobes allow for a sound level of 68 dBA at 80 feet which is more than adequate for all areas of the building other than room 107. The L shaped nature and long dimensions make meeting the minimum sound level requirement difficult. It is suggested that a second horn device be installed in room 107 along the exterior wall of room 110. This will help ensure adequate coverage is maintained. But, as the code states, actual average ambient sound levels should be recorded for use in calculations. Re-measurement should be done in order to better assess the buildings audible notification system.

Notification Devices (Strobes)

The visible strobe notification devices throughout the Bonderson Engineering Projects Center vary between 15, 30, and 75 Candela settings based upon their location (specific device setting and location can be seen in Appendix C), and are included in all normally occupied spaces. All devices are wall mounted (15, 30, and 75 CD) besides two ceiling mounted 30 CD strobe devices located in both bathrooms. NFPA 72, Section 18.5.5.4 governs strobe spacing's in rooms, with Table 18.5.5.4.1(a) governing room spacing for wall-mounted visible appliances and Table 18.5.5.4.1(b) governing room spacing for ceiling-mounted visible appliances. The maximum room size to be serviced by an individual strobe, based on its mounting position and intensity output, is shown in Table 17 below.

Table 17: Maximum Room Spacing Allowed Per Strobe

Wall Mounted	Maximum Spacing (ft x ft)
15 CD	20 x 20
30 CD	28 x 28
75 CD	45 x 45
Ceiling Mounted	
30 CD	30 x 30

Based on plan drawings and the spacing values seen above, the strobe notification devices located throughout the Bonderson Engineering Projects Center seem to meet the prescriptive code requirements set forth by NFPA 72.

4.3.4 Power Supply

Primary power is supplied to the Fire Alarm Control Panel through a 120 VAC source. Although this supply is generally reliable and consistent, interruption of the primary power supply could occur. Section 10.6.7.1.1 of NFPA 72 requires a secondary power supply which does not affect the required performance of the system in the event that the primary power supply fails. Backup batteries are provided which supply a direct 24 VDC to the Fire Alarm Control Panel. A backup battery satisfies the secondary power supply requirement through Section 10.6.7.3.1 of NFPA 72.

The backup power supply is required to have sufficient capacity to operate the system under a non-alarm condition for 24 hours and, at the end of that period, be capable of operating all alarm notification appliances for 5 minutes (10.6.7.2.1, NFPA 72). Furthermore, a 20 percent factor of safety is required to be added to all backup battery calculations in order to account for decreases in battery output over its service lifespan. The backup battery power calculation for the Bonderson Engineering Projects Center can be seen in Table below.

Two battery calculations have been performed, one for each Control Panel system. The FACP supplies 86 devices (detection and notification) over 4 Notification Appliance Circuits (NAC's) and 1 Signaling Line Circuit (SLC), while the FCPS1 supplies 13 devices (notification) over 2 Notification Appliance Circuit's (NAC's). A summary of the calculations can be seen in Table 18 below, while the detailed calculations can be found in Appendix C.

Table 18: Secondary Power (Battery) Supply Calculation Summary

Secondary Power Supply	Required Standby Capacity (Amp-Hours)	Required Alarm Capacity (Amp-Hours)	Total Capacity (Amp-Hours)	Factor of Safety Adjusted Capacity (Amp-Hours)
FACP	15.0	0.25	15.25	18.3
FCPS	2.16	0.10	2.26	2.71

4.3.5 Communication Systems

The Bonderson Engineering Projects Center does not have an Emergency Voice Communication System or Mass Notification System installed within the premise, but the Cal Poly Campus does feature an Emergency Mass Notification System for alerting students and faculty about emergency situations such as earthquakes, fires, or terrorist situations. Information on potential fire scenarios would be sent out through email and text message services to students in order to alert them about any fire situation developing within the Bonderson Engineering Projects Center.

4.4 Fire Suppression Systems

4.4.0 Fire Suppression Overview

The Bonderson Engineering Projects Center was designed and built with full coverage from an automatic, wet-pipe sprinkler system. This is the only fire suppression system installed within the building. The sprinkler system within the building was designed to play an integral part in ensuring life safety of occupants during any foreseeable fire scenarios. The sprinkler systems main purpose is to control most fire scenarios in order to maintain tenable conditions and allow occupants enough time to egress the building. While complete extinguishment would be considered a best case scenario, maintaining (controlling) the heat release rate of the burning material at a value lower than what would be expected without sprinkler activation is the expected and acceptable alternative.

4.4.1 Water Supply

Supply water for the sprinkler system comes from an 8” potable city water line. The point of connection branches off into 6” PVC pipe which runs under the adjacent North Perimeter Road and into the building. The 6” PVC pipe has two check valves (backflow preventers) which help prevent water flowing back into the water main and prevents potential contamination. The fire

department connection and the two back flow preventers are located towards the southwest portion of the building and can be seen in Figure 13 below:

Figure 13: Fire Department Connection and Double Back Flow Preventer

Water supply information was obtained from a test on a relatively nearby fire hydrant. A summary of the water flow and pressure information can be seen in Table 19 below, which was obtained from Cal Poly Facilities Planning and Capital Projects:

Table 19: Fire Hydrant Flow and Pressure Data

Hydrant Number	I-05-06
Test Date	9/3/2002
Static Pressure	80 PSI
Residual Pressure	60 PSI
Observed Flow	1210 GPM
Calculated Flow (20 psi)	2190 GPM

4.4.2 Riser, Piping, and Sprinklers

The wet pipe sprinkler system installed in the building is fed by a single 4” sprinkler riser located in room 108 in the south-western corner of the building near the fire department connection and double check valves (discussed previously), and can be seen in Figure 14 below.

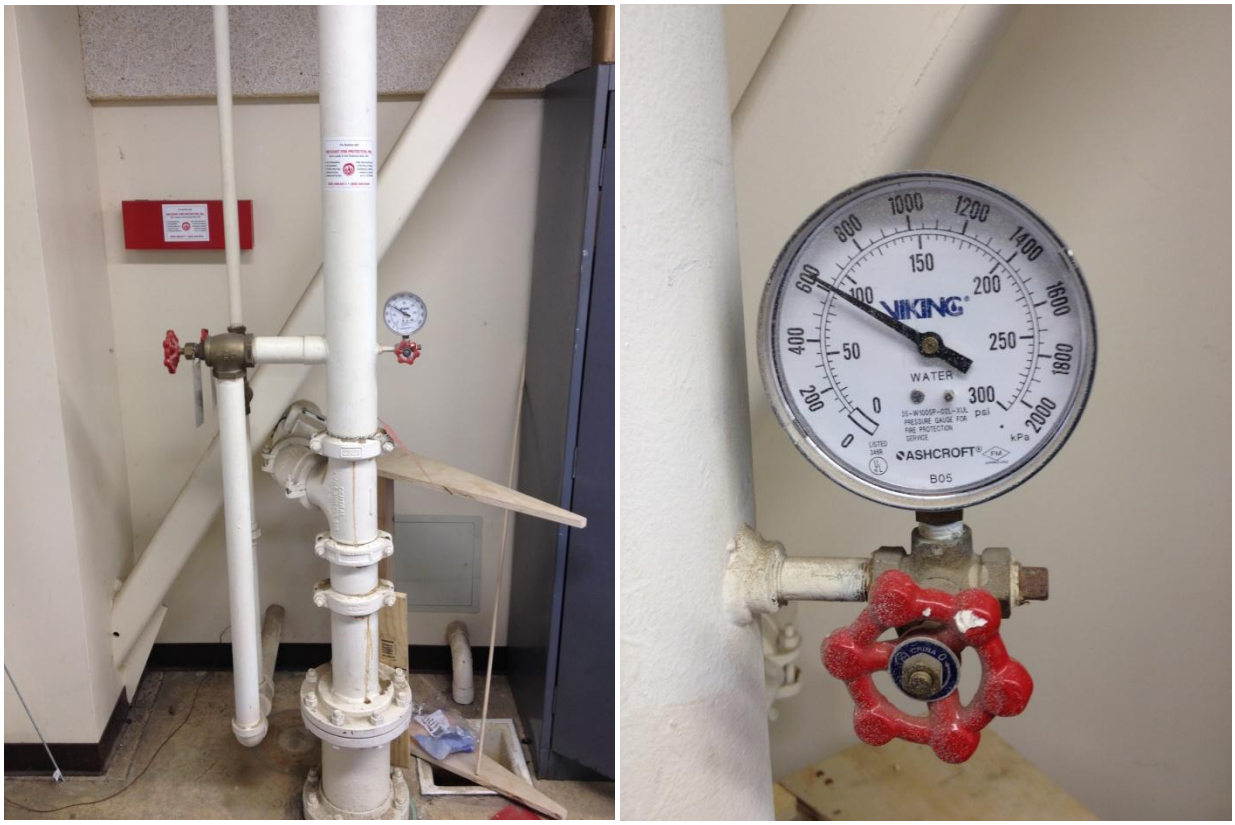


Figure 14: Sprinkler Riser and Pressure Gauge

Two main branch lines come off of the riser, with one feeding the ground level branch lines and ceiling sprinklers, and the other feeding the second floor branch lines and ceiling sprinklers. The riser and mains are 2.5" – 4" schedule 10 pipe while the branch lines are 1" – 2" schedule 40 piping. The wet pipe sprinkler system has a total of 271 sprinklers which are distributed throughout the building. Four different types of sprinklers are used throughout the building. All have a K-Factor of 5.6, but with various operating temperatures. The type, quantity, and operating temperature (°F) are described in Table 19 below:

Table 19: Sprinkler Types, Characteristics, and Quantities

Sprinkler Type	Finish	K-Factor	Degree	Quantity
1/2" Tyco TY-FRB Upright, 28 " Sprig	Brass	5.6	200	208
1/2" Tyco TY-FRB Upright	Brass	5.6	200	38
1/2" Tyco TY-FRB Pendant, 1" Drop	Chrome	5.6	155	24
1/2" Tyco TY-FRB Horiz. Sidewall	Brass	5.6	155	1

According to the manufacturer's specification sheet (Appendix D), the sprinklers installed throughout the building are quick response.

4.4.3 Water Demand Requirements

Section 11.2.3.1.1 of NFPA 13 allows the use of the Density/Area Method (11.2.3.2) for determining the water demand for the sprinkler system. This approach utilizes Figure 11.2.3.1.1 (Figure 13), *Density/Area Curves,* and the hazard classification of the most hydraulically remote area, to determine the water flow and pressure requirements at the base of the riser (BOR) and/or point of connection (POC).

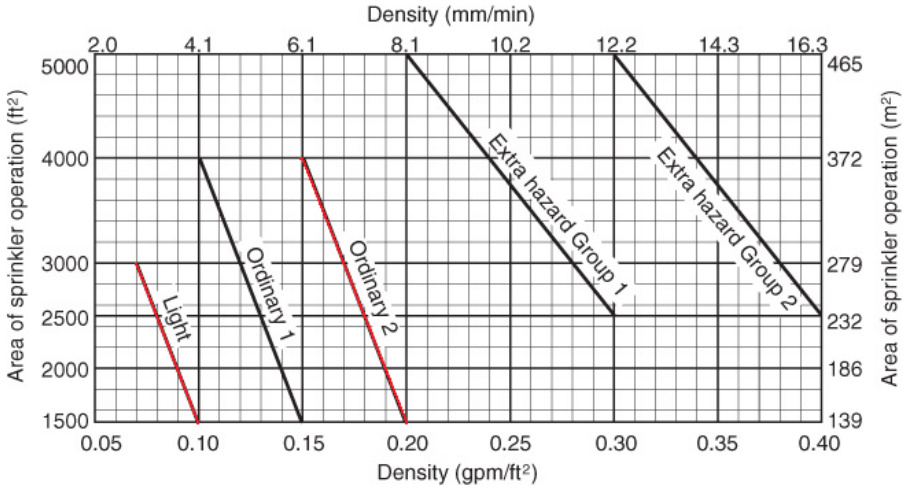


FIGURE 11.2.3.1.1
Density/Area Curves.

Figure 15: NFPA 13, Density/Area Curves

Since the sprinklers throughout the building are quick response, Figure 11.2.3.2.3.1 can be utilized in order to reduce the design area without revising the design density. The reduction in design area calculates out as 34 percent.

Normally, the most hydraulically remote area would create the most demand on the sprinkler system, and as such, would be utilized for flow and pressure calculations. The most hydraulically remote area in this case is found in the north-eastern corner of the building in proximity to Room 205. This area is classified as a Light Hazard Occupancy in that the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected (NFPA 13, Section 5.2). This location and occupancy would classify under a 1500 ft^2 area of operation and 0.10 gpm/ft^2 density design, but due to the area reduction, qualifies as a 990 ft^2 design area with 0.10 gpm/ft^2 density design. But, the machine shop on the first floor, while not the most hydraulically remote location, classifies as an Ordinary Hazard Group 2 Occupancy (NFPA 13, Section 5.3.2). The interesting situation arises in which a lower hazard occupancy (Light Hazard Occupancy - LHO) room on the second floor is more remote, and therefore will probably have a greater pressure requirement at the base of the riser, while the

greater hazard occupancy (OH2 – Machine Shop) could have a greater water flow requirement due to the greater density demand per Figure 11.2.3.1.1. Since it is impossible to tell offhand which situation will be more hydraulically demanding, both scenarios will be calculated using the friction loss method as outlined in Section 23.3.1 of NFPA 13. The results, with the addition of a hose stream allowance, are then graphed on hydraulic graph paper and compared to the water supply to ensure an adequate flow rate and pressure is available.

Light Hazard Occupancy

The Light Hazard Occupancy on the second floor (most hydraulically remote area) requires a minimum design area of 990 ft^2 with a 0.10 gpm/ft^2 density. The layout of the sprinklers is not entirely symmetrical, but the coverage area per sprinkler roughly equates to 120 ft^2. A 990 ft^2 design area with 120 ft^2 area coverage per sprinkler equates to 8.25 sprinklers. Since you cannot have half of a sprinkler, the amount required is rounded up to stay conservative. But, a check also has to be made to make sure that the minimum number of sprinklers actually cover the required design area. Because the three sprinklers in rooms 206, 206A, and 207 only cover roughly 80 ft^2 (due to the small room dimensions), two extra sprinklers needed to be added to the calculations in order to actually cover the required 990 ft^2. Sprinklers were laid out with 5 on one branch line and 6 on the other based upon the 1.2 * square root of the design area rule. The results of the hydraulic calculations for the light hazard occupancy are summarized in Table 20 below. The complete hydraulic calculations can be found in Appendix D.

Table 20: LHO Calculation Summary

Number of Sprinklers	11
Design Area	990 ft^2
Design Density	0.10 gpm/ft^2
Calculated Flow Rate	159 gpm
Calculated Pressure (B.O.R.)	64.2 psi

Table 20: LHO Calculation Summary

The values for the LHO are close to what the sprinkler designer calculated before the system was installed. The sprinkler designer's basis of design was a hydraulically remote area on the second floor computer lab (same location) with a density of 0.1 gpm/ft^2, an area of 996 ft^2, and a system demand of 164.66 gpm at 62.4 psi at the base of the riser.

Ordinary Hazard Group 2

The Ordinary Hazard Group 2 occupancy on the first floor requires a minimum design area of 990 ft^2 with a 0.2 gpm/ft^2 density. The layout of the sprinklers is such that each sprinkler covers approximately 100 ft^2. A 990 ft^2 design area with 100 ft^2 area coverage per sprinkler equates to 10 sprinklers. Again though, in order to adhere to the requirement of actually covering the minimum design area, 2 sprinklers needed to be added to the calculation. The 12 most hydraulically remote sprinklers within the Machine Shop and Covered Work Area will be considered, with 4 sprinklers per branch line based upon the 1.2 * square root of the design area. The results of the hydraulic calculations for the Ordinary Hazard Group 2 occupancy are summarized in Table 21 below. The complete calculations can be found in Appendix D.

Table 21: OH-2 Calculation Summary

Number of Sprinklers	12
Design Area	990 ft^2
Design Density	0.20 gpm/ft^2
Calculated Flow Rate	263 gpm
Calculated Pressure (B.O.R.)	54.4 psi

The hydraulic graph showing the results of the two calculations with respect to the water supply can be seen in Figure 16 below. The Bonderson building shares its supply water connection with Building 192 (Engineering IV), located behind it. It is assumed that no significant amount of water is being drawn into Building 192 while these calculations are being performed; ie: there are not two simultaneous fire situations. A 250 gpm hose stream allowance needs to be added to the OH requirements while a 100 gpm hose stream allowance needs to be added to the LHO requirement. As per NFPA 13, the 250 gpm hose stream would need to be able to flow for 60 – 90 minutes (60 minutes if sprinkler system is monitored), and the 100 gpm hose stream would need to be able to flow for a minimum of 30 minutes. Since the water supply comes from a city main, there would be no problem supplying this requirement.

Calculating the flow from the base of the riser back to the point of flow testing results in only a 1.34 psi loss due to 75 feet of 6” piping, 67 feet of equivalent piping for the two check valves, and 90 feet of 8” piping.

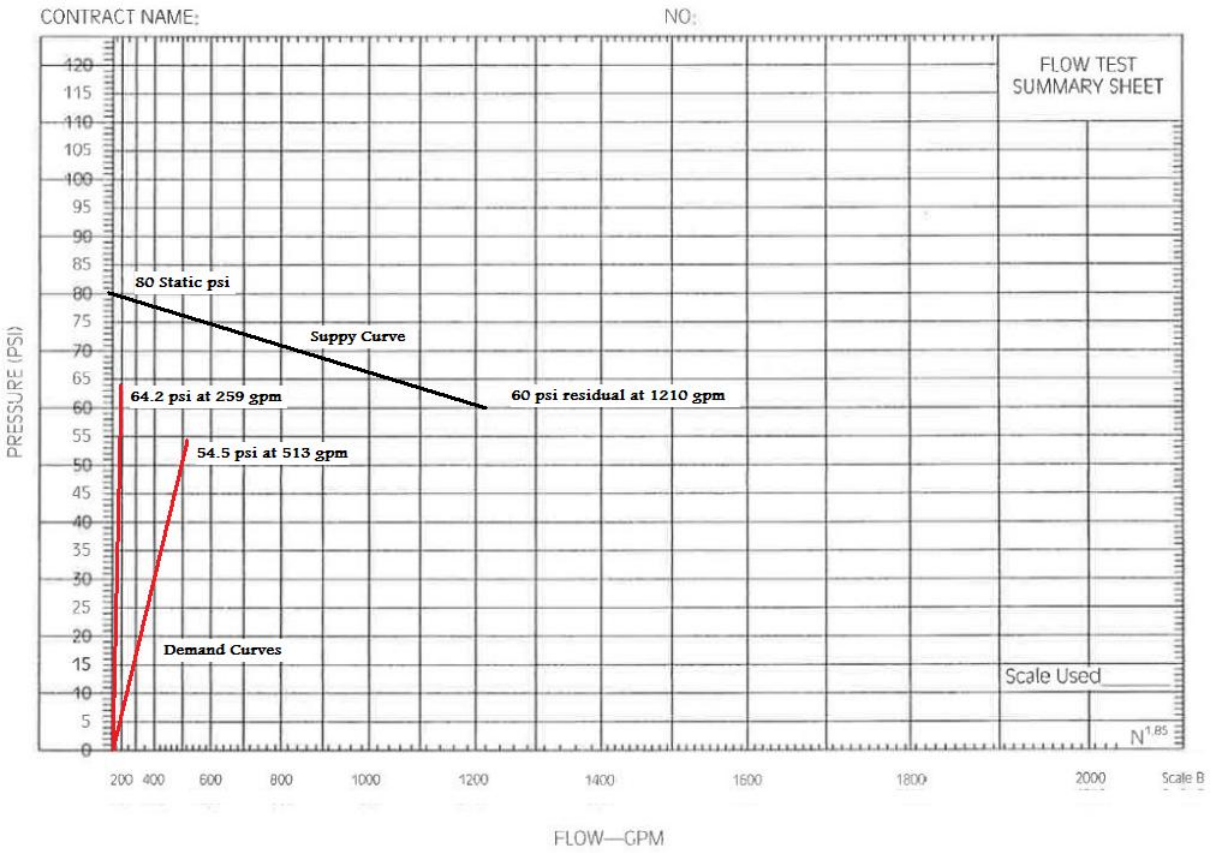


Figure 16: Hydraulic Graph of Supply vs Demand

4.4.4 Fire Sprinkler Bracing

Proper bracing of sprinkler systems is critical to ensuring adequate structural support and system continuity, especially in earthquake prone areas such as California. Chapter 9 of NFPA 13 addresses the structural issues related to the installation of fire protection piping.

A prescriptive approach to hanging sprinkler pipes is offered in place of the requirements set forth in Section 9.1.1. The performance based requirements of Section 9.1.1.2 require a registered professional engineer to design the bracing and support such that:

- Hangers are designed to support five times the weight of the water filled pipe plus 250 lb at each point of piping support
- Hanger points are adequate to support the system
- The spacing between hangers does not exceed the value given for the type of pipe as indicated in Table 9.2.2.1(a) or Table 9.2.2.1(b).
- That hanger components are ferrous
- And that detailed calculations are submitted, when required by the AHJ, showing stresses developed in hangers, piping, and fittings, and safety factors allowed

A number of support and bracing configurations are used throughout the building to help hold up the piping system. In some sections, the piping is attached directly to the steel I-beams, and in other areas the hangers are attached to the metal roof decking. In both cases, a 3/8" All Threaded Rod spans the distance between the hanger supporting the piping and the attachment point to the building's structural member. The main trapeze assembly consists of a top beam clamp which attaches to the top of a structural I-beam and which supports a 3" schedule 10 x 9'-1-" (SM = 1.04) lateral support section. From this, a 3/8" All Threaded Rod hangs down vertically and connects to a hanger assembly which supports the sprinkler piping.

Bracing consists of a 1" schedule 40 (7'-0" max) pipe connected by a TOLCO connector (Fig. 911) to the steel roof framing, with a 3/8" bold and nut fastener rated at 1,400 lbs. The brace rod is angled from vertical between 60 and 90 degrees and connects to the sprinkler piping by use of a TOLCO fastener (Fig. 1000). Maximum lateral bracing is 40 feet and maximum longitudinal spacing is 80 feet. Sample loading calculations from the design drawings (Appendix D) show general sprinkler pipe loading as follows:

- Total ½ Weight of Piping: 483 lb
- Fittings Allow 15%: 73 lb
- Total: 556 lb

The actual as-built bracing can been seen in Figure 17 below.

Figure 17: Example of Fire Sprinkler Bracing

5.0 Atrium

The Bonderson Engineering Projects Center features a two story atrium (Figure 18) as part of the main lobby construction. An atrium is defined by the International Building Code as follows:

> ***Atrium:*** *An opening connecting two or more stories other than enclosed stairways, elevators, hoist ways, escalators, plumbing, electrical, air-conditioning, or other equipment, which is closed at the top and not defined as a mall.*

From this definition, both the lobby and the interior stairway are considered atriums and need to meet the standards put forth under 404 of the IBC.

Figure 18: Main Entrance Lobby Atrium

5.1 Requirements

Section 404.2 states that the floor of an atrium shall not be used for other than low fire hazard uses and only approved materials and decorations (in accordance with the International Fire Code) shall be used in the atrium space.

Section 404.3 states that an approved automatic sprinkler system shall be installed throughout the entire building unless 2-hour fire separation is provided between the atrium space and

adjacent building areas. Since the atrium was constructed with 1-hr fire rated separation, an approved, automatic sprinkler is required. Additionally, because the height of the atrium is below 55 feet, the atrium itself also needs to be sprinklered.

Section 404.4 states that a fire alarm system needs to be provided. As seen in previous portions of this report, the Bonderson Engineering Projects Center features a fully functional ionization smoke detection system.

Section 404.5 requires a smoke control system be installed in atriums unless the atrium connects only two stories. The atrium within the building only connects the first and second floor, and as such, no smoke control system is needed.

Section 404.6 states that atrium spaces shall be separated from adjacent spaces by a 1-hour fire barrier. As discussed previously, fire rated separation was constructed around portions of the building, including the walls that separate the atrium from room 107 and 102.

Section 404.8 governs interior finish requirements concerning atriums, and states that the interior finishes of the walls and ceilings of the atrium shall not be less than Class B, and that no reduction in class is allowed for sprinkler protection.

All applicable standards set forth by the IBC with regards to the atrium lobby seem to be met.

6.0 Inspection, Testing, and Maintenance

6.1 Sprinkler System

Sprinkler system inspection, testing, and maintenance applicable to the project building are summarized below:

City Water Main**:** Responsibility of the city. Quarterly visual review of the connection should be performed.

Above Ground Piping/Supports**:** Annual inspection should be performed, covering all above ground piping and supports. Modifications or changes in occupancy require addition testing by the contractor performing the inspections.

Control Valves/Gauges**:** Inspection should be preformed to insure all valves are kept accessible, unobstructed, and open. No leakage, easy turning, and good operative condition of valves should also be checked. Post indicator valve should be open at all times and checked periodically by the Fire Department and monthly by building managers. Quarterly inspections and testing should

be a part of the contractor's services, as well as inspections during occupancy changes and building modifications.

Water Flow Alarm**:** Should be visually inspected each month by building managers. Water Flow Alarm and any supervisory devices/switches should be tested quarterly as part of the quarterly inspections.

Standpipe and Hose System**:** Building managers should conduct weekly inspection of gauges. Annual inspection should be conducted by the contractor performing maintenance duties.

Signs: Sign information and condition should be inspected annually by the sprinkler contractor. Occupancy changes or building modifications require additional inspections.

Sprinklers: If sprinklers have performed satisfactory through their service life, NFPA 25 requires testing of representative samples (1% of total sprinklers) of installed sprinklers periodically. For 50 year life sprinklers, testing must be repeated every 10 years thereafter. Annual inspections by the contractor should also be performed, and should review the following:

1) Absence of sprinklers from any room
2) Location of sprinklers in relation to other objects
3) Adherence to proper clearance / obstruction to sprinklers
4) Deflector distance and adherence to NFPA 13 guidelines
5) Review of sprinkler installation, including rating, type, and condition. Sprinklers should also be checked for corrosion and foreign object deposits (such as paint).

Addition inspections should be performed should the occupancy classification change or if the building is modified.

6.2 Fire Alarm System

The requirements concerning system inspection, testing, and maintenance are contained within Chapter 14 of NFPA 72. Part of the code requires the owner, California Polytechnic State University, SLO, to have a documented program covering inspection, testing, and maintenance of the Fire Alarm System. The owner, previously stated, is also responsible for the execution and implementation of the system. Notification must be provided when system testing is to be performed, and all applicable codes are to be recorded and safely stored, and be available for inspection by the Authority Having Jurisdiction (AHJ) at any time upon request.

Inspection is to be done on schedule as per provisions stated in Chapter 14, Section 3 of the code. The following is a list of inspections to be completed and the associated times:

- Fire Alarm Control Panel — Inspected Annually
- Trouble Signals — Inspected Weekly/Semi-Annually
- Supervisory Switches — Inspected Quarterly
- Initiating Devices — Inspected Semi-Annually

Devices must be tested that are added into the system at a later date, and re-testing of already installed devices must be completed if an alterations or removal is performed. Functional testing of at least 10% of the Fire Alarm Systems devices must be performed when any changes are made to the Fire Alarm Systems Control Unit. Testing and frequency is as follows, and is discussed in NFPA 72 under Table 14.4.2.2 and Table 14.4.5:

- Fire Alarm Control Panel — Tested Annually
- Batteries — Tested Annually
- Trouble Indications — Tested Annually
- Initiating Devices — Tested Annually
- Notification Appliances — Tested Annually
- Valve Supervisory Switch — Tested Semi-Annually
- Water flow Alarm — Tested Semi-Annually

Maintenance on the Fire Alarm System should be performed both preemptively to combat failures whenever a problem is noticed during inspections, both official or by persons frequenting the building who report problems to facility caretakers. Maintenance on faulty devices should be prompt and resolve any issues.

7.0 Performance Based Design

7.1 Performance Criteria

The Life Safety Code allows for the use of Performance Based Design as an alternative to the prescriptive approach for irregular buildings, buildings that might not meet the prescriptive code(s), or for when an engineer wishes to show that an acceptable level of equivalency of safety can be met through non-prescriptive means. The basis for a performance based design approach is laid out in Chapter 5 of the Life Safety Code.

The performance criteria for the following performance based design analysis was set forth under Section 5.2.2, *Performance Criterion,* of the Life Safety Code. The performance criteria includes the safe egress of all occupants not intimate with the fire source, and that any occupant who is not intimate with ignition shall not be exposed to instantaneous or cumulative untenable conditions. Life safety is the primary concern with this analysis, and as such, other

performance criteria such as structural failure (mission continuity) and environmental damage will not be addressed.

7.2 Software Overview

Fire Dynamics Simulator

Fire Dynamics Simulator (FDS), developed by the National Institute of Standards and Technology (NIST), is a computational fluid dynamics (CFD) model of fire-driven fluid flow. The software solves numerically a form of the Navier-Stokes equations which are appropriate for low-speed, thermally driven flow, with an emphasis on smoke and heat transport from fires. Smokeview is a separate, but integral visualization program that allows users to display the output of FDS simulations in an easy to understand way. From the FDS User Guide, the main features of Version 6 include:

- Hydrodynamic Model
- Combustion Model
- Radiation Transport
- Geometry
- Multiple Meshes
- Parallel Processing
- Boundary Conditions

FDS will be used to model fire conditions for the given fire scenarios, and to predict the smoke layer depth, temperature, visibility, and particulate concentration needed to perform an ASET vs RSET analysis.

Pyrosim

Pyrosim, a program developed by Thunderhead Engineering, is a graphical user interface for the Fire Dynamics Simulator (FDS). The Pyrosim interface provides immediate input feedback and ensures that users have the correct format for the FDS input file. Key features include:

- High-level 2D and 3D geometry creation
- Diagonal walls
- Importing of background images
- Object grouping
- Flexible displays
- Object replication

Pyrosim will be used to easily create and manipulate FDS input files so that the chosen fire scenarios can quickly be modeled and altered as needed.

Pathfinder

Pathfinder, developed by Thunderhead Engineering, is an agent based egress and human movement simulator. It provides a graphical user interface for simulation design and execution as well as 2D and 3D visualization tools for results analysis. Pathfinder will be used to model the Bonderson Engineering Projects Center floor plans and analyze the emergency egress movement of representative building occupants during fire scenarios.

DETACT

The DETACT (DETector ACTivation) Model is a program used for calculating the actuation time of thermal devices such as sprinklers and heat detectors. It is based upon an energy balance about the specific detector and utilizes the Alpert plume and ceiling jet correlations. DETACT will be used to cross check detector activation times determined through FDS modeling.

7.3 ASET and RSET

The Available Safe Egress Time (ASET) is the amount of time that elapses between fire ignition and the development of untenable conditions within a given room or space. The Required Safe Egress Time (RSET) is the amount of time, which is also measured from fire ignition, that is required for all occupants to evacuate a building or given space in order to reach either the building exterior or some dedicated, protected exit enclosure. RSET is defined by the general expression below and includes the following time subsets:

RSET = Detection Time + Notification Time + Pre-Movement Time + Movement Time

Detector Activation Time (t_d)

Detector Activation time is the time that elapses from ignition of the fuel source until activation of the first detector device. The detector device could be either automatic or manual, but is usually based on any automatic detection systems in place.

Notification Time (t_n)

The time until notification is the time that elapses between detector activation and notification appliance activation. This is usually assumed to be almost instantaneous in modern systems.

Occupant Pre-Movement Time (t_{p-m})

The pre-movement period is the time from when occupants receive notification until they begin to evacuate, and includes perception, interpretation, and any delays before movement. No situation will arise in which occupants within a building will react to evacuation alarms in the same way, and individual people will react differently based on setting and location. There are several factors that influence the pre-movement times of occupants within buildings after they have been alerted to a fire or other life safety emergency. Occupant reaction and movement times are influenced by a combination of audio, visual, and physical factors which include the following:

Audio Factors:

- Fire alarm
- Sprinkler system water alarm
- Occupant to occupant notification
- Audio cues of an impending fire situation

Visual Factors:

- Seeing the fire
- Seeing combustion products (smoke)
- Secondary impacts from fire (shattering glass)

Physical Factors:

- Smelling smoke
- Feeling heat
- Other physical cues stemming from a fire situation

Bryan's chapter in the SFPE handbook outlines several psychological and physical processes that are related to pre-movement time:

- Recognition: The initial stages of the occupant's awareness that a fire situation is developing. Audio and/or visual cues will help differentiate situations.
- Validation: This occurs when the occupant defines whether a fire situation has developed or not. More information is usually sought after.
- Definition: In this stage, the occupant defines the fire situation and processes available information relating to the situation.
- Evaluation: Occupant fully realizes the extent of the situation, acknowledges the presence of a potential life threatening situation, and comes to the conclusion that egress is necessary, and goes about determining the best way to do so.

- Commitment: Some situations arise in which the occupant may not want to leave, and during this stage the occupant decides whether to evacuate or to stay in place.
- Reassessment: Stress and anxiety levels of the occupant are at its highest levels at this point. Continual reassessment of whether to evacuate or not is at the forefront of the occupants mind.

It is hard to try and model the pre-evacuation time for a given scenario due to the many factors involved, so typically data is used that has been collected on delay times regarding typical occupancies. One such source of data is Table 4.2.1 from the NFPA Handbook which characterizes delay times for hotels, offices, and apartment buildings of varying heights.

Furthermore, there are six building characteristics that can help reduce the pre-movement time of building occupants. Proulx outlines these characteristics in the SFPE handbook:

- Types of warning systems: Advance and appropriate warning systems, such as fire alarms, smoke alarms, or voice evacuation systems, will have a positive effect in reducing the pre-movement times of occupants. Live messages meeting NFPA audibility and intelligibility have been shown to be the best way to move occupants from unsafe locations to safe areas.
- Building layout and way finding: Appropriate building layouts and exit signage is important for helping occupants decide where to go and how to go about exiting.
- Visual Access: Clear visual access of alarms and other occupants helps decrease pre-movement times by speeding up the decision of occupants to leave. Clear visual paths of exit signage is important as well.
- Training: Training is one of the most important aspects of decreasing pre-movement times of occupants, although it is not always possible (for example transient occupancies like malls). Regular fire and evacuation drills, either scheduled or unscheduled, help occupants be aware of proper procedures and pathways.
- Frequency of false alarms: To many false alarms create a complacent attitude and environment for occupants, so when a real life threatening fire situation arises, important seconds can be lost before occupants realize the severity of the situation.

Occupant Movement Time (t_m)

Movement time, or occupant travel time, is the time period from when occupants decide to evacuate until they safely egress the building. Pathfinder was used to model the building and occupant loads using the occupant load factors discussed previously. Both the Steering and SFPE models were utilized in determining occupant travel time, but the results from the Steering model were used in computing the RSET value because of its more complex and accurate nature. The SFPE method calculates travel time based on flow rates through egress

components (doors and stairways) but allows occupants to occupy the same space. The Steering method takes into account agent collision, inertia and momentum, and other factors during queuing and travel.

A Pathfinder simulation was modeled of egress under normal conditions (no fire, all exits available to occupants) in order to gain a baseline egress time for later comparison. The Steering and SFPE values for that simulation are as follows:

- **Steering: 70.5 seconds**
- **SFPE: 80 seconds**

A successful analysis is completed if ASET > RSET + Factor of Safety. The performance based design of this report will utilize the computer fire modeling software discussed previously (Fire Dynamics Simulator and Pathfinder) in order to complete an ASET/RSET analysis. Pathfinder will be utilized in order to calculate the movement time of building occupants in order to ultimately determine the Required Safe Egress Time. Fire Dynamics Simulator will then be used in order to model various reasonable but challenging fire scenarios in order to approximate the time needed to reach the predetermined tenability limits (ASET). Once both values are obtained, a comparison can be made, and depending upon the relationship between the ASET and RSET values, it can be reasonably determined whether or not the building meets the performance criteria set forth for each individual fire scenario.

7.4 Tenability Criteria

Visibility: While conventional analysis on tenability within buildings undergoing a fire scenario tend to focus on factors which can lead directly to incapacitation and death, visibility is just as an important of a factor. The reduction of visibility during a fire due to smoke obscuration from combustion of the fuel package(s) needs to be treated differently than the conventional factors such as exposure to toxic gases and temperature or heat. This is because, as stated before, those previous factors can lead directly to incapacitation whereas visibility does not have a direct correlation. Tenability criteria of 10 m, or smoke density which allows movement of 0.3 m/s, is given as the baseline for occupants unfamiliar with their surroundings (T. Jin and data from SFPE Handbook, 4th Edition) while a baseline of 5 m is suggested when occupants are familiar with their surroundings. Jin's study consisted of relating the walking speed of individuals to the extinction coefficient of the smoke as they walked down a 20-m corridor filled with smoke. An individual's walking speed in complete darkness was determined to be 0.3 m/s, and the optical density corresponding to a speed of 0.3 m/s was considered to be the minimum visibility needed for occupants who were familiar with the building in which they were attempting to egress. But, this criteria is slightly compounded by the fact that even with no visibility, people will continue to attempt to egress, and the only question is if the speed at

which they move is sufficient to allow egress before other tenability requirements are surpassed.

Toxic Gases: Another important tenability criteria has to do with exposure to toxic gases such as Hydrogen Cyanide, Carbon Monoxide, Carbon Dioxide, or an insufficient oxygen volume fraction. It should be emphasized that a single threshold magnitude or concentration of any particular combustion product does not exist. A combination of exposure time and concentration needs to be taken into account. Asphyxiant gases affect humans by impairing their ability to self evacuate. This occurs due to the decreasing amount of oxygen available, and this causes disorientation, incapacitation, and then eventually death. Due to these hypoxic effects, damage to both the central nervous and cardiovascular systems can occur. Irritant gases can cause incapacitation as a result of sensory irritation to the eyes, upper respiratory tract, and the lungs. The main limit under consideration is carbon monoxide. At high enough concentrations, the carboxyhemoglobin (COHb) count within a body increases quickly and brings about incapacitation and then eventually death. CO concentrations that bring about incapacitation and eventually death depend upon the individual and exposure time, but a baseline CO concentration of 1600 parts per million is a standard base line with which to gauge occupant exposure.

Temperature: The last major tenability criteria has to do with the temperature experienced by occupants as the result of the exposure to combustion products produced by the fire. Temperature tenability was set at 60 degrees Celsius. This value comes about due to thermal effects experienced by occupants who are close to the given fire or super hot combustion products. Close exposure to fire conditions can lead to hyperthermia, blistering, skin burns, and respiratory tract burns. When occupants experience heated smoke with a temperature less than 120 C, the principal limiting effect is hyperthermia, while skin burns are usually experienced with temperatures in excess of 120 C. If the heated air contains less than 10 percent by volume of water vapor, both respiratory tract burns and skin burns are usually encountered.

The tenability criteria chosen for this performance based design analysis are summarized in Table 22 below:

Table 22: Tenability Criteria Chosen For Performance Based Analysis

Tenability Criteria	
Visibility	
Unfamiliar	> 10 m
Familiar	> 5 m
Temperature	< 60 °C
CO Concentration	< 1600 ppm

7.5 Fire Scenario Selection

Chapter 5 of the Life Safety Code details 8 design fire scenarios which are to be performed by the engineer when undergoing a performance based design. These design fires are supposed to replicate realistic, yet challenging fires, such that a level of equivalency with regards to safety can be met. This section, as part of an academic exercise, is not meant to try and satisfy the code requirements relating to performance based design. Instead, it is meant as an exercise in performance based methodologies and practices. As such, the selected fire scenarios will closely resemble the code required fire scenarios but may not match up exactly.

7.6 Fire Scenario 1 – Entrance Lobby Atrium

The first design fire scenario considered was an acetone spill liquid pool fire in the main entrance lobby of Bonderson Engineering Projects Center. This fire scenario was modeled off of Design Fire 2 from Chapter 5 of the Life Safety Code. Design Fire 2 is described as an ultra-fast developing fire, in the primary means of egress, with interior doors open at the start of the fire. Acetone is an industrial strength solvent/cleaner used in the machine shop, and although codes restrict combustible materials such as Acetone from the atrium floor space, the lobby is sometimes used as a short term storage space while materials are being offloaded and transported into the machine shop for resupply or from various rooms after events, meetings, or other social gatherings have concluded.

The location of the fire in scenario 1 with respect to the overall building can be seen below in Figure 18.

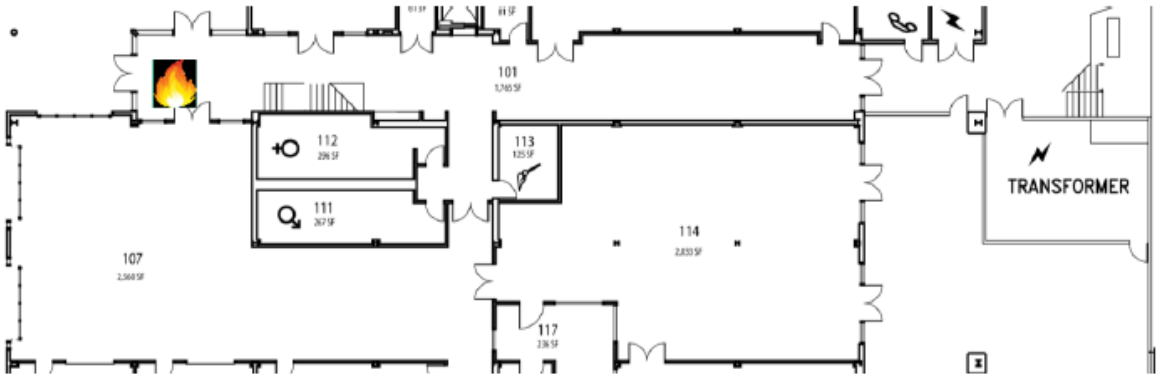


Figure 18: Location of Design Fire Scenario 1

Fire/HRR Modeling

Acetone is a colorless, mobile, flammable liquid, and is the simplest ketone. It is miscible with water, and as describer earlier, serves as an important industrial solvent for cleaning applications. Some important properties are listed below.

- Chemical Formula: C_3H_6O
- Flash Point: -17.8 °C
- Boiling Point: 56 °C
- Explosive Limits: 2.6 – 12.8 %
- Heat of Combustion: 25,800 kJ/kg
- Mass Burning Rate: 0.041 kg/m^2-sec
- Density: 791 kg/m^3

Data for modeling the Peak Heat Release Rate came from the United States Nuclear Regulatory Commission's "Chapter 3. Estimating Burning Characteristics of Liquid Pool Fire, Heat Release Rate, Burning Duration, and Flame Height" freely accessible Excel calculation tool which is based on the NUREG 1805 document.

A fuel amount and fuel spill area is entered into the document, along with a liquid fuel of choice, and the tool calculates the Heat Release Rate, burning duration, and other characteristics.

A fuel spill amount of 5 gallons was initially chosen based on IBC limits of flammable liquids (30 gallons for Factory occupancy, increase-able with an automatic sprinkler system) and assumed relative restock amounts. The 5 gallon spill volume was intended to represent crated containers breaking from mishandling during transport into the building and then leaking out onto the floor.

The fuel spill area was extrapolated from data collected and presented in a report carried out by NIST, for the NIJ, titled "Flammable and Combustible Liquid Spill/Burn Patterns"". In the report, spill areas of gasoline onto two types of carpet were recorded. The second carpet in the experiment, a short haired nylon carpet, most closely resembles the material present in the atrium lobby. Extrapolating the data results in a fuel spill area of 25 ft^2 (2.32 m^2). This spill area was then entered into the NUREG 1805 Chapter 3 Excel file to produce a Heat Release Rate of 2363 kW, with a burn duration of 157 seconds (2.62 minutes).

The next step in modeling the fire was determining the time from ignition until the fuel spill reached its peak heat release rate, or, the fire growth coefficient. Most solid combustible fuel sources (and some liquid fuels governed by liquid-phase flame spread) follow a t^2 growth curve in which the Heat Release Rate increases as a function of the time squared multiplied against some growth coefficient. These growth coefficients are classified as slow, medium, fast, and ultrafast. But, most flammable liquids do not follow the standard t^2 growth curves. Gottuk and White give an overview on liquid fuel fires in their SFPE Handbook chapter, and explain that liquid fuels that are governed by gas phase flame spread (based on relationship between flash point and ambient temperature), like Acetone, can experience rapid fire development as seen below in Figure 19.

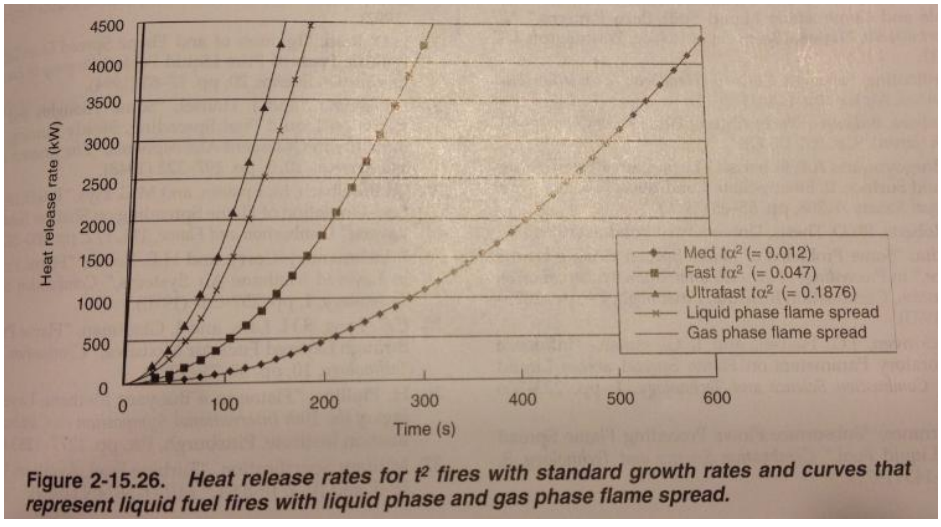


Figure 19: Relative Growth Rates of Liquid and Gas Phase Flame Spread Liquids

The rate depicted represents and extreme case, and luckily, some data on the growth development of Acetone fires exists. In a study performed by NIST (Quick Response Sprinklers in Chemical Laboratories: Fire Test Results) a free burn of Acetone (4 liters over 13 ft^2) was conducted and the Heat Release Rates and growth data was recorded using oxygen consumption calorimetry, which can be seen below in Figure 20.

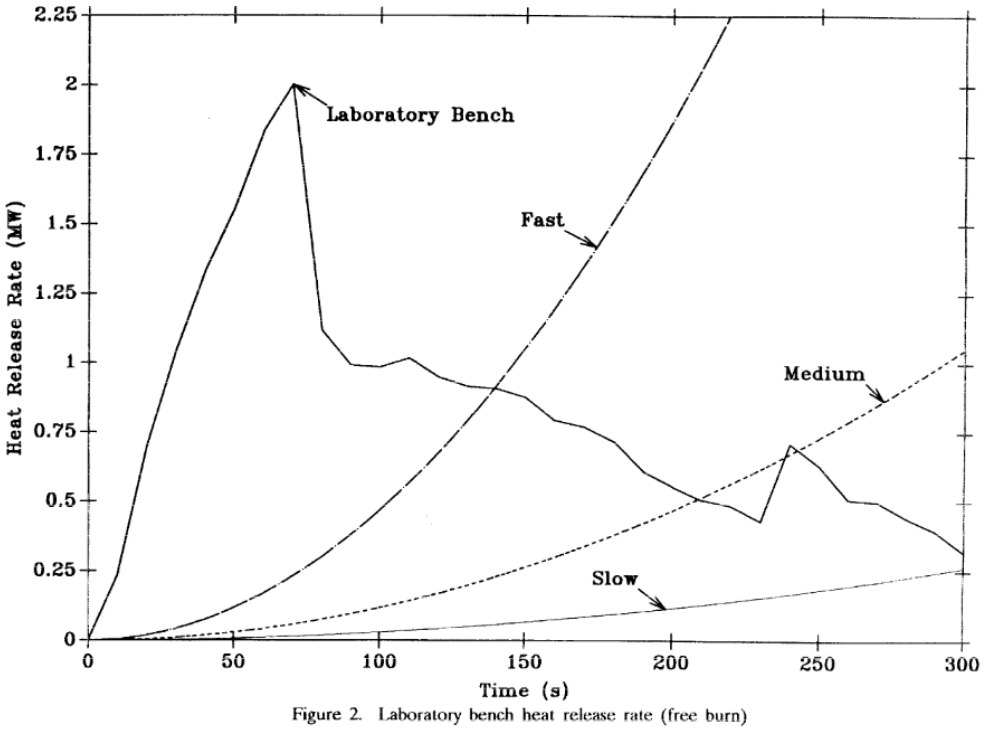


Figure 20: Acetone Free Burn Bench Test, NIST

The fire grew at a near linear rate, reaching 1 MW near 35 seconds, 1.5 MW near 50 seconds, and peaking at 2 MW at around 68 seconds. Since the Peak Heat Release Rate for this fire scenario, as determined earlier, is similar to the Peak Heat Release Rate from the NIST data, a similar growth rate was utilized and modeled. Important growth time steps modeled in FDS included 990 kW at 30 seconds, 1.58 MW at 50 seconds, and 2.36 MW at 70 seconds. Sprinkler activation and controlling effects were taken into consideration such that the growth rate and Peak Heat Release Rate were modified. From FDS modeling utilizing the original growth data, the atrium quick response sprinklers activated at a time of 37 seconds (68.3 °C). The fire was allowed to continue to grow until enough applied water was assumed to control and limit the fire to 25% of its Peak Heat Release Rate (590 kW). The rationale for limiting the Heat Release Rate comes about due to Acetone being soluble in water, and the application of water to acetone increases the flashpoint of the acetone water mixture. Additionally, the sprinkler spray is assumed to cool the acetone fire until either it burns out (all fuel is consumed) or the acetone water mixture becomes sufficiently diluted such that it can no longer support burning. For this

fire scenario, the fire was modeled as being restricted to 25% of its Peak HRR even after the burning duration calculated from the NUREG tool. This is because as long as the spill area stays constant, additional liquid will only increase the burning duration. It would therefore be conservative to model the fire lasting throughout the simulation and past any potential RSET times, and this can be thought of hypothetically as a slow, constant dripping of Acetone from the broken containers on a pallet onto the burning surface below, thereby supplying the fire but keeping a constant spill area.

By products, in terms of CO yield and Soot yield, were taken from Table 3-4.16, Yields of Fire Products, from the SFPE Handbook. The yields for Acetone utilized in this scenario can be seen below:

- CO Yield: 0.003 g/g
- Soot Yield: 0.014 g/g

With this data, the fire can be modeled. The eventual Heat Release Rate of the model graphed against time can be seen below in Figure 21.

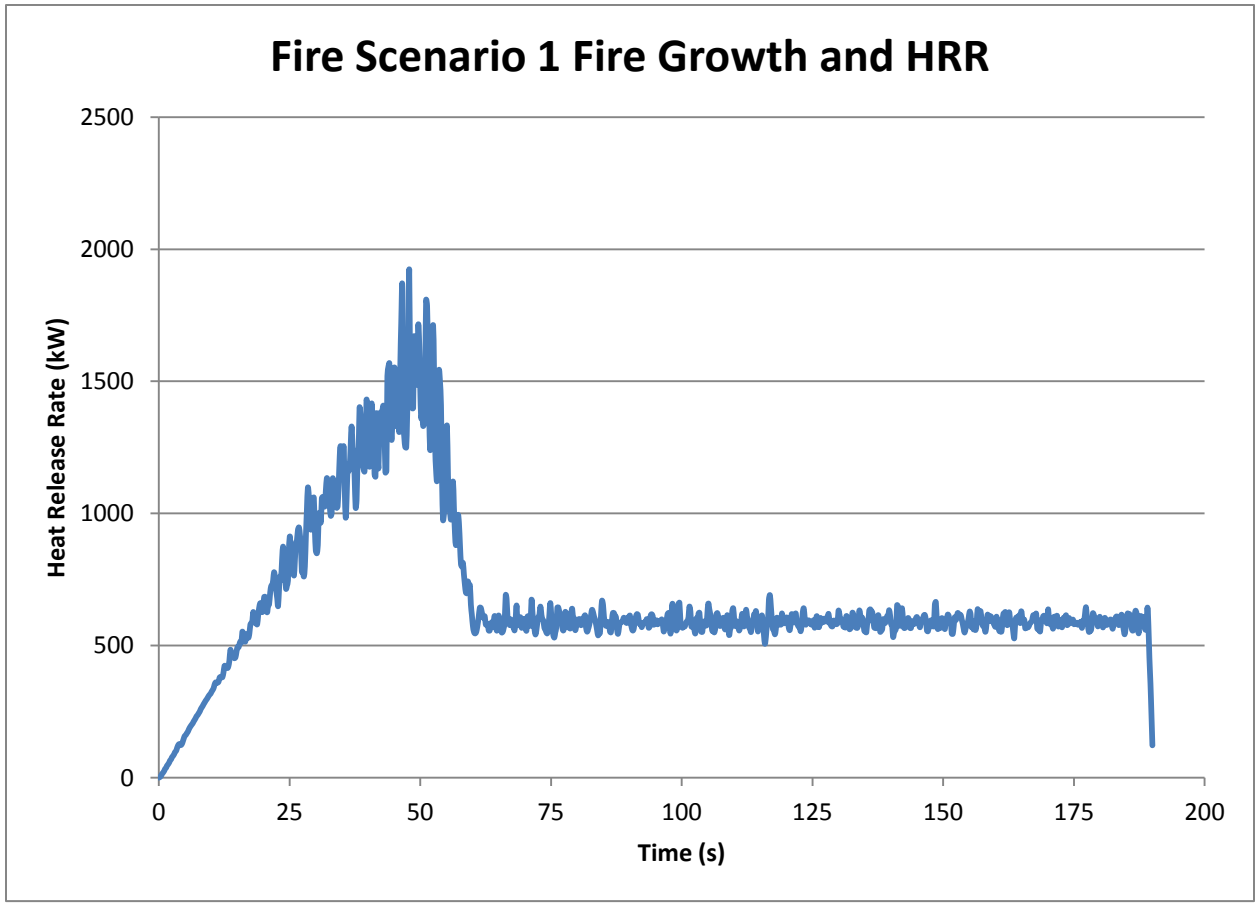


Figure 21: Fire Scenario 1 HRR Curve

FDS Model

The enclosure FDS model can be seen below in Figure 22. The fire location is on the first floor, with the atrium connecting both stories. Twenty-five centimeter grid sizes were utilized for the mesh in order to balance computer runtime performance and model resolution.

Figure 22: Lobby atrium FDS Model

Interior doors were modeled as open as required by the Design Fire 2 from Chapter 5 of the Life Safety Code which allowed additional area for smoke products to extend to. The modeled sky lights also provided additional space for combustion products. Although the interior doors in this building have automatic closing devices, they are often propped open during warm days to help with air circulation, as can be seen below in Figure 22. This helps add rational to the Design Fire Scenario requirement of open doors.

Figure 23: Interior Doors Propped Open

Available Safe Egress Time

With the above information, the FDS simulation was modeled and then run in order to predict the maximum Available Safe Egress Time before conditions inside the exit corridor became untenable for occupants attempting to egress.

Slice files of the conditions within the corridor for visibility, temperature, and CO concentration can be seen below.

The general smoke conditions at sprinkler activation (37 seconds) can be seen below in Figure 24:

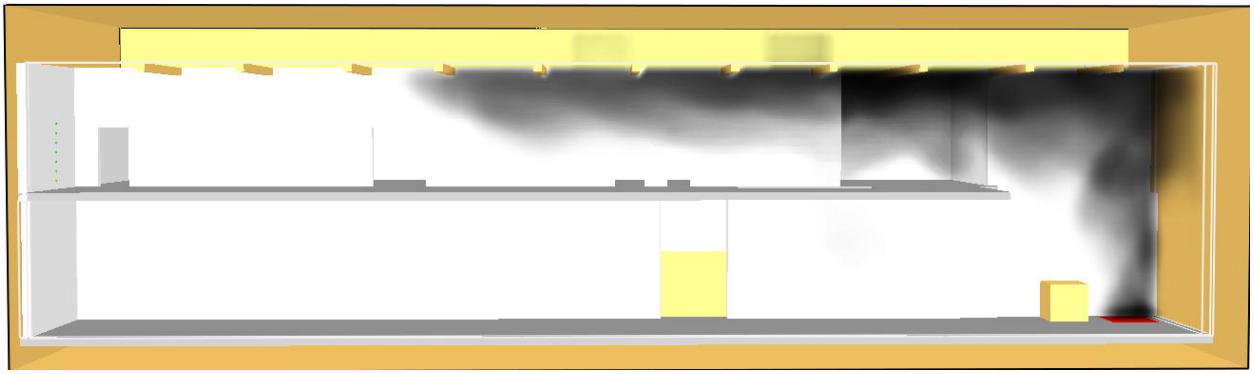


Figure 24: Smoke Conditions During Fire Build Up

Visibility Tenability Reached – 71.5 Seconds

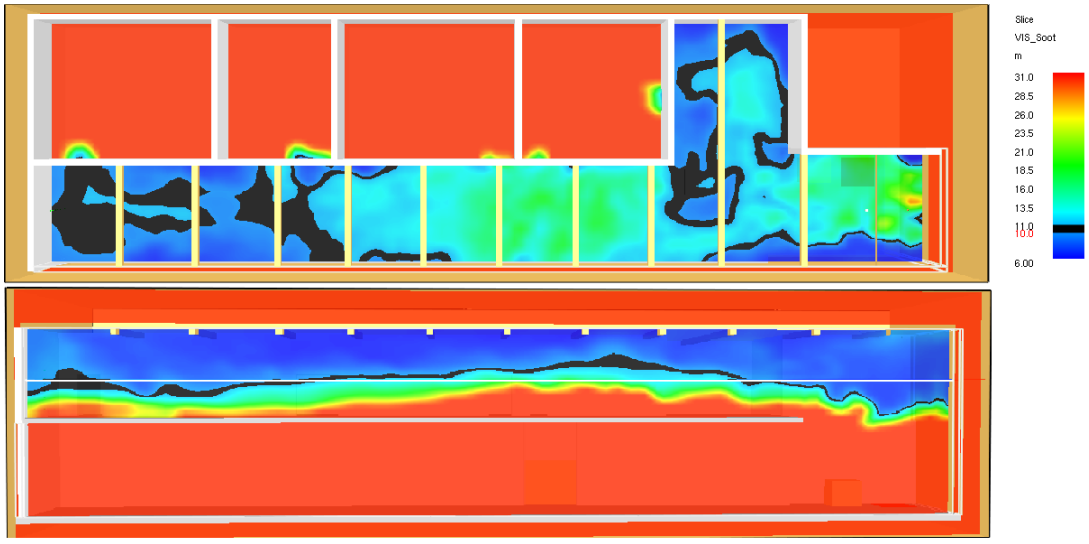


Figure 25: Lobby Visibility Slice Files

The above slice file (Figure 25) shows the visibility tenability being reached at 71.5 seconds after ignition. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor. The white marking along the side view is the 6 foot (above ground) reference line. Visibility remained untenable through the end of the simulation and well past the determined RSET value.

Temperature Tenability Reached – 81.1 Seconds

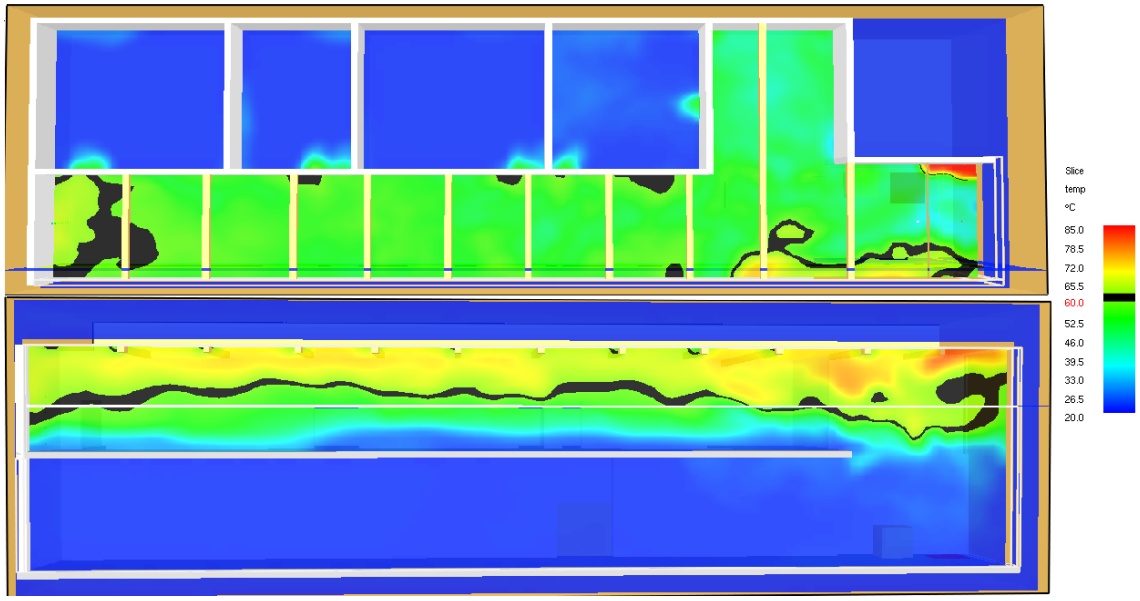


Figure 26: Lobby Temperature Slice Files

The above slice file (Figure 26) shows the temperature tenability being reached at 81.1 seconds after ignition. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor. The white marking along the side view is the 6 foot (above ground) reference line.

Because the sprinkler is assumed to control and partially suppress the fire after activation, untenable temperature conditions only last for 21.9 seconds (until 103 seconds after ignition), as seen in Figure 27.

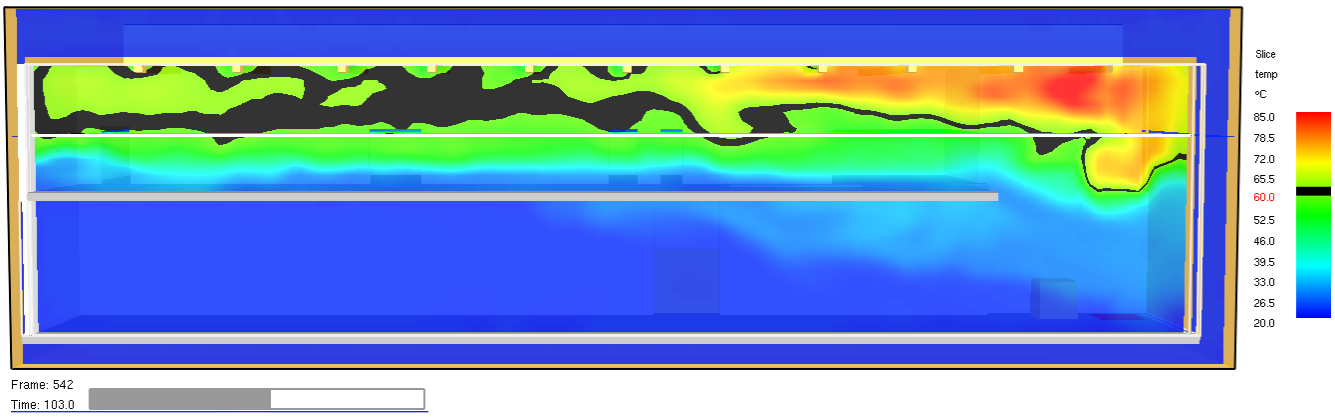


Figure 27: Temperature Tenability Conditions

Figure 28 below, showing a thermocouple grid at the end of the corridor, shows the temperature exceeding tenability requirements at approximately 80 seconds and then returning to tenable levels after sprinkler activation.

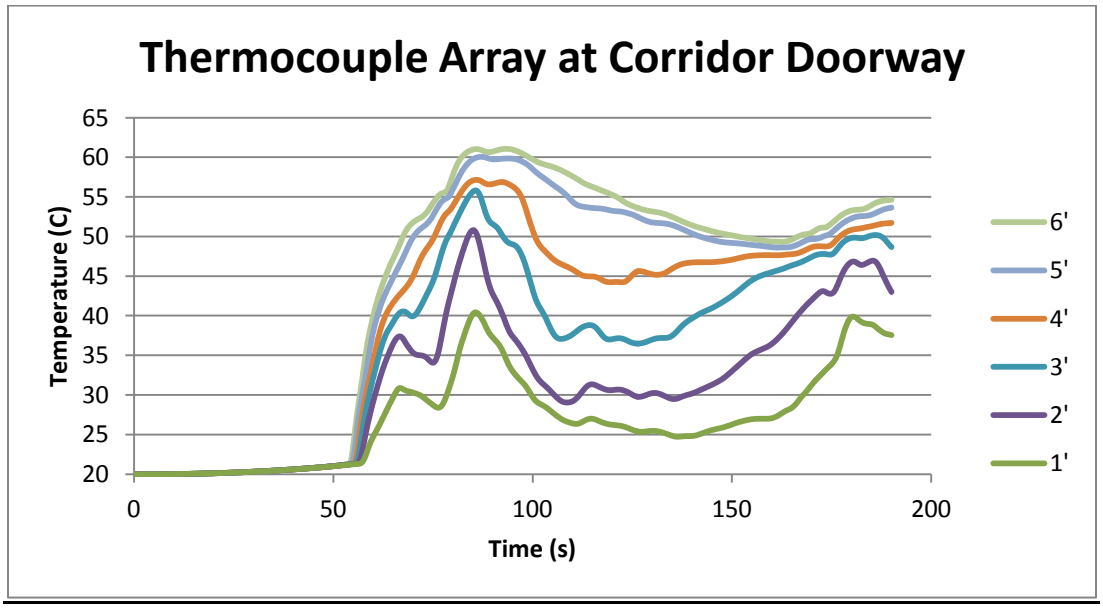


Figure 28: Corridor Thermocouple Array

Carbon Monoxide Tenability – Not Reached

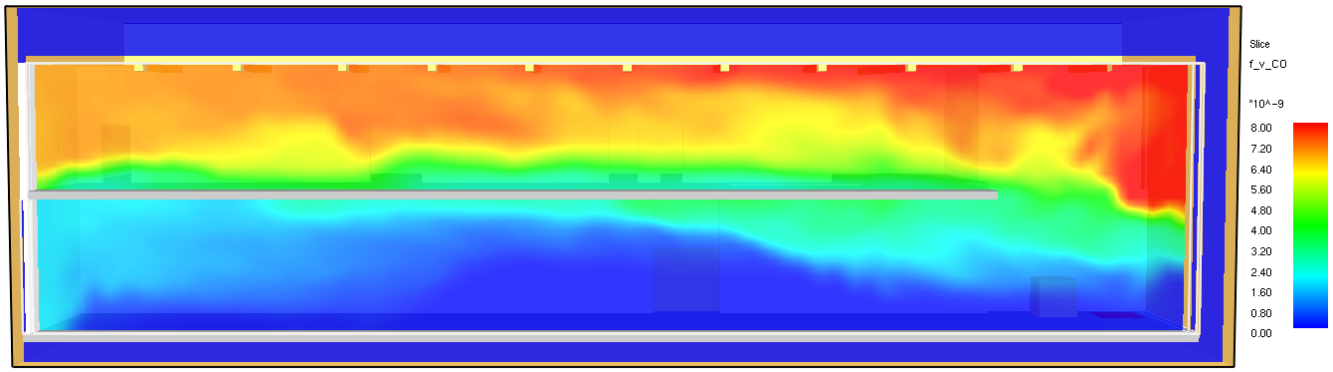


Figure 29: Lobby Carbon Monoxide Slice File

The above slice file (Figure 29) shows the carbon monoxide concentration at 190 seconds after ignition. The CO range of 0.0008 – 0.008 ppm (converted from ppb) is well below the 1600 ppm tenability criteria. This is most likely due to Acetone's very small carbon monoxide yield.

Required Safe Egress Time

Detection Time

An ionization smoke detector was modeled in the FDS simulation based on the real location of the detection system present within the lobby. From lack of manufacturer's information, the default FDS ionization values were utilized and the smoke detector was modeled to use the Cleary Model with the following values:

- Alpha C: 0.8
- Beta C: -0.9
- Alpha E: 2.5
- Beta E: -0.7

From the manufacturers specification sheet, the ionization detectors within the Bonderson building have an operating range of 0.5 – 2 %/ft obscuration. Although the detectors are capable of operating at the lowest value, a value of 1.0 %/ft obscuration was chosen in order to conservatively model the detector time. Utilizing the 1.0 %/ft value, the smoke detector was found to have activated at 19 seconds.

Notification Time

As discussed previously, notification time is assumed to be near instantaneous in modern systems. The notification time for this model was selected to be 1 second.

Pre-Movement Time

Pre-movement time was determined from Table 4.2.1 from the NFPA Handbook (Figure 30). The mid-rise office building occupancies most closely resemble the Bonderson Engineering Projects Center in occupant characteristics. The lower median value of 36 seconds was chosen instead of averaging the two mid-rise building times because the layout and building characteristics particular to the Bonderson building would make any higher of a delay time value unrealistic. The open nature of the building makes the spread of information (either through other occupants, notification devices, or the noticing of fire effects) occur quickly, which would allow occupants to realize conditions require egress much faster than if they were actually in a mid-rise office building.

TABLE 4.2.1 Delay Times (Minutes) Derived from Actual Fires and Evacuation Exercises Reported in the Referenced Literature

Event Description	*N*	*Min*	*1st Q*	*Median*	*3rd Q*	*Max*	*Mean*	*Factors*
High-rise hotel[14]	536	0	3.3	60.0	130.9	290.0	NA*	MGM Grand Hotel fire, no alarm notification, grouped data from questionnaires
High-rise hotel[15]	47	0	2.0	5.0	17.5	120.0	NA	Westchase Hilton Hotel fire, no alarm in early stages, grouped data from questionnaires
High-rise office building[16]	85	0	2.0	5.0	10.0	245.0	11.3	World Trade Center explosion and fire, no alarm notification (building closer to explosion)
High-rise office building[16]	46	0	4.5	10.0	31.5	185.0	28.4	World Trade Center explosion and fire, no alarm notification (building further from blast)
High-rise office building[17]	107	1.0	1.0	1.0	1.0	~6.0	NA	Fire incident, no alarms, data from interviews with occupants of four floors of building (11 interviewees were trapped)
High-rise office building[18]	12	0.5	NA	1.0	NA	2.3	1.2	Unannounced drill on three floors; data for first person to reach each of four stairwell doors to wait for voice instruction; trained staff; data from video recordings
Mid-rise office building[19]	92	0	0.4	0.6	0.8	<4.0	0.6	Unannounced drill, good alarm performance; fire wardens; warm day
Mid-rise office building[19]	161	0	0.5	0.9	1.4	<5.0	1.1	Unannounced drill, good alarm performance; fire wardens; cool day

Figure 30: Delay Times – NFPA Handbook

Movement Time

The egress (travel) time of occupants assuming a completely full occupant load as determined in the Egress Section was determined using a Pathfinder model utilizing imported CAD drawings

of the floor layout. Both the Steering and SFPE Models (discussed previously) were recorded, but only the travel time utilizing the Steering Model will be used due to its more realistic nature. As per the design scenario criteria, the two main lobby exits, as well as the interior stairway, were modeled as inaccessible due to the fire and products of combustion. Occupants in the model were free to choose any other available exit. The travel times for both egress models were as follows:

- **Steering:** **125 seconds**
- **SFPE:** **137 seconds**

The layout of the model at the beginning of the simulation can be seen below in Figure 31.

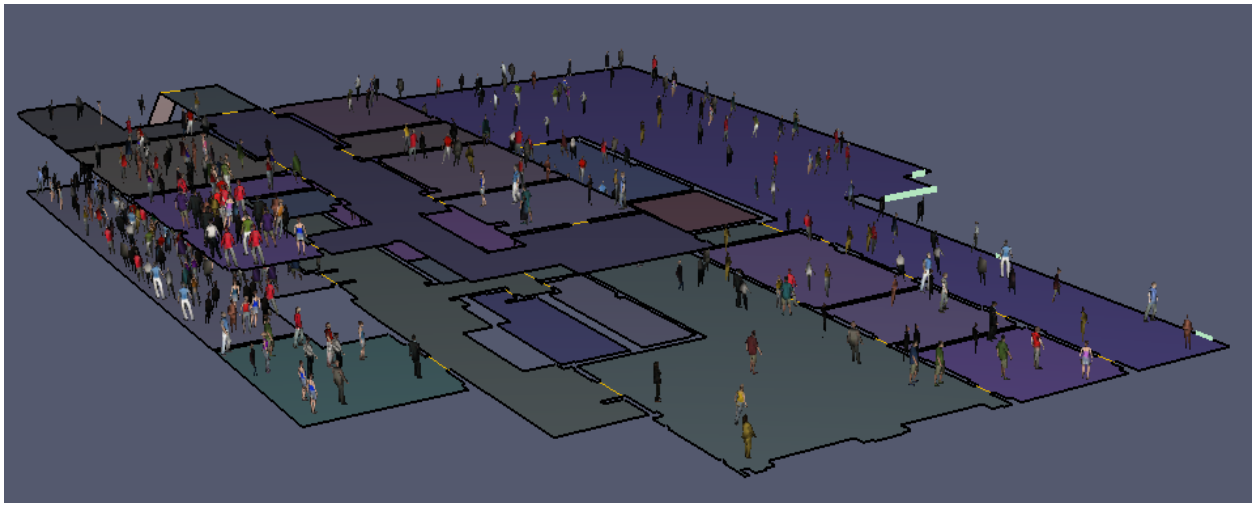


Figure 31: Pathfinder Egress Model – Atrium Fire

ASET vs. RSET

For this fire scenario, the tenability criteria was reached by exceeding the visibility limit at 71.5 seconds after ignition. This gives an ASET (Available Safe Egress Time) value of 71.5 seconds.

RSET was defined earlier as:

RSET = Detection Time + Notification Time + Pre-Movement Time + Movement Time

Substituting in the individual components gives

RSET = 19 s + 1 s + 36 s + 125 s

for a total RSET value of 181 seconds. For this fire scenario, RSET is greater than ASET, and as such, the performance objectives are not met.

Fire Scenario 1 Review and Recommendations

The first fire scenario considered for the Bonderson Engineering Projects Center was a liquid Acetone spill in the main entrance lobby which disabled two primary means of egress. The growth of the fire was modeled using data from a NIST study, and sprinklers were modeled to control and partially suppress the fire (reduce the heat release rate) after activation. Still, untenable conditions (ASET) were reached well before all occupants were able to egress from the building (RSET).

This fire scenario helps cement the IBC, LSC, and IFC requirements towards prohibiting highly combustible materials and finishes within the atrium space.

The best way to avoid a real life fire scenario similar to this is through continued and increased administrative control of the atrium floor space. Occupants should be made aware of the hazards of storing combustible materials in the atrium space. While an Acetone spill and a subsequent fire have a statistically low fire hazard probability, other combustible materials see much more frequent travel and temporary storage through the atrium space, including mainly foam cushioned folding chairs for special events held in the Engineering Plaza. These combustibles, in medium to high quantities within the atrium space, could prove just as significant of a hazard.

Lastly, a smoke control system could be installed within the atrium space to help control the spread of combustion products during a future fire scenario. While this is an option, a smoke control system is not required for this building, and furthermore, the risk probability most likely doesn't warrant the cost of a smoke control system.

7.7 Fire Scenario 2

The second design fire (Figure 32) scenario considered was a stack of metal-framed, soft segment polyester based thermoplastic polyurethane chairs igniting within the assembly occupancy room 104. This fire scenario was modeled off of Design Fire 1 from Chapter 5 of the Life Safety Code. Design Fire 1 is described as an occupancy-specific fire representative of a typical fire within the occupancy being considered.

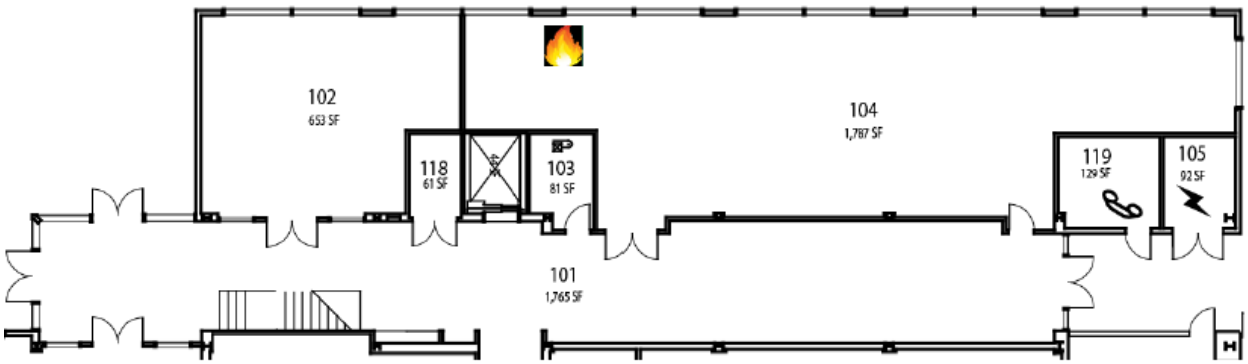


Figure 32: Location of Design Fire Scenario 1

Fire/HRR Modeling

Because of the lack of Heat Release Rate data for chairs made from a thermoplastic polyurethane material, available data from the SFPE Handbook for stacks of metal-framed, polypropylene chairs will be used for initially modeling the Heat Release Rate of the fire (Figure 33). Using this data is considered appropriate since the Heat of Combustion of polypropylene is approximately 38.6 kJ/g while the Heat of Combustion for a polyester based polyurethane is approximately 20.0 kJ/g. Since polypropylene has a Heat of Combustion of almost 2 times that of polyurethane, there is a very small chance that the Heat Release Rate data will underestimate that which would have occurred had polyurethane been used. Therefore, the Heat Release Rate data can be considered conservative for the actual occupancy fuel load and should solidify any positive ASET vs RSET outcomes. The Heat Release Rate data can be seen in the figure below. The data for 12 chairs in 2 stacks will be used since that most closely resembles the fuel arrangement as seen in Figure 34, as well as is the most critical and challenging fuel arrangement.

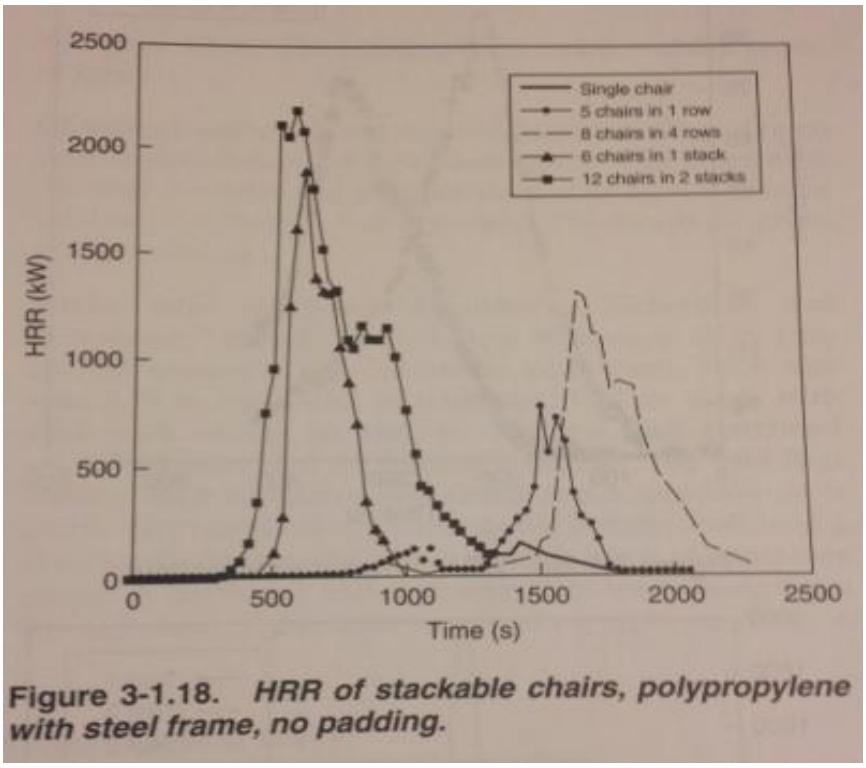


Figure 33 Fire Scenario 1 Heat Release Date – SFPE Handbook 4th Ed.

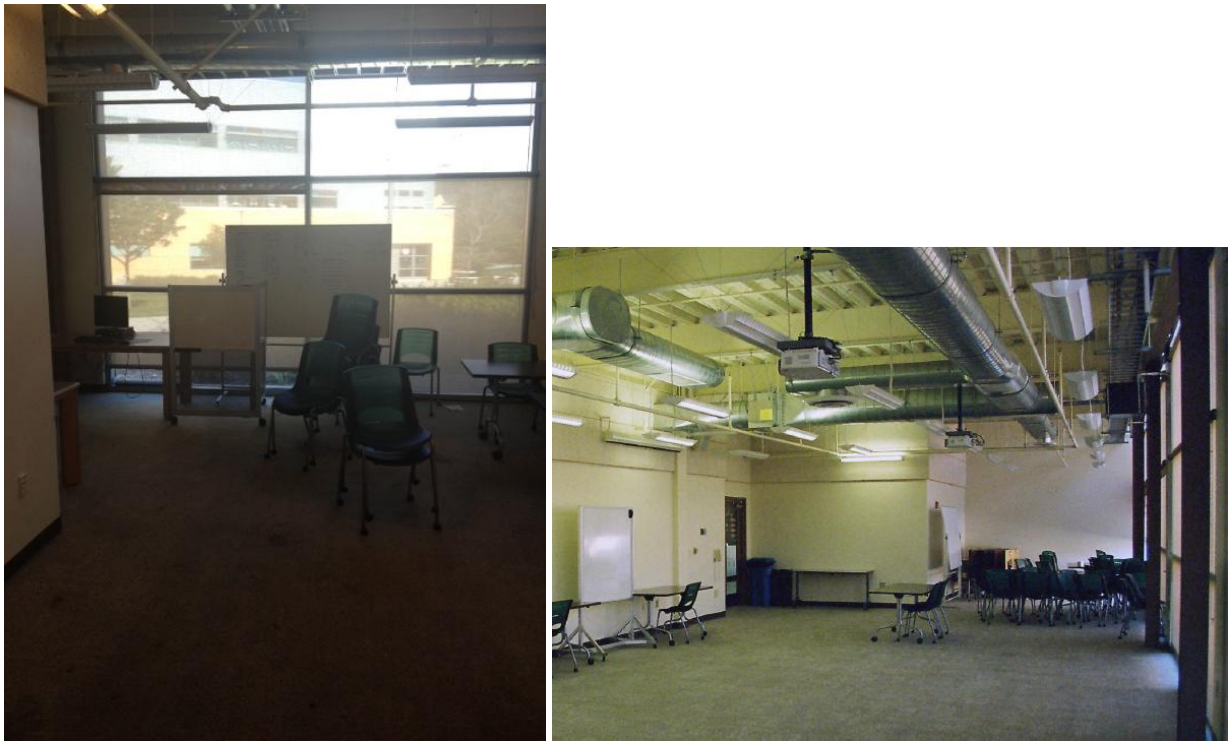


Figure 34: Fire Scenario 2 Fuel Arrangement

Based on the HRR data from Figure , the fire for this scenario was modeled as being between a medium and fast fire with a fire growth coefficient, α, equal to 0.035 kW/s^2.

An initial simulation run was modeled in order to determine the time the sprinklers would activate. Sprinkler 1, closest to the recessed wall, activated at 149 seconds while sprinkler 2 activated at 167 seconds. A DETACT analysis predicted a sprinkler activation very close to the 149 seconds as seen in Figure 35 below (153 seconds) but a slightly high Heat Release Rate.

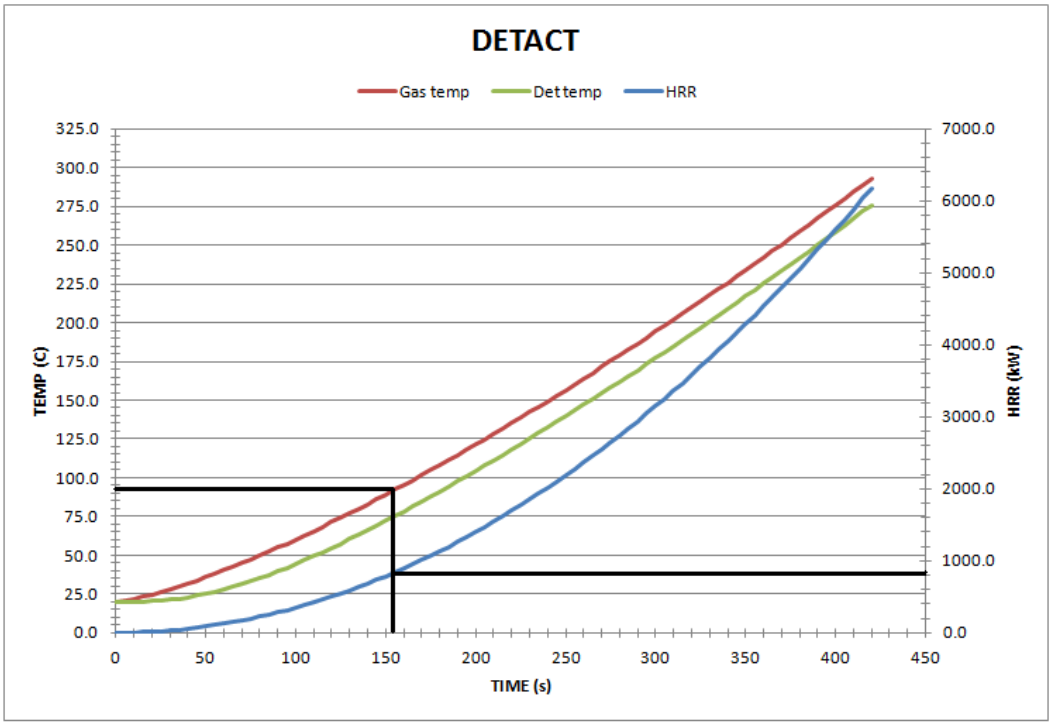


Figure 35: DETACT Model Showing Sprinkler Activation and Non-Inhibited Growth Curve

The Heat Release Rate was then adjusted to account for the sprinkler system controlling the fire. After sprinkler activation occurred, the heat release rate was held constant at a value of 450 kW. The Heat Release Rate vs. Time graph for the fire used in the model can be seen below in Figure 36.

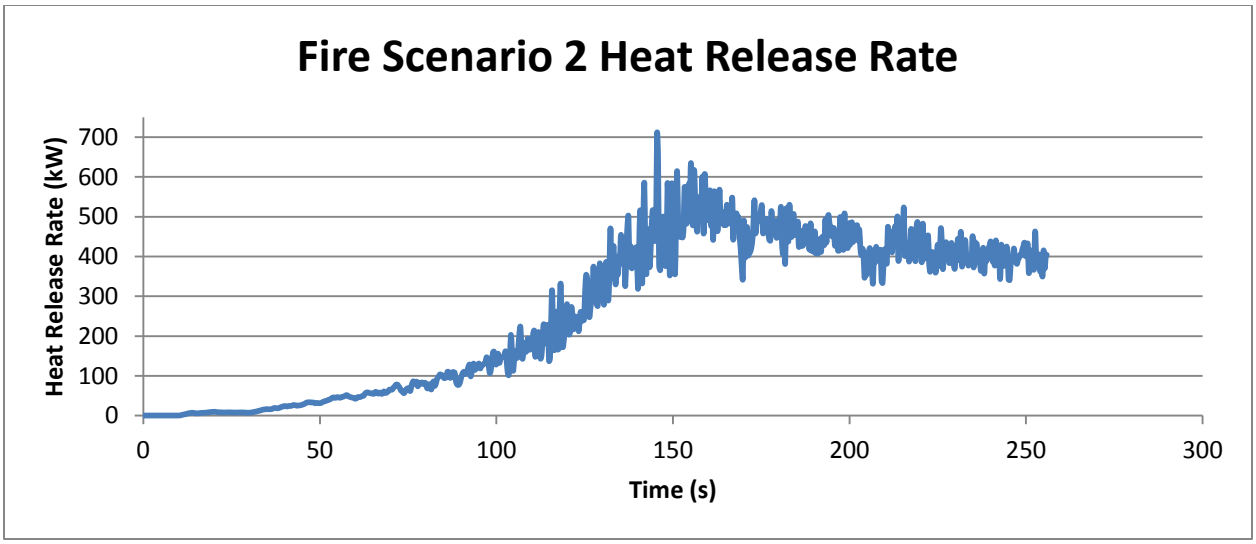


Figure 36: Fire Scenario 2 HRR Curve

The byproducts of combustion were modeled off of the two polyester samples that are displayed as part of Table 3-4.16, Yields of Fire Products, from the SFPE Handbook. The data can be seen summarized below in Figure 37.

	CO Yield (g/g)	Soot Yield (g/g)
Polyester 1	0.07	0.091
Polyester 2	0.08	0.089

Figure 37: SFPE Yield Data - Polyester

Since the two values are fairly similar, the highest of each was selected for use in the model in order to stay conservative and add an extra factor of safety to the model.

FDS Model

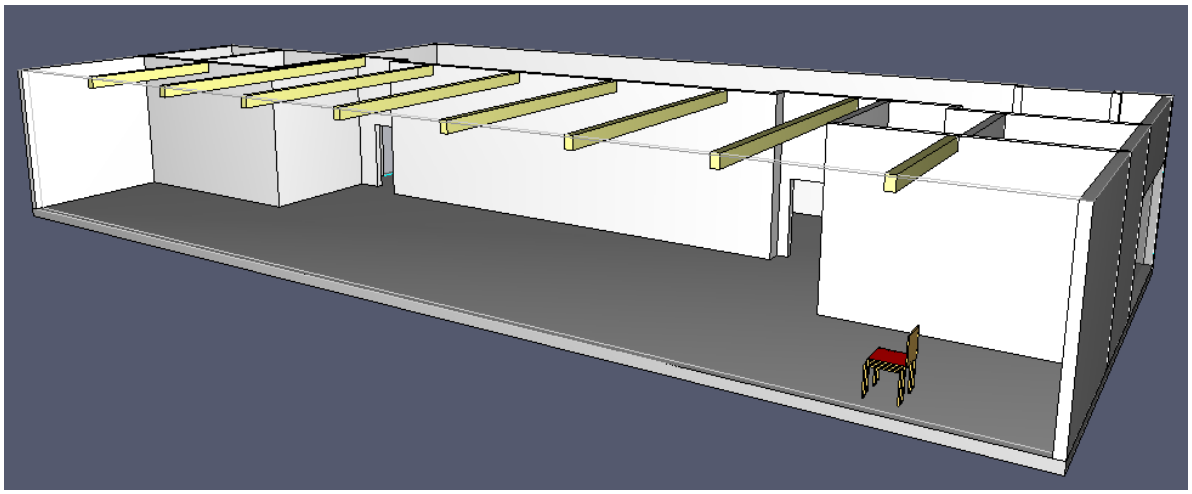


Figure 38: Fire Scenario 2 - Room 104 Pyrosim Model

The Pyrosim model for fire scenario 2 can be seen in Figure 38 above. The stack of chairs was modeled to reside in one of the room corners which is the typical arrangement when the room is in use with a high occupant load. The exposed structural beams were modeled in order to simulate an effect smoke curtain effect. Pyrosim control logic was added to simulate the opening of both room doors at 37 seconds which coincides with the start of occupant egress. The same control logic then shut the doors at 107 seconds after the last occupant had left the room.

Available Safe Egress Time

With the above information, the FDS simulation was modeled and then run in order to predict the maximum Available Safe Egress Time before conditions inside the room became untenable for occupants attempting to egress.

Slice files of the conditions within the room for visibility, temperature, and CO concentration can be seen below.

<u>Visibility Tenability Reached – 135.8 Seconds</u>

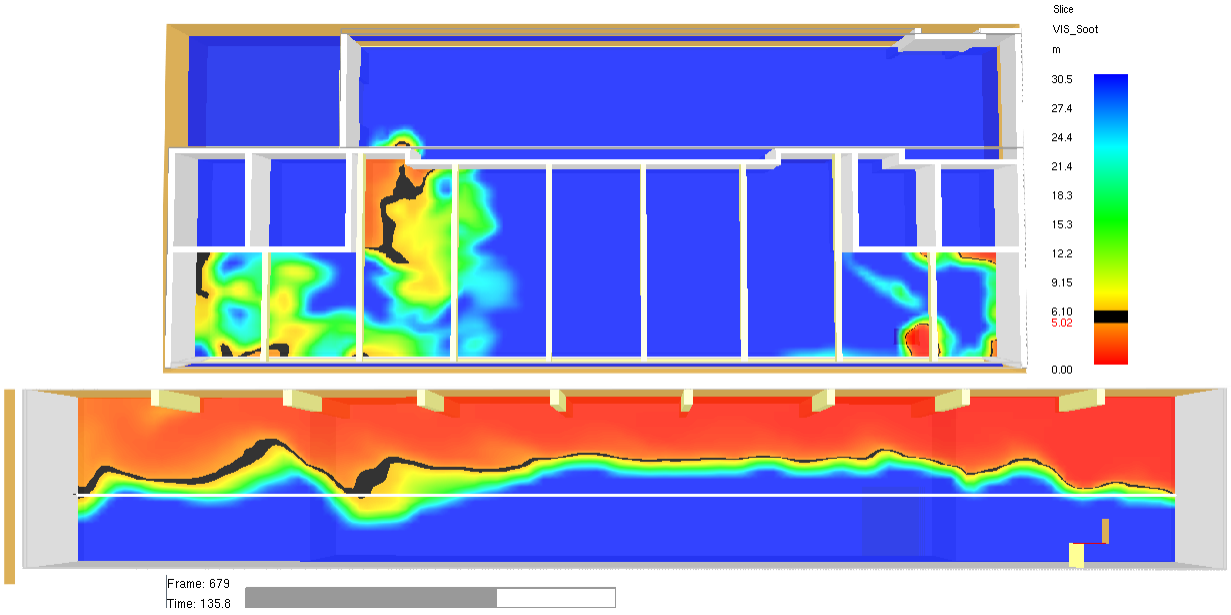


Figure 39: Room 104 Visibility Slice File

The above slice file (Figure 39) shows the visibility tenability being reached at 135.8 seconds after ignition. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor. The white marking along the side view is the 6 foot (above ground) reference line. Visibility remained untenable through the end of the simulation and well past the determined RSET value.

Temperature Tenability – Not Reached

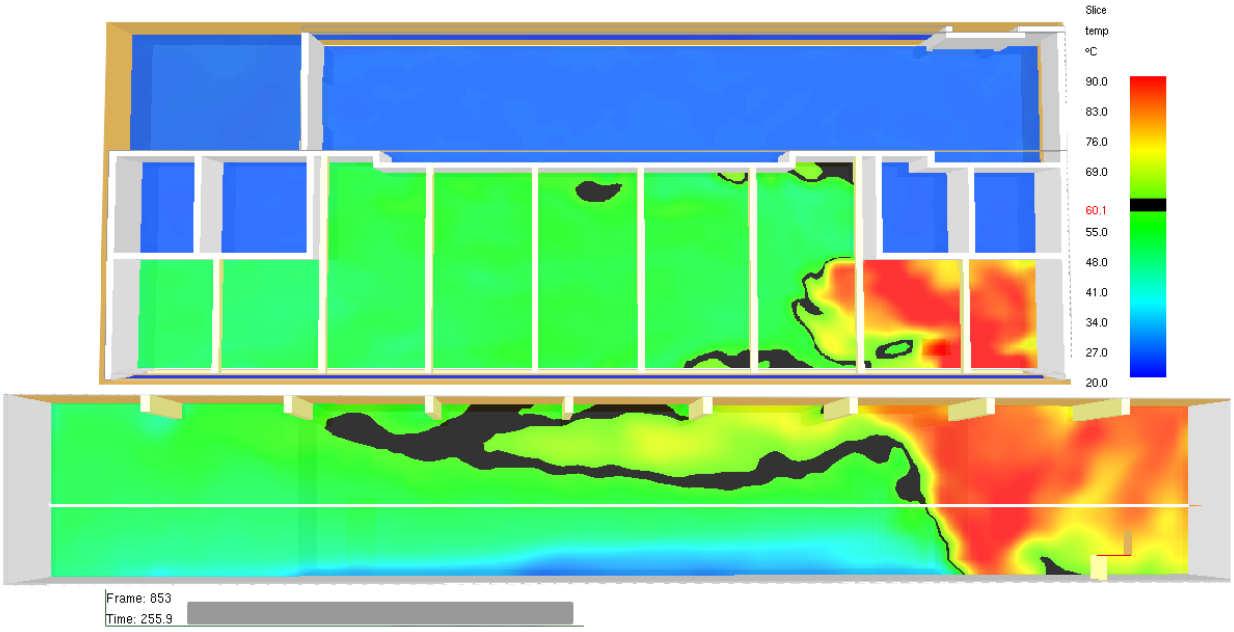


Figure 40: Room 104 Temperature Slice File

The above slice file (Figure 40) shows the temperature slice file at 256 seconds after ignition. The temperature within the room never exceeds the tenability criteria. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor. The white marking along the side view is the 6 foot (above ground) reference line. The temperature stayed low at the 6 foot mark most likely due to the large size of the room and heat transfer occurring between the hot gas layer and the enclosing room materials.

Carbon Monoxide Tenability – Not Reached

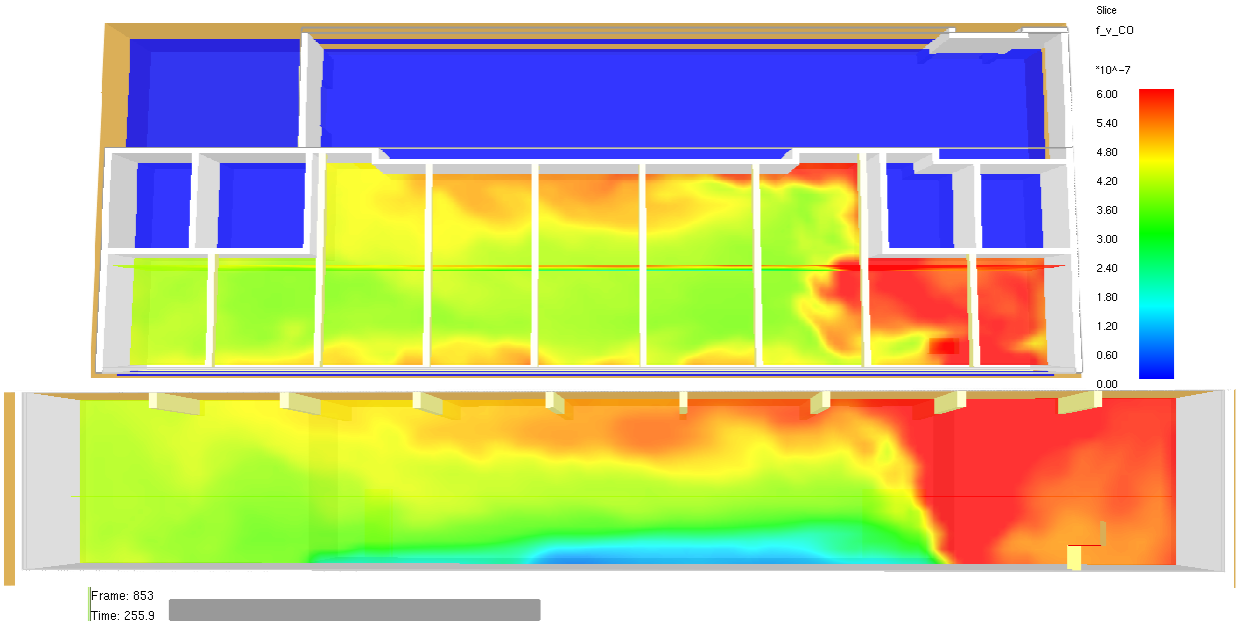


Figure 41: Room 104 CO Slice File

The above slice file (Figure 41) shows the carbon monoxide concentration slice file at 256 seconds after ignition. The carbon monoxide within the room (0.06 – 0.6 ppm) never exceeds the tenability criteria. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor.

Required Safe Egress Time

Detection Time:

An ionization smoke detector was modeled in the FDS simulation based on the real location of the detection system present within the room. From lack of manufacturer's information, the default FDS ionization values were utilized and the smoke detector was modeled to use the Cleary Model with the following values:

- Alpha C: 0.8
- Beta C: -0.9
- Alpha E: 2.5
- Beta E: -0.7

From the manufacturers specification sheet, the ionization detectors within the Bonderson building have an operating range of 0.5 – 2 %/ft obscuration. Although the detectors are capable of operating at the lowest value, a value of 1.0 %/ft obscuration was chosen in order to

conservatively model the detector time. Utilizing the 1.0 %/ft value, the smoke detector was found to have activated at 26 seconds. This is a conservative value though, as occupants most likely would detected the fire themselves due to the rising plume as seen below in Figure 42.

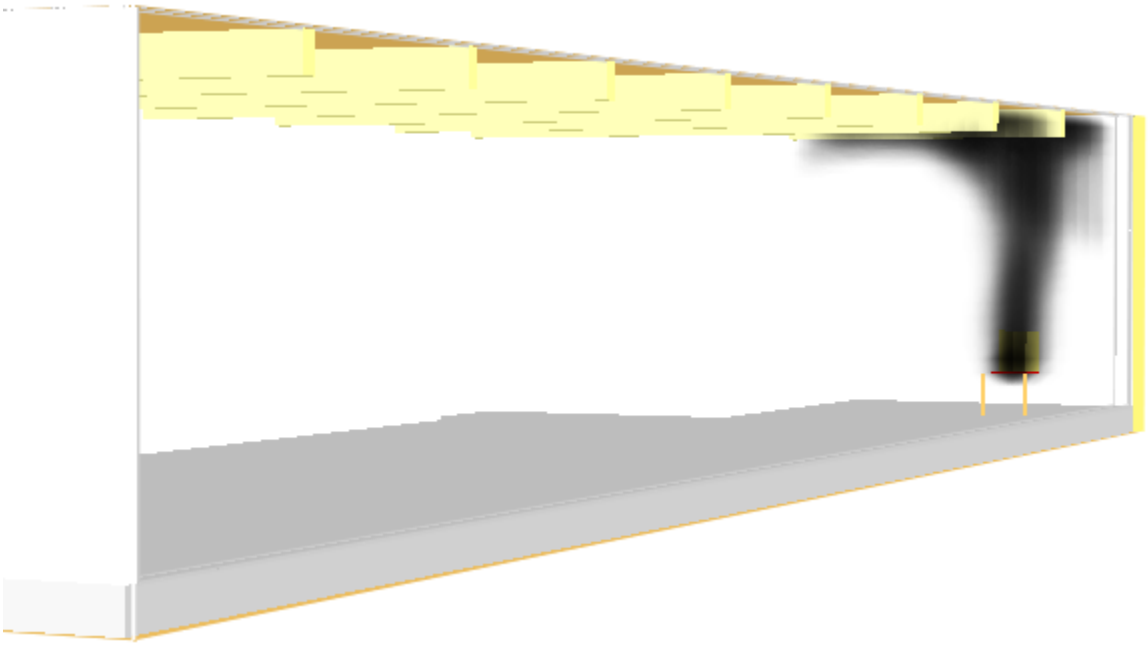


Figure 42: Fire Plume at 26 Seconds (Detection Time)

Notification Time:

As discussed previously, notification time is assumed to be near instantaneous in modern systems. The notification time for this model was selected to be 1 second.

Pre-Movement Time

Pre-movement time was reduced from the 36 second from fire scenario 1 to 10 seconds due to the close proximity between the occupants and the developing fire plume. Occupants would quickly realize the seriousness of the situation and after a few seconds of hesitation and review, would decide to leave the room. The plume at 37 seconds (10 seconds after notification) can be seen below in Figure 43.

Figure 43: Smoke Presence During Growth Stage

Movement Time

The egress (travel) time of occupants assuming a completely full room (120 occupants) was determined using a Pathfinder model utilizing imported CAD drawings of the floor layout. Both the Steering and SFPE Models (discussed previously) were recorded, but only the travel time utilizing the Steering Model will be used due to its more realistic nature. The travel times for both egress models were as follows:

- **Steering: 67 seconds**
- **SFPE: 69 seconds**

The layout of the model at the beginning of the simulation can be seen below in Figure 44.

Figure 44: Pathfinder Egress Model – Room 104

ASET vs. RSET

For this fire scenario, the tenability criteria was reached by exceeding the visibility limit at 135.8 seconds after ignition. This gives an ASET (Available Safe Egress Time) value of 135.8 seconds.

RSET was defined earlier as:

RSET = Detection Time + Notification Time + Pre-Movement Time + Movement Time

Substituting in the individual components gives

RSET = 26 s + 1 s + 10 s + 67 s

for a RSET value of 104 seconds. Factoring in a 15% factor of safety gives a total RSET value of 119.6 seconds. For this fire scenario, ASET (135.8) is greater than RSET plus a Factor of Safety (119.6), and as such, the performance objectives are met.

A second Pathfinder analysis for room 104 was analyzed in which the 72" door closest to the fire source was assumed to be inaccessible leaving only the 36" door available to egress for all 120 occupants. All conditions and model parameters are the same as the initial simulation except for disabling the 72" door and altering the control logic for the 36" door in (as before) open at 37 seconds but then stay open until 171 seconds – the time when the last occupant egresses the room. The Pathfinder model for the situation can be seen below in Figure 45.

Figure 45: Pathfinder Egress Model – Room 104, Single Exit Condition

The egress times for this condition are summarized in the table below.

- **Steering: 134**
- **SFPE: 166**

Available Safe Egress Time

After the new model was set up and run, the slice files for visibility, temperature, and carbon monoxide concentration were analyzed to see if any of the tenability criteria were surpassed.

Visibility Tenability Reached – 135.8 Seconds

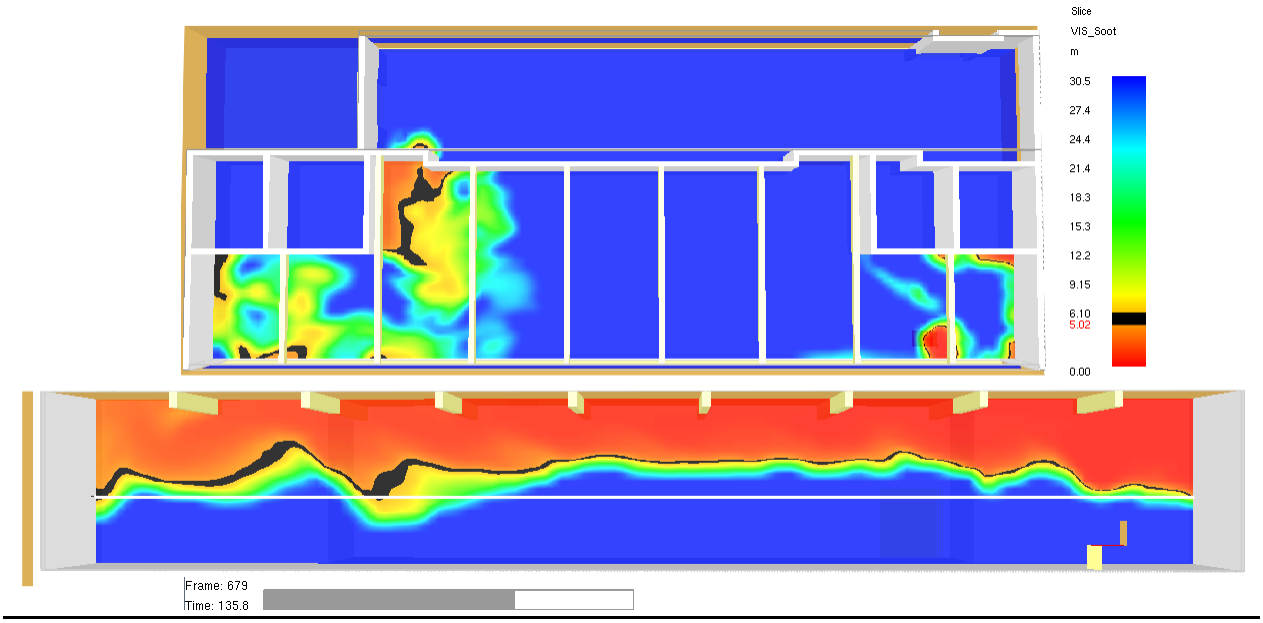


Figure 46: Room 104 Visibility Slice File

The above slice file (Figure 46) shows the visibility tenability being reached at 135.8 seconds after ignition, the same as for the initial simulation run. The top half of the figure shows the view looking down on the corridor while the bottom figure shows the side view along the corridor. The white marking along the side view is the 6 foot (above ground) reference line. Visibility remained untenable through the end of the simulation and well past the determined RSET value. Since only the 36" was available, it stayed open long enough for the smoke layer to descend below the doorway and spill out into the corridor as seen below in Figure 47.

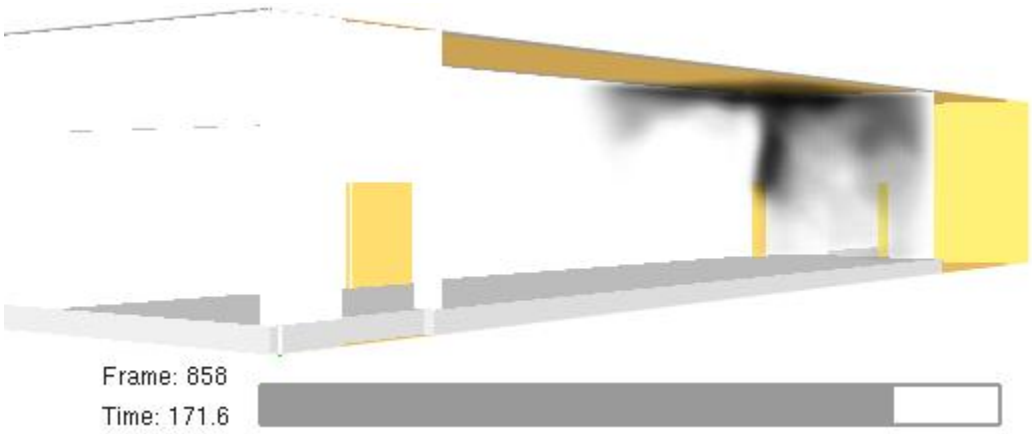


Figure 47: Room 104 Combustion Products Spilling Into Corridor

Temperature and Carbon Monoxide Concentration Tenability – Not Reached

As with before, neither temperature nor carbon monoxide surpassed their tenability criteria. The slice files through the middle of the room for carbon monoxide on the top and temperature on the bottom can be seen below in Figure 48.

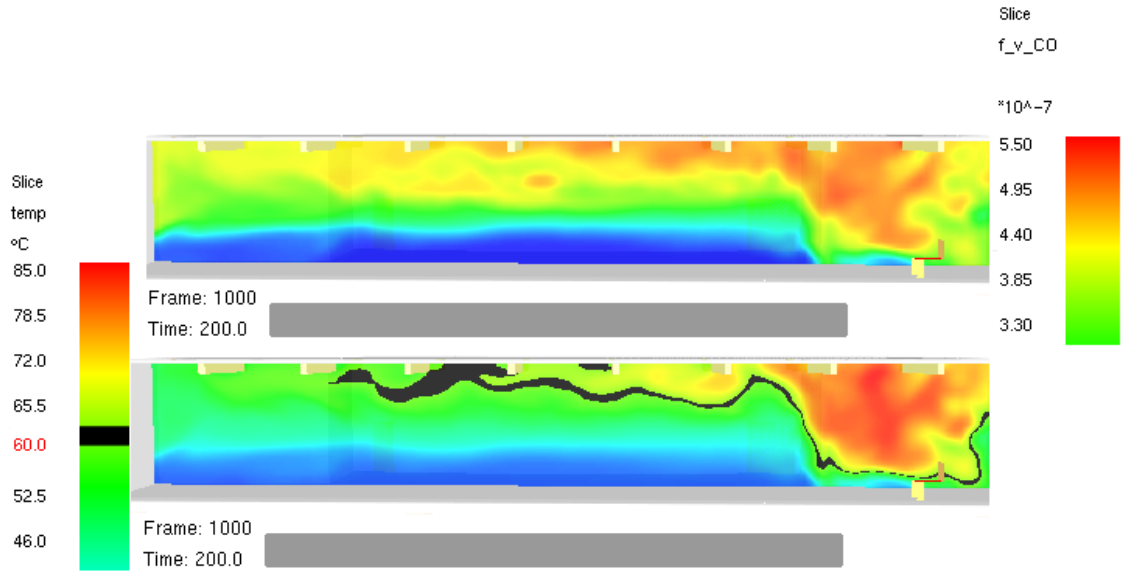


Figure 48: Room 104 Temperature and Carbon Monoxide Slice Files

Required Safe Egress Time

The Required Safe Egress Time will remain unchanged from the previous simulation except for the movement time which will be longer since egress can only occur through the single 36" door as opposed to both the 72" and the 36" door.

As a summary,

- Detector Time: 26 seconds
- Notification Time: 1 second
- Pre-Movement Time: 10 seconds
- Movement Time: 134 seconds

RSET = 26 s + 1 s + 10 s + 134 s = 171 seconds

ASET vs RSET

The ASET value remains unchanged at 135.8 seconds, but the RSET value increases almost 61% up to 171 seconds. Since RSET (171 s) is greater than ASET (135.8 s), the performance criteria is not met.

Fire Scenario 2 Summary and Recommendations

For this second fire scenario, the assembly occupancy room 104 was analyzed for performance under fire conditions with regards to visibility, temperature, and carbon monoxide tenability limits. A polyester based thermoplastic polyurethane stack of chairs was considered to ignite and burn until sprinklers activated and controlled its heat release rate. Two variations of the scenario were considered, one where both egress pathways were available (72" and 36" door) and the other where only one egress pathway was available for use (the 36" door). The Available Safe Egress Time stayed the same through both simulations since the fire conditions went unchanged, and was determined to be 135.8 seconds. The Required Safe Egress Time was calculated based mainly on Pathfinder simulations. RSET for when both egress path ways were available was 119.6 seconds (104 seconds + 0.15 F.O.S.), and as such met performance criteria. RSET for the second iteration was 171 seconds, and as such, was greater than the calculated ASET. The second scenario did not met performance criteria.

Even though the performance criteria wasn't met with regards to visibility (Figure 49), the temperature and carbon monoxide threshold were not surpassed. A lack of visibility by itself will not lead to incapacitation and death. So while occupants will be exposed to irritant gases and have difficulty seeing as they egress, they should be able to egress safely if they stay low to the ground and out of the hot gas layer as long as possible.

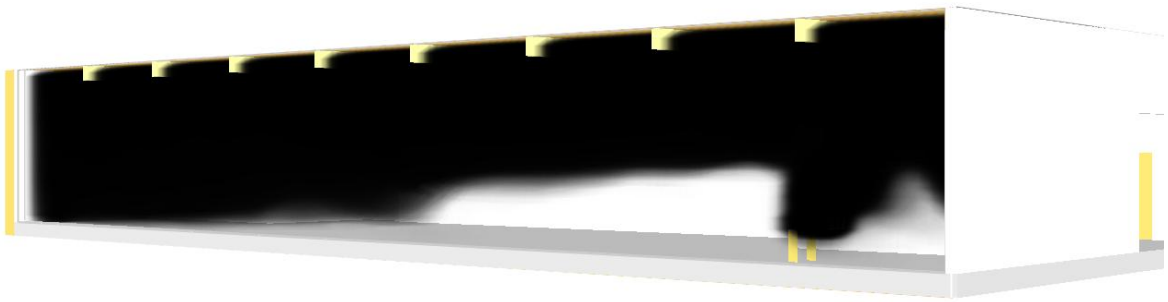


Figure 49: Smoke Layer at RSET

The sprinklers installed in room 104 are quick response sprinklers but are rated at 200 F rather than the more standard 150 F range for this occupancy. Replacing the sprinkler heads with ones that operate at lower a temperature could be a relatively cost effective way of increase the life safety of room 104. Furthermore, the 36" door should be fixed to swing in the direction of egress and be installed with panic hardware as required based on its occupancy (discussed previously in the Egress section). Although door swing direction and panic hardware are not taken into consideration for Pathfinder modeling, in a real life situation, the door opening in he correct direction could save precious seconds when evacuating the room under full occupant load conditions.

8.0 Summary and Recommendations

The Bonderson Engineering Projects Center was selected for the purpose of performing a fire and life safety analysis using current codes and standards. The International Building Code, the Life Safety Code, the National Alarm and Signaling Code, and the Standard for Installation of Sprinkler Systems were utilized during the prescriptive review of the egress systems, structural system, detection and alarm systems, and suppression system.

The occupant load was determined for the building as a whole using LSC practices as part of the prescriptive egress analysis. During the overview, it was determined that the occupancy of room 104 has changed due to its fundamental use. Room 104 was originally classified as a Business occupancy, but it is now used in such a way as to classify it as an Assembly Occupancy. Some deficiencies were noted due to this reclassification. The 36" door should be refitted such that it swings outward in the direction of egress. Furthermore, panic hardware needs to be installed on both of the doors so that code requirements are met.

The structural analysis revealed that the building does not meet LSC requirements to be classified as a Separated Occupancy, although it does meet the IBC code requirements for the same classification. The business office 117 does not have a 1 hour fire rated separation from the machine shop (room 114) or the wood shop (room 115), both of which are classified as an Industrial Occupancy. As such, the building was analyzed as a Mixed Use Occupancy. Maximum area, height, and story limitations satisfy code requirements, as well as structural fire rating requirements. Fire rated requirements for hazardous areas as well as the atrium were also satisfied.

Analysis of the Detection and Notification systems showed that the building has what is defined as a total coverage detection system in that all normally occupied spaces feature an automatic smoke detector. Numerous detection and notification devices throughout the building provide a robust system, but some coverage gaps do exit, although they are minor compared to the overall coverage. Additionally, the notification appliances in some of the Industrial occupancy areas do not meet the code requirements for minimum audibility using the predefined average ambient sound levels. The use of the average ambient noise level for Industrial occupancies (80 dBA), the required 15 dBA above ambient rule, and the 6dBA drop off rule show that some areas fall below the allowed minimum noise level. Utilizing an average ambient noise level more in line with an educational occupancy (45 dBA), which fits with personal experience after walk through's of the building, allows for the code requirements to be met. Still, an actual measurement of the buildings average ambient noise level should be performed in order to better assess the audible notification system.

The sprinkler system was also analyzed as part of the prescriptive approach. The building features a fully automatic, wet-pipe system with quick response sprinklers throughout all occupancies. Determining the most hydraulically remote area for analysis turned out to be tricky. The most hydraulically remote area, a Light Hazard Occupancy on the second floor, would most likely demand the highest pressure. But, one of the Ordinary Hazard Group-2 Occupancies on the first floor, while most likely requiring a lower pressure, would need a higher flow rate due to the higher density requirement. Both situations were analyzed and then compared to the water supply servicing the building. Both scenarios were well under the available flow and pressure provided by a city water main. Bracing throughout the building also seemed to meet code requirements for supporting and bracing the sprinkler system and other components.

The building features a two story atrium in the main lobby as part of its aesthetics and open design. Although they are beautiful architectural feats, atriums present unique fire hazards that need to be considered since they allow easy travel routes for combustion products and they usually are situated near exits and means of egress. The atrium was analyzed prescriptively and then in a performance based design scenario. Prescriptively, the atrium met code requirements for having sprinkler and smoke detection protection, low hazard finishes, and separation from adjoining occupancies. As part of the fire based scenario, an Acetone spill and subsequent fire was considered. This fire blocked off a substantial portion of the main means of egress and exit way for occupants. FDS and Pathfinder modeling showed that the Available Safe Egress Time for occupants was less than the Required Safe Egress Time, meaning that occupants trying to egress the building would encounter conditions described as untenable. Improved focus on administrative control by building management was recommended in order to help ensure that an atrium fire does not occur.

Lastly, a fire scenario in the assembly room 104 was considered. Two situations were modeled, one where both the 72” and 36” doors were available for use, and one where only the 36” door was available. Occupants were able to egress safely when both doors were available, but encountered a descending hot gas layer and untenable visibility conditions due to decreased egress capacity when only the 36” door was available. The main recommendation regarding this fire scenario was to fix the 36” doors swing direction and to install panic hardware in order to help occupants egress faster should a similar situation ever arise.

Overall, the Bonderson Engineering Projects Center largely meets prescriptive code requirements.

9.0 References

Cal Poly Environmental Health & Safety Fire Drill & Building Evacuation Procedure

Cal Poly San Luis Obispo Campus Emergency Management Plan, 2013

International Building Code, 2009

NFPA 101: Life Safety Code, 2012

NFPA 13, Standard for Installation of Sprinkler Systems, 2010

NFPA 30, Flammable and Combustible Liquids Code Handbook, 2012

NFPA 45, Standard on Fire Protection for Laboratories, 2011

NFPA 72, National Fire Alarm and Signaling Code, 2010

NFPA Fire Protection Handbook, 19th Edition

NIJ, Flammable and Combustible Liquid Spill/Burn Patterns, Report 604-00

NIST, FDS 6 User Guide, Special Publication 1019

NIST, Quick Response Sprinklers in Chemical Laboratories: Fire Results, IR 89-4200

NUREG 1805, Chapter 3: Estimating Burning Characteristics of Liquid Pool Fires, Heat Release Rate, Burning Duration, and Flame Height

Pathfinder Technical Reference, Pathfinder 2014, Thunderhead Engineering

Pyrosim User Manual, Pyrosim 2014, Thunderhead Engineering

SFPE Handbook of Fire Protection Engineering, 4th Edition

10.0 Appendix

Appendix A - Egress

Appendix B - Structural

Appendix C – Detection and Alarm

Appendix D - Suppression

Appendix E – Performance Based Design

Appendix F - Additional

Figure A1: First Floor Exit's and Stairways

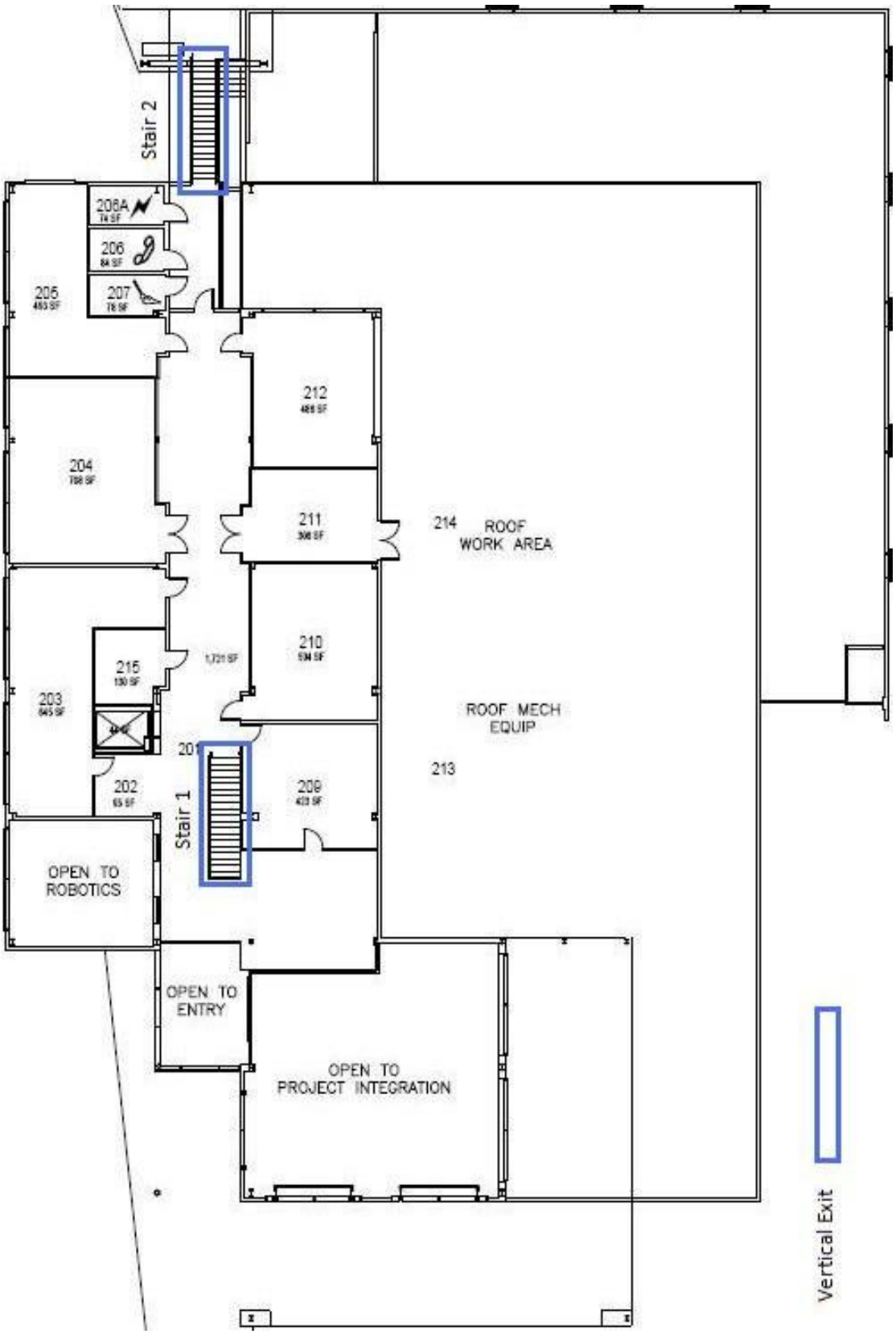


Figure A2: Second Floor Vertical Exits / Stairways

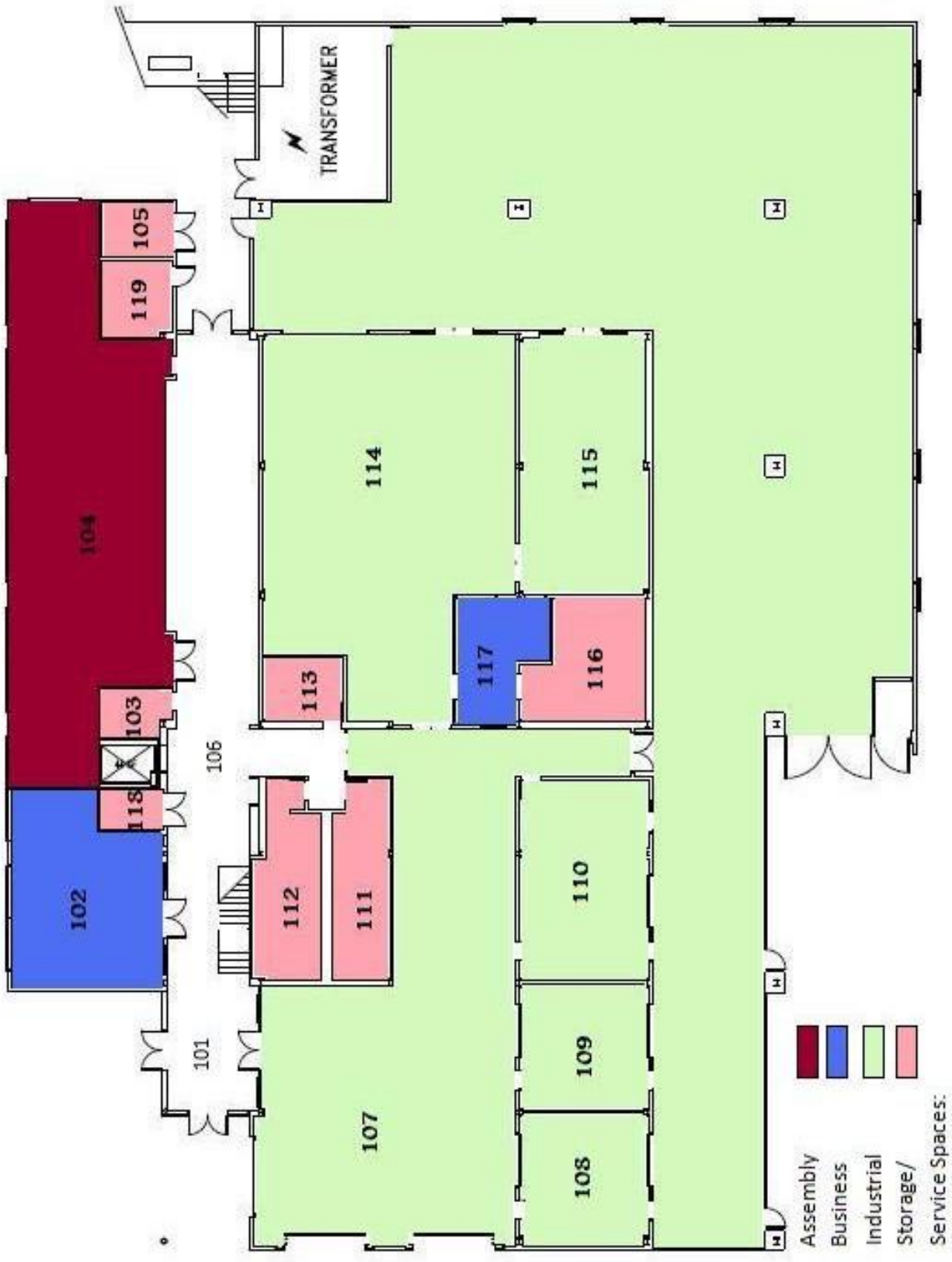


Figure A3: First Floor Color Coded Occupancy Classification Layout

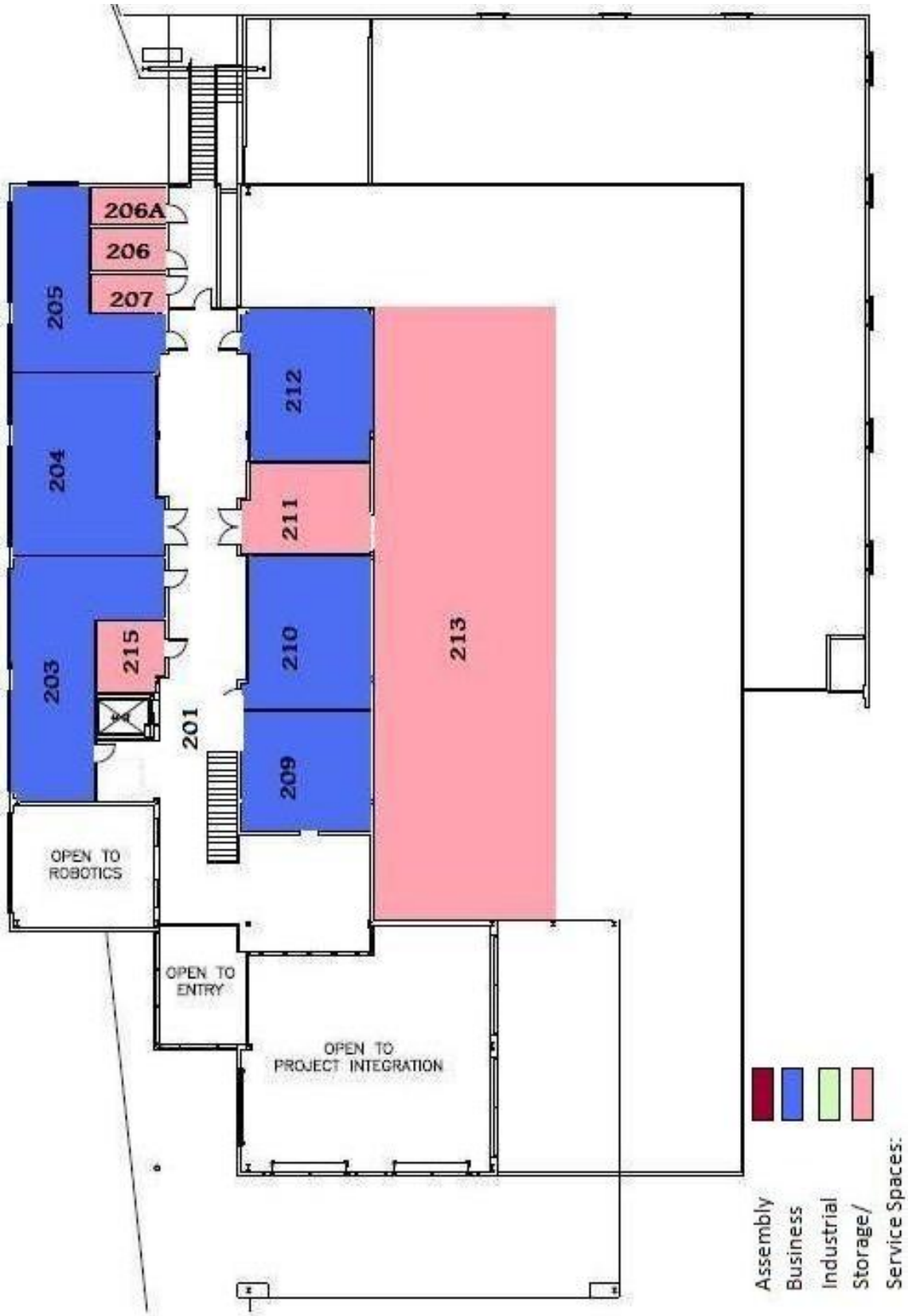


Figure A4: Second Floor Color Coded Occupancy Classification Layout

Room #	Name/Activity	Room Area	LSC Occupancy	LSC Use	O.L.F.	Occupant Load
CWA	Covered Work Area	8110	Industrial	General	100	82
101	Entry	275	-	-	-	-
102	Robotics	655	Business	Vocational Room	50	14
103	Elevator Equip.	75	Storage	Other Than	500	-
104	Group Work	1,790	Assembly	Assembly - Less C.	15	120
105	Electrical	90	Storage	Other Than	500	-
106	Hallway	1,570	-	-	-	-
107	Project Integ.	2,095	Industrial	General	100	21
108	Dedicated Proj. 1	405	Industrial	General	100	5
109	Dedicated Proj. 2	390	Industrial	General	100	4
110	Dedicated Proj. 3	620	Industrial	General	100	7
111	Men's Restroom	295	-	-	-	-
112	Women's Restroom	275	-	-	-	-
113	Custodial	110	Storage	Other Than	500	-
114	Machine Shop	2,050	Industrial	General/Shop	100	21
115	Wood Shop	790	Industrial	General/Shop	100	8
116	Tool Storage	335	Storage	Other Than	500	-
117	Tech Support	235	Business	Office	100	3
118	Cart Storage	60	Storage	Other Than	500	-
119	Main Data Frame	125	Storage	Other Than	500	-
Total		**20350**				**283 Persons**

Figure A5: First Floor Occupant Load Details

Room #	Name/Activity	Room Area	LSC Occupancy	LSC Use	O.L.F.	Occupant Load
201	Waiting	410	-	-	-	-
202	Vending	95	-	-	-	-
203	Device Control Lab	650	Business	Assembly	15	44
204	Open Computer Lab*	705	Business	Office	100	25*
205	Computer Cluster	500	Business	Office	100	5
206	Telecommunication	125	Storage	Other Than	500	-
207	Custodial	110	Storage	Other Than	500	-
208	Hallway	1,100	-	-	-	-
209	Chemistry Lab	425	Business	Lab	50	9
210	Electronics Repair	490	Business	Vocational	50	10
211	Enclosed Mechanical	310	Storage	Other Than	500	-
212	Systems Computer Lab	490	Business	Office	100	5
213	Mechanical Bay	-	-	-	-	-
214	Enclosed Work Area	790	Storage	Other	500	-
215	Server	125	Storage	Other	500	-
Total		**6325**				**98 Persons**

*Increased based on number of available computer stations

Figure A6: Second Floor Occupant Load Details

Room #	Name/Activity	Width (in)	Cap. Factor	Cal. Capacity	Req. Capacity	Req. Exits	Available Exits	Meets Code
CWA	Covered Work Area	108	0.2	540	82	2	3	**Yes**
101	Entry	144	0.2	720	-	-	-	**-**
102	Robotics	72	0.2	360	14	1	1	**Yes**
103	Elevator Equip.	36	0.2	180	-	1	1	**Yes**
104	Group Work	108	0.2	540	120	2	2	**Yes**
105	Electrical	72	0.2	360	-	1	1	**Yes**
106	Hallway	-	-	-	-	-	-	**-**
107	Project Integ.	216	0.2	1080	21	1	7	**Yes**
108	Dedicated Proj. 1	72	0.2	360	5	1	2	**Yes**
109	Dedicated Proj. 2	72	0.2	360	4	1	2	**Yes**
110	Dedicated Proj. 3	144	0.2	720	7	1	2	**Yes**
111	Men's Restroom	36	0.2	180	-	-	-	**-**
112	Women's Restroom	36	0.2	180	-	-	-	**-**
113	Custodial	36	0.2	180	-	1	1	**Yes**
114	Machine Shop	144	0.2	720	21	1	3	**Yes**
115	Wood Shop	144	0.2	720	8	1	2	**Yes**
116	Tool Storage	36	0.2	180	-	1	1	**Yes**
117	Tech Support	36	0.2	180	3	1	1	**Yes**
118	Cart Storage	72	0.2	360	-	1	1	**Yes**
119	Main Data Frame	36	0.2	180	-	1	1	**Yes**
203	Device Control Lab	72	0.2	360	44	1	2	**Yes**
204	Open Computer Lab	72	0.2	360	25	1	1	**Yes**
205	Computer Cluster	36	0.2	180	6	1	1	**Yes**
206	Telecommunication	36	0.2	180	-	1	1	**Yes**
207	Custodial	36	0.2	180	-	1	1	**Yes**
208	Hallway	-	-	-	-	-	-	**Yes**
209	Chemistry Lab	72	0.2	360	9	1	2	**Yes**
210	Electronics Repair	36	0.2	180	10	1	1	**Yes**
211	Enclosed Mechanical	72	0.2	360	-	1	1	**Yes**
212	Systems Computer Lab	36	0.2	180	5	1	1	**Yes**
213	Mechanical Bay	-	-	-	-	-	1	**Yes**
214	Roof Equipment	72	0.2	360	-	1	1	**Yes**
215	Server	36	0.2	180	-	1	1	**Yes**

Figure A7: Available/Required Egress Capacity and Available/Required Number of Exits

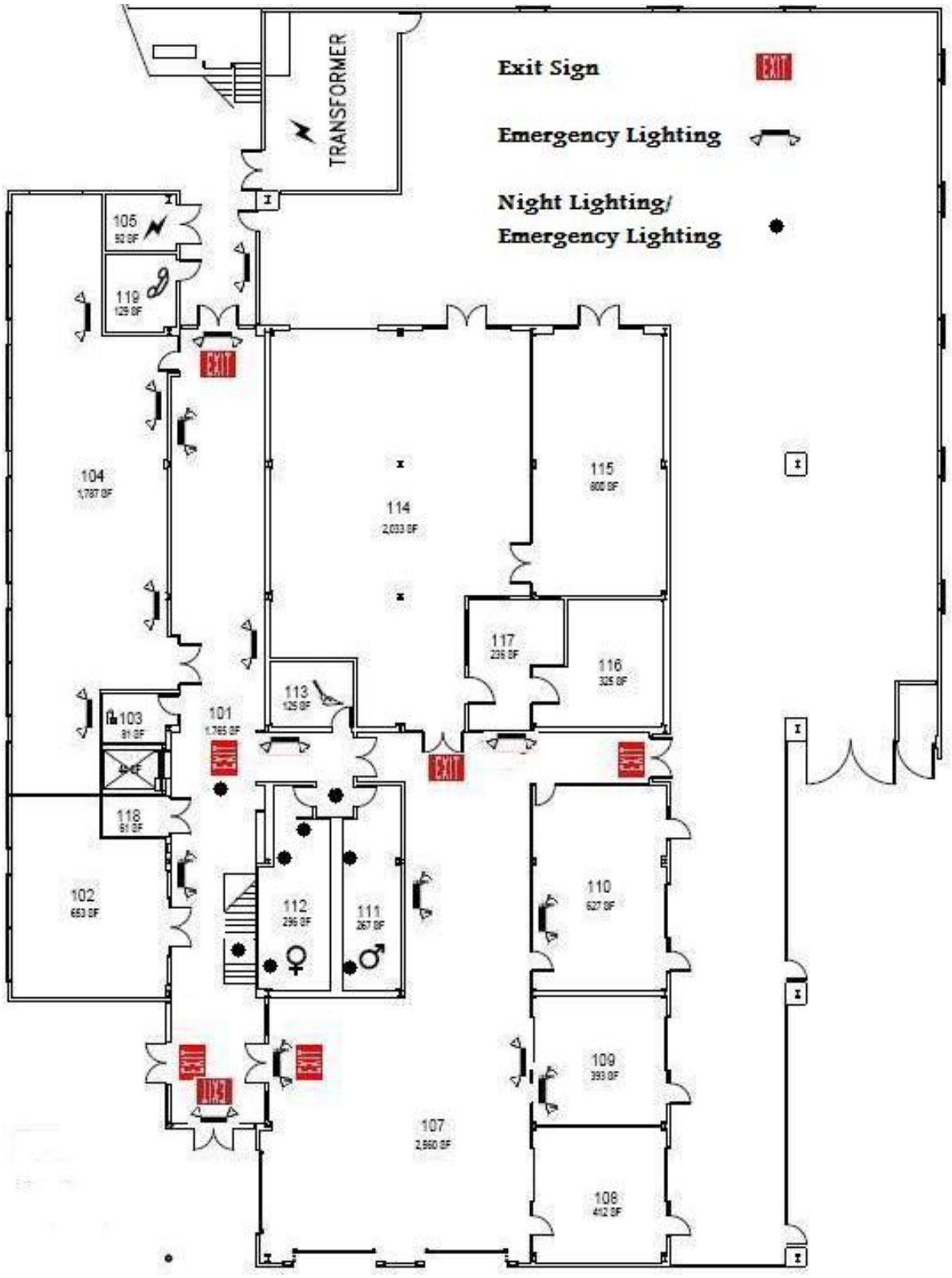


Figure A8: First Floor Exit Signage, Emergency Lighting, and Night Time Egress Lighting

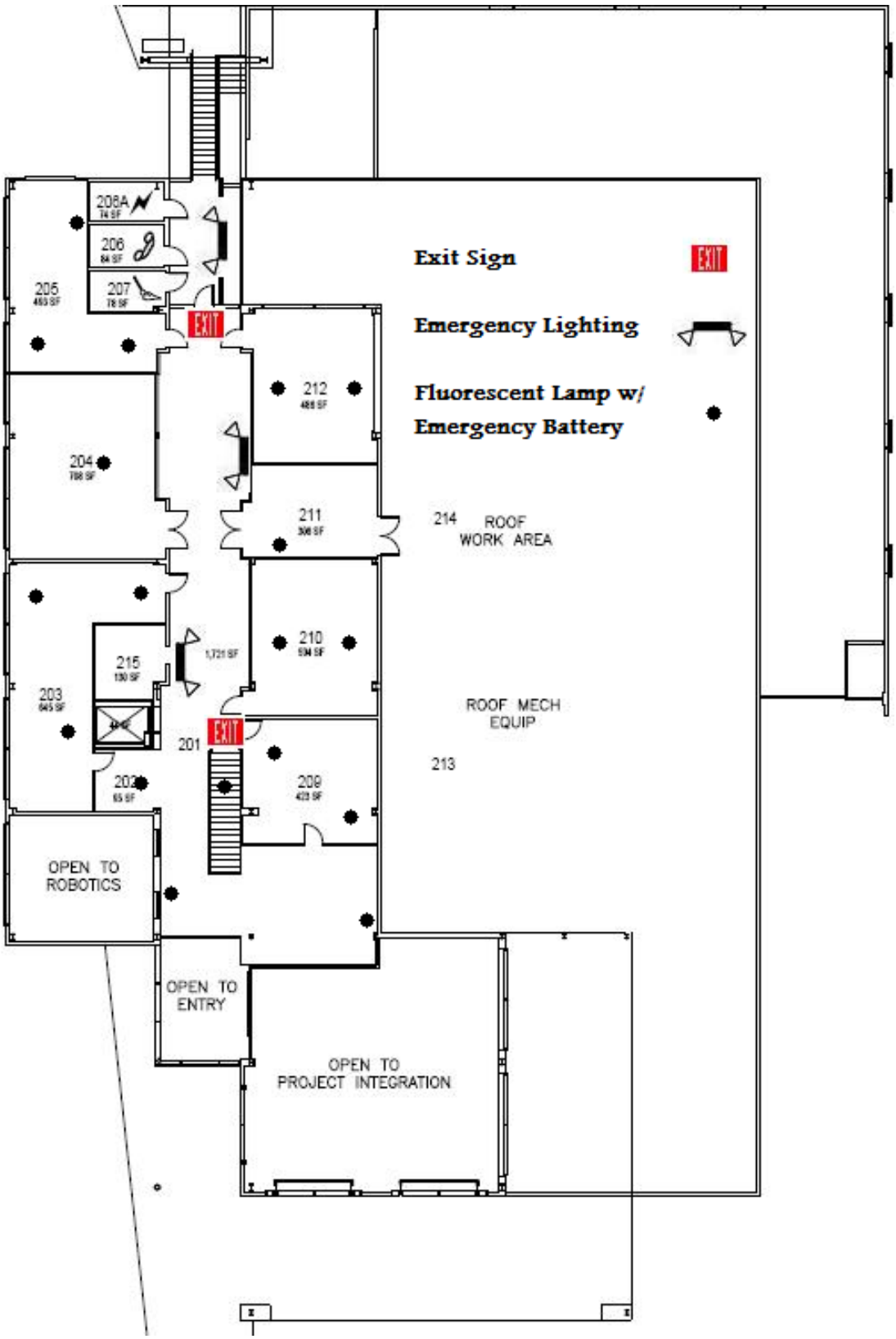


Figure A9: Second Floor Exit Signage, Emergency Lighting, and Night Time Egress Lighting

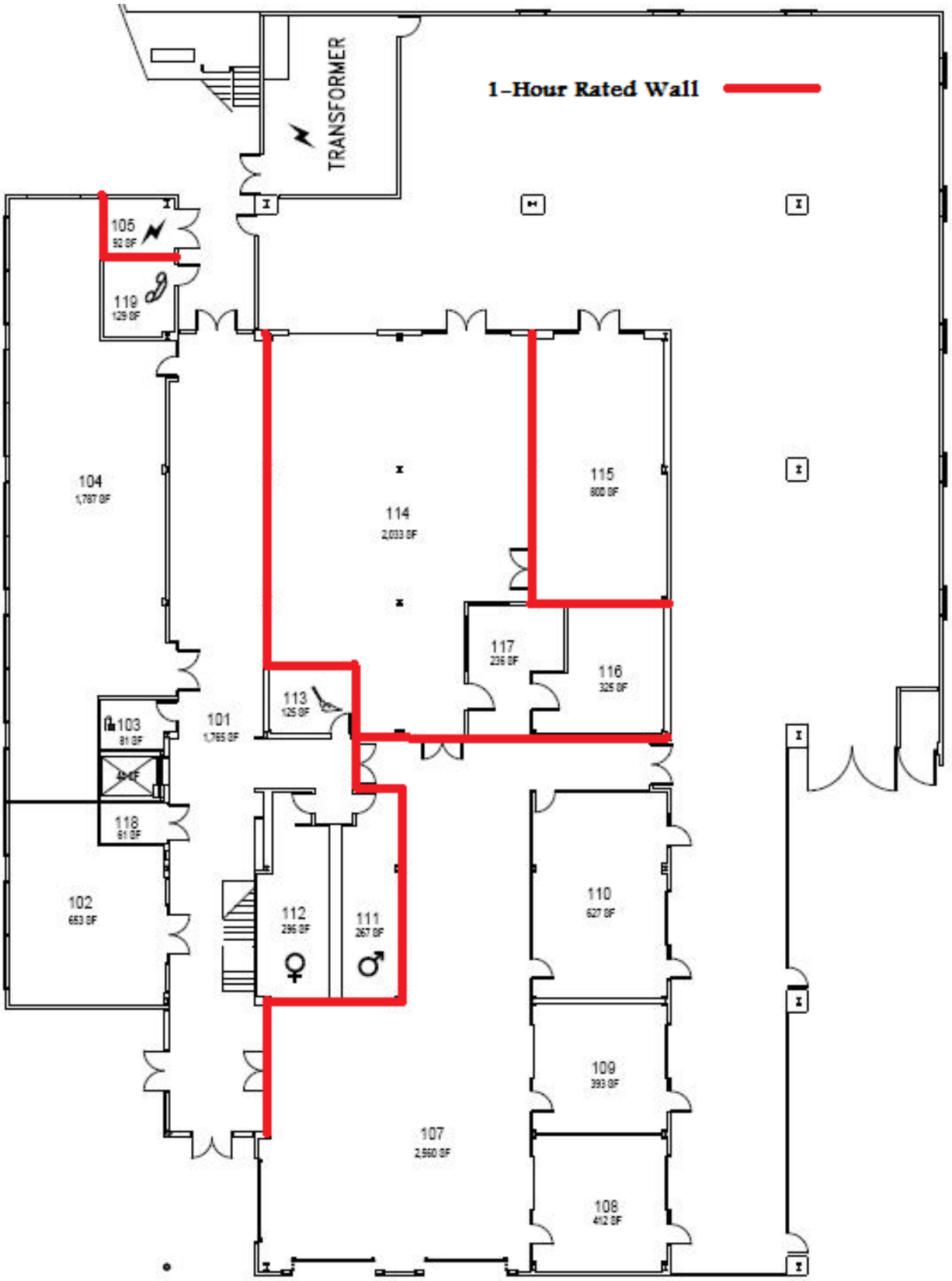


Figure B1: First Floor 1-Hour Rated Wall Locations

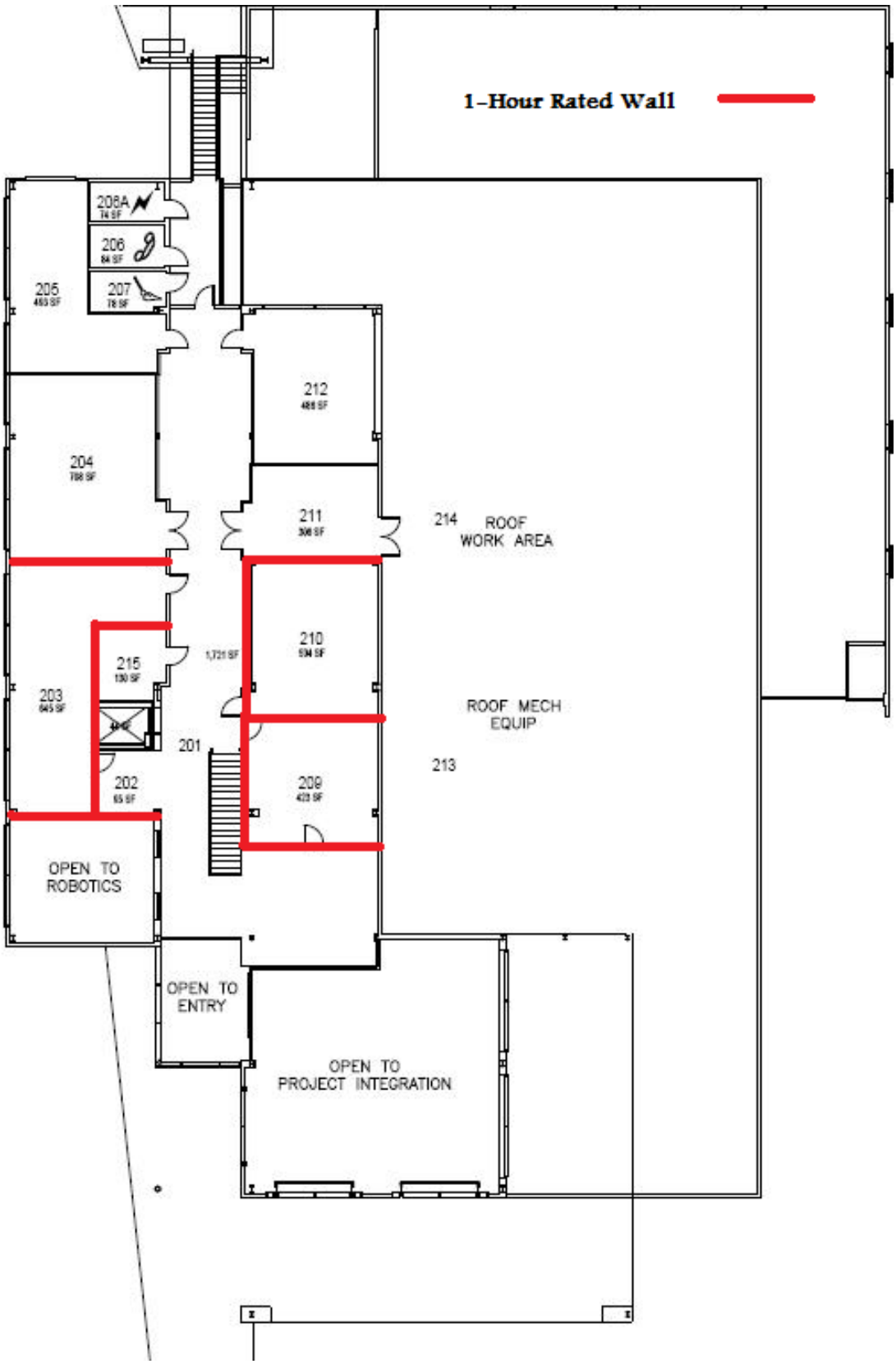


Figure B2: Second Floor 1-Hour Rated Wall Locations

GENERAL ABBREVIATIONS

A

A/C	AIR CONDITIONING
AC	ASPHALT CONCRETE
AD	AREA DRAIN
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
ALUM	ALUMINUM
ALT	ALTERNATE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APPROX	APPROXIMATELY
ARCH	ARCHITECT, ARCHITECTURAL
ASSY	ASSEMBLY
AVG	AVERAGE
AWS	ACCESSIBLE WORK SURFACE

B

BC	BOTTOM OF CURB, BEGIN CURVE
BD	BOARD
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BEAM, BENCH MARK
BOT	BOTTOM

C

CAB	CABINET
CG	CORNER GUARD
CJ	CONSTRUCTION JOINT
CL	CENTERLINE
CLG	CEILING
CLJ	CONTROL JOINT
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
COMM	COMMUNICATIONS
CONC	CONCRETE
CONN	CONNECTION
CONSTR	CONSTRUCTION
CONT	CONTINUE, CONTINUATION, CONTINUOUS
CSK	COUNTERSINK
CT	CERAMIC TILE
CTB	CERAMIC TILE BASE

D

DBL	DOUBLE
DEMO	DEMOLITION
DET	DETAIL
DF	DRINKING FOUNTAIN
DFP	DOOR & FRAME PAINT
DIA	DIAMETER
DIM	DIMENSION
DN	DOWN
DO	DITTO
DR	DOOR, DRAIN
DS	DOWNSPOUT

E

E	EAST
EA	EACH
EJ	EXPANSION JOINT
EL	ELEVATION HEIGHT
ELEC	ELECTRIC
ELEV	ELEVATOR, ELEVATION
EMERG	EMERGENCY
EQ	EQUAL
EQUIP	EQUIPMENT
EST	ESTIMATE
ETC	ETCETERA
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
EWS	EYE WASH STATION
EXIST	EXISTING
EXP	EXPOSED, EXPANSION
EXT	EXTERIOR, EXTERNAL

F

FA	FIRE ALARM
FCRC	FLUOROCARBON RESIN COMPOUND
FD	FLOOR DRAIN, FIRE DAMPER
FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHER CABINET
FF	FACTORY FINISH, FINISHED FLOOR
FFE	FINISHED FLOOR ELEVATION
FG	FINISHED GRADE
FHC	FIRE HOSE CABINET
FHMS	FLAT HEAD MACHINE SCREW
FHWS	FLAT HEAD WOOD SCREW
FIN	FINISH
FL	FLOOR, FLOW LINE
LMT	FLUSH MOUNT
FM	FACTORY MUTUAL
FO	FACE OF
FOC	FACE OF CONCRETE
FOEP	FACE OF EXTERIOR PANEL
FOS	FACE OF STUD
FOW	FACE OF WALL
FP	FIREPROOF, FIREPROOFED
FR	FROM, FIRE RATED
FRP	FIBER REINFORCED PLASTIC
FS	FLOOR SINK, FINISHED SURFACE
FT	FOOT, FEET
FTG	FOOTING, FITTING
FV	FIELD VERIFY

G

GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GI	GALVANIZED IRON
GWB	GYPSUM WALLBOARD
GYP	GYPSUM

H

HDW	HARDWARE
HDWD	HARDWOOD
HM	HOLLOW METAL
HP	HORSEPOWER, HIGH POINT
HPL	HIGH PRESSURE LAMINATE
HR	HOUR
HT	HEIGHT
HVAC	HEATING, VENTILATING, & AIR CONDITIONING

I

IAW	IN ACCORDANCE WITH
ID	INSIDE DIAMETER
IN	INCH
INSUL	INSULATE, INSULATION
INT	INTERIOR

J

JT	JOINT

L

L	LENGTH
LAB	LABORATORY
LAM	LAMINATE
LAT	LATERAL
LAV	LAVATORY
LBS	POUNDS
LF	LINEAR FEET
LH	LEFT HAND
LP	LOW POINT
LTG	LIGHTING

M

MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MECH	MECHANICAL
MFR	MANUFACTURER
MET	METAL
MIL	THOUSANDTH OF AN INCH
MIN	MINIMUM, MINUTE
MR	MIRROR
MISC	MISCELLANEOUS
MM	MILLIMETER
MRGW	MOISTER RESISTANT GYPSUM WALLBOARD
MRTD	MULTI-ROLL TISSUE DISPENSER
MTD	MOUNTED
MULL	MULLION

N

N	NORTH
NA	NOT APPLICABLE
NC	NORMALLY CLOSED, NOISE CRITERIA
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NIC	NOT IN CONTRACT
NO	NUMBER
NTS	NOT TO SCALE

O

OA	OVERALL
OC	ON CENTER
OD	OUTSIDE DIAMETER, OVERFLOW DRAIN
OF	OUTSIDE FACE
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFE	OWNER FURNISHED EQUIPMENT
OFM	OWNER FURNISHED MATERIAL
OH	OPPOSITE HAND, OVERHEAD
OPNG	OPENING
OPP	OPPOSITE

P

PA	PUBLIC ADDRESS
PART BD	PARTICLE BOARD
PL	PROPERTY LINE, PLATE
PLAM	PLASTIC LAMINATE
PLCS	PLACES
PLWD	PLYWOOD
PM	PARTITION MOUNTED
POC	POINT OF CURVE, POINT OF CONNECTION
POT	ACCESSIBLE PATH OF TRAVEL
PTD	PAPER TOWEL DISPENSER, PAINTED
PTN	PARTITION
PVC	POLYVINYL CHLORIDE

Q

QTY	QUANTITY

R

R	RISER, RADIUS
RCD	RECESSED
RD	ROOF DRAIN
REBAR	REINFORMING STEEL BAR
RE, REF	REFERENCE
REFR	REFRIDGERATOR
REINF	REINFORMEMENT, REINFORCED
REQD	REQUIRED
REV	REVISION
RH	RIGHT HAND, ROBE HOOK
RHMS	ROUND HEAD MACHINE SCREW
RHWS	ROUND HEAD WOOD SCREW
RM	ROOM
RMS	ROOMS
RO	ROUGH OPENING
ROD	ROOF OVERFLOW DRAIN

S

S	SOUTH
S/EWS	SHOWER / EYE WASH STATION
SAN	SANITARY
SAP	SOUND ABSORBING PANEL
SC	SEALED CONCRETE
SCD	SEAT COVER DISPENSER
SD	SOAP DISPENSER, STORM DRAIN
SECT	SECTION
SHT, SHTS	SHEET, SHEETS
SIM	SIMILAR
SM	SURFACE MOUNTED, SMALL
SMSD	SURFACE MOUNTED SOAP DISPENSER
SNTV	SANITARY NAPKIN & TAMPON VENDOR
SND	SANITARY NAPKIN DISPENSER
SPEC	SPECIFICATIONS
SPKR	SPEAKER
SQ FT	SQUARE FOOT, SQUARE FEET
SS	STAINLESS STEEL, SANITARY SEWER
STL	STEEL
STOR	STORAGE
STRL	STRUCTURAL
SURF	SURFACE
SUSP	SUSPENDED
SYM	SYMMETRICAL

T

T	TREAD
T&B	TOP & BOTTOM
TBD	TO BE DETERMINED
TBR	TO BE REMOVED
TC	TOP OF CURB, TOILET COMPARTMENT
TCTD	TOILET SEAT COVER & TISSUE DISPENSER
TEL	TELEPHONE
TG	TEMPERED GLASS
THK	THICK, THICKNESS
T.O	TOP OF
TOC	TOP OF CONCRETE
TOD	TOP OF DRAIN
TOR	TOP OF ROOF
TOW	TOP OF WALL
TPD	TOILET PAPER DISPENSER
TPO	THERMOPLASTIC OLEFIN
TYP	TYPICAL

U

UBC	UNIFORM BUILDING CODE
UC	UNDERCUT
UL	UNDERWRITERS LABORTORIES
UON	UNLESS OTHERWISE NOTED
UR	URINAL

V

VB	VINYL BASE, VALVE BOX
VBT	VINYL BASE & TRIM
VCT	VINYL COMPOSITION TILE
VERT	VERTICAL
VFY	VERIFY
VIF	VERIFY IN FIELD
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING

W

W/	WITH
W	WEST, WIDTH
WC	WATER CLOSET
WD	WOOD
WH	WATER HEATER, WALL HYDRANT
WP	WATERPROOF, WORKING POINT
WR	WATER RESISTANT
WSCT	WAINSCOT
WT	WEIGHT
WV	WATER VALVE
WWF	WELDED WIRE FABRIC

MISCELLANEOUS

<	GREATER THAN, ANGLE
>	LESS THAN
#	NUMBER, POUNDS
&	AND
@	AT
'	FEET & SECONDS
"	INCHES & MINUTES
°	DEGREES
ø	DIAMETER, ROUND
±	PLUS OR MINUS
℄	CENTERLINE
△	CENTRAL ANGLE OF CURVE

SYMBOLS LEGEND

- OOOX — WINDOW NUMBER; RE: SHEET A10.10 FOR WINDOW SCHEDULE
- OOO–O (ROOM NO / DOOR NO) — DOOR NUMBER; RE: SHEET A10.01 FOR DOOR SCHEDULE
- COOX — CURTAINWALL NUMBER; RE: SHEET A05.30/A05.31 FOR CURTAINWALL SCHEDULE
- SO4A — STOREFRONT NUMBER; RE: SHEET A05.30/A05.31 FOR STOREFRONT SCHEDULE
- OOO (LEVEL NO / ROOM NO) — ROOM NUMBER; RE: SHEET A10.01 FOR FINISH SCHEDULE
- XO (XO XO XO XO / XO XO XO XO) — ROOM FINISHES KEY; RE: SHEET A10.01 FOR FINISH SCHEDULE
- 0 (ROOM NO) / 00 A0.00 (DRAWING NO / SHEET NO) — INTERIOR ELEVATION
- 00 A0.00 (DRAWING NO / SHEET NO) — MAJOR SECTION REFERENCE
- 00 A0.00 (DRAWING NO / SHEET NO) — MAJOR ELEVATION REFERENCE
- 00 A0.00 (DETAIL NO / SHEET NO) — DETAIL REFERENCE
- ELEVATION DATUM
- EXIT SIGN
- 0 — WALL TYPE DESIGNATION; RE: SHEET A07.10/A07.11 FOR WALL TYPES
- 0 — HORIZONTAL GRID LINE DESIGNATION
- X — VERTICAL GRID LINE DESIGNATION
- 1-HR FIRE RATED WALL
- 2-HR FIRE RATED WALL
- 1 — REVISION MARK MADE AFTER BID PHASE (PR, BULLITIN, OR RFI)
- 1 — REVISION MARK MADE DURING BID PHASE (ADDENDUM)
- EXTENT OF REVISION
- WORKING NORTH / TRUE NORTH — PLAN REFERENCE NORTH MARK
- MATCHLINE
- ACCESSIBLE PATH OF TRAVEL
- FENCE
- ASSISTIVE LISTENING DEVICE LOCATION

MATERIAL SYMBOLS

- CAST IN PLACE/ PRECAST CONCRETE
- GYPSUM BOARD
- STEEL / OTHER METALS
- RIGID INSULATION
- BATT / LOOSE FILL INSULATION
- EARTH / COMPACT FILL
- PLYWOOD
- SPECIAL FINISH; FINISH OR MATERIAL/MEMBRANE AS NOTED
- WOOD – CONTINUOUS ROUGH FRAMING
- WOOD – INTERRUPTED MEMBER ROUGH BLOCKING

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT — JOHN TRAUTMANN — C-21914 — 31 AUG 05 RENEWAL — STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

GENERAL ABBREVIATIONS & SYMBOLS

SCALE: NO SCALE DRAWN BY: MCL

DWG NO.

A00.01

DATE: BID SET 03 JAN '05

SCOPE OF WORK

BONDERSON ENGINEERING PROJECTS CENTER (BEPC) IS A PROPOSED 2-STORY, APPROX 20,000 SQ FT, STL-FRAMED BLDG DEDICATED TO COLLEGE OF ENGINEERING STUDENTS' DEVELOPING THEIR SENIOR PROJECTS. VOCATIONAL-SHOP-TYPE, COMPUTER, OFFICE AND SUPPORT SPACES ARE INCLUDED, ALONG WITH PAVED OUTDOOR WORK AREA ENCLOSED BY CONC WALLS AND STL FENCING. SITEWORK EXTENDS BEYOND BUILDING FOOTPRINT TO INTEGRATE BLDG WITH ITS SURROUNDINGS, PROVIDE A SETTING FOR INFORMAL GATHERING & TO PROVIDE ACCESSIBILITY.

ACCESSIBILITY STRATEGY

TO PROVIDE ACCESSIBILITY TO BEPC FROM SURROUNDINGS & THROUGHOUT BEPC, STRATEGY IS AS FOLLOWS:

(E) GENTLY-INCLINED SIDEWALK POT AT S EDGE OF SITE (ALONG N PERIMETER ROAD) IS KEY TO BEPC ACCESSIBILITY:

- CROSSWALKS & CURB DEPRESSIONS AT N PERIMETER ROAD INTERSECTIONS IMMEDIATELY SOUTHWEST & SOUTHEAST OF SITE LINK SIDEWALK POT TO OTHER COLLEGE OF ENGINEERING FACILITIES, ACCESSIBLE PARKING & GREATER CAMPUS

- SIDEWALK POT IN TURN SHALL PROVIDE ACCESS TO BEPC'S W & E ENTRANCES VIA POT THAT EXTEND NORTHWARD TO ENGINEERING IV FLANK SITE ON W AND E, RESPECTIVELY

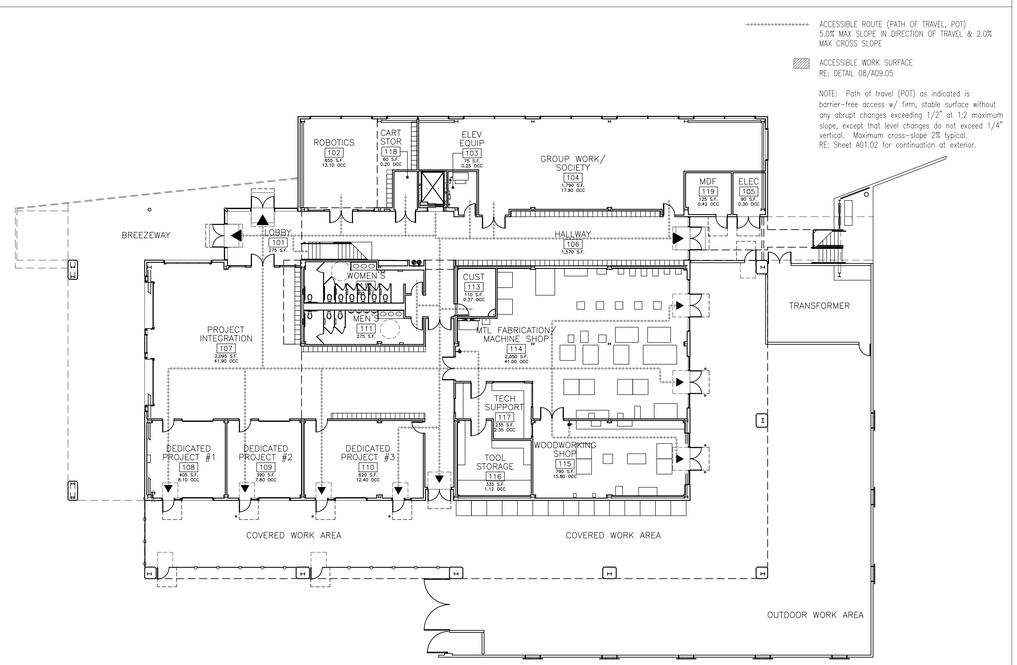
- ACCESS TO BEPC SECONDARY ENTRANCES FRONTING OUTDOOR WORK AREA SHALL BE FROM SIDEWALK POT

ACCESSIBLE PARKING FOR BEPC SHALL BE PROVIDED IMMEDIATELY E OF SITE AS PART OF ENGINEERING IV PROJECT. POT PROVIDING ACCESS TO E ENTRY OF BEPC SHALL SERVE ACCESSIBLE PARKING. POT TO BEPC E ENTRANCE SHALL DESCEND GRADUALLY (2% MAX SLOPE) ABOUT 3 FT, FROM NATURAL GRADE AT PARKING TO BEPC GROUND LEVEL FFE.

INTERMEDIATE LANDING AT E ENTRANCE, ABOUT 4 FT ABOVE GROUND FFE SHALL BE ACCESSIBLE, WITH AN EMERG "BLUE" PHONE. ANOTHER, EXISTING EMERG "BLUE" PHONE, ALSO ACCESSIBLE, SHALL BE MAINTAINED AT SOUTHWEST OF SITE.

ACCESS TO W PART OF SITE SHALL BE VIA A N-S POT THAT SHALL LINK SIDEWALK POT TO FORMAL W ENTRANCE OF BEPC & BEYOND, ENGINEERING IV. A POT CONNECTS ACCESSIBLE GATES INTO OUTDOOR WORK AREA & DOORS INTO INDIVIDUAL SHOP SPACES ALONG BEPC'S S & E SIDES (& ULTIMATELY, VIA ANOTHER GATE, E BEPC ENTRANCE).

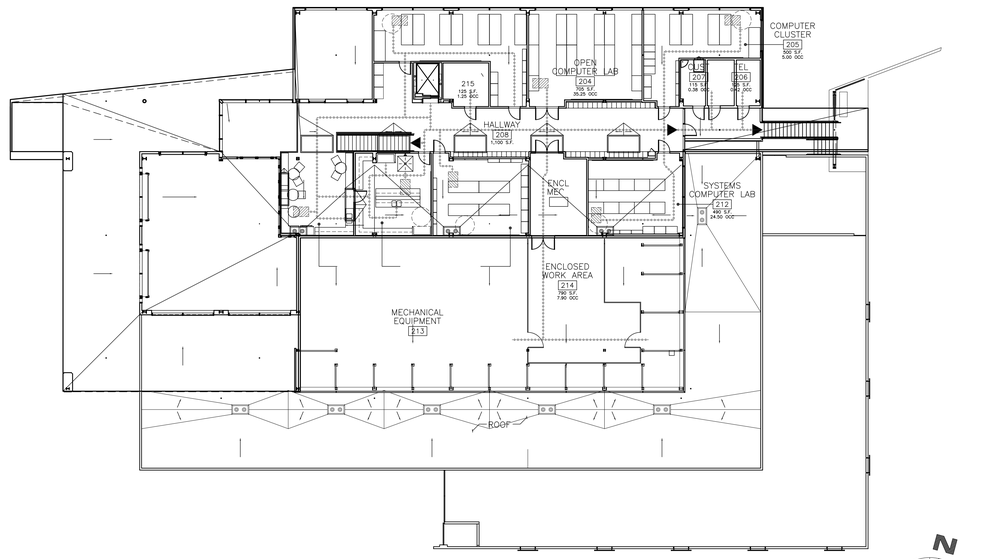
ACCESS TO BEPC GROUND LEVEL, THEREFORE, SHALL BE VIA W, E & SECONDARY ENTRANCES. GROUND LEVEL, SECOND LEVEL SHALL BE ACCESSIBLE THROUGHOUT, EXCEPT NON-PUBLIC ROOF AREAS. ENCLOSED WORK AREA "ROOM" 214, OPEN TO SKY, SHALL BE ACCESSIBLE. ACCESS FROM GROUND TO SECOND LEVELS IS VIA AN ACCESSIBLE, HYDRAULIC ELEV. RMS WHERE AN INFORMAL LECTURE SITUATION IS ANTICIPATED SHALL BE EQUIPPED W/ ASSISTED LISTENING DEVICES.



1 A0.02 GROUND LEVEL ACCESSIBILITY PLAN

0' 16' 48' 96' 160'

1/16" = 1'-0"



2 A0.02 SECOND LEVEL ACCESSIBILITY PLAN

0' 16' 48' 96' 160'

1/16" = 1'-0"

AREA TABULATION - GROUND LEVEL

NUMBER	NAME / ACTIVITY	AREA (SQ FT) ROOM AREA	LESS THRU CIRCULATION	NET AREA	OCCUPANCY PER UBC TABLE 3-A	USE CLASSIFICATION PER UBC TABLE 10-A	OCCUPANT LOAD FACTOR PER UBC TABLE 10-A	OCCUPANT LOAD
101	ENTRY	275	275	–	B	–	–	–
102	ROBOTICS	655	–	655	B	VOCATIONAL ROOM	50	13.10
103	ELEVATOR EQUIPMENT	75	–	75	B	MECHANICAL EQUIPMENT	300	0.25
104	GROUP WORK / SOCIETY	1,790	–	1,790	B	OFFICE	100	17.90
105	ELECTRICAL	90	–	90	B	MECHANICAL EQUIPMENT	300	0.30
106	HALLWAY	1,570	1,570	–	B	–	–	–
107	PROJECT INTEGRATION	2,095	–	2,095	B	VOCATIONAL ROOM	50	41.90
108	DEDICATED PROJECT #1	405	–	405	B	VOCATIONAL ROOM	50	8.10
109	DEDICATED PROJECT #2	390	–	390	B	VOCATIONAL ROOM	50	7.80
110	DEDICATED PROJECT #3	620	–	620	B	VOCATIONAL ROOM	50	12.40
111	MEN'S	295	295	–	B	–	–	–
112	WOMEN'S	275	275	–	B	–	–	–
113	CUSTODIAL	110	–	110	B	STORAGE & STOCK	300	0.37
114	METAL FABRICATION/MACHINE SHOP	2,050	–	2,050	B	SCHOOL SHOP	50	41.00
115	WOODWORKING SHOP	790	–	790	B	SCHOOL SHOP	50	15.80
116	TOOL STORAGE	335	–	335	B	STORAGE & STOCK	300	1.12
117	TECH SUPPORT	235	–	235	B	OFFICES	100	2.35
118	CART STORAGE	60	–	60	B	STORAGE & STOCK	300	0.20
119	MAIN DATA FRAME	125	–	125	B	STORAGE & STOCK	300	0.42
	GROUND LEVEL TOTALS	12,240	2,415	9,825				163.01

AREA TABULATION - SECOND LEVEL

NUMBER	NAME / ACTIVITY	AREA (SQ FT) ROOM AREA	LESS THRU CIRCULATION	NET AREA	OCCUPANCY PER UBC TABLE 3-A	USE CLASSIFICATION PER UBC TABLE 10-A	OCCUPANT LOAD FACTOR PER UBC TABLE 10-A	OCCUPANT LOAD
201	WAITING	410	–	410	B	(ACCESSORY TO HALLWAY)	–	–
202	VENDING	95	–	95	B	(ACCESSORY TO HALLWAY)	–	–
203	DEVICE CONTROL LAB	650	–	650	B	VOCATIONAL ROOM	50	13.00
204	OPEN COMPUTER LAB	705	–	705	B	CLASSROOM	20	35.25
205	COMPUTER CLUSTER	500	–	500	B	OFFICE	100	5.00
206	TELECOMMUNICATION	125	–	125	B	MECHANICAL EQUIPMENT	300	0.42
207	CUSTODIAL	110	–	110	B	STORAGE & STOCK	300	0.37
208	HALLWAY	1,100	1,100	–	B	–	–	–
209	CHEMISTRY LAB	425	–	425	B	VOCATIONAL SHOP	50	8.50
210	ELECTRONICS REPAIR	490	–	490	B	VOCATIONAL SHOP	50	9.80
211	ENCLOSED MECHANICAL	310	–	310	B	MECHANICAL EQUIPMENT	300	1.10
212	SYSTEMS COMPUTER LAB	490	–	490	B	CLASSROOM	20	24.50
213	MECHANICAL BAY	–	–	–	B	–	–	–
214	ENCLOSED WORK AREA	790	–	790	B	ALL OTHERS	100	7.90
215	SERVER	125	–	125	B	OFFICE	100	1.25
	SECOND LEVEL TOTALS	6,335	1,100	5,235				107.09
	1ST LEVEL TOTALS	12,240	2,415	9,825				163.01
	GRAND TOTALS	18,575	3,515	15,060				270.1

CODE ANALYSIS

APPLICABLE CODES:
1. CALIFORNIA CODE OF REGULATIONS (CCR), INCLUDING TITLES 19 & 24
2. AMERICANS WITH DISABILITIES ACT (ADA)
3. CALIFORNIA BUILDING CODE, 2001 (AS AMENDED & INCLUDED IN CCR TITLE 24)

OCCUPANCY CLASSIFICATION:
B /F - "BUSINESS" W/ WOODSHOP AS ACCESSORY USE (<10% OF TOTAL AREA)

CONSTRUCTION TYPE:
II-N; SPRINKLED

ALLOWABLE FLOOR AREA:

ALLOWABLE AREA (TABLE 5B)	12,000 SQ FT
MULTISTORY INCREASE (504.2)	12,000 SQ FT
BASIC ALLOWABLE FLOOR AREA:	24,000 SQ FT

ALLOWABLE AREA INCREASES:

> 20' SEPARATION ON ALL SIDES @ 100% (505.1.3)	24,000 SQ FT
ADJUSTED ALLOWABLE FLOOR AREA	48,000 SQ FT

ACTUAL FLOOR AREAS:

FIRST FLOOR AREA:	12,240 SQ FT
ALLOWABLE FLOOR AREA:	24,000 SQ FT
THEREFORE THE FIRST FLOOR AREA IS IN COMPLIANCE	
SECOND FLOOR AREA:	6,335 SQ FT
ALLOWABLE FLOOR AREA:	24,000 SQ FT
THEREFORE THE SECOND FLOOR AREA IS IN COMPLIANCE	
TOTAL BUILDING FLOOR AREA:	18,575 SQ FT
ALLOWABLE FLOOR AREA:	48,000 SQ FT
THEREFORE THE BUILDING FLOOR AREA IS IN COMPLIANCE	

ALLOWABLE HEIGHT:

ACTUAL HEIGHT:	29'-0"
ALLOWABLE HEIGHT (TABLE-5B)	55'-0"
THEREFORE, BUILDING HEIGHT IS IN COMPLIANCE	

FIRE RESISTIVE REQUIREMENTS:

EXTERIOR NON-BEARING & BEARING WALL:	ONE-HOUR < 20 FT NON RATED ELSEWHERE
EXTERIOR OPENINGS:	NOT PERMITTED < 5 FT PROTECTED < 10 FT
STRUCTURAL FRAME:	NON-RATED
PERMANENT PARTITIONS:	NON-RATED
SHAFT ENCLOSURES:	NON-RATED < 2 STORIES
STAIRWAY:	NON-COMBUSTABLE
FLOOR-CEILING & ROOF-CEILING	NON-RATED

INTERNAL OCCUPANCY SEPARATION:
I. FIRE-RATED SEPARATION BETWEEN USES WITHIN THE MAIN BUILDING:
A. "LABORATORIES AND VOCATIONAL SHOPS IN BUILDINGS USED FOR EDUCATIONAL PURPOSES, AND SIMILAR AREAS CONTAINING HAZARDOUS MATERIALS, SHALL BE SEPARATED FROM EACH OTHER AND FROM OTHER PORTIONS OF THE BUILDING BY NOT LESS THAN ONE-HOUR FIRE-RESISTIVE OCCUPANCY SEPARATION: (CBC 304.2.2.1).
1. HAZARDOUS MATERIALS TO BE USED IN CHEMISTRY LABORATORY, ROOM 209 AS PROVIDED BY COLLEGE OF ENGINEERING AND PER CBC TABLE 3-D AND 3-E, ARE WITHIN EXEMPT QUANTITIES FOR USE AND STORAGE.
2. THEREFORE, OCCUPANCY IS "B" NOT "H" AND THE REQUIREMENTS OF CBC SECTIONS 307.5 AND 307.8 SHALL APPLY.

EXITING REQUIREMENTS:
B-OCCUPANCY CORRIDORS SHALL BE OF ONE-HOUR CONSTRUCTION W/ 20-MIN DOOR OPENINGS & 45-MIN WINDOW OPENINGS (1007.4.3).

OCCUPANTS IN LABORATORIES HAVING AN AREA IN EXCESS OF 200 SQ FT SHALL HAVE ACCESS TO AT LEAST TWO EXITS OR EXIT ACCESS DOORS FROM THE ROOM AND ALL PORTIIONS OF THE ROOM SHALL BE WITHIN 75 FEET OF AN EXIT OR EXIT-ACCESS DOOR. (CBC SECTION 304.2.2.1)

FOR PLUMBING FIXTURE OCCUPANT LOAD
RE: MEMORANDUM #03 FROM CAL POLY, DATED 08/13/2004

	WATER CLOSETS	URINALS	LAVATORIES
MEN'S	1 PER 40	1 PER 35	1 PER 40
WOMEN'S	1 PER 30	–	1 PER 40
REQ'D MEN'S	(1/40)120=3	(1/35)120=4	(1/40)120=3
REQ'D WOMEN'S	7	–	(1/40)120=3

GROUND LEVEL
I. OFFICES
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 100
B. OFFICES (NET USABLE): 2,025 SQ FT
C. TOTAL OCCUPANTS: 20.25
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (20.25)(.2)= 4.1"
II. MECHANICAL EQUIPMENT
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 300
B. MECHANICAL EQUIPMENT (NET USABLE): 165 SQ FT
C. TOTAL OCCUPANTS: .55
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (.55)(.2) = 0.1"
III. SCHOOL SHOP & VOCATIONAL ROOMS
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10A): 50
B. SCHOOL SHOP & VOCATIONAL ROOMS (NET USABLE): 7,190 SQ FT
C. TOTAL OCCUPANTS: 28.40
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (28.40)(.2)=5.6"
IV. STORAGE & STOCK
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 300
B. STORAGE & STOCK (NET USABLE): 630 SQ FT
C. TOTAL OCCUPANTS: 2.1
D. TOTAL EXITS REQUIRED:1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (2.1)(.2) = 0.4"

TOTAL OCCUPANTS GROUND LEVEL: 163.01; TOTAL EXITS REQUIRED: 2; TOTAL EXIT WIDTH REQUIRED: (163.01)(.2)=32.6"

2ND LEVEL
I. CLASSROOM
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 20
B. CLASSROOM (NET USABLE): 1195 SQ FT
C. TOTAL OCCUPANTS, CLASSROOM: 59.75
D. TOTAL EXITS REQUIRED: 2
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (59.75)(.2) = 11.95"
II. OFFICES
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 100
B. OFFICES (NET USABLE): 625 SQ FT
C. TOTAL OCCUPANTS, OFFICES: 6.25
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (6.25)(.2) = 1.3"
III. MECHANICAL EQUIPMENT
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 300
B. MECHANICAL EQUIPMENT (NET USABLE): 435 SQ FT
C. TOTAL OCCUPANTS, MECHANICAL EQUIPMENT: 1.45
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (1.45)(.2) = 0.3"
IV. STORAGE AND STOCK ROOMS
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 300
B. STORAGE AND STOCK ROOMS (NET USABLE): 110 SQ FT
C. TOTAL OCCUPANTS, STORAGE & STOCK: 0.42
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (0.42)(.2)(1) = .1"
V. VOCATIONAL ROOMS
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 50
B. VOCATIONAL ROOMS (NET USABLE): 1,565 SQ FT
C. TOTAL OCCUPANTS, VOCATIONAL ROOMS: 31.3
D. TOTAL EXITS REQUIRED: 1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (31.3)(.2)(1) = 6.3"
VI. ALL OTHERS
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 100
B. ALL OTHERS (NET USABLE): 790 SQ FT
C. TOTAL OCCUPANTS: 7.9
D. TOTAL EXITS REQUIRED:1
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (7.9)(.2) = 1.6"

TOTAL OCCUPANTS, 2ND LEVEL: 107.09; TOTAL EXITS REQUIRED: 2; TOTAL EXIT WIDTH REQUIRED: (107.09)(.2) = 21.4"

GROUND LEVEL EXT ENCLOSED WORK AREA
I. ALL OTHERS
A. ALLOWED SQ FT PER OCCUPANT (CBC TABLE 10-A): 100
B. ALL OTHERS (NET USABLE): 8110 SQ FT
C. TOTAL OCCUPANTS, ALL OTHERS: 81.10
D. TOTAL EXITS REQUIRED: 2
E. TOTAL EXIT WIDTH REQUIRED (CBC 1003.2): (81.1)(.2) = 16.2"

REQ'D # OF BATHROOM PLUMBING FIXTURES
OCCUPANT LOAD EQ 239 PEERSONS (SEE ABOVE)
120 MEN & 120 WOMEN

John Trautmann Architects
2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE
APPL. #:
ACCESS COMPLIANCE SECTION
DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING
THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER
ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE
CODE ANALYSIS, SCOPE OF WORK & ACCESSIBILITY STRATEGY & PLANS

SCALE: AS NOTED DRAWN BY: MCL

DWG NO.
A00.02

DATE: 08 NOV '04

TENTATIVE EQUIPMENT LIST (NIC)

METAL FABRICATION/MACHINE SHOP

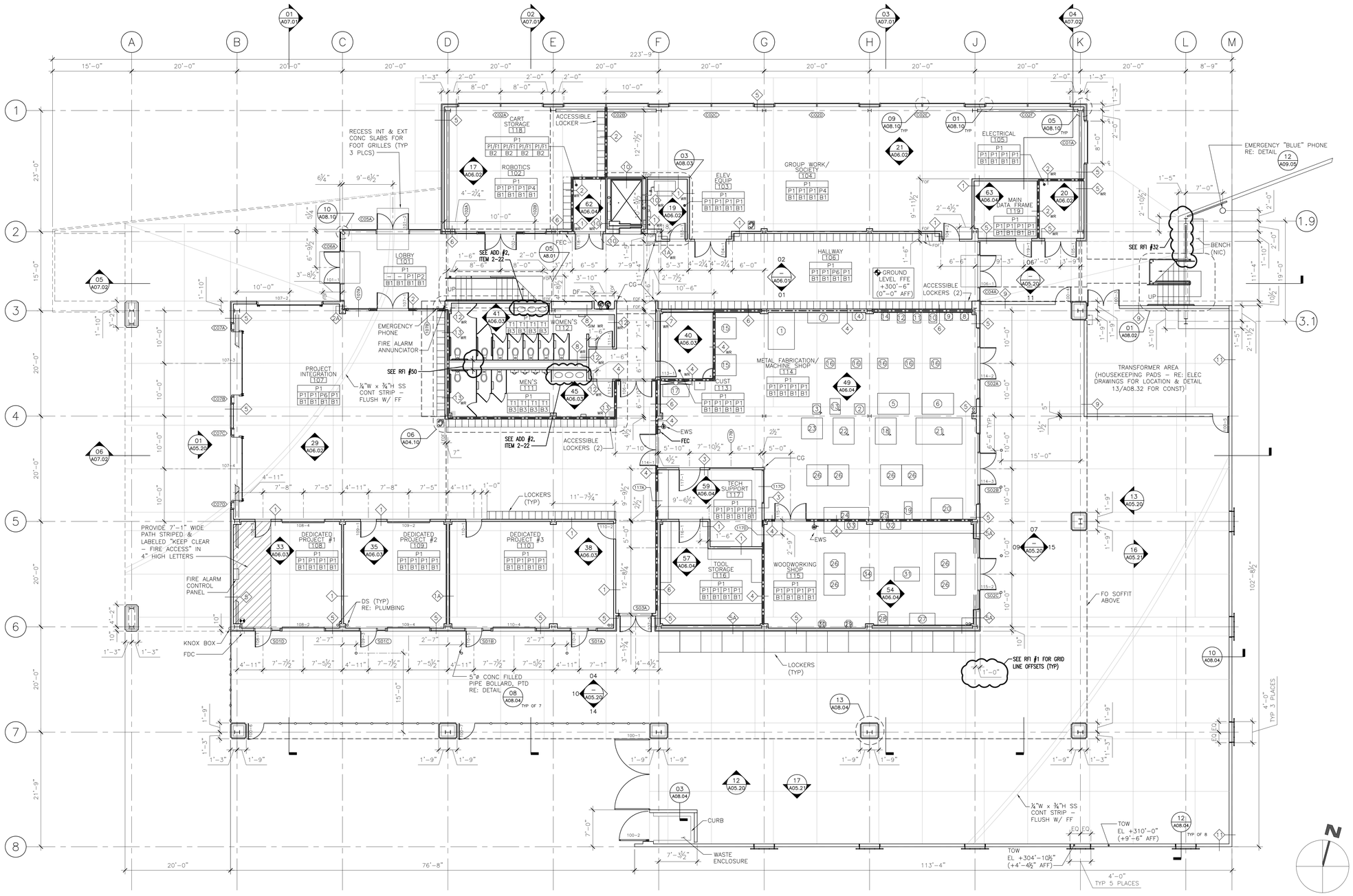
1. TILT FRAME VERTICAL BAND SAW (60x84x84)
2. ABRASIVE CUT OFF SAW (24x24x60)
3. PORTABLE PLASMA CUTTING OUTFIT (18x24x18)
4. PORTABLE OXY/ACET CUTTING OUTFIT (30x18x72)
5. BOX & PAN BRAKE 4 ft x 16 ga. (72x48x48)
6. POWER SQUARING SHEAR, 4 ft x 16 ga. (72x48x48)
7. SHEETMETAL ROLL, 4 ft, x 16 ga. (72x24x48)
8. SHEETMETAL NOTCHER, 6" x 16 ga. (18x18x36)
9. TURRET PUNCH, 16 ga. (18x18x36)
10. GTAW-WELDER (18x24x36)
11. MIG (SHORT ARC) WELDER (18x24x18)
12. MIG (SPRAY TRANSFER) WELDER (18x24x18)
13. RESISTANCE WELDER (24x36x72)
14. BELT SANDER (18x18x36)
15. 4ft x 4ft FABRICATION TABLE (48x48x36)
16. 2ft x 2ft FABRICATION TABLE (24x24x36)
17. WELDING TABLE & FUME HOOD (70x48x32)
18. MANUAL/CNC MILL (48x60x84)
19. DRILL PRESS (18x40x72)
20. MANUAL LATHE (12") (72x48x72)
21. MANUAL/CNC LATHE (16") (105x60x60)
22. 24" VERTICAL BAND SAW
23. SMALL HORIZONTAL CUT OFF BAND SAW
24. ARBOR PRESS
25. PEDESTAL TOOL GRINDER
26. WORK TABLE (48x48x36)

WOODWORKING SHOP

27. WOOD LATHE (58x27x54)
28. WOODWORKING BANDSAW (22x30-3/4)
29. DRILL PRESS (8.5x12)
30. HEAVY DUTY DRILL PRESS (8.5x12)
31. TABLESAW (32x57-5/8x34)
32. EDGE HORIZONTAL / VERTICAL SANDER (46x18x38)
33. 6"x48" BELT / 12" DISC SANDER (30x18)
34. PLANER / MOLDER MACHINE (30x30)

LEGEND

- 1-HR FIRE RATED WALL
- ASSISTIVE LISTENING SYSTEM SIGNAGE RE: DETAIL 06/A09.05
- P7 P1 P1 P1 P1 B1 B1 B1 B1 — ROOM FINISHES KEY RE: SHT A10.01
- 5 — WALL TYPES KEY RE: SHTS A07.10 & A07.11 (WR INDICATES WR GYP BD WET SIDE)
- TILE FLOOR



01 A02.10 GROUND LEVEL FLOOR PLAN

0' 8' 16' 32' 64' 128' 256'

LOCKER TABULATION

TOTAL LOCKERS GROUND LEVEL	310
ACCESSIBLE LOCKERS REQ'D (1%) (.01)310=3.1	4
ACCESSIBLE LOCKERS PROVIDED	5

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEW STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

ADDENDUM #2 08 FEB '05

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

GROUND LEVEL FLOOR PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: MCL

DWG NO.

A02.10

DATE: 08 NOV '04

TENTATIVE EQUIPMENT LIST (NIC)

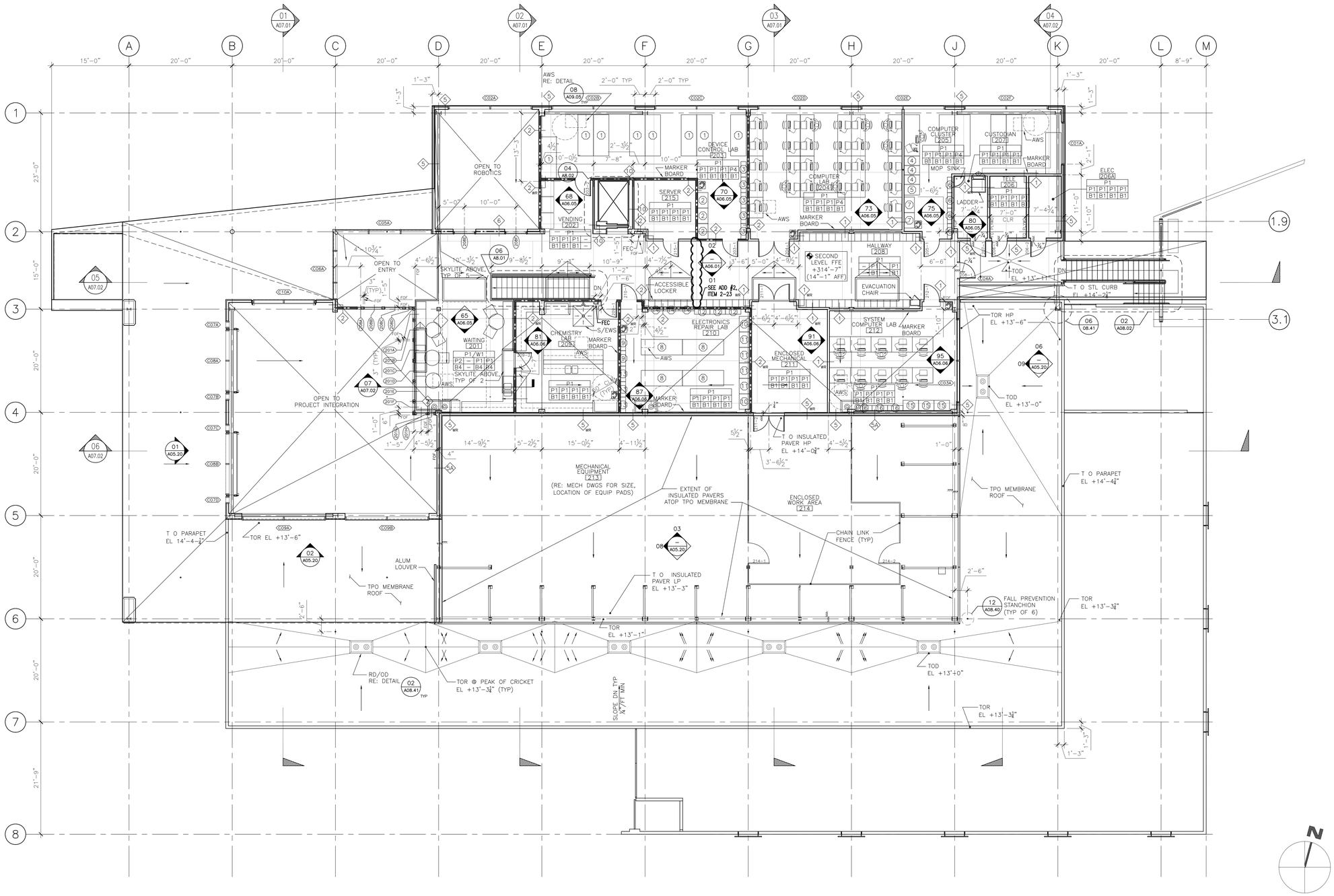
DEVICE CONTROL LAB
1. ELECTRONIC TEST BENCH (8'x3')
2. CABINET W/ DOORS (36x24x72)
3. BOOK CASES (36x12x72)

COMPUTER CLUSTER LAB
4. 19" RACK (22x36x72)
5. 23" RACK (25x36x72)
6. BOOK CASE (36x12x72)
7. CABINET (36x24x72)

ELECTRONICS REPAIR LAB
8. ELECTRONIC TEST BENCH (8'x3')
9. BOOK CASES (36x12x72)
10. CABINET W/ DOORS (36x24x72)
11. HEAVY DUTY SHELVES (36x24x72)
12. SHELVES (36x12x72)
13. PARTS DRAWERS (36x12x72)
14. LEED RACKS (36x4x72)

SYST COMP LAB
15. CABINETS W/ DOORS (36x24x72)
16. BOOK CASE (36x12x72)

LEGEND
- 1-HR FIRE RATED WALL
- ASSISTIVE LISTENING SYSTEM SIGNAGE RE: DETAIL 06/A09.05
- ROOM FINISHES KEY RE: SHT A10.01
- WALL TYPES KEY RE: SHTS A07.10 & A07.11 (WR INDICATES WR GYP BD WET SIDE)



01 A02.20 SECOND LEVEL FLOOR PLAN / LOW ROOF PLAN

0' 8' 16' 32' 64' 128' 256'

LOCKER TABULATION

TOTAL LOCKERS SECOND LEVEL	100
ACCESSIBLE LOCKERS REQ'D (1%) (.01)100=1.0	1
ACCESSIBLE LOCKERS PROVIDED	1

John Trautmann Architects
2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEW 08 STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

ADDENDUM #2 08 FEB '05

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER
ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

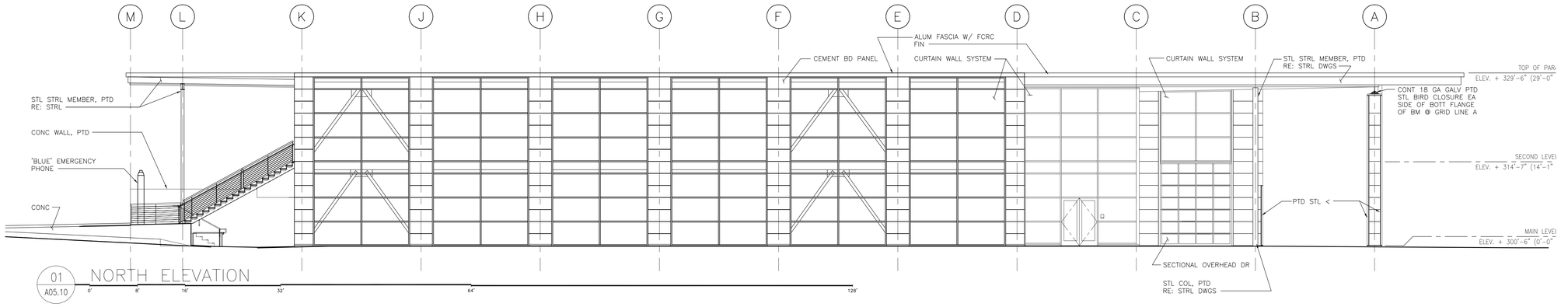
SECOND LEVEL FLOOR PLAN / LOW ROOF PLAN

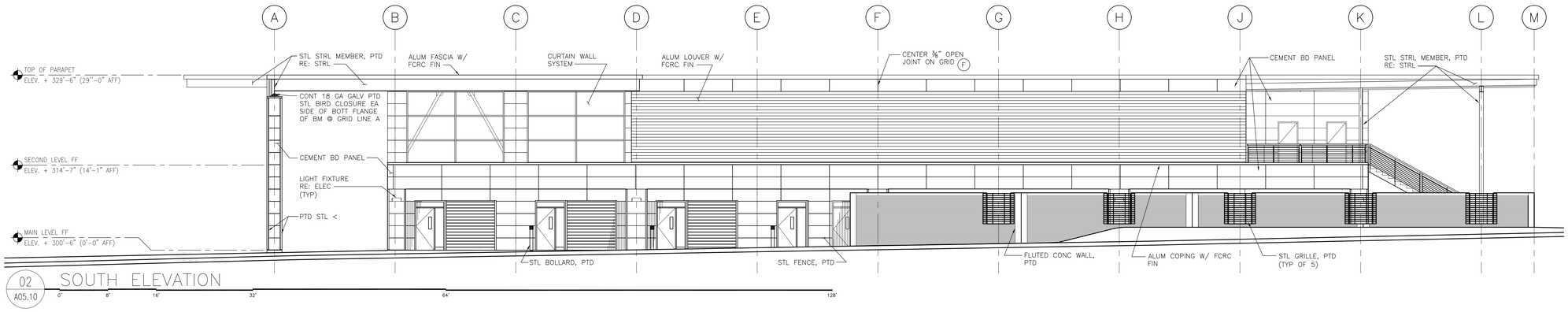
SCALE: 1/8" = 1'-0" DRAWN BY: MCL

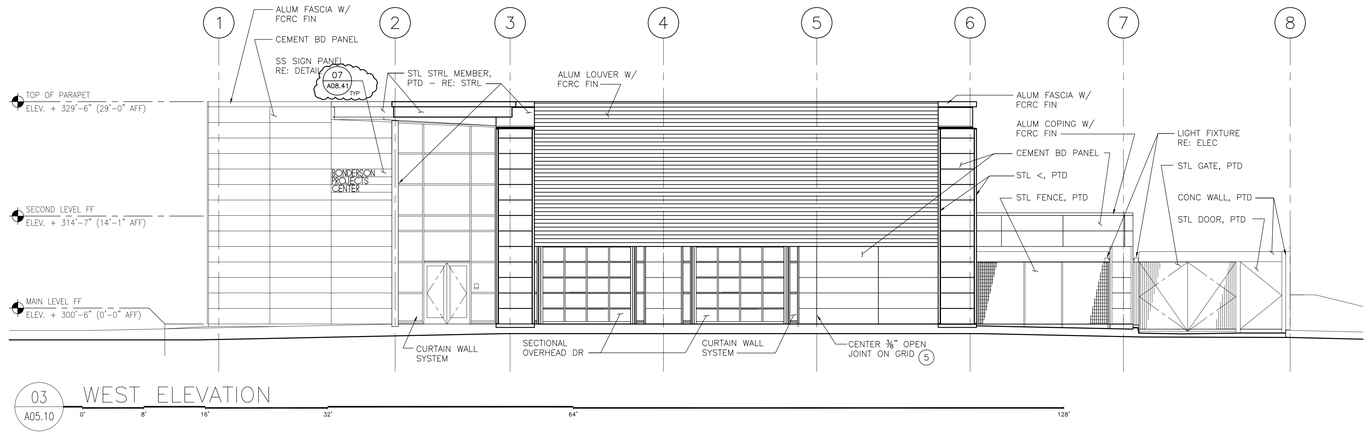
DWG NO.

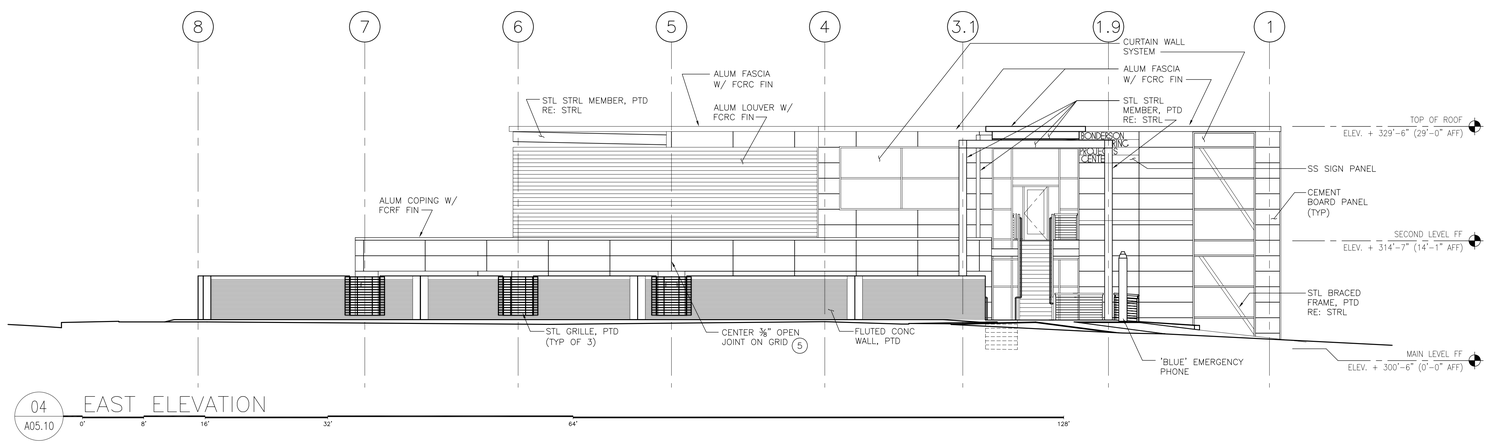
A02.20

DATE: 08 NOV '04









John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT
JOHN TRAUTMANN
C-21914
31 AUG 05
RENEWAL DATE
STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

A	ADDENDUM #2	08 FEB '05

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER
ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

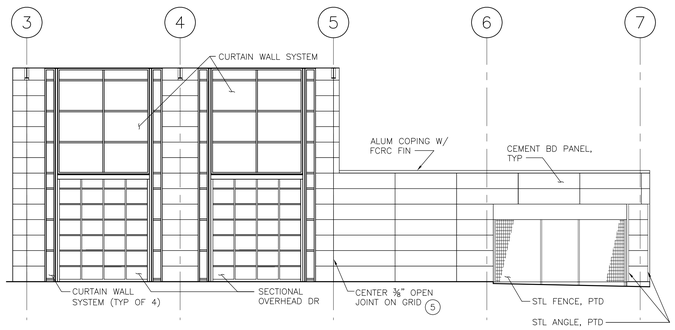
EXTERIOR ELEVATIONS

SCALE: 1/8"=1'-0" DRAWN BY: MCL

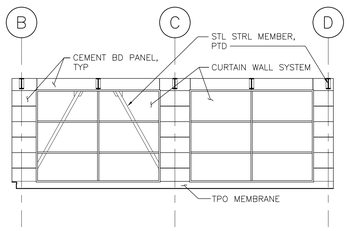
DWG NO.

A05.10

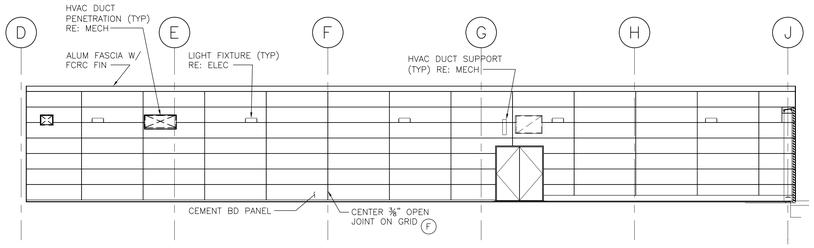
DATE: 08 NOV '04



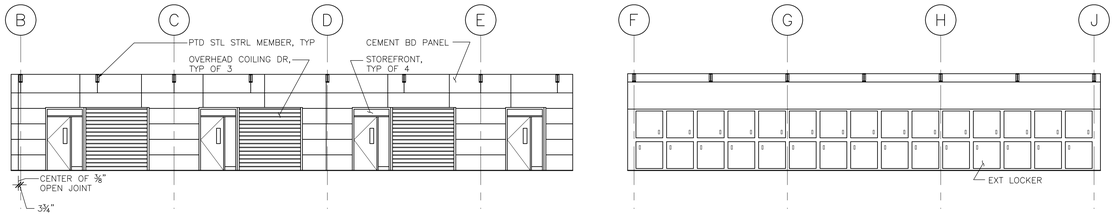
01 A05.20 0' 4' 8' 16' 32' 64'



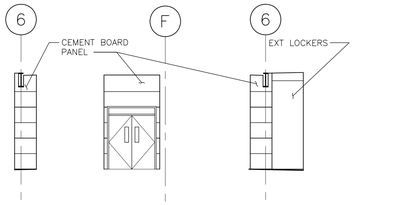
02 A05.20 0' 4' 8' 16' 32'



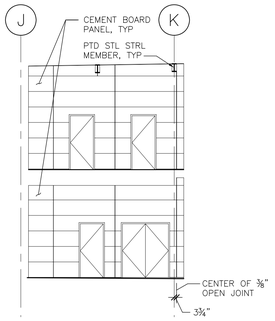
03 A05.20 0' 8' 16' 32' 64'



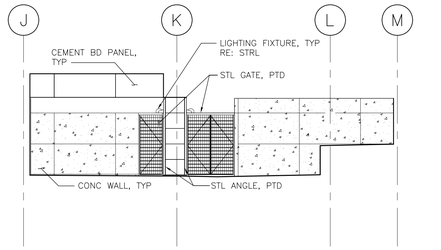
04 A05.20 0' 8' 16' 32' 64' 128'



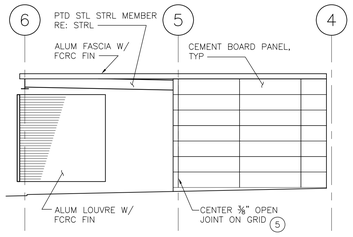
05 A05.20 0' 4' 8' 16' 48'



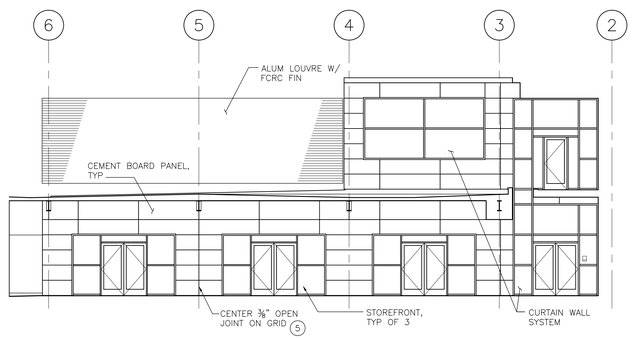
06 A05.20 0' 4' 8' 16' 32'



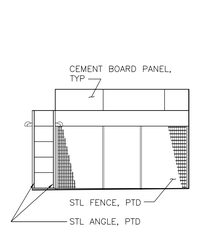
07 A05.20 0' 4' 8' 16' 48'



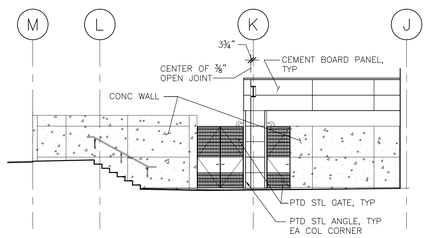
08 A05.20 0' 4' 8' 16' 32'



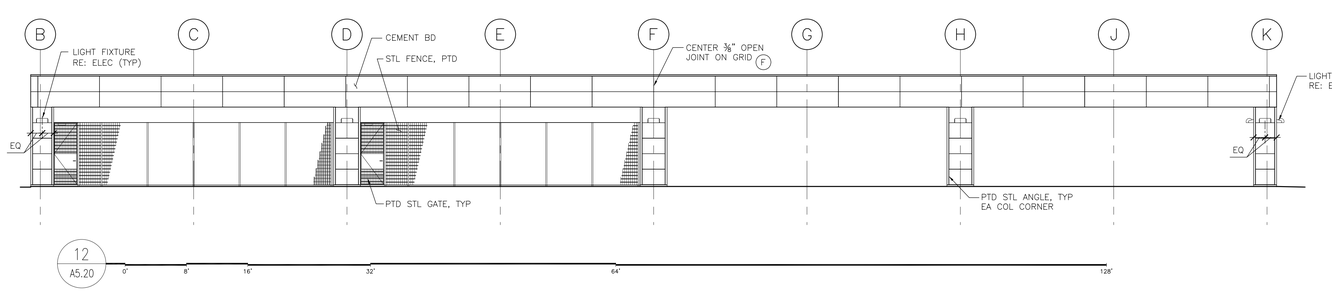
09 A05.20 0' 8' 16' 32' 64'



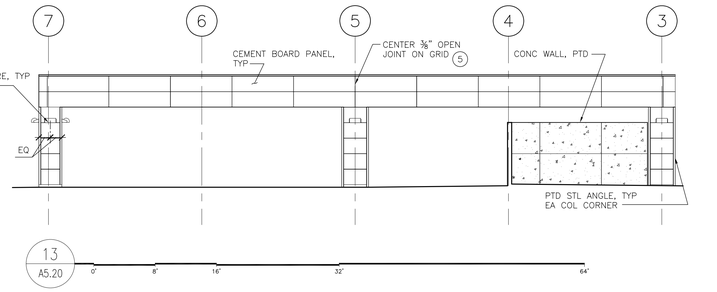
10 A05.20 0' 4' 8' 16'



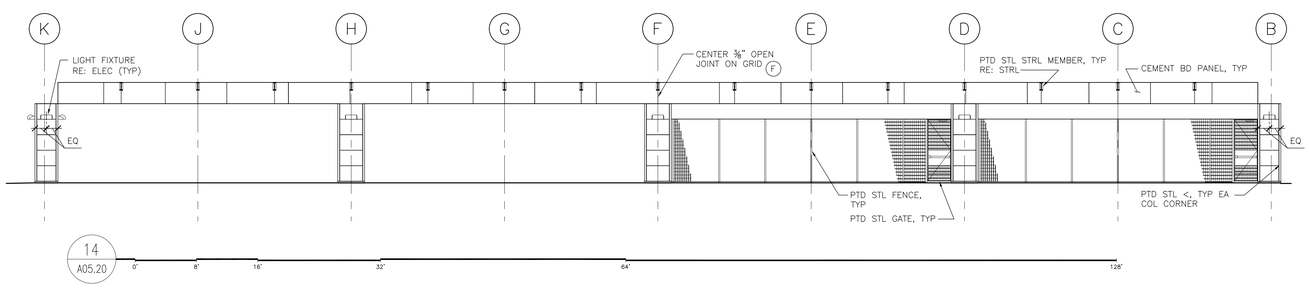
11 A05.20 0' 4' 8' 16' 32'



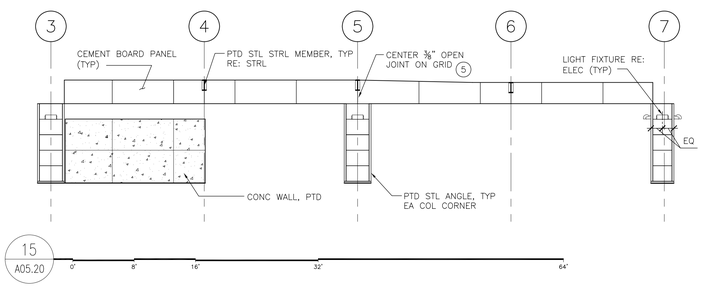
12 A5.20 0' 8' 16' 32' 64' 128'



13 A5.20 0' 8' 16' 32' 64'



14 A5.20 0' 8' 16' 32' 64' 128'



15 A5.20 0' 8' 16' 32' 64'

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

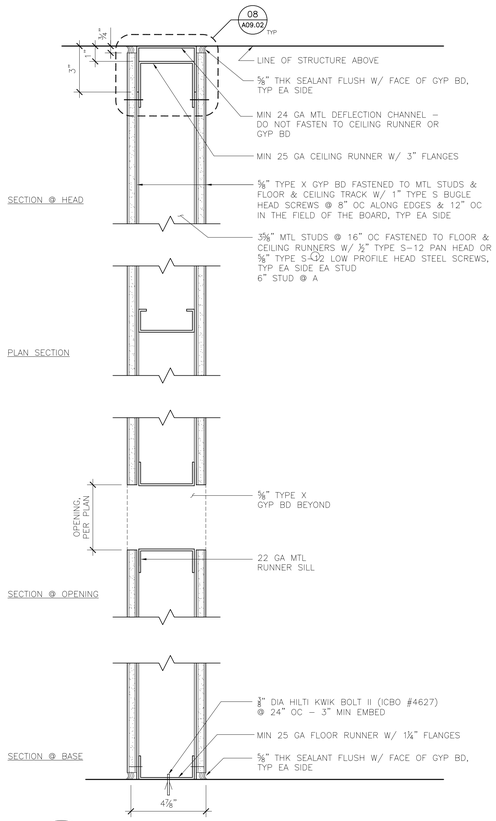
EXTERIOR PARTIAL WALL ELEVATIONS – PAGE 1

SCALE: 1/8" = 1'-0" DRAWN BY: MCL

DWG NO.

A05.20

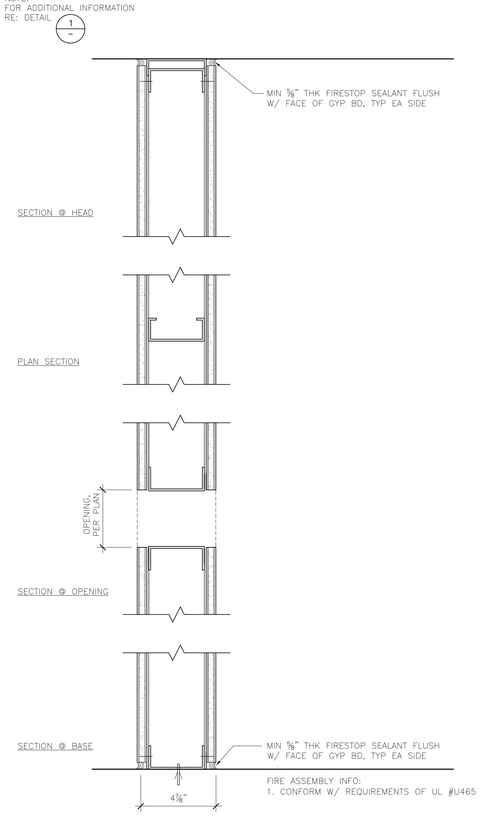
DATE: 08 NOV '04



1 A07.10 NON–RATED – 1

3" = 1'–0"

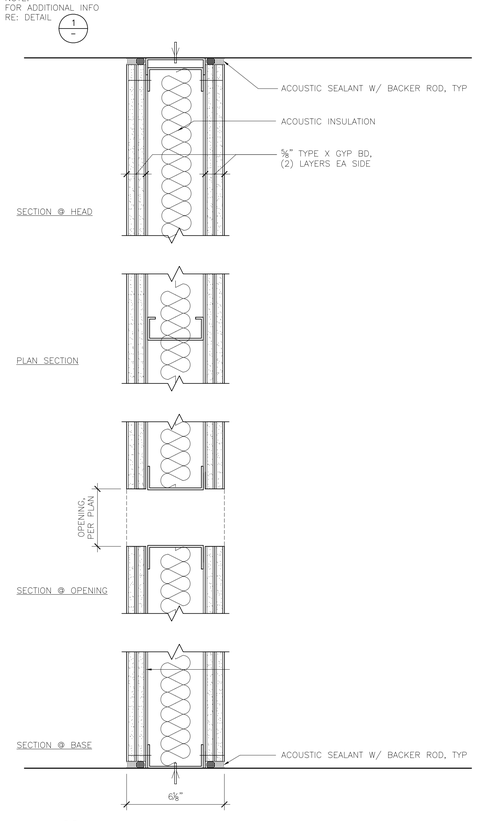
NOTE:
FOR ADDITIONAL INFORMATION
RE: DETAIL 1/–



2 A07.10 1–HOUR – 2

3" = 1'–0"

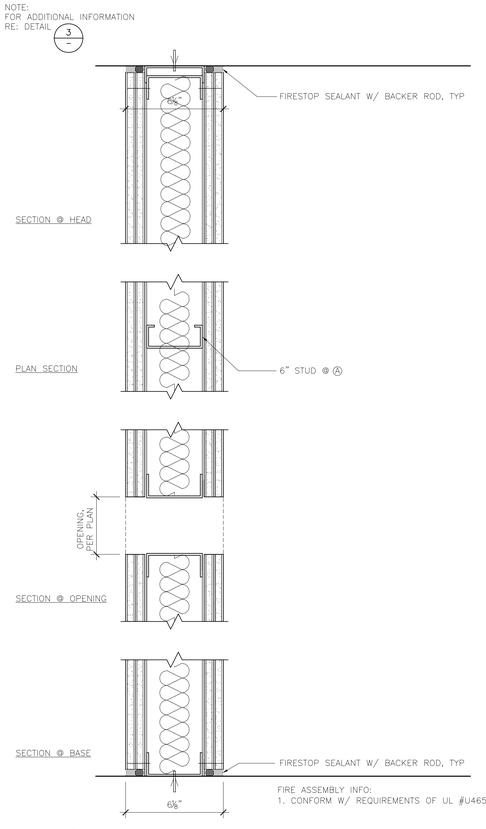
NOTE:
FOR ADDITIONAL INFO
RE: DETAIL 1/–



3 A07.10 NON–RATED ACOUSTIC – 3

3" = 1'–0"

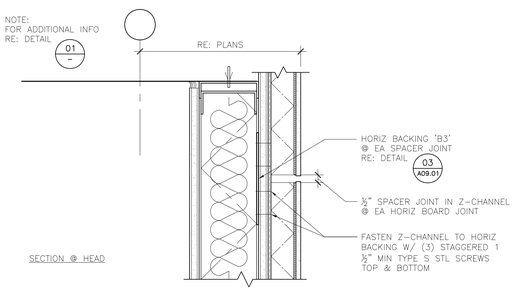
NOTE:
FOR ADDITIONAL INFORMATION
RE: DETAIL 3/–



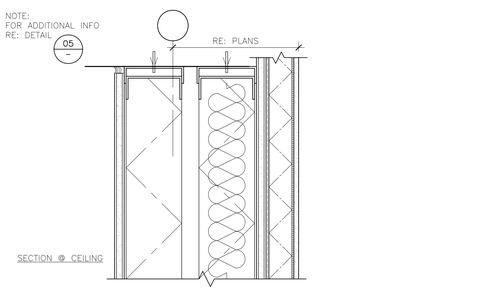
4 A07.10 1–HOUR RATED ACOUSTIC – 4

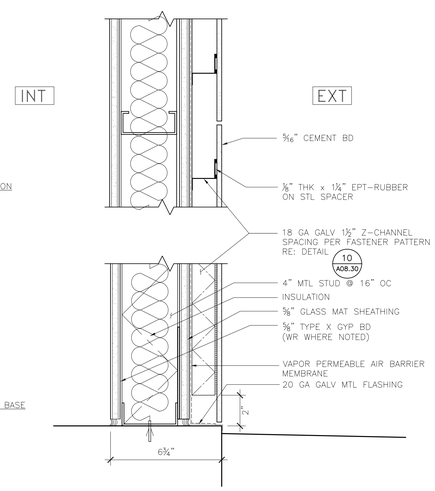
3" = 1'–0"

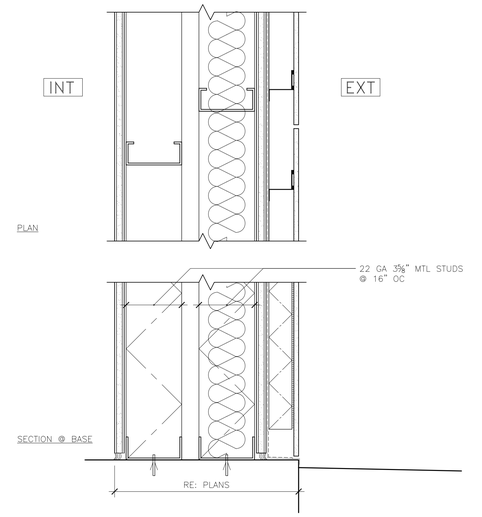
NOTE:
FOR ADDITIONAL INFO
RE: DETAIL 01/–



NOTE:
FOR ADDITIONAL INFO
RE: DETAIL 05/–







5 A07.10 EXT WALL – 5

SEE ADD #2, ITEM 2–30

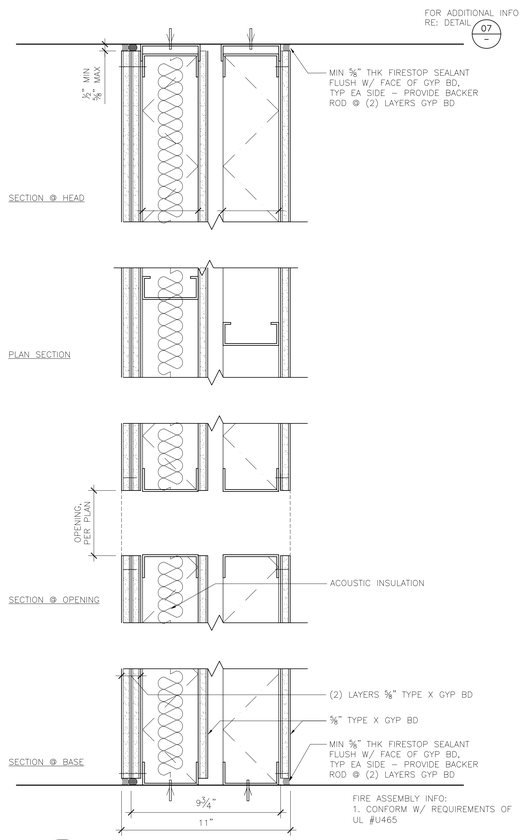
3" = 1'–0"

5A A07.10 EXT WALL – 5A

SEE ADD #2, ITEM 2–30

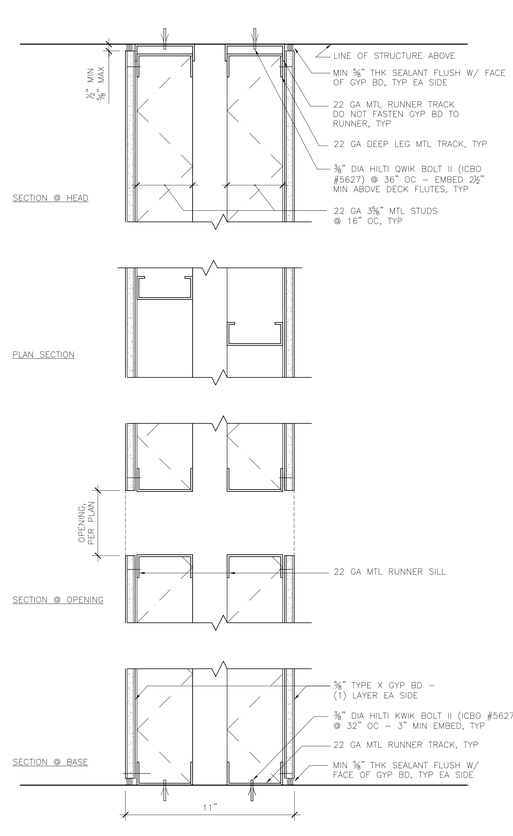
3" = 1'–0"

FOR ADDITIONAL INFO
RE: DETAIL 07/–



6 A07.10 FURRED 1–HR RATED ACOUSTIC – 6

3" = 1'–0"



7 A07.10 FURRED NON–RATED – 7

3" = 1'–0"

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C–21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

ADDENDUM #2 08 FEB '05

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04–600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II–A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

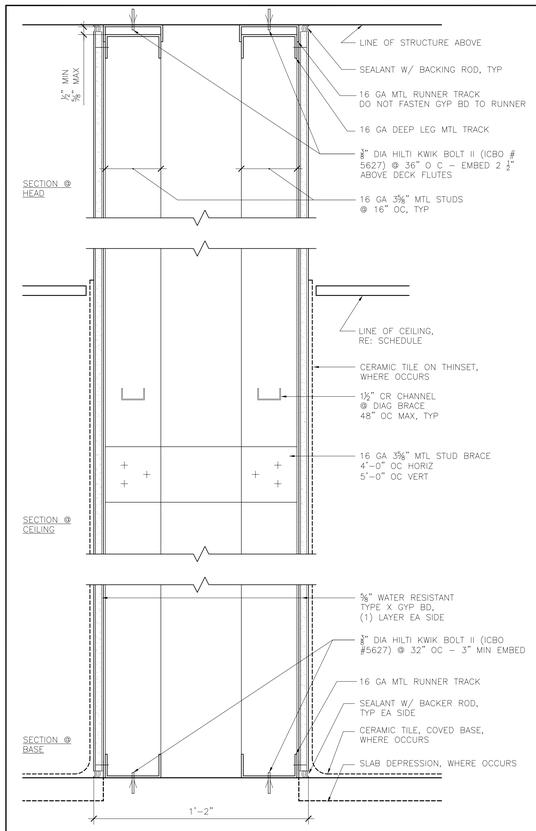
WALL TYPES – PAGE 1

SCALE: 3" = 1'–0" DRAWN BY: MCL

DWG NO.

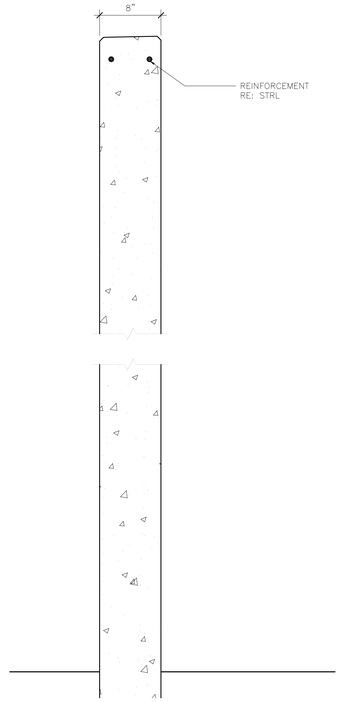
A07.10

DATE: 08 NOV '04



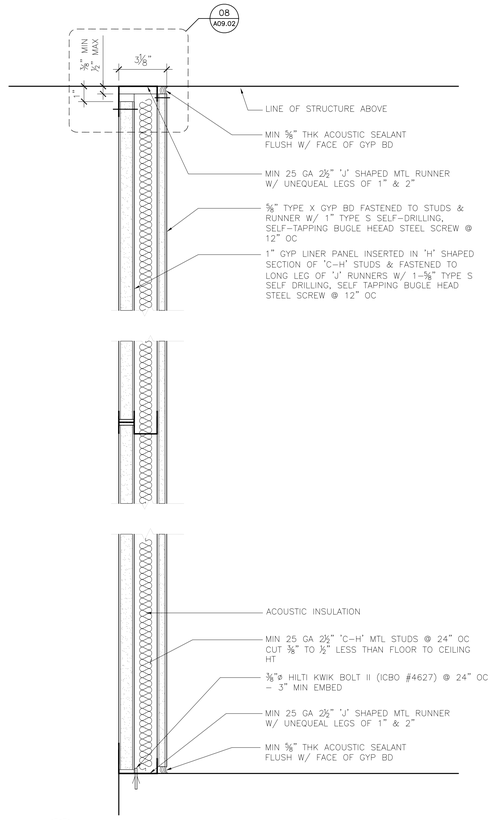
08 A07.11 CHASE WALL – 08

3" = 1'–0"



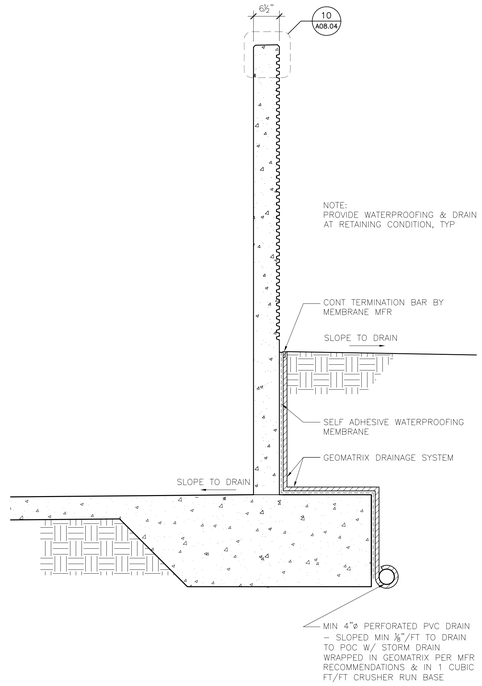
09 A07.11 CONC WALL – 09

SCALE: 1–1/2" = 1'–0"



10 A07.11 NON–RATED SHAFTWALL

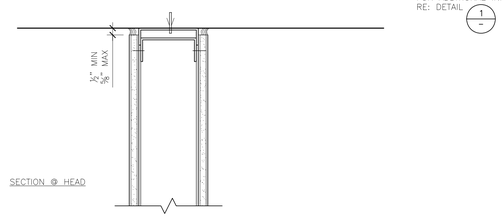
3" = 1'–0"

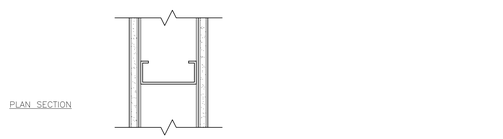


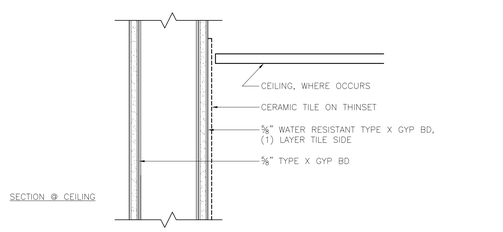
11 A07.11 CONC WALL – 11

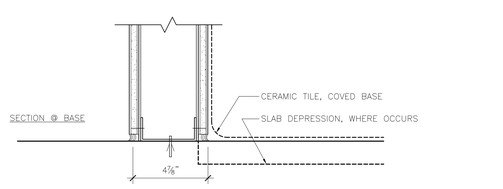
3/4" = 1'–0"

FOR ADDITIONAL INFO RE: DETAIL 1/–





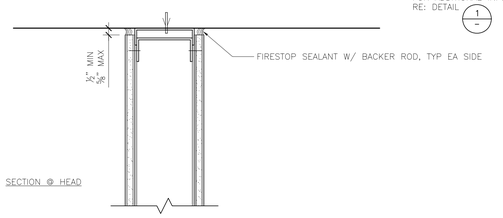


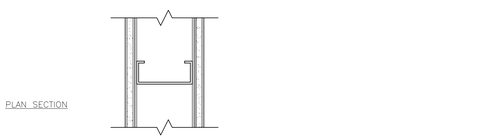


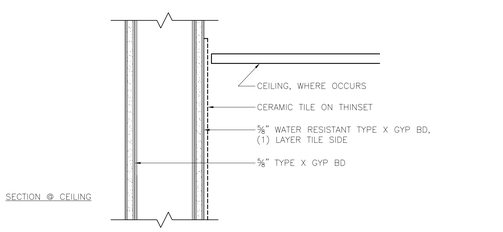
12 A07.11 NON–RATED – 12

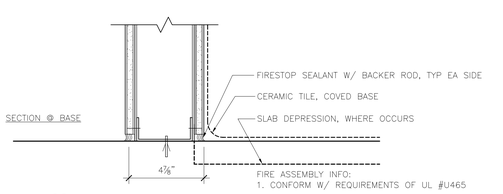
3" = 1'–0"

FOR ADDITIONAL INFO RE: DETAIL 1/–









13 A07.11 1–HOUR – 13

3" = 1'–0"

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C–21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04–600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT PHASE II–A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

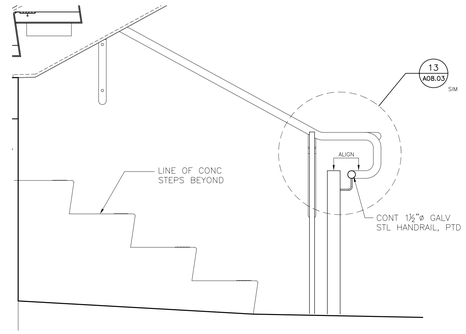
WALL TYPES – PAGE 2

SCALE: 3" = 1'–0" DRAWN BY: MCL

DWG NO.

A07.11

DATE: 08 NOV '04



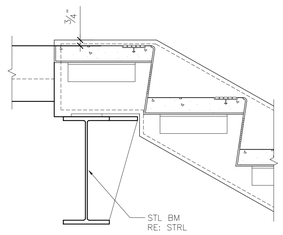
13 A8.01 GUARDRAIL ELEVATION

0" 9" 1'-6" 3' 6'

ELEVATION SCALE: 1" = 1'-0"

Bonderson\Prototype\Details\ADETL69.dwg

NOTE:
FOR ADDITIONAL INFO
RE: DETAIL 7



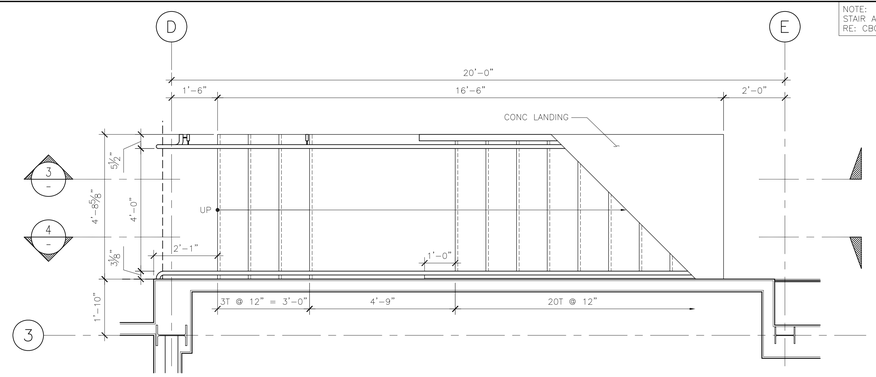
9 A8.01 FLOOR LANDING @ STAIR

0" 6" 1' 2' 4'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL65.dwg

NOTE:
STAIR ACCESSIBILITY NOTES
RE: CBC SEC 1104.1.2 & 1133B.4

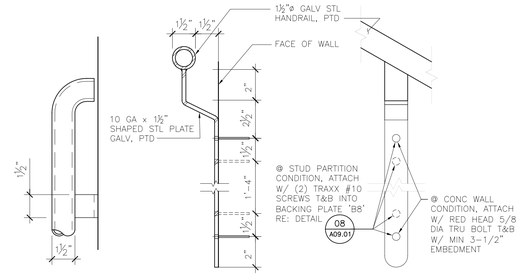


5 A8.01 STAIR 1 – LOWER LEVEL PLAN

0" 1'-4" 3' 6' 12' 28'-6"

SECTION 3" = 1'-0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR1.dwg



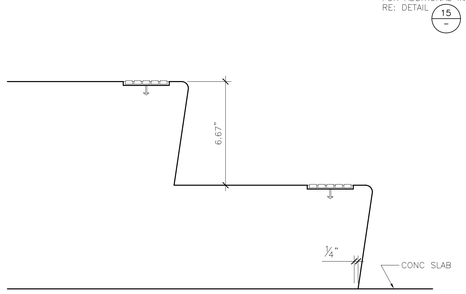
14 A8.01 HANDRAIL @ WALL

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL70A.dwg

FOR ADDITIONAL INFO
RE: DETAIL 15

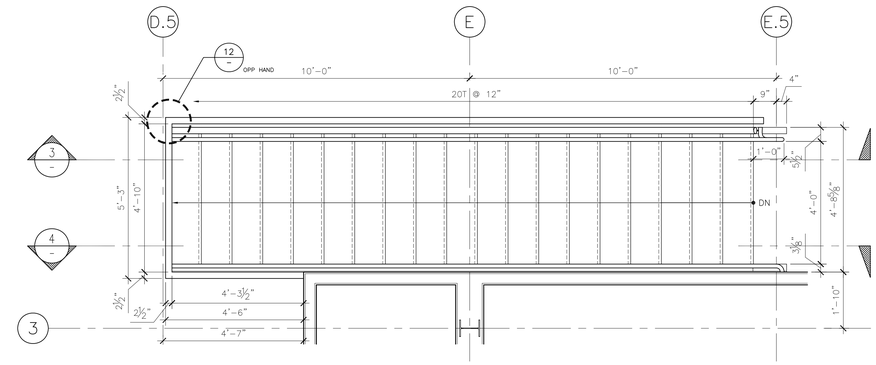


10 A8.01 CONC STAIR

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL66.dwg

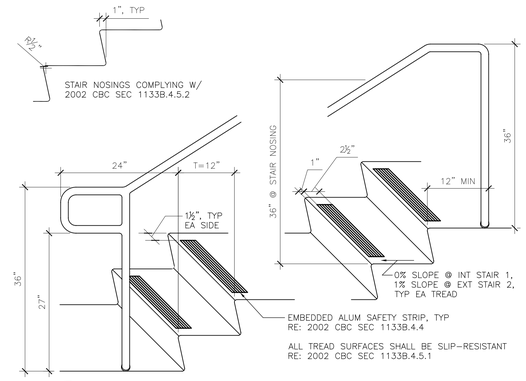


6 A8.01 STAIR 1 – 2ND LEVEL PLAN

0" 1'-4" 3' 6' 12' 28'-6"

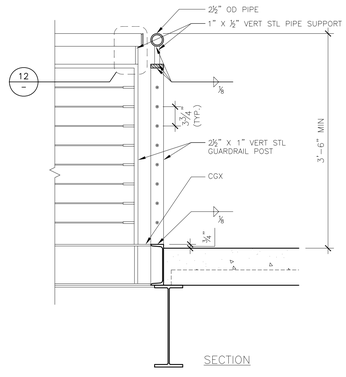
PLAN 1/2" = 1'=0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR1-UPPER LEVEL PLAN.dwg



15 A8.01 STAIRS

NTS

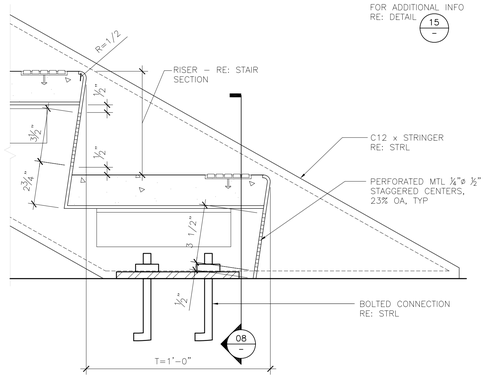


11 A8.01 GUARDRAIL ASSEMBLY

0" 9" 1'-4" 3' 6'

SECTION SCALE: 1" = 1'-0"

Bonderson\Prototype\Details\ADETL67.dwg

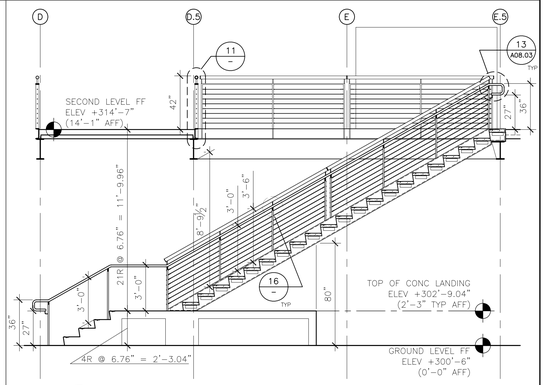


7 A8.01 INTERMEDITE CONC LANDING

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL63.dwg

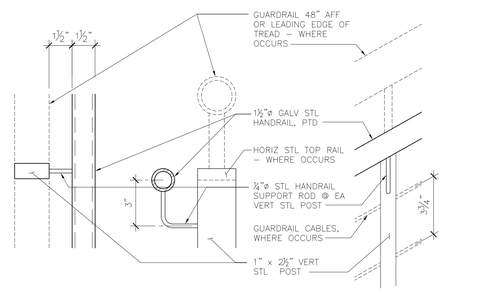


3 A8.01 STAIR 1 – SECTION 1

0" 3" 6" 12" 24"

SECTION SCALE: 1/4" = 1'-0"

Bonderson\Prototype\Details\ADETL70.dwg

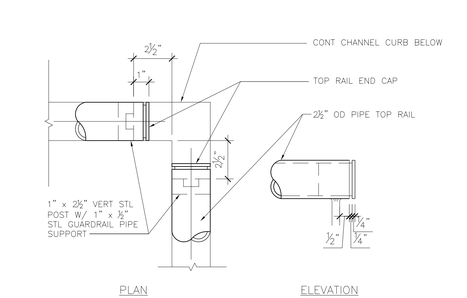


16 A8.01 HANDRAIL @ GUARDRAIL

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL70.dwg

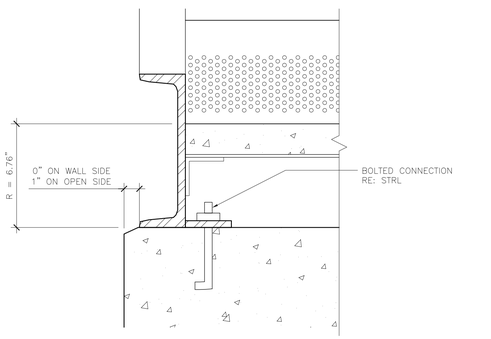


12 A8.01 GUARDRAIL CORNER

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL68.dwg

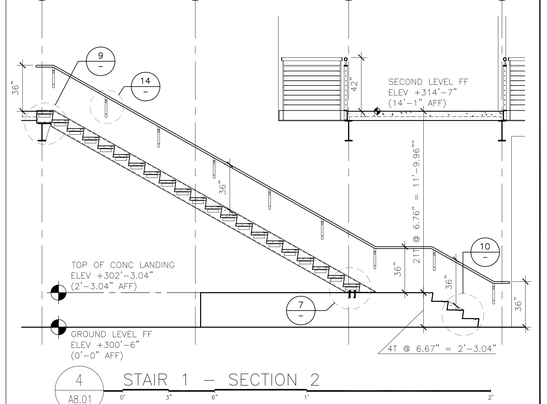


8 A8.01 INTERMEDIATE LANDING @ CONC STAIR

0" 3" 6" 1' 2'

SECTION SCALE: 3" = 1'-0"

Bonderson\Prototype\Details\ADETL64.dwg



4 A8.01 STAIR 1 – SECTION 2

0" 3" 6" 1' 2'

SECTION SCALE: 1/4" = 1'-0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR1-SECTION2.dwg

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

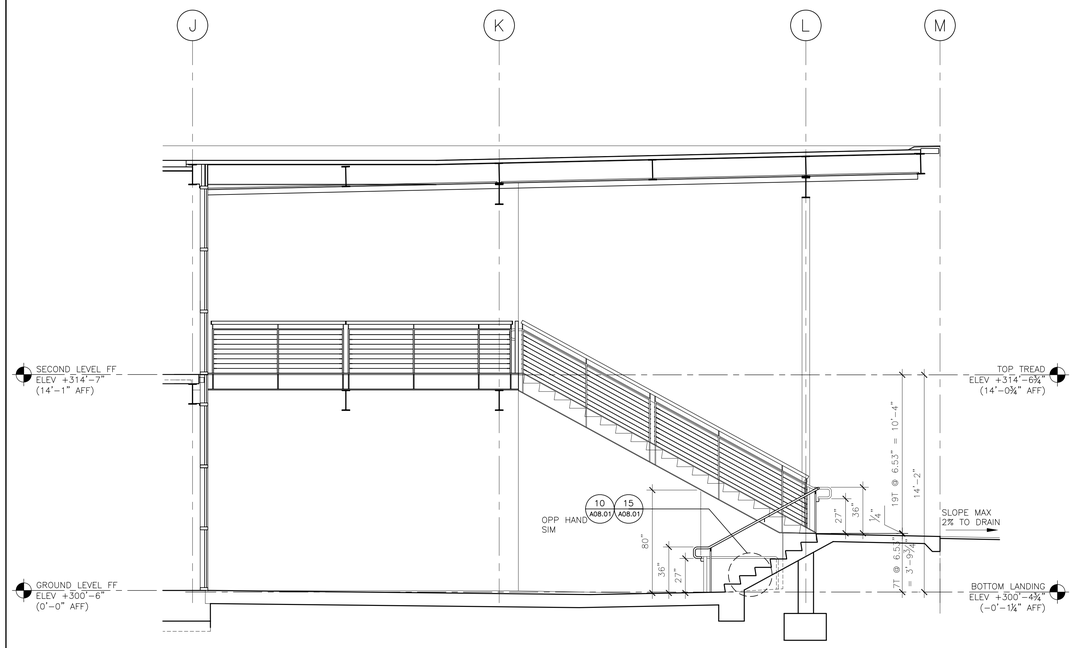
STAIR DETAILS – PAGE 1

SCALE: AS NOTED DRAWN BY: MCL

DWG NO.

A08.01

DATE: 08 NOV '04



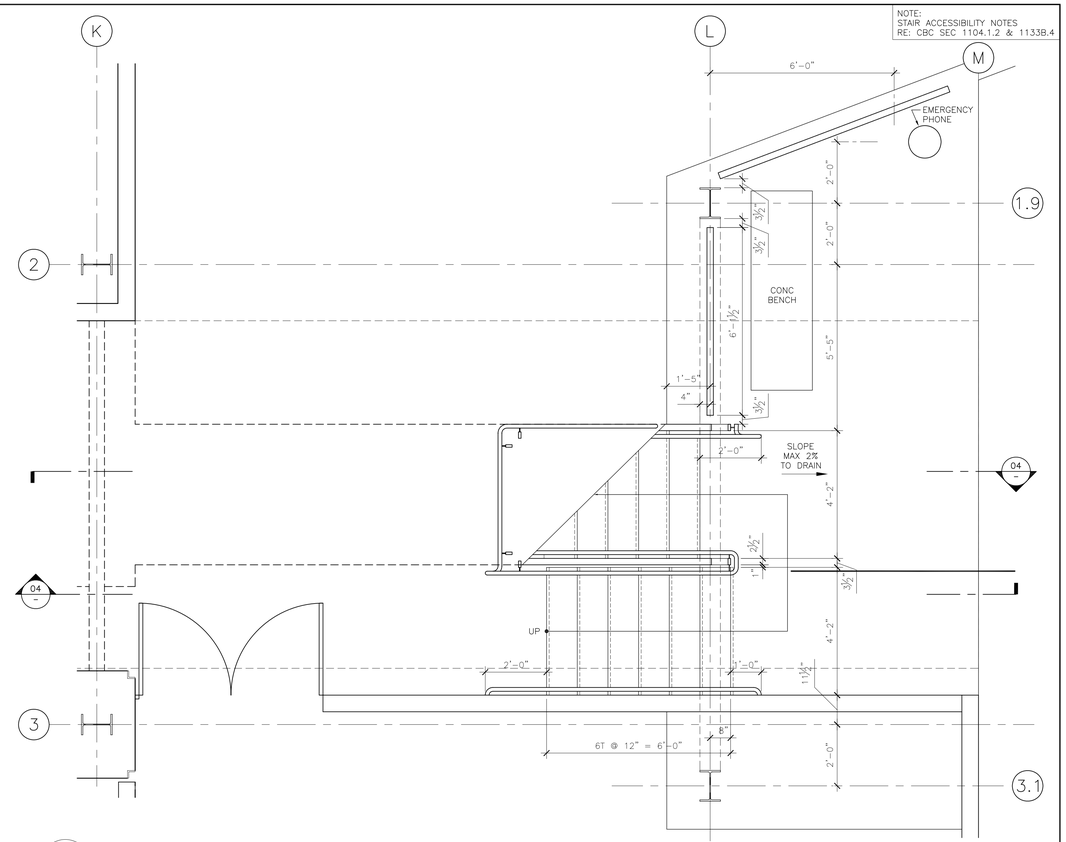
03 A08.02 STAIR 2 – SECTION 1

PLAN

0' 3' 6' 12' 24' 57"

SCALE: 1/4" = 1'=0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR2-SECTION.dwg



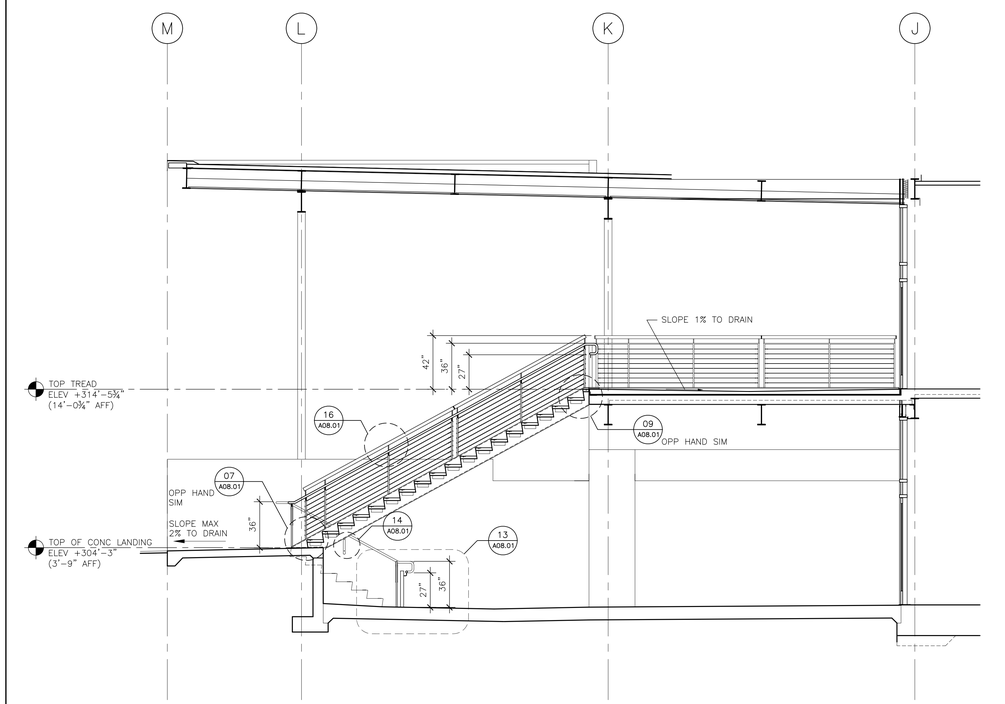
01 A08.02 STAIR 2 – LOWER LEVEL

PLAN

0' 1'-6" 3' 6' 12' 28'-6"

SCALE: 1/2" = 1'=0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR2-LOWER LEVEL PLAN.dwg



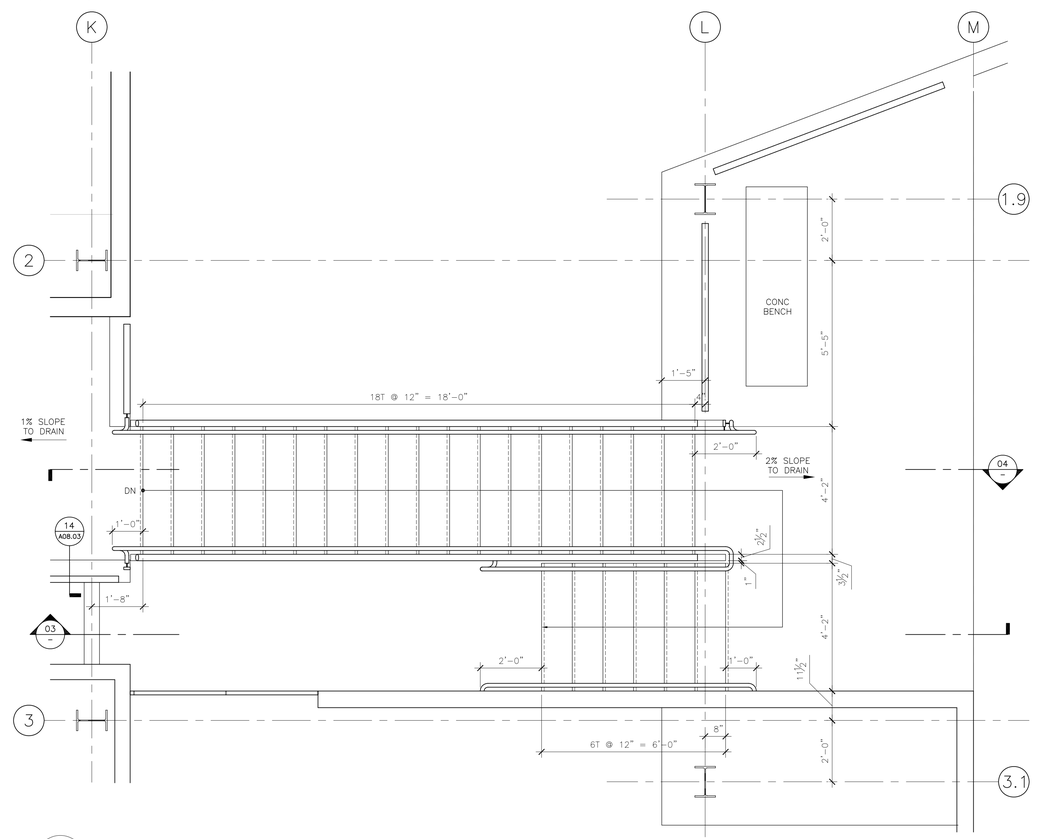
04 A08.02 STAIR 2 – SECTION 2

PLAN

0' 3' 6' 12' 24' 57"

SCALE: 1/4" = 1'=0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR2-SECTION2.dwg



02 A08.02 STAIR 2 – 2ND LEVEL

PLAN

0' 1'-6" 3' 6' 12' 28'-6"

SCALE: 1/2" = 1'=0"

Bonderson\Prototype\Plans\Enlarged Plans\STAIR2.dwg

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEW STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

STAIR DETAILS – PAGE 2

SCALE: AS NOTED DRAWN BY: MCL

DWG NO.

A08.02

DATE: 08 NOV '04

DOOR SCHEDULE – GROUND LEVEL

SEE ADD #2, ITEM 2-37

DOOR NUMBER	DOOR SIZE WIDTH	DOOR SIZE HEIGHT	DOOR SIZE THICK	DOOR TYPE	DOOR CON	DOOR FRAME	PANIC HDW	FIRE RATED	HDW SET	DETAILS HEAD	DETAILS JAMB	DETAILS THRES	NOTE
100–1	12'–6"	8'–0"	1 3/4"	L	D5	F5	–	–	14	–	–	–	
100–2	5'–6"	6'–0"	1 3/4"	M	D5	F5	–	–	11	–	07/A08.04	–	
100–3	6'–0"	7'–9"	1 3/4"	O	D5	F5	YES	–	09	–	12/A08.32	–	1
100–4	3'–0"	7'–9"	1 3/4"	P	D5	F5	YES	–	10	–	12/A08.32	–	1
100–5	3'–0"	7'–9"	1 3/4"	P	D5	F5	YES	–	11	–	12/A08.32	–	1
100–6	3'–0"	7'–9"	1 3/4"	P	D5	F5	YES	–	10	–	12/A08.32	–	1
100–7	3'–0"	7'–9"	1 3/4"	P	D5	F5	YES	–	10	–	12/A08.32	–	1
101–1	6'–0"	8'–0"	1 3/4"	H	D4	F4	YES	–	1	12/A08.10	13/A08.10	14/A08.32	
101–2	6'–0"	8'–0"	1 3/4"	H	D4	F4	YES	–	1	12/A08.10	13/A08.10	14/A08.32	
102–1	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	60MIN	12	05/A08.31	05/A08.31	–	
103–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	17	05/A08.31	05/A08.31	–	
104–1	6'–0"	7'–0"	1 3/4"	F	D1	F1	–	–	15	05/A08.31	05/A08.31	–	
104–2	3'–0"	7'–0"	1 3/4"	D	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
105–1	6'–0"	7'–0"	1 3/4"	G	D1	F1	–	–	4	12/A08.31	13/A08.31	06/A08.31	
106–1	6'–0"	7'–0"	1 3/4"	F	D4	F4	YES	–	1	12/A08.10	13/A08.10	14/A08.32	
106–2	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	60MIN	12	05/A08.31	05/A08.31	–	
107–1	6'–0"	8'–0"	1 3/4"	H	D1	F1	–	60MIN	13	05/A08.31	05/A08.31	–	
107–2	12'–0"	14'–1"	1 3/4"	I	D3	F3	–	–	22	09/A08.32	05/A08.32	–	
107–3	12'–0"	14'–1"	1 3/4"	I	D3	F3	–	–	22	10/A08.32	03/A08.32	–	
107–4	12'–0"	14'–1"	1 3/4"	I	D3	F3	–	–	22	10/A08.32	03/A08.32	–	
107–5	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	–	2	16/A08.31	13/A08.31	06/A08.31	
108–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	3	16/A08.31	08/A08.31	06/A08.31	
108–2	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	10/A08.31	08/A08.31	–	
108–3	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	10/A08.31	08/A08.31	–	
108–4	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	11/A08.31	09/A08.31	–	
109–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
109–2	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	11/A08.31	09/A08.31	–	
109–3	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	3	16/A08.31	08/A08.31	06/A08.31	
109–4	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	10/A08.31	08/A08.31	–	
110–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
110–2	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
110–3	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	3	16/A08.31	08/A08.31	06/A08.31	
110–4	8'–0"	8'–1"	1 3/4"	K	D3	F3	–	–	22	10/A08.31	08/A08.31	–	
110–5	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	–	3	16/A08.31	08/A08.31	06/A08.31	
111–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	23	05/A08.31	05/A08.31	07/A08.31	
112–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	23	05/A08.31	05/A08.31	07/A08.31	
113–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	18	05/A08.31	05/A08.31	–	
114–1	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	60MIN	12	05/A08.31	05/A08.31	–	
114–2	6'–0"	7'–0"	1 3/4"	Q	D1	F1	–	–	2	16/A08.31	14/A08.31	06/A08.31	
114–3	6'–0"	7'–0"	1 3/4"	Q	D1	F1	–	–	2	16/A08.31	14/A08.31	06/A08.31	
115–1	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	60MIN	12	05/A08.31	05/A08.31	–	
115–2	6'–0"	7'–0"	1 3/4"	Q	D1	F1	–	–	2	16/A08.31	14/A08.31	06/A08.31	
116–1	4'–0"	7'–0"	1 3/4"	B	D1	F1	–	–	21	05/A08.31	05/A08.31	–	
117–1	4'–0"	7'–0"	1 3/4"	B	D1	F1	–	–	20	05/A08.31	05/A08.31	–	
118–1	5'–4"	7'–0"	1 3/4"	R	D1	F1	–	–	19	05/A08.31	05/A08.31	–	
119–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	5	12/A08.31	13/A08.31	06/A08.31	

SIGNAGE SCHEDULE

DOOR NUMBER	SIGN TYPE	ROOM ID
–	–	–
–	–	–
–	–	–
–	–	–
–	–	–
–	–	–
101–1	ISA, EXIT A	–
101–2	ISA, EXIT A	–
102–1	ID, EXIT B	102
103–1	ID	103
104–1	ID, EXIT B	104
104–2	ID, EXIT B	104
105–1	ID	105
106–1	ISA, EXIT A	–
106–2	ISA, EXIT B	106
107–1	ID, EXIT B	107
–	–	–
–	–	–
107–5	ID, ISA, EXIT A	107
108–1	ID, ISA, EXIT A	108
–	–	–
108–3	ID, EXIT B	108
–	–	–
109–1	ID, EXIT B	109
–	–	–
109–3	ID, ISA, EXIT A	109
–	–	–
110–1	ID, EXIT B	110
110–2	ID, EXIT B	110
110–3	ISA, ID, EXIT A	110
–	–	–
110–5	ID, ISA, EXIT A	110
111–1	R1A, R2A	112
112–1	R1B, R2B	111
113–1	ID	113
114–1	ID, EXIT B	114
114–2	ID, ISA, EXIT A	114
114–3	ID, ISA, EXIT A	114
115–1	ID, EXIT B	115
115–2	ID, ISA, EXIT A	115
116–1	ID	116
117–1	ID	117
118–1	ID	118
119–1	ID	119

DOOR SCHEDULE – SECOND LEVEL

SEE ADD #2, ITEM 2-37

DOOR NUMBER	DOOR SIZE WIDTH	DOOR SIZE HEIGHT	DOOR SIZE THICK	DOOR TYPE	DOOR CON	DOOR FRAME	PANIC HDW	FIRE RATED	HDW SET	DETAILS HEAD	DETAILS JAMB	DETAILS THRES	NOTE
203–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	60MIN	24	05/A08.31	05/A08.31	–	
203–2	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	60MIN	24	05/A08.31	05/A08.31	–	
204–1	6'–0"	7'–0"	1 3/4"	F	D1	F1	–	–	15	05/A08.31	05/A08.31	–	
205–1	3'–0"	7'–0"	1 3/4"	D	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
206–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	7	12/A08.31	13/A08.31	06/A08.31	
207–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	8	12/A08.31	13/A08.31	06/A08.31	
208–1	3'–0"	7'–0"	1 3/4"	D	D4	F4	YES	–	6	12/A08.10	13/A08.10	06/A08.31	
209–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	60MIN	24	05/A08.31	05/A08.31	–	
209–2	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	60MIN	24	05/A08.31	05/A08.31	–	
210–1	3'–0"	7'–0"	1 3/4"	A	D1	F1	–	60MIN	24	05/A08.31	05/A08.31	–	
211–1	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	–	15	05/A08.31	05/A08.31	–	
214–2	6'–0"	7'–0"	1 3/4"	N	D1	F1	–	–	15	12/A08.31	13/A08.31	06/A08.31	
212–1	3'–0"	7'–0"	1 3/4"	D	D1	F1	–	–	16	05/A08.31	05/A08.31	–	
214–1	3'–0"	7'–0"	1 3/4"	–	D1	–	–	–	14	–	–	–	CHAIN LINK
214–2	3'–0"	7'–0"	1 3/4"	–	D1	–	–	–	14	–	–	–	CHAIN LINK
215–1	3'–0"	7'–0"	1 3/4"	C	D1	F1	–	–	16	05/A08.31	05/A08.31	–	

DOOR SCHEDULE NOTES:

1. FOR EXT STL DR CONST RE: DETAIL 11/A08.32
2. FOR ACCESSIBLE DOOR NOTES RE: 2001 CBC SEC 1133B.2

SIGNAGE SCHEDULE

DOOR NUMBER	SIGN TYPE	ROOM ID
203–1	ID	203
203–2	ID, EXIT B	203
204–1	ID, EXIT B	204
205–1	ID, EXIT B	205
206–1	ID	206
207–1	ID, EXIT B	207
208–1	EXIT C	–
209–1	ID, EXIT B	209
209–2	ID, EXIT B	209
210–1	ID, EXIT B	210
211–1	ID	211
–	–	214
212–1	ID, EXIT B	212
–	–	–
–	–	–
215–1	ID	215

ROOM FINISHES KEY

P1			
T1	T1	T1	T1
B3	B3	B3	B3

CEILING
WALLS
BASE

WEST + NORTH + EAST + SOUTH

P1 : PAINT: FRAZEE 182 "ARIZONA WHITE" LRV 82 OR APPROVED EQUIVALENT
W1 : SUSPENDED WOOD CEILING PANELS

P1 : PAINT: FRAZEE 182 "ARIZONA WHITE" LRV 82 OR APPROVED EQUIVALENT
P2 : PAINT: FRAZEE 7454D "BLACK EYED SUSAN" LRV 67 OR APPROVED EQUIVALENT
P3 : PAINT: FRAZEE 7066N "STARS FOREVER" LRV 15 OR APPROVED EQUIVALENT
P4 : PAINT: FRAZEE 7175A "BELLADONA" LRV 31 OR APPROVED EQUIVALENT
P5 : PAINT: FRAZEE "COPPER CANYON" LRV 19 OR APPROVED EQUIVALENT
P6 : PAINT: FRAZEE AC110N "FIREKING RED" LRV 17 OR APPROVED EQUIVALENT
P7 : PAINT: [TBD]

F1 : FIBER–REINFORCED PLASTIC OVER SEALER COAT OF PAINT TO 48" AFF; P1 ABOVE

T1 : PORCELAIN TILE

B1 : 4" VINYL BASE
B2 : TILE SANITARY COVE BASE
B3 : TILE COVE BASE TO MATCH T1

ROOM FINISH NOTES:
1. ALL FLOORS SLIP–RESISTANT SEALED CONC UNLESS NOTED ON PLANS AS TILE
2. PAINT STRUCTURE, EQUIPMENT & SUPPORTS SAME AS CEILING

DOOR CON (CONSTRUCTION)

D1 = STL
D2 = (NOT USED)
D3 = OVERHEAD DOOR
D4 = ALUM
D5 = STL GATE

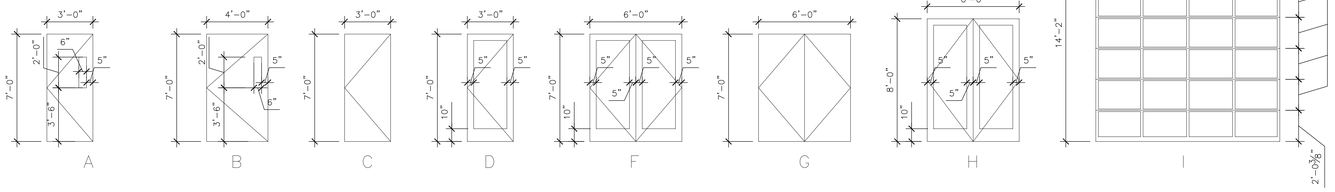
DOOR FRAME

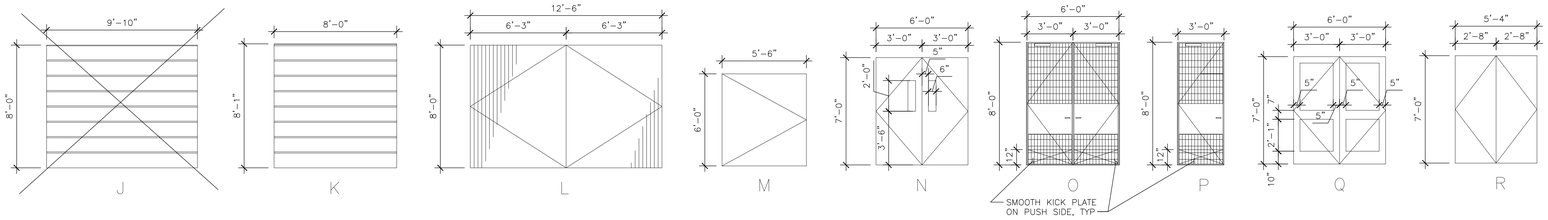
F1 = HM
F2 = (NOT USED)
F3 = OVERHEAD DOOR GUIDES
F4 = ALUM
F5 = STL GATE

SIGN TYPE

ISA = INTERNATIONAL SYMBOL OF ACCESSIBILITY – RE: 03/A09.05
EXIT A = TACTILE EXIT SIGN – RE: 05A/A09.05
EXIT B = INTERIOR (ROOM SIDE) MOUNT TACTILE EXIT SIGN – RE: 05B/A09.05
EXIT C = TACTILE EXIT SIGN – RE: 05C/A09.05
ID = ROOM SIGNAGE – RE: 04/A09.05
R1A = WOMEN'S ROOM IDENTIFICATION – RE: 15/A04.10
R1B = MEN'S ROOM IDENTIFICATION – RE: 16/A04.10
R2A = WOMEN'S DOOR SIGNAGE – RE: 03B/A04.10
R2B = MEN'S DOOR SIGNAGE – RE: 03A/A04.10

DOOR TYPE





WINDOW SCHEDULE – GROUND LEVEL

WINDOW NUMBER	WINDOW SIZE WIDTH	WINDOW SIZE HEIGHT	SILL HT	GLASS TYPE	DETAILS HEAD	DETAILS JAMB	DETAILS SILL	NOTES
102A	4'–0"	4'–0"	3'–0"	5	03/A08.31	03/A08.31	03/A08.31	1–HR
102B	4'–0"	4'–0"	3'–0"	5				1–HR
107A	4'–0"	5'–0"	3'–0"	5				1–HR
107B	4'–0"	5'–0"	3'–0"	5				1–HR
117A	3'–6"	3'–6"	3'–6"	5				1–HR
117B	8'–0"	3'–6"	3'–6"	1				
117C	6'–0"	3'–6"	3'–6"	1				
117D	3'–0"	3'–6"	3'–6"	5	"	"	"	1–HR

WINDOW SCHEDULE – SECOND LEVEL

WINDOW NUMBER	WINDOW SIZE WIDTH	WINDOW SIZE HEIGHT	SILL HT	GLASS TYPE	DETAILS HEAD	DETAILS JAMB	DETAILS SILL	NOTES
201A	11'–7⅞"	4'–11"	4'–11"	5	03/A08.31	03/A08.31	03/A08.31	1–HR
201B	3'–3⅞"	5'–7⅞"	4'–3½"	5				
201C	3'–5"	5'–7⅞"	4'–3½"	5				
201D	3'–5"	5'–7⅞"	4'–3½"	5				
201E	3'–3⅞"	5'–7⅞"	4'–3½"	5				
201F	11'–7⅞"	5'–7⅞"	4'–3½"	5				
201G	11'–11"	5'–7⅞"	4'–3½"	5				
201H	6'–10"	4'–11"	4'–11"	5				
208A	6'–8½"	6'–11"	6'–11"	5				
208B	3'–5"	6'–11"	6'–11"	5				
208C	3'–5"	6'–11"	6'–11"	5				
208D	0'–8½"	6'–11"	6'–11"	5				
208E	4'–0"	5'–8"	5'–6"	5				
208F	4'–0"	3'–8"	3'–6"	5	"	"	"	

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C–21914 31 AUG 05 RENEW STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA – CSU
MOU – _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

ADDENDUM #2 08 FEB '05

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04–600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II–A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

SCHEDULES

SCALE: NO SCALE DRAWN BY: MCL

DWG NO.

A10.01

DATE: 08 NOV '04

GENERAL NOTES

1. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO SPECIFICATIONS, PLANS AND ALL GOVERNING ORDINANCES.
2. ALL WORK SHALL COMPLY WITH CALIFORNIA BUILDING CODE 2001, AND ALL OTHER LOCAL OR STATE AGENCIES HAVING JURISDICTION OVER THIS PROJECT.
3. CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS OF THE JOB PRIOR TO STARTING CONSTRUCTION AND THE OWNER, ARCHITECT OR ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES OR INCONSISTENCIES. DO NOT SCALE DIMENSIONS, WHERE NO DIMENSIONS ARE PROVIDED, CONSULT WITH OWNER, ARCHITECT OR ENGINEER FOR CLARIFICATION BEFORE PROCEEDING WITH THE WORK.
4. ANY WORK PERFORMED IN CONFLICT WITH THE CONTRACT DOCUMENTS OR ANY CODE REQUIREMENTS SHALL BE CORRECTED BY THE CONTRACTOR AT HIS OWN EXPENSE AND AT NO EXPENSE TO THE OWNER, ARCHITECT OR ENGINEER.
5. ALL SYMBOLS AND ABBREVIATIONS USED ON THE DRAWINGS ARE CONSIDERED TO BE CONSTRUCTION STANDARDS. IF CLARIFICATION IS REQUIRED, THE CONTRACTOR SHALL NOTIFY THE ARCHITECT OR ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
6. NO OPENINGS, POCKETS, NOTCHES, BLOCKOUTS, ETC., ARE ALLOWED IN STRUCTURAL ELEMENTS UNLESS DETAILED ON THE STRUCTURAL DRAWINGS. NOTIFY THE ARCHITECT OR ENGINEER OF ANY OPENINGS, POCKETS, ETC., SHOWN BY OTHER DRAWINGS BUT NOT SHOWN ON STRUCTURAL DRAWINGS.
7. THE CONTRACTOR SHALL PROVIDE ALL MEASURES NECESSARY TO PROTECT THE STRUCTURE DURING CONSTRUCTION. SUCH MEASURES SHALL INCLUDE BUT NOT LIMITED TO BRACING, SHORING, ETC. OBSERVATION VISITS OT THE SITE BY OWNER, ARCHITECT OR ENGINEER SHALL NOT INCLUDE THE INSPECTION OF BRACING, SHORING, ETC.
8. CONSTRUCTION MATERIAL SHALL BE SPREAD OUT IF PLACED ON FRAMED FLOORS, ROOFS, ETC. THE LOAD SHALL NOT EXCEED THE DESIGN LIVE LOAD.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL EXCAVATION PROCEDURES INCLUDING LAGGING, SHORING AND PROTECTION OF ADJACENT PROPERTY, STRUCTURES, STREETS AND UTILITIES IN ACCORDANCE WITH ALL NATIONAL, STATE AND LOCAL SAFETY ORDINANCES.
10. SEE MECHANICAL, ELECTRICAL AND/OR ARCHITECTURAL DRAWINGS FOR LOCATION AND SIZE OF PIPE, VENT, DUCT AND OTHER SIMILAR OPENINGS, AND EMBEDDED OR ATTACHED ITEMS.
11. NOTES AND DETAILS ON DRAWINGS SHALL TAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS.
12. DO NOT SCALE DRAWINGS.
13. DURING COURSE OF CONSTRUCTION, THE ENGINEER, ARCHITECT SHALL VISUALLY REVIEW STRUCTURAL SYSTEM FOR GENERAL CONFORMANCE WITH THE APPROVED PLANS. ANY OBSERVED DEFICIENCIES SHALL BE REPORTED IN WRITING TO THE OWNER'S REPRESENTATIVE, TO THE CONTRACTOR AND TO THE DEPARTMENT.
14. STRUCTURAL OBSERVATION SHALL BE PROVIDED BY ENGINEER OF RECORD IN ACCORDANCE WITH SECTION 1702 A, CALIFORNIA BUILDING CODE 1998.

SOIL DATA

1. SOIL BEARING PRESSURE FOR COLUMN PADS = 750 psf FOR MAT MODULUS OF SUBGRADE = 45 pci
2. THE DESIGN IS BASED ON THE RECOMMENDATIONS GIVEN ON THE GEOTECHNICAL ENGINEERING INVESTIGATION REPORT FILE NO. PROJECT 2-1281 BY GSI SOILS INC. GEOTECHNOLOGIES INC. DATED JULY 01, 2003. ALL RECOMMENDATIONS RELATED TO SOIL PREPARATION AND CONSTRUCTION SHALL BE FOLLOWED THROUGH.

METAL DECK

1. ALL ROOF AND FLOOR METAL DECK AND ACCESSORIES SHALL BE FORMED FROM STEEL SHEETS CONFORMING TO ASTM A653 PER SECTION 05300 OR HIGHER SPECIFICATIONS.
2. DECK SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A525 COMMERCIAL COATING CLASS G-60 OR G-90.
3. CUTTING AND FRAMING OF OPENINGS FOR OTHER TRADES LARGER THAN 6 INCHES AND NOT SHOWN ON THE DRAWINGS WILL REQUIRE APPROVAL FROM THE ENGINEER.
4. ALL DECK SHALL BE ASC PACIFIC (I.C.B.O. 2757), VERCO (I.C.B.O. 2078) OR APPROVED EQUAL, AND THE TYPES AND GAUGES SHALL BE AS INDICATED ON THE DRAWINGS.
5. DECKS SHALL HAVE MINIMUM 2" BEARING AT SUPPORTS.
6. WELDING OF DECK AT ROOF DECKING SHALL BE CONTINUOUSLY INSPECTED BY THE DISTRICT INSPECTOR OR HIS REPRESENTATIVE.

CONCRETE

1. CONCRETE SHALL BE AS FOLLOWS:

LOCATION	AGGREGATES	STRENGTH @ 28 DAYS	DRY WEIGHT
A. CONTINUOUS FOOTING	HARDROCK	3000 PSI	145 PCF
B. FOOTING PADS	HARDROCK	3000 PSI	145 PCF
C. GRADE SLABS/MAT	HARDROCK	3500 PSI	145 PCF
	DESIGNED FOR	2000 PSI	
D. GRADE BEAMS	HARDROCK	3000 PSI	145 PCF
E. STRUCTURAL SLAB AND BEAMS	HARDROCK	4000 PSI	145 PCF
F. COLUMNS	HARDROCK	4000 PSI	145 PCF
G. CONCRETE OVER METAL DECK	LIGHTWEIGHT	3500 PSI	110 PCF

NOTE: A HIGHER GRADE OF CONCRETE MAY BE SUBSTITUTED FOR THOSE SHOWN ABOVE, BUT WILL BE SUBJECT TO THE CODE REQUIREMENTS OF THE HIGHER GRADE.

2. CEMENT SHALL CONFORM TO ASTM C150 TYPE I OR II.
3. HARDROCK AGGREGATES SHALL CONFORM TO ASTM C33. THEIR MAX. SIZE SHALL BE 1-1/2 INCHES FOR FOOTINGS GRADE BEAMS AND 1 INCH FOR ALL OTHER WORK.
4. LIGHTWEIGHT AGGREGATES (CONFORMING TO ASTM C330) SHALL BE APPROVED BY THE ENGINEER, AND THEIR MAXIMUM SIZE SHALL BE ONE INCH.
5. A STATEMENT OF MIX DESIGN SHALL BE MADE FOR CONCRETE WITH DESIGN STRENGTHS OVER 2500 PSI.. COPIES OF THE MIX DESIGN SHALL BE SUBMITTED TO THE OWNER, ARCHITECT, ENGINEER, AND BUILDING DEPARTMENT FOR APPROVAL BEFORE USE.
6. ONLY ONE GRADE OF CONCRETE SHALL BE POURED ON THE JOB AT ONE TIME.
7. CONTINUOUS INSPECTION IS REQUIRED FOR ALL CONCRETE WITH DESIGN STRENGTHS OVER 2000 PSI.
8. CONCRETE COVER OVER REINFORCING SHALL BE AS FOLLOWS:
   a) CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH 3"
   b) EXPOSED TO EARTH OR WEATHER
      1) CAST-IN-PLACE - NON-STRESSED 2"
   c) NOT EXPOSED TO EARTH OR WEATHER
      1) MAIN BARS IN BEAMS AND COLUMNS 2"
      2) TIES AND STIRRUPS 1-1/2"
9. ALL REINFORCING SHOWN CONTINUOUS SHALL BE LAPPED PER ACI 318 CLASS B SPLICE AND A MIN. OF 40 DIAM. (GRADE 60) AT SPLICES, AND SHALL BE MADE AWAY FROM POINTS OF MAXIMUM STRESS. MINIMUM LAP SHALL BE 2'-0" LONG.
10. BEFORE CONCRETE IS POURED, CHECK WITH ALL TRADES TO INSURE PROPER PLACEMENT OF ALL OPENINGS, SLEEVES, CURBS, CONDUITS, BOLTS, INSERTS, ETC., RELATING TO WORK.
11. ALL SLEEVES NOT SPECIFICALLY SHOWN ON THE DRAWINGS SHALL BE LOCATED BY THE TRADES INVOLVED AND SHALL BE APPROVED BY THE ENGINEER.

    DRY PACK CONCRETE SHALL BE ONE PART PORTLAND CEMENT AND ONE PART SAND WITH SUFFICIENT WATER TO ALLOW A SMALL
12. AMOUNT OF PASTE TO COME TO THE SURFACE.
13. CONCRETE GROUT SHALL BE NON-SHRINKING WITH SUFFICIENT WATER TO ALLOW POURING. ULTIMATE COMPRESSIVE STRENGTH (F'C) AT 28 DAYS SHALL BE EQUAL TO 5000 PSI MINIMUM.
14. A MIX THAT PRODUCES LOWEST SLUMP COMPATIBLE WITH PROPER PLACEMENT SHALL BE USED. (4-1/2" MAXIMUM SLUMP UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER.)
15. ALL CONCRETE IS DESIGNED BY ULTIMATE STRENGTH DESIGN METHOD.
16. FORMS FOR CONCRETE STRUCTURAL MEMBERS (SLABS, BEAMS) SHALL NOT BE STRIPPED UNTIL THE CONCRETE HAS REACHED ITS DESIGN STRENGTH.

REINFORCING

1. ALL REINFORCING SHALL CONFORM TO ASTM A-615 SPECIFICATIONS, 2-2628(B) GRADE 60 EXCEPT #3 BARS MAY BE GRADE 40. WELDED BARS SHALL BE ASTM A-706.
2. REINFORCING BARS SHALL BE SPLICED AND BENT IN STRICT ACCORDANCE WITH THE DRAWINGS AND DETAILS AND C.R.S.I. PUBLICATIONS. NO KINKS ALLOWED. ALL BARS SHALL BE CLEAN PRIOR TO CONCRETE PLACEMENT.
3. PROVIDE DOWELS OF SAME SIZE AND NUMBER FROM ADJACENT POUR, BOTH VERTICALLY AND HORIZONTALLY TO MATCH TYPICAL REINFORCING SHOWN. LAPS TO BE IN ACCORDANCE WITH THE DRAWINGS AND DETAILS. DOWELS SHALL BE CLEANED AFTER POUR.
4. USE LOW HYDROGEN ELECTRODES, GRADE E-70 OR E-90, FOR WELDING OF REINFORCING BARS.
5. SHOP DRAWINGS FOR REINFORCING STEEL SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER FOR APPROVAL PRIOR TO FABRICATION.
6. FIELD WELDING OR BENDING OF REINFORCING IS NOT PERMITTED EXCEPT AS INDICATED ON THE DRAWINGS OR AS APPROVED BY THE STRUCTURAL ENGINEER.

STRUCTURAL STEEL

1. STRUCTURAL STEEL SHALL CONFORM TO ASTM A-36 UNO, AND TO THE AISC SPECIFICATIONS FOR FABRICATION AND ERECTION.
2. TUBES SHALL CONFORM TO ASTM A-500 STANDARD SPECIFICATIONS, GRADE B.
3. ALL STEEL EXPOSED TO WEATHER SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION.
4. BOLTS SHALL CONFORM TO ASTM A-307 SPECIFICATIONS TYPICALLY UNLESS NOTED OTHERWISE AS H.S.B. HIGH STRENGTH BOLTS (H.S.B.) TO CONFORM TO ASTM A-325SC.
5. ALL STRUCTURAL STEEL SHALL BE FABRICATED IN THE SHOP OF A FABRICATOR LICENSED BY THE CITY OF LOS ANGELES AND SHOP DRAWINGS SHALL BE SUBMITTED TO THE ARCHITECT FOR APROVAL PRIOR TO FABRICATION.
6. ALL WELDING, EXCEPT MINOR OR TACK WELDING, SHALL BE CONTINUOUSLY INSPECTED BY THE DISTRICT INSPECTOR.
7. PROVIDE ONE SHOP COAT OF PAINT ON ALL STRUCTURAL STEEL NOT COVERED WITH CONCRETE, FIREPROOFING, MASONRY OR AT CONTACT SURFACES AT HIGH STRENGTH BOLTS.
8. CONTRACTOR SHALL SUBMIT METHOD OF CONSTRUCTION AND TEMPORARY BRACING OF STRUCTURAL STEEL FRAMING TO THE STRUCTURAL ENGINEER AND BUILDING DEPARTMENT FOR APPROVAL.
9. STUDS AND SHEAR ANCHORS TO CONFORM TO ASTM A-108 OR A-496 SPECIFICATIONS. ALL STUDS SHALL BE AUTOMATIC END WELDED PER MANUFACTURER'S RECOMMENDATION TO PROVIDE FUSION BETWEEN THE END OF STUD AND STEEL SURFACE OF BEAM/COLUMN.
10. HIGH STRENGTH BOLTING SHALL BE CONTINUOUSLY INSPECTED BY THE DISTRICT INSPECTOR.

BLOCK MASONRY NOTES

1. UNITS SHALL BE CONCRETE BLOCK CONFORMING TO ASTM C90 WITH AN ULTIMATE COMPRESSIVE STRENGTH OF MASONRY F'm=2000 PSI AT 28 DAYS.
2. GROUT SHALL BE OF FLUID CONSISTENCY AND SHALL BE ONE PART CEMENT, THREE PARTS SAND, AND MAY CONTAIN AN ADDITIONAL TWO PARTS PEA GRAVEL IF GROUT SPACES ARE 4" OR MORE IN EVERY DIRECTION. F'c = 2000 PSI MINIMUM AT 28 DAYS.
3. MORTAR MIX SHALL BE 1:3 PORTLAND CEMENT TO SAND WITH NOT MORE THAN ONE-HALF NOR LESS THAN ONE-QUARTER PART LIME PUTTY WITH RED LABEL ADDED, TYPE S, 2000 PSI.
4. ALL BLOCK REINFORCING SHALL HAVE A MINIMUM LAP OF 50 BAR DIAMETER OR 2'-0" MINIMUM.
5. GROUT FILL ALL CELLS UNLESS NOTED OR SHOWN OTHERWISE.
6. ALL CONCRETE BLOCK WALLS SHALL BE CONSTRUCTED UTILIZING COMMON RUNNING BOND UNLESS NOTED OR SHOWN OTHERWISE.
7. CONTINUOUS SPECIAL INSPECTION IS REQUIRED FOR CMU, MORTAR AND GROUT WORK BY AN APPROVED INSPECTOR.
8. CONCRETE BLOCK SHALL BE OF SIZES SHOWN ON THE DRAWINGS, TYPE AND COLORS AS SELECTED BY THE ARCHITECT AND CONFORM TO ASTM C-90, GRADE N-1. BLOCK SHALL BE NORMAL WEIGHT UNIT.

SEE RFI #74

EXCAVATION

1. THE PREPARATION OF BUILDING PAD SHALL BE PER RECOMMENDATIONS IN THE GEOTECHNICAL REPORT. 4 FEET DEEP OVEREXCAVATION AND COMPACTED FILL OF MIN. 90% OF MAX. DRY DENSITY IS REQUIRED.

SPECIAL INSPECTION

SPECIAL INSPECTION SHALL BE PERFORMED PER SECTION 1701 OF CBC FOR THE FOLLOWING:

CONCRETE:
a) DURING TAKING OF TEST SPECIMENS AND PLACING OF REINFORCED CONCRETE.
b) PRIOR TO AND DURING PLACEMENT OF CONCRETE AROUND BOLTS.

STRUCTURAL WELDING:
a) FLOOR DECK WELDING.
b) WELDED STUDS ON STEEL BEAMS.
c) WELDING OF REINFORCING STEEL.
d) MOMENT FRAME FIELD WELDING.

HIGH STRENGTH BOLTING:
HIGH STRENGTH A325 BOLT INSTALLATION.

EARTHWORK:
DURING EARTHWORK EXCAVATION, GRADING AND FILLING OPERATIONS.

STRUCTURAL DESIGN CRITERIA

CODE: CALIFORNIA BUILDING CODE 2001 ED.

LOADING: DEAD LOADS

ROOF	12 PSF
2ND FLOOR	80 PSF AND

LIVE LOADS

ROOF	20 PSF
2ND FLOOR	80 PSF FOR CLASSROOM
	80 PSF FOR CORRIDORS
	80 PSF FOR RESTROOMS

SOIL BEARING: 3000 PSF FOR WALL FOUNDATION

SEISMIC LOADS/PARAMETERS:

SOURCE TYPE B	N_a = 1.0
SOIL PROFILE TYPE B	N_v = 1.2
	R = 7.0
SEISMIC IMPORTANCE FACTOR	1.0

STRUCTURAL OBSERVATION

1. STRUCTURAL OBSERVATION IS REQUIRED FOR THE STRUCTURAL SYSTEM IN ACCORDANCE WITH UBC SECTION 1702. STRUCTURAL OBSERVATION IS THE VISUAL OBSERVATION OF THE ELEMENTS AND CONNECTIONS OF THE STRUCTURAL SYSTEM AT SIGNIFICANT CONSTRUCTION STAGES AND THE COMPLETED FOR GENERAL CONFORMANCE TO THE APPROVED PLANS AND SPECIFICATIONS. STRUCTURAL OBSERVATION DOES NOT WAIVE THE RESPONSIBILITY FOR THE INSPECTIONS REQUIRED OF THE INSPECTOR OR THE DEPUTY INSPECTOR.
2. THE OWNER SHALL EMPLOY A CIVIL OR STRUCTURAL ENGINEER OR ARCHITECT TO PERFORM THE STRUCTURAL OBSERVATION. THE ENGINEER OR ARCHITECT SHALL BE REGISTERED OR LICENSED IN THE STATE OF CALIFORNIA. THE DEPARTMENT OF BUILDING AND SAFTEY RECOMENDS THE USE OF THE ENGINEER OR ARCHITECT RESPONSIBLE FOR THE STRUCTURAL DESIGN WHEN THEY ARE INDEPENDENT OF THE CONTRACTOR.
3. THE STRUCTURAL OBSERVER SHALL PROVIDE EVIDENCE OF EMPLOYMENT BY THE OWNER A LETTER FROM THE OWNER OR A COPY OF THE AGREEMENT FOR SERVICES SHALL BE SENT TO THE BUILDING INSPECTOR BEFORE THE FIRST SITE VISIT. THE STRUCTURAL OBSERVER SHALL ALSO INFORM THE OWNER OF THE REQUIREMENTS FOR A PRECONSTRUCTION MEETING AND SHALL PRESIDE OVER THIS MEETING.
4. THE OWNER OR THE OWNER'S REPRESENTATIVE SHALL COORDINATE AND CALL FOR A MEETING BETWEEN THE ENGINEER OR ARCHITECT RESPONSIBLE FOR THE STRUCTURAL DESIGN, STRUCTURAL OBSERVER, CONTRACTOR, AFFECTED SUBCONTRACTORS AND DEPUTY INSPECTORS. THE PURPOSE OF THE MEETING SHALL BE TO IDENTIFY THE MAJOR STRUCTURAL ELEMENTS AND CONNECTIONS THAT AFFECT THE VERTICAL AND LATERAL LOAD SYSTEMS OF THE STRUCTURE AND TO REVIEW SCHEDULING OF THE REQUIRED OBSERVATIONS. A RECORD OF THE MEETING SHALL BE INCLUDED IN THE FIRST OBSERVATION REPORT SUBMITTED TO THE BUILDING INSPECTOR.
5. THE STRUCTURAL OBSERVER SHALL PERFOM SITE VISITS AT THOSE STEPS IN THE PROGRESS OF THE WORK THAT ALLOW FOR CORRECTION OF DEFICIENCIES WITHOUT SUBSTANTIAL EFFORT OR UNCOVERING OF THE WORK INVOLVED. AT A MINIMUM, THE FOLLOWING SIGNIFICANT CONSTRUCTION STAGES REQUIRED A SITE VISIT AND AN OBSERVATION REPORT FROM THE STRUCTURAL OBSERVER.

CONSTRUCTION STAGES	ELEMENTS/CONNECTIONS TO BE OBSERVED
a) _____	/ REINFORCEMENT
b) STRUCTURAL FRAMES	/ STRUCTURAL MEMBERS AND CONNECTIONS
c) SECOND FLOOR	/ FLOOR
d) ROOF	/ FRAMING, SHEATHING

6. THE STRUCTURAL OBSERVER SHALL PREPARE A REPORT ON THE DEPARTMENT FORM FOR EACH SIGNIFICANT STAGE OF CONSTRUCTION OBSERVED. THE ORIGINAL OF THE OBSERVATION REPORT SHALL BE SENT TO THE BUILDING INSPECTOR'S OFFICE AND SHALL BE SIGNED AND SEALED (WET STAMP) BY THE RESPONSIBLE STRUCTURAL OBSERVER. ONE COPY OF THE OBSERVATION REPORT SHALL BE ATTACHED TO THE APPROVED PLANS. THE COPY ATTACHED TO THE PLANS NEED NOT BE SEALED BUT SHALL BE SIGNED BY THE RESPONSIBLE STRUCTURAL OBSERVER OR THEIR DESIGNEE. COPIES OF THE REPORT SHALL ALSO BE GIVEN TO THE OWNER, CONTRACTOR AND DEPUTY INSPECTOR.
7. A FINAL OBSERVATION REPORT MUST BE SUBMITTED WHICH SHOWS THAT ALL OBSERVED DEFICIENCIES WERE RESOLVED AND THE STRUCTURAL SYSTEM GENERALLY CONFORMS WITH THE APPROVED PLANS AND SPECIFICATIONS. THE DEPARTMENT OF BUILDING AND SAFTEY WILL NOT ACCEPT THE STRUCTURAL WORK WITHOUT THIS FINAL OBSERVATION REPORT AND THE CORRECTION OF SPECIFIC DEFICIENCIES NOTES DURING NORMAL BUILDING AND DEPUTY INSPECTION.
8. WHEN THE OWNER ELECTS TO CHANGE THE STRUCTURAL OBSERVER OF RECORD, THE OWNER SHALL:
   a) NOTIFY THE BUILDING INSPECTOR IN WRITING BEFORE THE NEXT INSPECTION.
   b) CALL AN ADDITIONAL PRECONSTRUCTION MEET, AND
   c) FURNISH THE REPLACEMENT OBSERVER WITH A COPY OF ALL PREVIOUS OBSERVATION REPORTS.

   THE REPLACEMENT STRUCTURAL OBSERVER SHALL APPROVE THE CORRECTION OF THE ORIGINAL OBSERVED DEFICIENCIES UNLESS OTHERWISE APPROVED BY PLAN CHECK SUPERVISION. THE POLICY OF THE DEPARTMENT SHALL BE TO CORRECT ANY PROPERLY NOTED DEFICIENCIES WITHOUT CONSIDERATION OF THEIR SOURCE.

STRUCTURAL STEEL

1. STRUCTURAL STEEL SHALL CONFORM TO ASTM A-36 UNO, AND TO THE AISC SPECIFICATIONS FOR FABRICATION AND ERECTION.
2. TUBES SHALL CONFORM TO ASTM A-500 STANDARD SPECIFICATIONS, GRADE B.
3. ALL STEEL EXPOSED TO WEATHER SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION.
4. BOLTS SHALL CONFORM TO ASTM A-307 SPECIFICATIONS TYPICALLY UNLESS NOTED OTHERWISE AS H.S.B. HIGH STRENGTH BOLTS (H.S.B.) TO CONFORM TO ASTM A-325N (STD.).
5. (NOT USED)
6. ALL WELDING, EXCEPT MINOR OR TACK WELDING, SHALL BE CONTINUOUSLY INSPECTED BY AN APPROVED WELDING INSPECTOR.
7. PROVIDE ONE SHOP COAT OF PAINT ON ALL STRUCTURAL STEEL NOT COVERED WITH CONCRETE, FIREPROOFING, MASONRY OR AT CONTACT SURFACES AT HIGH STRENGTH BOLTS.
8. CONTRACTOR SHALL SUBMIT METHOD OF CONSTRUCTION AND TEMPORARY BRACING OF STRUCTURAL STEEL FRAMING TO THE STRUCTURAL ENGINEER AND BUILDING DEPARTMENT FOR APPROVAL.
9. HIGH STRENGTH BOLTING SHALL BE CONTINUOUSLY INSPECTED BY AN APPROVED INSPECTOR.

John Trautmann Architects

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL STATE OF CALIFORNIA

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

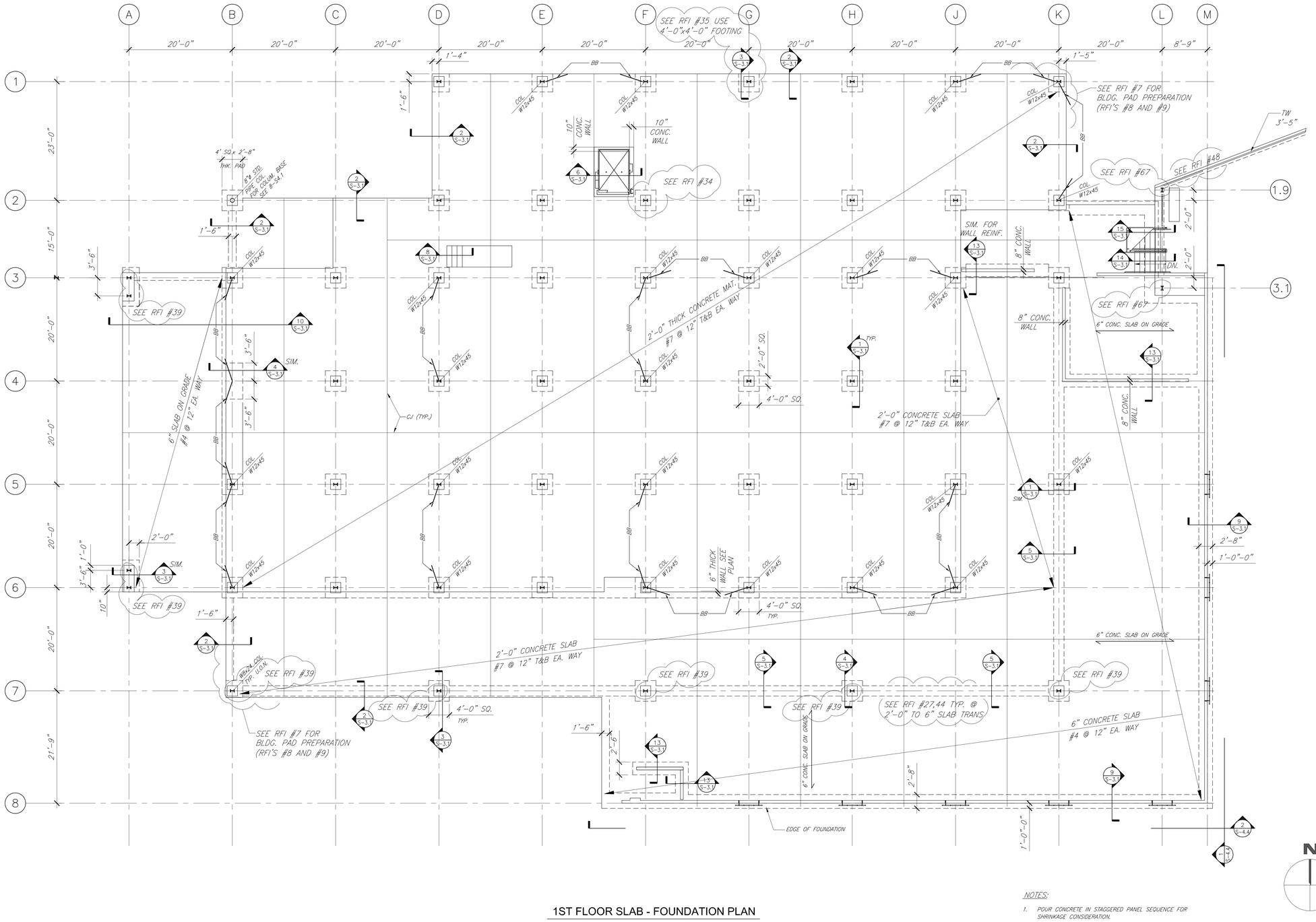
GENERAL NOTES

SCALE: DRAWN BY: SC

DWG NO.

S1.0

DATE: 08 NOV '04



1ST FLOOR SLAB - FOUNDATION PLAN

Scale: 1/8" = 1' - 0"

NOTES:

1. POUR CONCRETE IN STAGGERED PANEL SEQUENCE FOR SHRINKAGE CONSIDERATION.

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU -

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

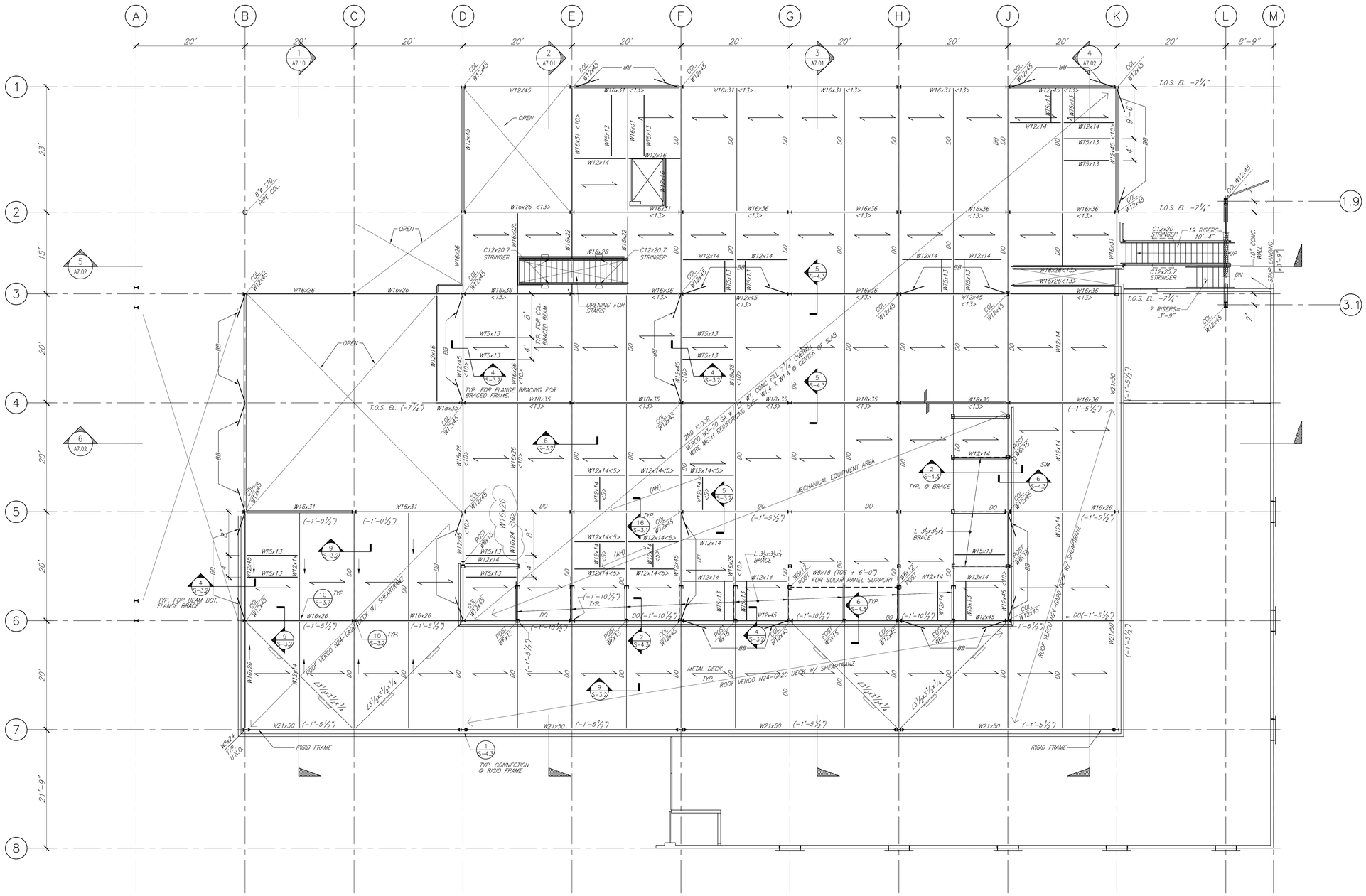
1ST FLOOR SLAB/ FOUNDATION PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: APSG

DWG NO.

S2.1

DATE: 08 NOV '04



ROOF: DL = 12 PSF
LL = 20 PSF

FLOOR & MECH. EQUIPMENT AREA: DL = 80 PSF
LL = 80 PSF

NOTES:

1. ⟷ INDICATE DIRECTIONS OF FLOOR/ROOF DECK SPAN.
2. ( ) INDICATES TOP OF STEEL ELEV. TOS ELEVATION AS SHOWN ARE BASED ON DATUM (0'-0") TO TOP OF CONCRETE ELEVATION FOR THE MAIN FLOOR CONCRETE DECK.
3. BB INDICATES BRACED BAYS.
4. < > INDICATED NO. OF EQUALLY SPACED 3/4" ø x 5" WELDED STUDS.

SECOND FLOOR - FRAMING PLAN

Scale: 1/8" = 1' - 0"

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

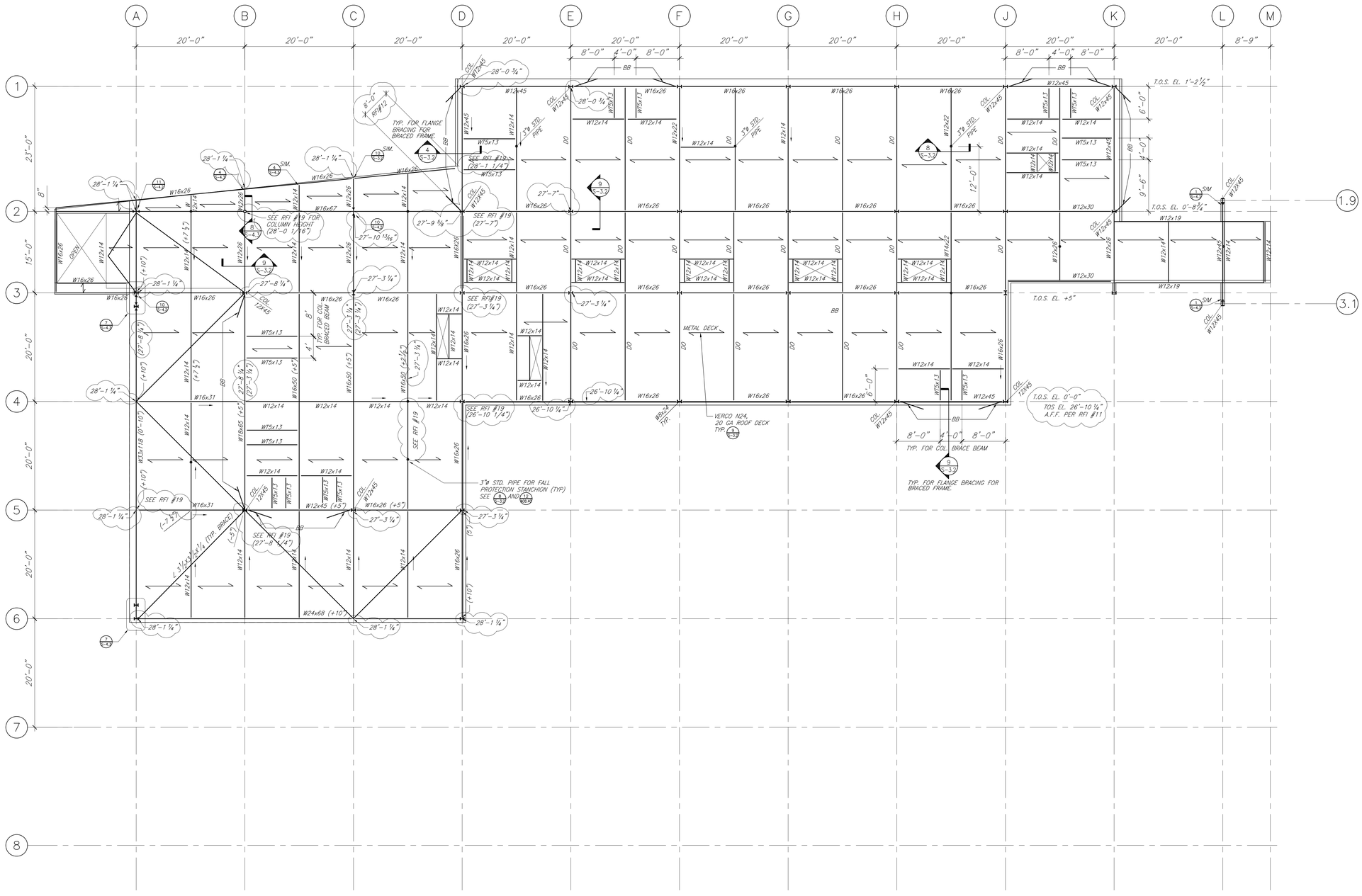
SECOND FLOOR
FRAMING PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: APSG

DWG NO.

S2.2

DATE: 08 NOV '04



HIGH ROOF - FRAMING PLAN

Scale: 1/8" = 1' - 0"

NOTES:

1. INDICATE DIRECTIONS OF FLOOR/ROOF DECK SPAN. ROOF DECK VERCO N24 G-20, SIDE LAP BCP12" O.C. 4 WELDS PER SHEET TO SUPPORT. (TYP.)
2. TOS ELEVATIONS SHOWN ARE TO SUIT ROOF SLOPE AND SHALL BE COORDINATED W/ ARCHITECTURAL DRAWINGS. TOS EL. (0'-0") DATUM IS BASED ON LOW POINT OF ROOF.

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

HIGH ROOF
FRAMING PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: APSG

DWG NO.

S2.3

DATE: 08 NOV '04

ELECTRICAL LEGEND

ELECTRICAL ABBREVIATIONS

A
- A — AMPERE
- AC — ALTERNATING CURRENT
- A\C — AIR CONDITIONER
- AF — AMPERE FRAME
- AHU — AIR HANDLING UNIT
- AIC — AMPERE INTERRUPTING CAPACITY
- ALT — ALTERNATE
- AT — AMPERE TRIP
- ATS — AUTOMATIC TRANSFER SWITCH
- AUX — AUXILIARY
- AWG — AMERICAN WIRE GAUGE
- AFF — ABOVE FINISHED FLOOR

B
- BATT — BATTERY
- BC — BARE COPPER
- BKBD — BACKBOARD
- BKR — BEAKER
- BOT — BOTTOM OF TRAY

C
- C — CONDUIT
- CB — CIRCUIT BREAKER
- CKT — CIRCUIT
- C.O. — CONDUIT ONLY
- CPT — CONTROL POWER TRANSFORMER
- CU — COPPER

D
- DIA — DIAMETER
- DISC — DISCONNECT
- DIST — DISTRIBUTION
- DWG — DRAWING

E
- EF — EXHAUST FAN
- ELEC — ELECTRIC
- EMERG — EMERGENCY
- EQUIP — EQUIPMENT
- EWC — ELECTRIC WATER COOLER

F
- FA — FIRE ALARM PANEL
- FDR — FEEDER
- FLA — FULL LOAD AMPERES
- F/O — FIBER OPTIC
- FT — FEET
- FVNR — FULL VOLTAGE NON-REVERSING

G
- GFI — GROUND FAULT INTERRUPTER
- GND — GROUND

J
- JB — JUNCTION BOX

K
- KA — KILOAMPERES
- KCMIL — THOUSAND CIRCULAR MILLS
- KV — KILOVOLT
- KVA — KILOVOLT AMPERES
- KVAR — KILOVOLT AMPERES-REACTIVE
- KW — KILOWATT
- KWH — KILOWATTHOUR

L
- LOC — LOCATION
- LTG — LIGHTING

M
- MCB — MAIN CIRCUIT BREAKER
- MCC — MOTOR CONTROL CENTER
- MCP — MOTOR PROTECTION CIRCUIT
- MCS — MOLDED CASE SWITCH
- MH — MOUNTING HEIGHT
- MIN — MINIMUM
- MLO — MAIN LUGS ONLY
- MTD — MOUNTED
- MTG — MOUNTING

N
- N — NEUTRAL
- NEC — NATIONAL ELECTRIC CODE
- N.C. — NORMALLY CLOSED
- NIC — NOT IN CONTRACT
- N.O. — NORMALLY OPEN

O
- O.C. — ON CENTER

P
- PF — POWER FACTOR
- PH — PHASE
- PNL — PANEL
- PR — PAIR
- PWR — POWER

R
- RCPT — RECEPTACLE

S
- SA — SURGE ARRESTER
- SECT — SECTION
- SW — SWITCH
- SWBD — SWITCHBOARD
- SWGR — SWITCHGEAR

T
- T — TRANSFORMER
- TEL — TELEPHONE
- THWN — MOISTURE AND HEAT RESISTANT THERMOPLASTIC INSULATION
- TRANSF — TRANSFORMER
- T/S — TWISTED SHIELDED
- TYP — TYPICAL

U
- UPS — UNINTERRUPTABLE POWER SUPPLY
- UON — UNLESS OTHERWISE NOTED
- U/G — UNDERGROUND

V
- V — VOLT, VOLTAGE, VOICE
- VA — VOLT AMPERE

W
- W — WATT, WIRE, WEST
- WP — WEATHERPROOF
- WTR HTR — WATER HEATER

X
- XFMR — TRANSFORMER

MISCELLANEOUS
- Z — IMPEDANCE
- ø — PHASE, DIAMETER
- & — AND
- # — NUMBER
- 3P — THREE POLE

LIGHTING FIXTURES

- FLUORESCENT FIXTURE
  1a = DENOTES CKT #1. CONTROLLED BY SWITCH "a"
  F1 = DENOTES TYPE "F1" FIXTURE, PER FIXTURE SCHEDULE
  (7) = DENOTES 7 FIXTURES
- FLUORESCENT FIXTURE WITH BUILT-IN EMERGENCY BATTERY PACK — SEE FRI#38
- RECESSED INCANDESCENT, HID OR COMPACT FLUORESCENT FIXTURE. TYPE AS SHOW ON PLANS
- LIGHTING FIXTURE ON EMERGENCY OR NIGHT LIGHT CIRCUIT TYPE AS SHOWN ON PLANS
- WALL WASHER FIXTURE, SHADED SIDE INDICATESDIRECTION OF AIM
- WALL MOUNTED LIGHTING FIXTURE
- WALL MOUNTED LIGHTING FIXTURE
- WALL MOUNTED EXIT SIGN
- SHADING INDICATES ILLUMINATED FACE OF EXIT SIGN
- ARROW INDICATES EXIT SIGN DIRECTIONAL ARROW
- WALL MTD EMERGENCY BATTERY PACK WITH LTG HEADS (TWO SHOWN)
- RECESSED FIXTURE WITH ADJUSTABLE DIRECTINOAL LIGHT
- PARKING LOT TYPE. POLE MTD LIGHTING FIXTURE
- SURFACE MTD DIRECTIONAL AIMING LIGHT
- FLOOD LIGHT FIXTURE WITH DIRECTIONAL AIMING LIGHT
- TRACK LIGHT

SWITCHES AND CONTROLS

- PUSH BUTTON OR CONTROL STATION
- PHOTO ELECTRIC CELL
- CONTACTOR
- MOTOR STARTER: 0 = STARTER SIZE
- COMBINATION MOTOR STARTER DISCONNECT SWITCH
  30 = AMPERE RATING
  (12) = FUSE SIZE
  0 = STARTER SIZE
- FUSED DISCONNECT SWITCH
  30 = AMPERE RATING
  (15) = FUSE SIZE
- NON-FUSED DISCONNECT SWITCH
  30 = AMPERE RATING
- TOGGLE SWITCH, SWITCH DESIGNATION
  SUBSCRIPT:
  3 = THREE WAY
  4 = FOUR WAY
  D = DIMMER
  K = KEY SWITCH
  P = PILOT LIGHT
  T = TIME DELAY SWITCH
  WP = WEATHERPROOF
  XP = EXPLOSION PROOF
- MANUAL MOTOR STARTER SWITCH, 20A, 125V
- DUAL-RELAY WALL SWITCH INFRARED OCCUPANCY SENSOR +48" A.F.F.
- DRAWING REFERENCE NOTE: (SEE NOTE ON DRAWING)
- CONCEALED CONDUIT (3/4", UON)
- UNDERGROUND CONDUIT
- WIRING HATCH MARKS DENOTES NUMBER OF #12 AWG CONDUCTORS, LONG HATCH MARK DENOTES NEUTRAL CONDUCTOR, LONG HATCH WITH DOT DENOTES GROUND WIRE.
- CONDUIT OR CABLE TURNING UP
- CONDUIT OR CABLE TURNING DOWN
- CONDUIT CAPPED
- DENOTES HOMERUN TO PANEL "LPA" WITH CIRCUITS 1,3 & 5 WITH COMMON NEUTRAL, AND CIRCUITS 2,4, EACH WITH ITS OWN NEUTRAL

SINGLE LINE DIAGRAM LEGEND

- DRAW-OUT POWER BREAKER 3 POLES. SIZE AS INDICATED
- PLUG-IN MOLDED CASE BREAKER 3 POLES. SIZE AS INDICATED
- MOLDED CASE CIRCUIT BREAKER 3 POLES. SIZE AS INDICATED
- AUTOMATIC TRANSFER SWITCH
- POWER TRANSFORMER
- LIMIT OF EQUIPMENT
- CONTACTOR, NORMALLY OPEN
- CONTACTOR, NORMALLY CLOSED
- MOTOR STARTER, SINGLE SPEED
  0 = STARTER SIZE
- 3 PHASE MOTOR
  2 = HORSEPOWER
- GROUNDING/DOWNLEAD CONDUCTOR
- STATIC AUTOMATIC TRANSFER SWITCH
- DC BATTERY
- SA OR TVSS "A" — SURGE ARRESTER OR TRANSIENT VOLTAGE SURGE SUPPRESSORS
  A = LETTER INDICATES SUPPRESSORS CATEGORY
- BUS DUCT
- FEEDER IDENTIFICATION, SEE SINGLE LINE DIAGRAM
- LOAD INTERRUPTER SWITCH WITH FUSE
- DELTA CONNECTION
- WYE CONNECTION WITH GROUND
- DISCONNECT
- POWER SHIELDED TRANSFORMER
- SINGLE PHASE MOTOR

FIXTURE SCHEDULE

TYPE	WATTS TOTAL	MANUFACTURER AND CATALOG NO.	DESCRIPTION	LAMP NO.	LAMP WATTS	LAMP TYPE	FURNISHED AND INSTALLED BY ELECTRICAL CONTRACTOR	MOUNTING (S: SURFACE, R: RECESSED, W: WALL, G: GROUND, C: COVE)	REMARKS
F1	104	PEERLITE # 10CRMS-332-70/30-R4-277-GEB	INDIRECT BAFFLE	3	32	T8	✓	S	SEE FRI#30 47,38
F2	70	DEL RAY LTG. 2542-S-0-70-120-E	HIGH BAY LOBBY	1	70	MH		S	SEE RFI#30
F3	42	DEL RAY LTG. 2363-S42	WALL MTD. HALLWAY	1	42	CFL		W	
F4	32	DEL RAY LTG. 7601-1-32-277	PENDANT HALLWAY	1	32	CFL		S	
F5	26	DEL RAY LTG. 6010-26-2-120V.	PENDANT WAITING ROOM	1	26	CFL		S	
F6	68	LITHONIA RP-2-RS-S-PBL-277	RECESSED PERIMETER	2	32	T8		R	
F7	68	LITHONIA C-2-25-277-GEB-AL	4' STRIP	2	32	T8		S	
F8	104	SPEC LIGHT # FTS8-332-NI-X12-11-277-1/4	8' UNIBODY HIGH BAY	3	32	T8		S	SEE RFI#30 47
F8A	104	SPEC LIGHT # FTS8-332-NI-X12-11-277-1/4	4' UNIBODY HIGH BAY	3	32	T8		S	SEE RFI#30 47
F9	70	LITHONIA WFL2-70M-RW-277	COLUMN MTD.	1	70	MH		W	
F10	68	LITHONIA DMW-232-AR-277-1/3 EB	WORK AREA	2	32	T8		S	
F11	50	GOTHAM LGH-50M-9-FW-FFL-277	HIGH CEILING CANOPY	1	50	MH		R	SEE RFI#32
F12	32	GOTHAM LGF-218DTT-9-FW-FFL-277	CANOPY	2	18	CFL		R	
F13	5	LITHONIA EDG(1AND/OR2)G-277-ELN	EXIT	1	5	LED		S	
F14	175	LUMINIS# W740	POLE	1	150	HPS		–	(1)
F15	68	SAME AS F6 EXCEPT W/120VOLT BALLAST	RECESSED PERIMETER	2	32	T8		R	
F16	68	SAME AS F7 EXCEPT W/120 VOLT BALLAST	4' STRIP	2	32	T8		S	
F17	68	SAME AS F7 EXCEPT W/EMERGENCY BACK UP.	4' STRIP	2	32	T8		S	
F18	525	KURT VERSEN 1-1/4" APERTURE ON 277 V PRIMARY TRANSFORMER.	DROPPED CEILING CANOPY	15	35	MR16		R	

(1) FURNISH AND INSTALL A 12'-0" POLE WITH CONCRETE BASE.

FIRE ALARM CODE

- FACP — FIRE ALARM CONTROL PANEL + 72" TO TOP
- FAAP — FIRE ALARM ANNUNCIATOR PANEL + 5'-6" TO TOP
- ASSD — AIR SAMPLING SMOKE DETECTION CONTROL PANEL
- FIRE ALARM MANUAL PULL STATION (ADDRESSABLE) + 48" AFF
- FIRE ALARM AUDIO/VISUAL SIGNAL (SPEAKER/STROBE) + 80" AFF
- CEILING MTD IONIZATION TYPE SMOKE DETECTOR
- CEILING MTD PHOTOELECTRIC TYPE SMOKE DETECTOR
- CEILING MTD RATE OF RISE HEAT DETECTOR
- IONIZATION TYPE DUCT DETECTOR
- ADDRESSABLE INTERFACE DEVICE
- ADDRESSABLE CONTROL DEVICE
- FA — CONDUIT DEDICATED TO THE FIRE ALARM SYSTEM
- STROBE DEVICE
- NOTIFIER HARSH SMOKE DETECTOR
- NOTIFIER ACCLIMATE SMOKE DETECTOR
- GENTEX HORN STROBE

RECEPTACLES

- DUPLEX RECEPTACLE, 20A, 125V, 2P, 3W, 18" AFF UON
- SINGLE RECEPTACLE, 20A, 125V, 2P, 3W, 18" AFF UON
- 480V POWER RECEPTACLE, TYPE AS NOTED
- SPECIAL RECEPTACLE, 18" AFF UON, VOLTAGE, NUMBER OF POLES AND AMPS AS INDICATED
- DOUBLE RECEPTACLE, 15A, 125V, 2P, 3W, 18" AFF UON
- FLUSH FLOOR MOUNTED POWER AND COMMUNICATION OUTLET BOX WITH DOUBLE DUPLEX CONVENIENCE RECEPTACLES AND TWO ETHERNET FIBER OPTIC OUTLET JACKS, PER PLAN DWGS AND SPECIFICATIONS.
- PLUGMOLD RECEPTACLE, 6" ABOVE COUNTER UON
- WALL MOUNTED TELEPHONE OUTLET
- JUNCTION BOX WALL MOUNTED, 10" AFF UON
- JUNCTION BOX INSTALLED IN CEILING
- FLUSH FLOOR MOUNTED JUNCTION BOX
- PULL BOX
- FLOOR MOUNTED OUTLET. DOUBLE DUPLEX PEDESTAL TYPE.
- WALL MOUNTED. DOUBLE DUPLEX OUTLET
- DATA OUTLET
- PULL BOX

DISTRIBUTION EQUIPMENT

- PANEL BOARD
- POWER PANEL OR DISTRIBUTION BOARD
- ELECTRICAL CABLE TRAY
- BUS DUCT# 3 480V 3ø-3W
- BUS DUCT #1 208V 3ø-3W
- BUS DUCT#2 240V 3ø-3W

COMMUNICATIONS LEGEND

- MICROPHONE OUTLET
- PUBLIC ADDRESS SPEAKER – CEILING MOUNTED
- PUBLIC ADDRESS SPEAKER SPEAKER/INTERCOM

GENERAL NOTES:

1- FIRE ALARM SYSTEM WILL BE DESIGN BUILT AND UNDER SEPARATE PLAN CHECK AND PERMIT.

2- WHERE EVER CABLE TRAY PENETRATE AND PASS THROUGH FIRE RATED WALL, CONTRACTOR TO MAKE, PROVIDE AND USE CONDUIT TRANSITION FROM CABLE TRAY TO CONDUIT TO CABLE TRAY.

3- CONTRACTOR TO FURNISH AND INSTALL SOLID BUTTOM CABLE TRAY IN EXPOSED AREAS AND WIRE BASKET TRAY ONLY IN ACCESSIBLE CEILING AREAS.

4- ELECTRICAL CONTRACTOR TO PROVIDE 1#6 GROUND WIRE AT MDF AND "IGF". BOND TO MAIN ELECTRICAL GROUND.

John Trautmann Architects
2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: ____________________
Code Enforcement South

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.

DSA – CSU
MOU – __________

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: __________

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER
ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT PHASE II-A

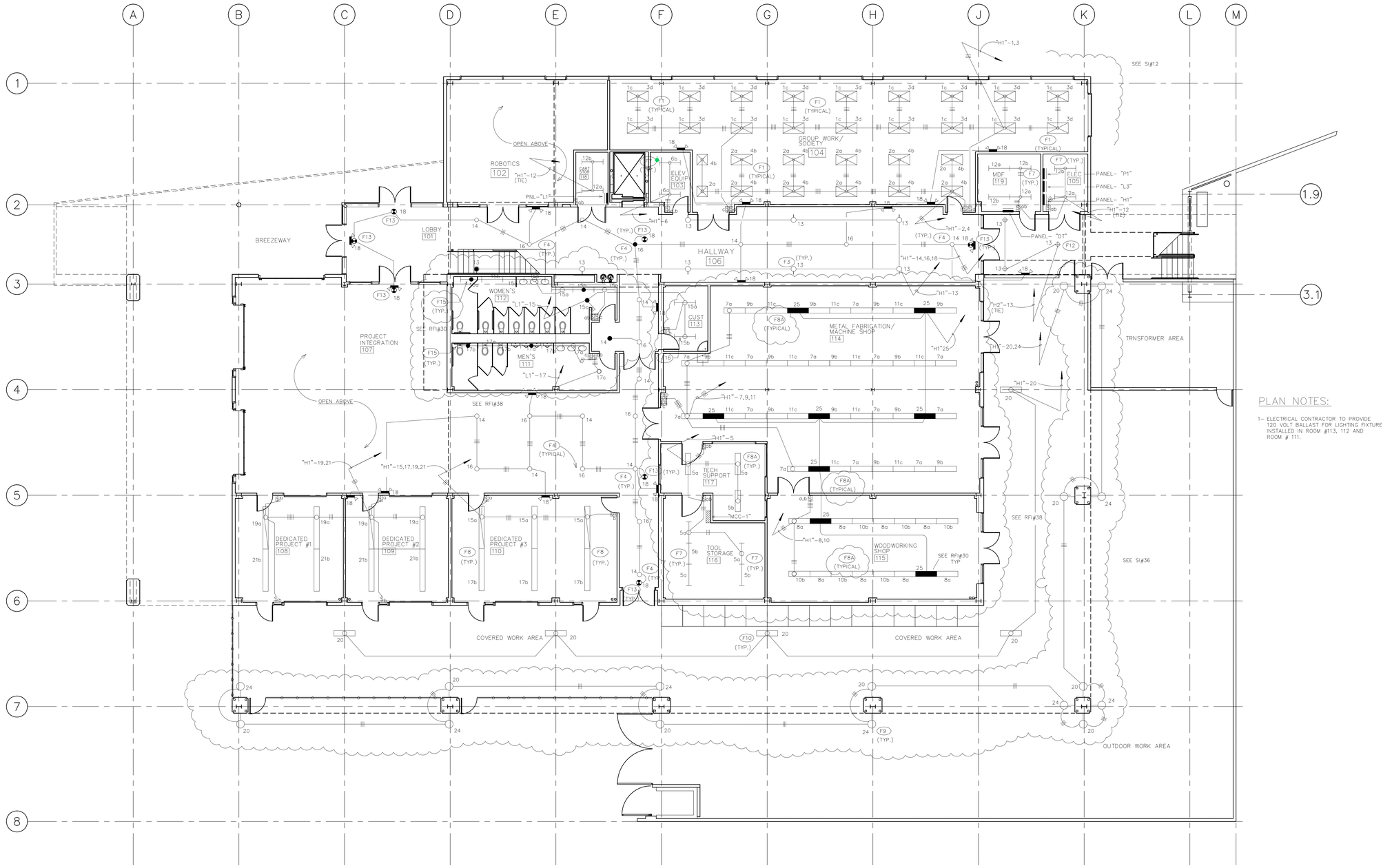
COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE
ELECTRICAL SYMBOLS, LEGEND AND FIXTURE SCHEDULE

SCALE: NONE DRAWN BY: FE

DWG NO.
E-1 ASI #27
OF – 14

DATE: 08 NOV '04



PLAN NOTES:

1- ELECTRICAL CONTRACTOR TO PROVIDE 120 VOLT BALLAST FOR LIGHTING FIXTURE INSTALLED IN ROOM #113, 112 AND ROOM # 111.

GROUND LEVEL LIGHTING PLAN

0' 8' 16' 32' 64' 128' 256'

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

[CONSULTANT'S SIGNATURE]
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

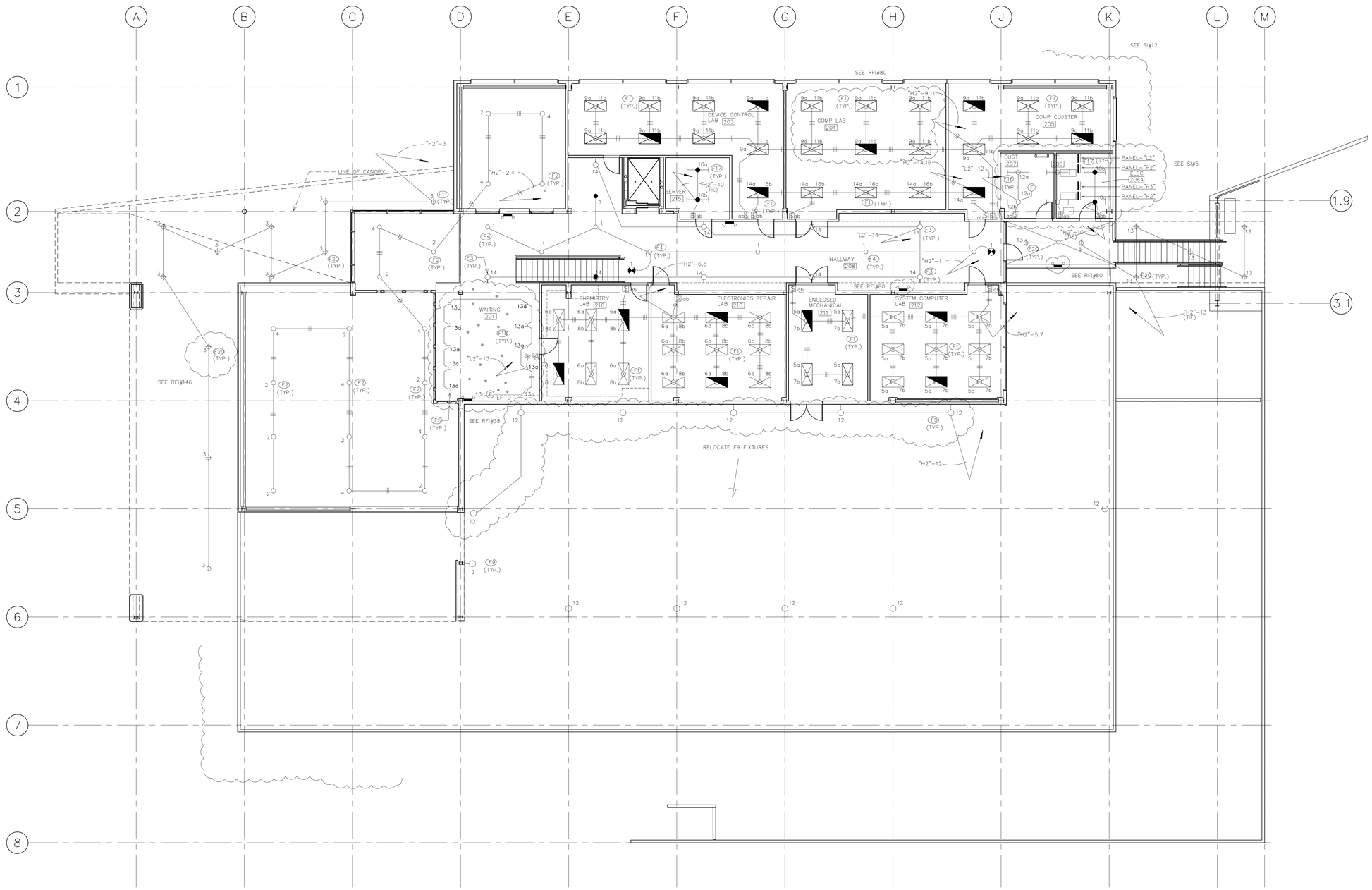
GROUND LEVEL LIGHTING PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: FE

DWG NO.

E-4 ASI #27
OF - 14

DATE: 08 NOV '04



1 A2.21 SECOND LEVEL EQUIPMENT PLAN

0' 8' 16' 32' 64' 128' 256'

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER

ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

SECOND LEVEL LIGHTING PLAN

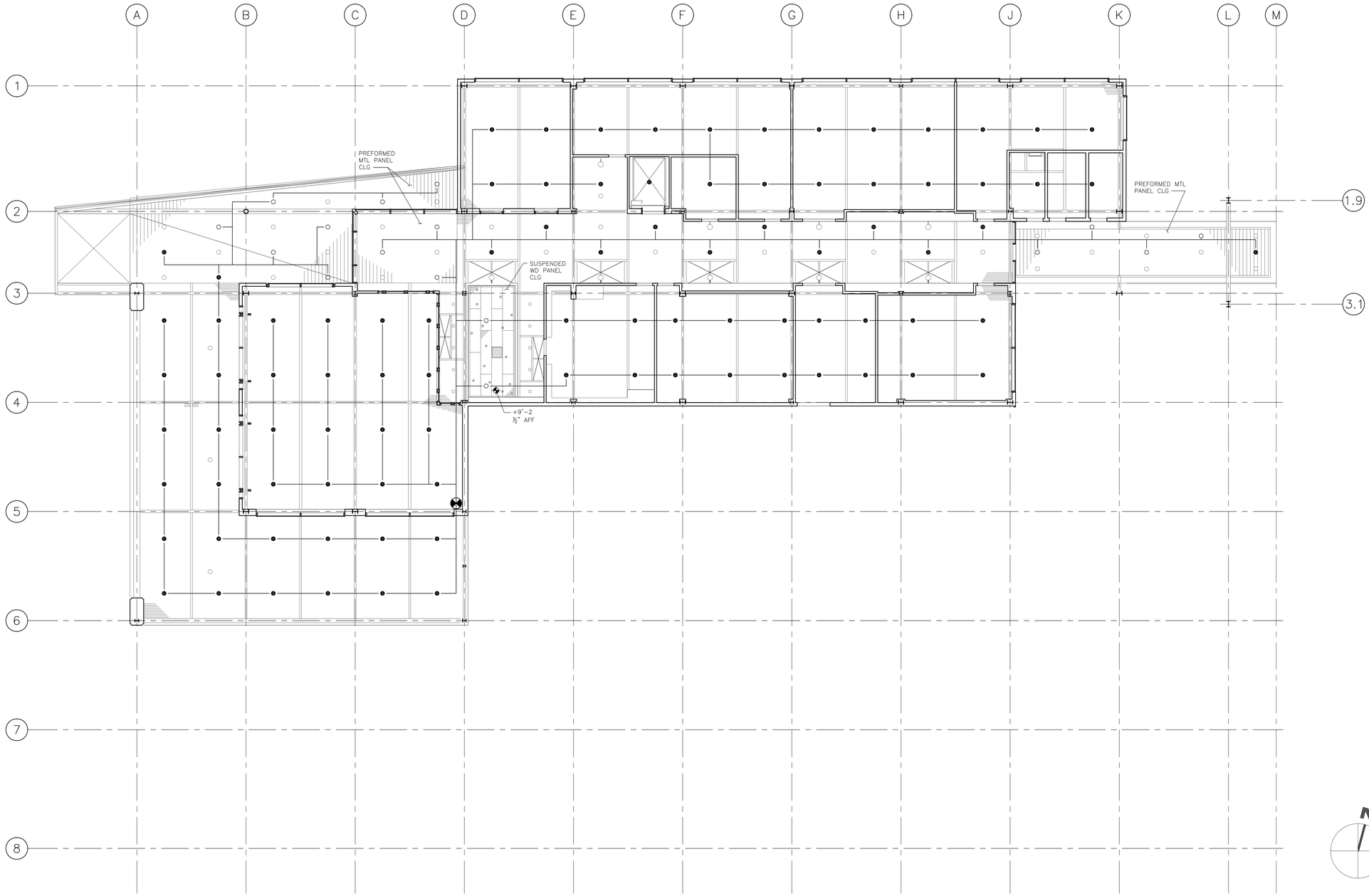
SCALE: 1/8" = 1'-0" DRAWN BY: FE

DWG NO. E-5 ASI #27
OF - 14

DATE: 08 NOV '04

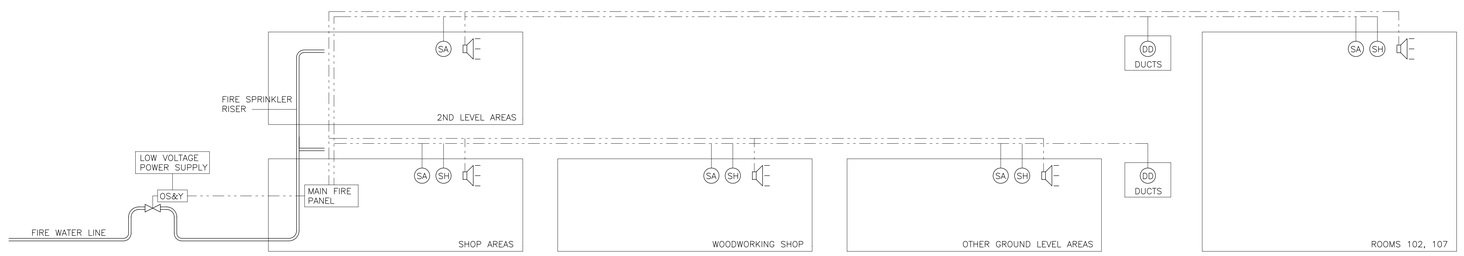
LEGEND

- PENDANT, CONCEALED
- PENDANT, UPRIGHT
- AUTOMATIC FIRE SPRINKLER RISER (AFSR)
- POINT OF CONNECTION
- DETAIL NUMBER / SHEET NUMBER — DETAIL REFERENCE



01 A03.10 SECOND LEVEL FIRE SPRINKLER PLAN

0' 8' 16' 32' 64' 128' 256'



SCHEMATIC DIAGRAM LEGEND

- (SH) NOTIFIER HARSH SMOKE DETECTORS MOUNTED @10' AFF
- (SA) NOTIFIER FAPT-851 ACCLIMATE SMOKE DETECTORS
- GENTEX HORN STROBES

NOTE: FOR LOCATIONS RE: SHTS E-6 & E-8

- (DD) DUCT DETECTORS RE: MECH

01 A03.10 FIRE ALARM SCHEMATIC DIAGRAM

0' 8' 16' 32' 64' 128' 256'

John Trautmann Architects

2904B Colorado Avenue
Santa Monica, CA 90404
Tel 310 453 1620
Fax 310 828 9131

LICENSED ARCHITECT JOHN TRAUTMANN C-21914 31 AUG 05 RENEWAL DATE STATE OF CALIFORNIA

CIVIL ENGINEER
eda
1198 Santa Barbara Street
San Luis Obispo, CA 93401
Tel 805 237 1035
Fax 805 549 8704

STRUCTURAL ENGINEER
APSG ENGINEERS INC.
285 N Hill Avenue
Pasadena, CA 91106
Tel 626 229 9100
Fax 626 229 9104

MECHANICAL ENGINEER
SOUTH COAST ENGINEERING GROUP, INC.
23901 Calabasas Road
Suite 1068
Calabasas, CA 91302
Tel 818 224 2700
Fax 818 224 2711

ELECTRICAL ENGINEER
LLANES ENGINEERING, INC.
4022 Fountain Avenue
Suite 201
Los Angeles, CA 90029
Tel 323 661 7745
Fax 323 661 0504

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Reviewed by: _____
Code Enforcement South

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.

DSA - CSU
MOU - _____

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICE

APPL. #:

ACCESS COMPLIANCE SECTION

DATE: _____

(CONSULTANT'S SIGNATURE)
PC ASSOCIATES

RECORD DRAWINGS
WARNING

THESE RECORD DRAWINGS HAVE BEEN PREPARED BASED ON INFORMATION PROVIDED BY OTHERS. THE CONSULTANT HAS NOT VERIFIED THE ACCURACY AND/OR COMPLETENESS OF THIS INFORMATION AND SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS THAT ME BE INCORPORATED AS A RESULT OF ERRONEOUS INFORMATION PROVIDED BY OTHERS.

JTA JOB NO: 0309 FOUNDATION PROJECT NO: PR 04-600

CAL POLY

BONDERSON ENGINEERING PROJECTS CENTER
ENGINEERING / ARCHITECTURE RENOVATION & REPLACEMENT
PHASE II-A

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA 93407

DWG TITLE

SECOND LEVEL
FIRE SPRINKLER PLAN

SCALE: 1/8" = 1'-0" DRAWN BY: MCL

DWG NO.

F02.00

DATE: 08 NOV '04

Appendix C

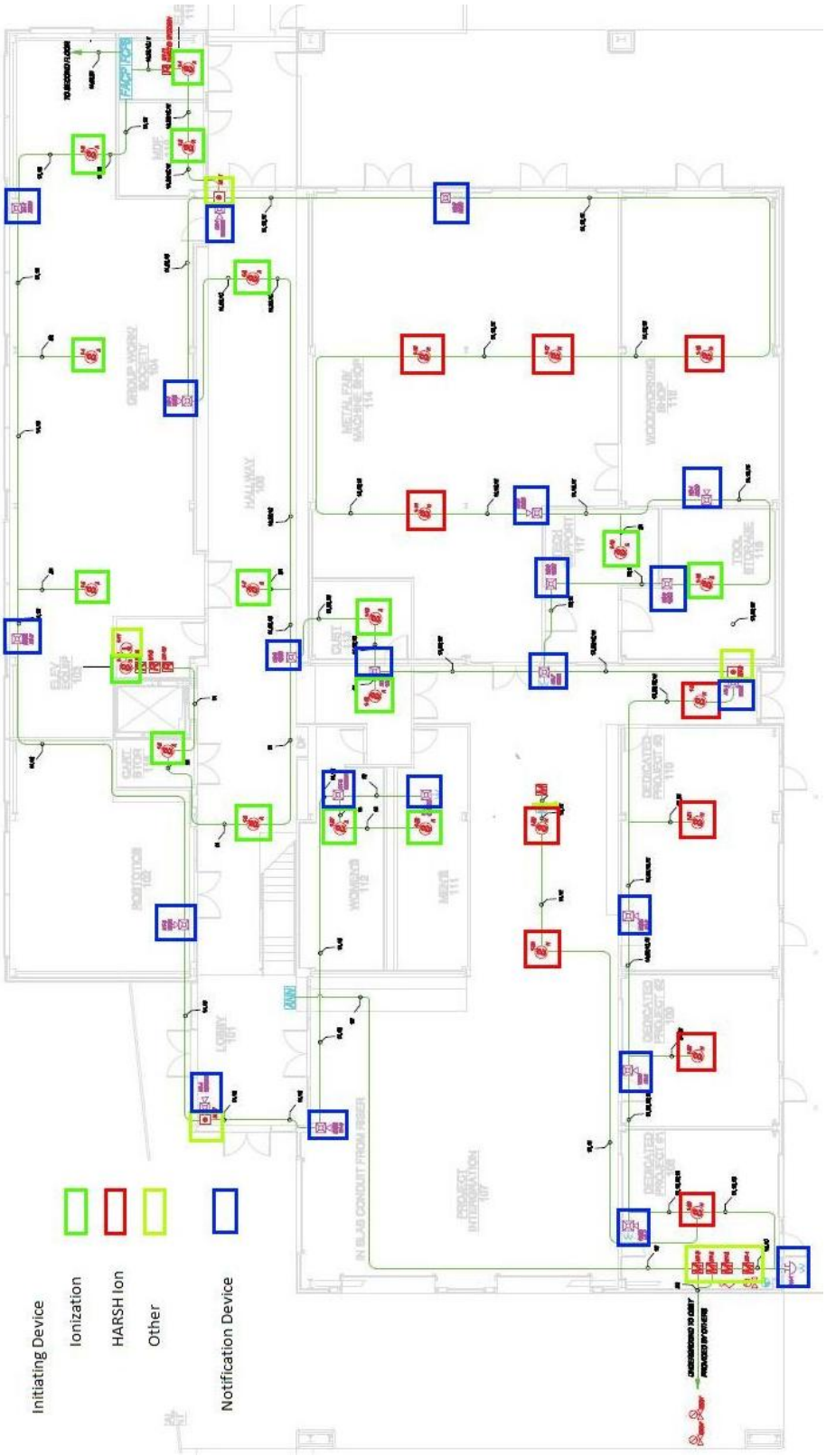
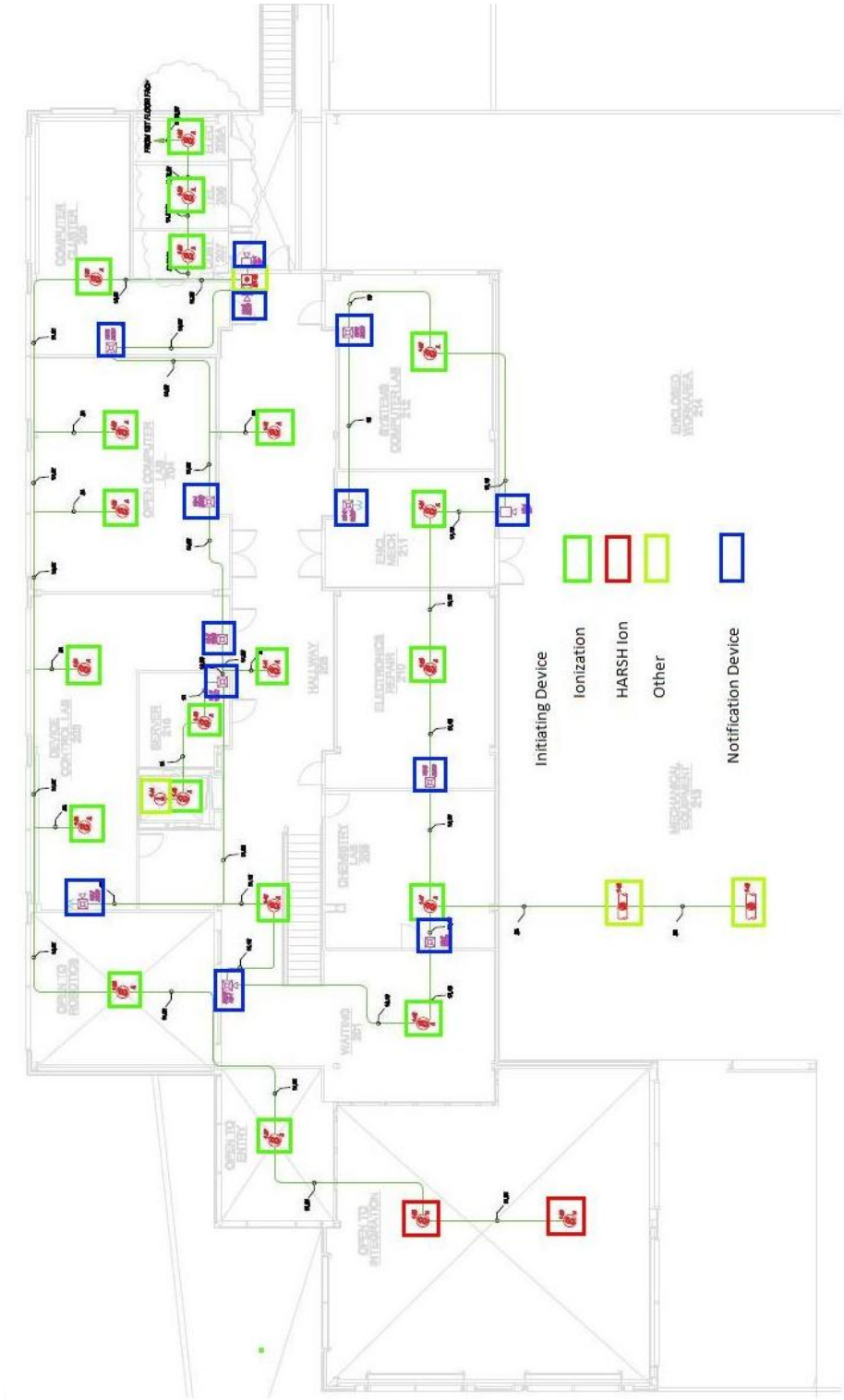


Figure C1: First Floor Detection and Notification Devices

Appendix C



Second Floor Notification and Detection

Description	STBY (amps)	Qty	Tot STBY (amps)		Alarm Amps	Qty	Total Alarm (amps)		
Power Suppy	0.285	1	0.285		0.090	1	0.090		
Smoke Det	0.0003	36	0.011		0.0065	36	0.234		
HARSH Det	0.027	12	0.324		0.033	12	0.396		
Duct Det	0.0003	2	0.001		0.0065	2	0.013		
Heat Det	0.0003	2	0.001		0.0065	2	0.013		
Pull Station	0.00038	4	0.002		0.005	4	0.020		
Module	0.00038	5	0.002		0.005	5	0.025		
Relay	0.00038	4	0.002		0.007	4	0.026		
Horn/Strobe (75 CD)	0.000	6	0.000		0.161	6	0.966		
Horn/Strobe (15/75	0.000	2	0.000		0.077	2	0.154		
Strobe (75 CD)	0.000	4	0.000		0.153	4	0.612		
Strobe (30 CD)	0.000	2	0.000		0.096	2	0.192		
Strobe (15 CD)	0.000	5	0.000		0.071	5	0.355		
Bell	0.000	1	0.000		0.03	1	0.030		
Total			0.626				3.126		
Required STBY Time	Total STBY Current (amps)		Required Standby Capacity (amp-hours)		Required Alarm Time		Total Alarm Current (amps)	Required Alarm Capacity (amp-hours)	
24	0.626	=	15		0.08	*	3.13	0.25	
Required Stby Capacity		Required Alarm Cap (amp-hours)		Total Cap (amp-hours)		Total Capacity (amp-hours)		F.O.S.	
15	+	0.25	=	15.25		15.25	+	0.2	
			Adjusted Batter Cap	18.3					

Figure C3: Back Up Battery Calculations - FACP

Description	STBY (amps)	Qty	Tot STBY (amps)		Alarm Amps	Qty	Total Alarm (amps)	
Power Suppy	0.090	1	0.090		0.090	1	0.090	
Horn/Strobe (75 CD)	0.000	2	0.000		0.161	2	0.322	
Horn/Strobe (30 CD)	0.000	1	0.000		0.105	1	0.105	
Strobe (15 CD)	0.000	3	0.000		0.071	3	0.213	
Strobe (30 CD)	0.000	5	0.000		0.096	5	0.480	
Total			0.090				1.210	
Required STBY Time	Total STBY Current (amps)		Required Standby Capacity (amp-hours)		Required Alarm Time		Total Alarm Current (amps)	Required Alarm Capacity (amp-hours)
24	0.09	=	2.16		0.08	•	1.3	0.1
Required Stby Capacity		Required Alarm Cap (amp-hours)		Total Cap (amp-hours)		Total Capacity (amp-hours)		F.O.S.
2.16	+	0.1	=	2.26		2.26	+	0.2
				Adjusted Batter Cap				
				2.71				

Figure C4: Back Up Battery Calculations – FCPS

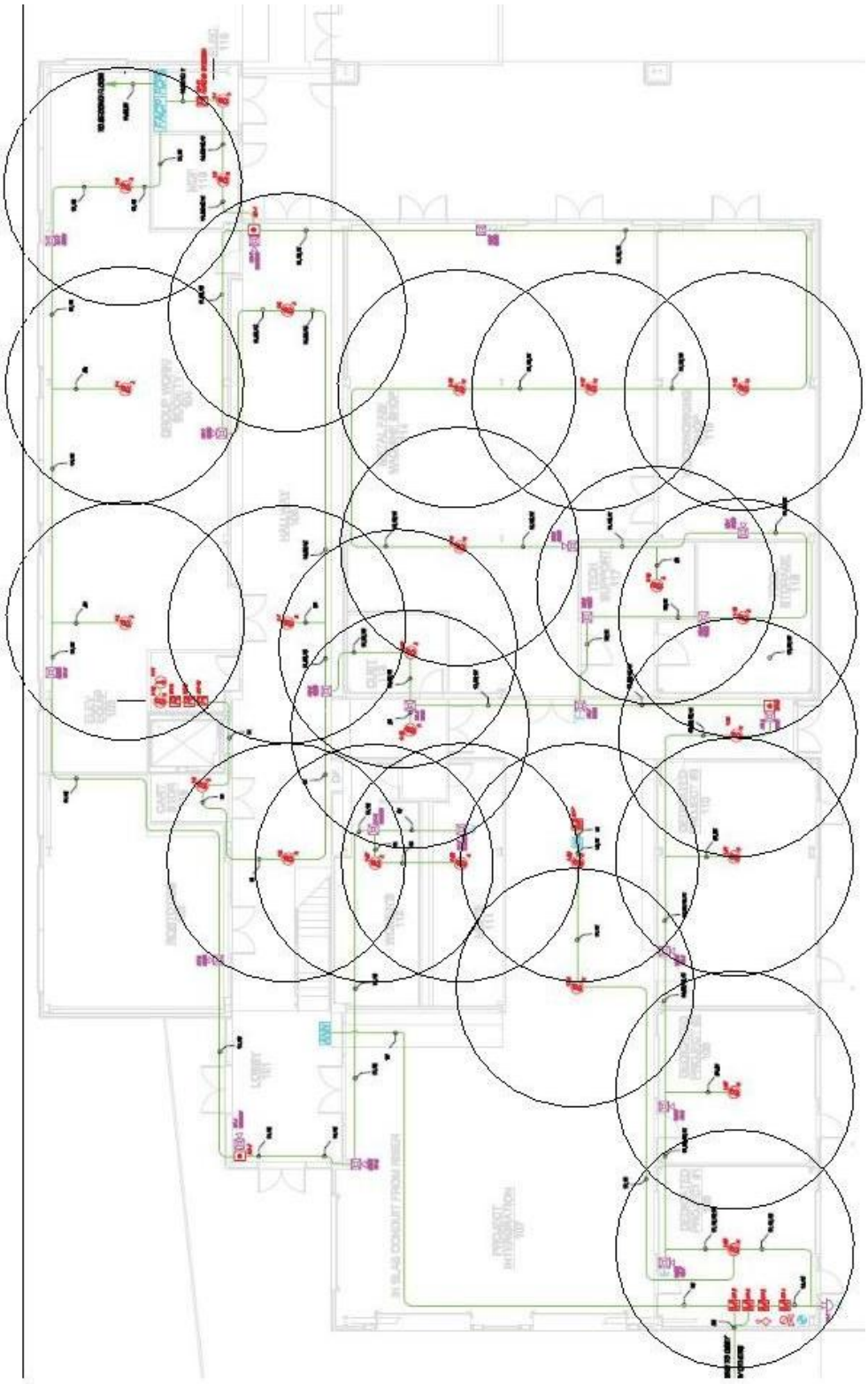


Figure C5: Smoke Detector Spacing – First Floor

Appendix C

Figure C6: Visual Notification Spacing – 1st Floor

Figure C7: Visual Notification Spacing – 2nd Floor

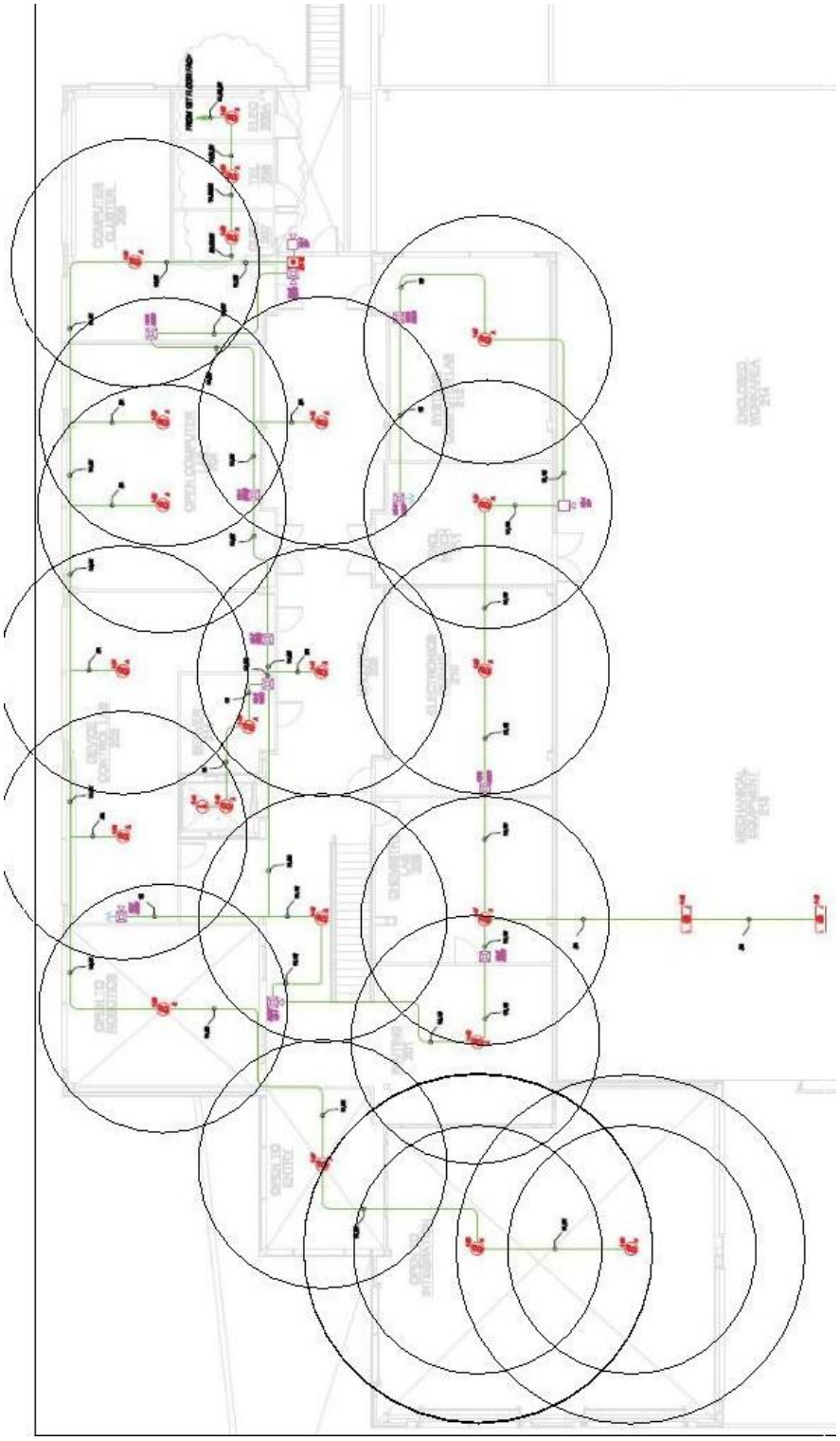


Figure C8: Smoke Detector Spacing – 2nd Floor

A.H.J. APPROVAL

03/06/2020

ELEV. EQUIP 103

ROBOTICS 102

CART STOR 118

GROUP WORK/ SOCIETY 104

MDF 119

ELEC 115

LOBBY 101

HALLWAY 106

DF

ANN

CUST 113

WOMEN'S 112

MEN'S 111

METAL FAB/ MACHINE SHOP 114

TRANSFORMER

PROJECT INTERGRATION 107

TECH SUPPORT 117

DEDICATED PROJECT #1 108

DEDICATED PROJECT #2 109

DEDICATED PROJECT #3 110

WOODWORKING SHOP 115

TOOL STORAGE 116

COVERED WORK AREA

OUTDOOR WORK AREA

IN SLAB CONDUIT FROM RISER

TO SECOND FLOOR

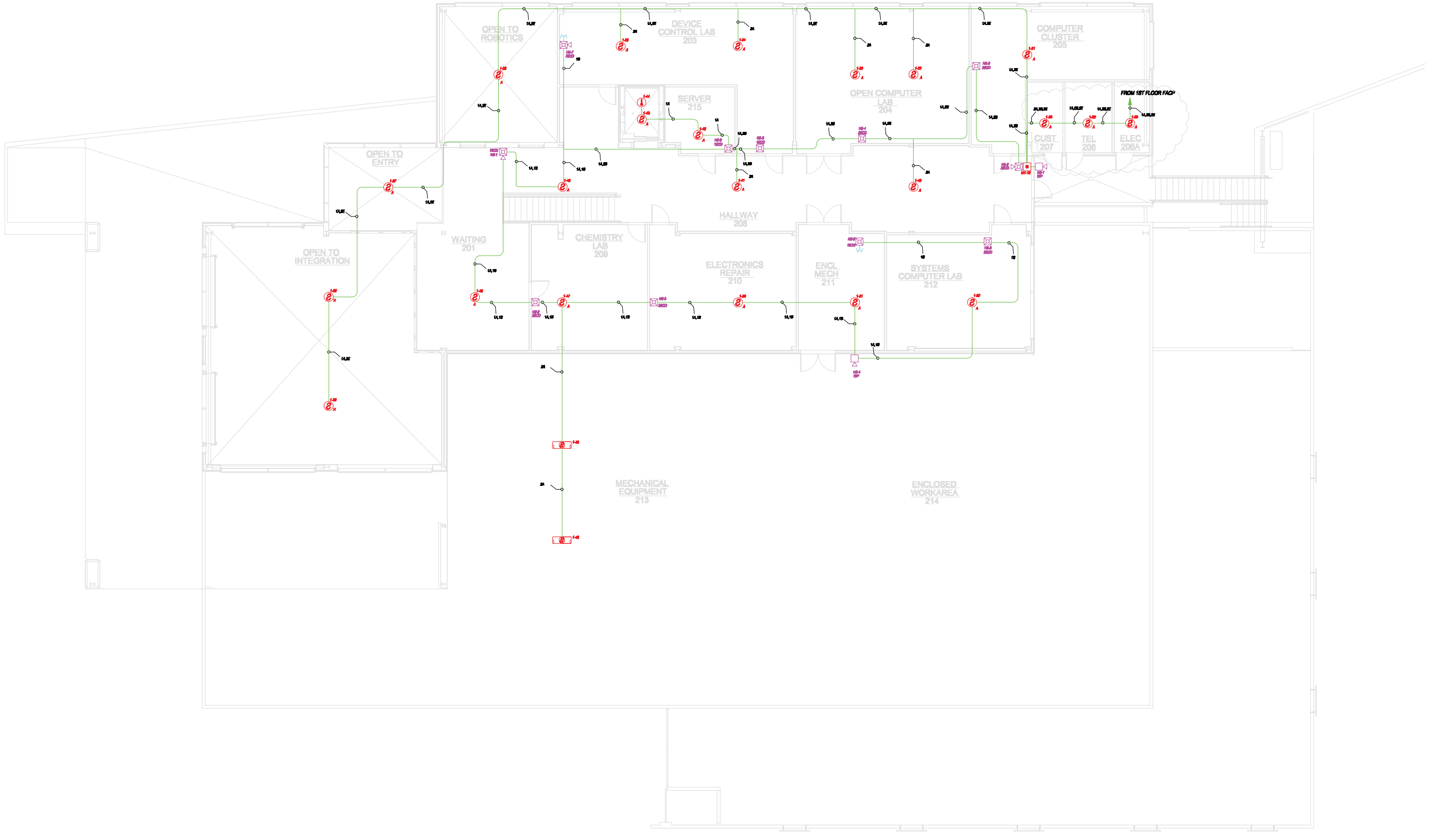
FACP | FCPS

UNDERGROUND TO OBEY PROVIDED BY OTHERS

FIRE ALARM FLOOR PLAN FIRST FLOOR

1/8" = 1'

FA-2

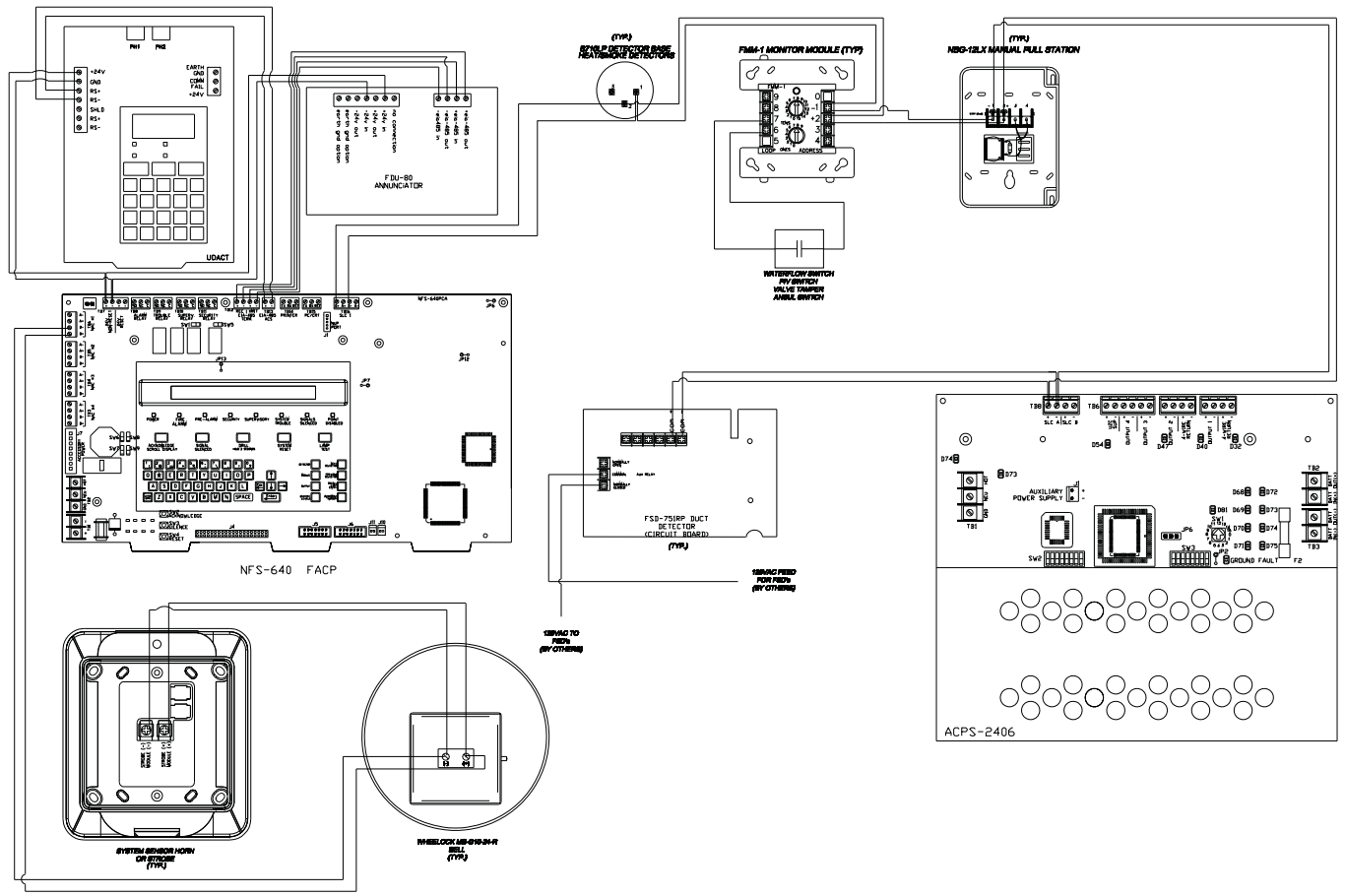


03/06/2006 A.H.J. APPROVAL

FIRE ALARM FLOOR PLAN SECOND FLOOR

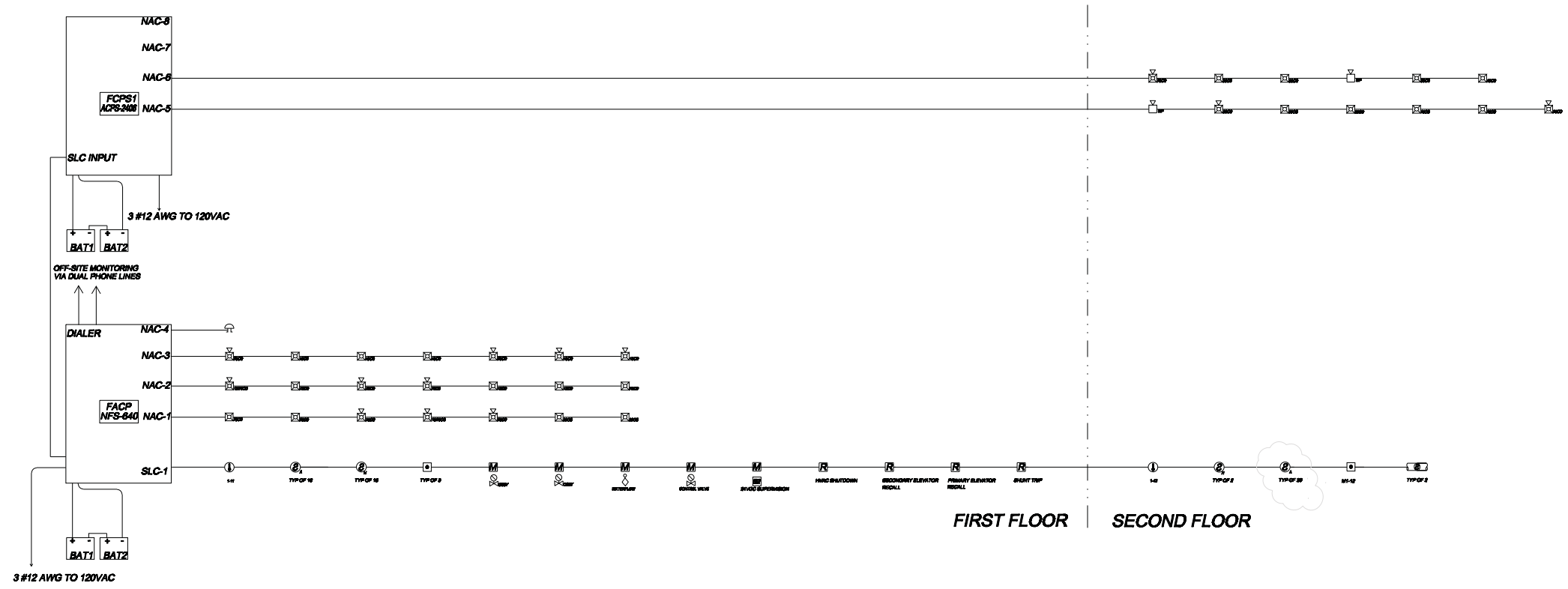
1/8" = 1'

FA-3



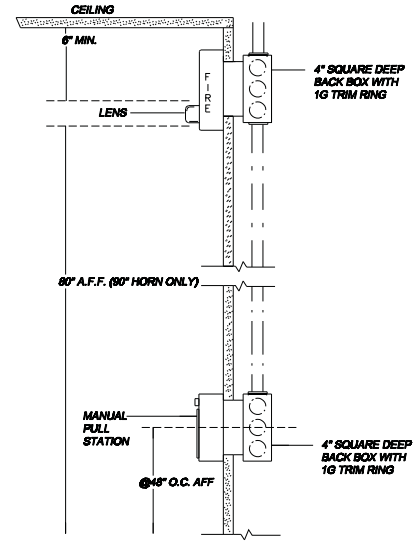
POINT TO POINT

NO SCALE



MOUNTING DETAIL

NO SCALE



MOUNTING NOTES

1. *All Hornstrobes and Strobes shall be mounted at 80" (90" Horn only) from the finished floor to the bottom of the lens, or 6" from the ceiling to the top of the lens, whichever is lower.*

2. *All Manual Pull Stations shall be mounted at 48" on center.*

A.H.J. APPROVAL

03/09/2020

RISER DIAGRAM

NO SCALE

NBG-12LX

Addressable Manual Pull Station

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

The Notifier NBG-12LX is a state-of-the-art, dual-action (i.e., requires two motions to activate the station) pull station that includes an addressable interface for any Notifier intelligent control panel except FireWarden series panels, and the NSP-25 panel. Because the NBG-12LX is addressable, the control panel can display the exact location of the activated manual station. This leads fire personnel quickly to the location of the alarm.

Features

- Maintenance personnel can open station for inspection and address setting without causing an alarm condition.
- Built-in bicolor LED, which is visible through the handle of the station, flashes in normal operation and latches steady red when in alarm.
- Handle latches in down position and the word “ACTIVATED” appears to clearly indicate the station has been operated.
- Captive screw terminals wire-ready for easy connection to SLC loop (accepts up to 12 AWG/3.25 mm² wire).
- Can be surface mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Smooth dual-action design.
- Meets ADAAG controls and operating mechanisms guidelines (Section 4.1.3[13]); meets ADA requirement for 5 lb. maximum activation force.
- Highly visible.
- Attractive shape and textured finish.
- Key reset.
- Includes Braille text on station handle.
- Optional trim ring (BG12TR).
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.
- Up to 99 NBG-12LX stations per loop on CLIP protocol loops.
- Up to 159 NBG-12LX stations per loop on FlashScan® protocol loops.
- Dual-color LED blinks green to indicate normal on FlashScan® systems.

Construction

Shell, door, and handle are molded of durable polycarbonate material with a textured finish.

Specifications

- **Shipping Weight:** 9.6 oz. (272.15 g)
- **Normal operating voltage:** 24 VDC.
- **Maximum SLC loop voltage:** 28.0 VDC.
- **Maximum SLC standby current:** 375 µA.
- **Maximum SLC alarm current:** 5 mA.
- **Temperature Range:** 32°F to 120°F (0°C to 49°C)
- **Relative Humidity:** 10% to 93% (noncondensing)
- **For use indoors in a dry location**

The NBG-12LX
Addressable Manual Pull Station

Installation

The NBG-12LX will mount semi-flush into a single-gang, double-gang, or standard 4" (10.16 cm) square electrical outlet box, or will surface mount to the model SB-10 or SB-I/O surface backbox. If the NBG-12LX is being semi-flush mounted, then the optional trim ring (BG12TR) may be used. The BG12TR is usually needed for semi-flush mounting with 4" (10.16 cm) or double-gang boxes (not with single-gang boxes).

Operation

Pushing in, then pulling down on the handle causes it to latch in the down/activated position. Once latched, the word “ACTIVATED” (in bright yellow) appears at the top of the handle, while a portion of the handle protrudes from the bottom of the station. To reset the station, simply unlock the station with the key and pull the door open. This action resets the handle; closing the door automatically resets the switch.

Each manual station, on command from the control panel, sends data to the panel representing the state of the manual switch. Two rotary decimal switches allow address settings (1 – 159 on FlashScan® systems, 1 – 99 on CLIP systems).

Architectural/Engineering Specifications

Manual Fire Alarm Stations shall be non-coded, with a key-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red-colored polycarbonate material with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger. Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang, or

4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

Manual stations shall connect with two wires to one of the control panel SLC loops. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch. Manual stations shall provide address setting by use of rotary decimal switches.

The loop poll LED shall be clearly visible through the front of the station. The LED shall flash while in the normal condition, and stay steadily illuminated when in alarm.

Product Line Information

NBG-12LX: Dual-action addressable pull station. Includes key locking feature. (Listed for Canadian and non-Canadian applications.)

NBG-12LXSP: Spanish/English labelled version.

NBG-12LXP: Portuguese labelled version.

SB-10: Surface backbox; metal.

SB-I/O: Surface backbox; plastic.

BG12TR: Optional trim ring.

17021: Keys, set of two.

NY-Plate: New York City trim plate.

Agency Listings and Approvals

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/ULC Listed:** S692 (listed for Canadian and non-Canadian applications).
- **MEA:** 67-02-E.
- **CSFM:** 7150-0028:0199.
- **FDNY:** COA #6085 (NFS2-640), COA #6098 (NFS2-3030).
- **BSMI:** CI313066760047.
- **U.S. Coast Guard.**
- **Lloyd's Register.**
- **FM Approved.**

Patented: U.S. Patent No. D428,351; 6,380,846; 6,314,772; 6,632,108.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

SpectrAlert® Advance

Selectable Output Notification Appliances

NOTIFIER® by Honeywell

Audio/Visual Devices

General

System Sensor® SpectrAlert® Advance selectable-output horns, strobes and horn/strobes are rich with features guaranteed to cut installation times and maximize profits. The SpectrAlert Advance series of notification appliances is designed to simplify your installations, with features such as: plug-in designs, instant feedback messages to ensure correct installation of individual devices, and eleven field-selectable candela settings for wall and ceiling strobes and horn/strobes.

More specifically, when installing Advance products, first attach a universal mounting plate to a four-inch square, four-inch octagon, or double-gang junction box. The two-wire mounting plate attaches to a single-gang junction box.

Then, connect the notification appliance circuit wiring to the SEMS terminals on the mounting plate.

Finally, attach the horn, strobe, or horn/strobe to the mounting plate by inserting the product's tabs in the mounting plate's grooves. The device will rotate into position, locking the product's pins into the mounting plate's terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

SpectrAlert Advance products allow you to choose:

- 12 or 24 volts.
- 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela by way of a rear-mounted slide switch and front viewing window.
- Horn tones and volume by way of a rotary switch.
- The SpectrAlert Advance series includes outdoor notification appliances. Outdoor strobes and horn/strobes (two-wire and four-wire) are available for wall or ceiling. Outdoor horns are available for wall only. All System Sensor outdoor products are rated between –40°F and 151°F (–40°C and 66°C) in wet or dry applications.

Models available:

- Indoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Indoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.

Features

- Plug-in design.
- Same mounting plate for wall- and ceiling-mount units.
- Shorting spring on mounting plate for continuity check before installation.
- Captive mounting screw.
- Tamper-resistance capability.
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela.
- Outdoor wall and ceiling products.

7087pho1.jpg

Indoor Ceiling Horn/Strobe

7087pho4.jpg

Outdoor Ceiling Strobe

7087pho3.jpg

Indoor Wall Horn/Strobe

7087pho2.jpg

Indoor Ceiling Strobe


7087pho5.jpg

Indoor Wall Horn

7087pho6.jpg

Outdoor Wall Strobe

- Outdoor products rated from –40°F and 151°F (–40°C and 66°C).
- Outdoor products rainproof per UL50 (NEMA 3R) and weatherproof per NEMA 4X, IP56
- Minimal intrusion into the backbox.
- Horn rated at 88+ dbA at 16 volts.
- Rotary switch for tone selection.
- Three horn volume settings.
- Electrically compatible with existing SpectrAlert products.

Engineering Specifications

SpectrAlert Advance horns, strobes, and horn/strobes shall mount to a standard 4.0" x 4.0" x 1.5" (10.16 x 10.16 x 3.81 cm) backbox, 4.0" (10.16 cm) octagonal backbox, or a double-gang backbox. Two-wire products shall also mount to a single-gang 2.0" x 4.0" x 1.875" (5.08 x 10.16 x 4.763 cm) backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32°F and 120°F (0°C and 49°C) from a regulated DC, or full-wave-rectified, unfiltered power supply. Strobes and horn/strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

STROBE

The strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

HORN/STROBE COMBINATION

The horn/strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and UL 464 and shall be approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a Temporal 3 pattern and a Non-Temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

OUTDOOR PRODUCTS

SpectrAlert Advance outdoor horns, strobes and horn/strobes shall be listed for outdoor use by UL and shall operate between –40°F and 151°F (–40°C and 66°C). The products shall be listed for use with a System Sensor outdoor/weatherproof backbox with half-inch and three-fourths-inch conduit entries.

SYNCHRONIZATION MODULE

The module shall be a System Sensor Sync•Circuit MDL3R or MDL3W listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at Temporal 3. Also, while operating the strobes, the module shall silence the horns on horn/strobe models over a single pair of wires. The module shall mount to a 4.688" x 4.688" x 2.125" (11.906 x 11.906 x 5.398 cm) backbox. The module shall also control two Style Y (class B) circuits or one Style Z (Class A) circuit. The module shall synchronize multiple zones. Daisy-chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

Operating Specifications

- **Standard operating temperature:** 32°F to 120°F (0°C to 49°C).
- **K Series operating temperature:** –40°F to 151°F (–40°C to 66°C).
- **Humidity range:** 10% to 93% non-condensing (indoor products).
- **Strobe flash rate:** 1 flash per second.
- **Nominal voltage:** regulated 12 VDC/FWR or regulated 24 VDC/FWR. ***NOTE:*** *Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.*
- **Operating voltage range:** 8 V to 17.5 V (12 V nominal); or 16 V to 33 V (24 V nominal). ***NOTE:*** *P, S, PC, and SC products will operate at 12 V nominal only for 15 cd and 15/75 cd.*
- **Input terminal wire gauge:** 12 to 18 AWG (3.31 to 0.821 mm^2).
- **Ceiling-mount dimensions (including lens):** 6.8" diameter x 2.5" deep (17.3 cm diameter x 6.4 cm deep).
- **Wall-mount dimensions (including lens):** 5.6" H x 4.7" W x 2.5" D (14.2 cm H x 11.9 cm W x 6.4 cm D).
- **Horn dimensions:** 5.6" H x 4.7" W x 1.3" D (14.2 cm H x 11.9 cm W x 3.3 cm D).

Agency Listings and Approvals

The listings and approvals below apply to SpectrAlert Advance Selectable Output Notification Devices. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed: S4011** (HR__, HW__, P2__, P4__, PC2__, PC4__ models); **S5512** (models SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); **S3593** (SCRHK, SCRK, SRHK, SRK).
- **ULC Listed: S4011** (HRA, HRKA); **S5512** (typically "A" models, with exception of outdoor strobes). *See Canadian data sheet for listings and specifications.*
- **FM approved**
- **MEA**: **452-05-E**
- **CSFM: 7125-1653:0186** (SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); **7300-1653:0188** (P2_, P4_, PC2_, PC4_ modules); **7135-1653:0189** (HR, HRK, HW); **7300-1653:0187** (SCRHK, SCRK, SRHK, SRK).

Strobe Current Draw, UL Maximum (mA RMS)

Candela		8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Standard Candela Range	15	123	128	66	71
	15/75	142	148	77	81
	30	NA	N/A	94	96
	75	NA	NA	158	153
	95	NA	NA	181	176
	110	NA	NA	202	195
	115	NA	NA	210	205
High Candela Range	135	NA	NA	228	207
	150	NA	NA	246	220
	177	NA	NA	281	251
	185	NA	NA	286	258

Horn Current Draw, UL Maximum (mA RMS)

Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Temporal	High	57	55	69	75
Temporal	Medium	44	49	58	69
Temporal	Low	38	44	44	48
Non-temporal	High	57	56	69	75
Non-temporal	Medium	42	50	60	69
Non-temporal	Low	41	44	50	50
Coded	High	57	55	69	75
Coded	Medium	44	51	56	69
Coded	Low	40	46	52	50

Horn and Horn/Strobe Rotary Switch Setting

Setting	Repetition Rate	dB Level
1	Temporal horn	High
2	Temporal horn	Medium
3	Temporal horn	Low
4	Normal horn	High
5	Normal horn	Medium
6	Normal horn	Low
7*	Externally coded	High
8*	Externally coded	Medium
9*	Externally coded	Low

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

Horn and Horn/Strobe Output (dBA)

Switch Position	Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
			DC	FWR	DC	FWR
1	Temporal	High	78	78	84	84
2	Temporal	Medium	74	74	80	80
3	Temporal	Low	71	73	76	76
4	Non-temporal	High	82	82	88	88
5	Non-temporal	Medium	78	78	85	85
6	Non-temporal	Low	75	75	81	81
7*	Coded	High	82	82	88	88
8*	Coded	Medium	78	78	85	85
9*	Coded	Low	75	75	81	81

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

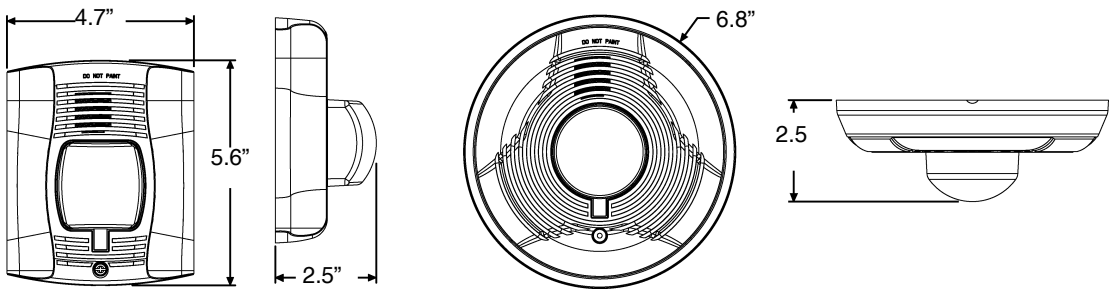
Two-Wire Horn/Strobe, *STANDARD* Candela Range (15 – 115 cd), UL Maximum Current Draw (mA RMS)

Input, Sound Pattern, dB Level	8 – 17.5 V		16 – 33 V						
	15	15/75	15	15/75	30	75	95	110	115
DC Input, Temporal, High	137	147	79	90	107	176	194	212	218
DC Input, Temporal, Medium	132	144	69	80	97	157	182	201	210
DC Input, Temporal, Low	132	143	66	77	93	154	179	198	207
DC Input, Non-temporal, High	141	152	91	100	116	176	201	221	229
DC Input, Non-temporal, Medium	133	145	75	85	102	163	187	207	216
DC Input, Non-temporal, Low	131	144	68	79	96	156	182	201	210
FWR Input, Temporal, High	136	155	88	97	112	168	190	210	218
FWR Input, Temporal, Medium	129	152	78	88	103	160	184	202	206
FWR Input, Temporal, Low	129	151	76	86	101	160	184	194	201
FWR Input, Non-temporal, High	142	161	103	112	126	181	203	221	229
FWR Input, Non-temporal, Medium	134	155	85	95	110	166	189	208	216
FWR Input, Non-temporal, Low	132	154	80	90	105	161	184	202	211

Two-Wire Horn/Strobe, *HIGH* Candela Range (135 – 185 cd), UL Maximum Current Draw (mA RMS)

DC Input	16 – 33 V				FWR Input	16 – 33 V			
	135	150	177	185		135	150	177	185
DC, Temporal, High	245	259	290	297	FWR, Temporal, High	215	231	258	265
DC, Temporal, Medium	235	253	288	297	FWR, Temporal, Medium	209	224	250	258
DC, Temporal, Low	232	251	282	292	FWR, Temporal, Low	207	221	248	256
DC, Non-temporal, High	255	270	303	309	FWR, Non-temporal, High	233	248	275	281
DC, Non-temporal, Medium	242	259	293	299	FWR, Non-temporal, Medium	219	232	262	267
DC, Non-temporal, Low	238	254	291	295	FWR, Non-temporal, Low	214	229	256	262

7087dim12009.tif



Ordering Information

Model	Description	Model	Description
WALL HORN/STROBES		***CEILING HORN/STROBES***	
P2R	2-wire horn/strobe, standard cd, red.	**PC2R**	2-wire horn/strobe, standard cd, red.
P2RH	2-wire horn/strobe, high cd, red.	**PC2RH**	2-wire horn/strobe, high cd, red.
P2RK	2-wire horn/strobe, standard cd, red, outdoor.	**PC2RK**	2-wire horn/strobe, standard cd, red, outdoor.
P2RHK	2-wire horn/strobe, high cd, red, outdoor.	**PC2RHK**	2-wire horn/strobe, high cd, red, outdoor.
P2W	2-wire horn/strobe, standard cd, white.	**PC2W**	2-wire horn/strobe, standard cd, white.
P2WH	2-wire horn/strobe, high cd, white.	**PC2WH**	2-wire horn/strobe, high cd, white.
P4R	4-wire horn/strobe, standard cd, red.	**PC4R**	4-wire horn/strobe, standard cd, red.
P4RH	4-wire horn/strobe, high cd, red.	**PC4RH**	4-wire horn/strobe, high cd, red.
P4RK	4-wire horn/strobe, standard cd, red, outdoor.	**PC4RK**	4-wire horn/strobe, standard cd, red, outdoor.
P4RHK	4-wire horn/strobe, high cd, red, outdoor.	**PC4RHK**	4-wire horn/strobe, high cd, red, outdoor.
P4W	4-wire horn/strobe, standard cd, white.	**PC4W**	4-wire horn/strobe, standard cd, white.
P4WH	4-wire horn/strobe, high cd, white.	**PC4WH**	4-wire horn/strobe, high cd, white.
WALL STROBES		***CEILING STROBES***	
SR	Strobe, standard cd, red.	**SCR**	Strobe, standard cd, red.
SRH	Strobe, high cd, red.	**SCRH**	Strobe, high cd, red.
SRK	Strobe, standard cd, red, outdoor.	**SCRK**	Strobe, standard cd, red, outdoor.
SRHK	Strobe, high cd, red, outdoor.	**SCRHK**	Strobe, high cd, red, outdoor.
SW	Strobe, standard cd, white.	**SCW**	Strobe, standard cd, white.
SWH	Strobe, high cd, white.	**SCWH**	Strobe, high cd, white.
ACCESSORIES		***HORNS***	
BBS-2A	Backbox skirt, wall, red.	**HR**	Horn, red.
BBSW-2A	Backbox skirt, wall, white.	**HRK**	Horn, red, outdoor.
BBSC-2A	Backbox skirt, ceiling, red.	**HW**	Horn, white.
BBSCW-2A	Backbox skirt, ceiling, white.	***ACCESSORIES, continued***	
SA-WBB	Weatherproof backbox, wall.	**TR-HS**	Trim Ring, wall, red, package of 5
SA-WBBC	Weatherproof backbox, ceiling.	**TRW-HS**	Trim Ring, wall, white, package of 5
WTP	Weatherproof, flush mount plate, red	**TRC-HS**	Trim Ring, ceiling, red, package of 5
WTPW	Weatherproof, flush mount plate, white	**TRCW-HS**	Trim Ring, ceiling, white, package of 5

NOTE: *"High cd" refers to strobes that include 135, 150, 177, and 185 candela settings. "Standard cd" refers to strobes that include 15, 15/75, 30, 75, 95, 110, and 115 candela settings.*

NOTE: *For strobes and horn/strobes, add suffix "F" for French or "B" for Bilingual.*

NOTE: *All outdoor models ("K(A)" suffix) include a plastic weatherproof backbox.*

NOTE: *Add "-R" to models for weatherproof replacement device (no back box included). Only for use with weatherproof outdoor flush mounting plate, WTP and WTPW.*

NOTE: *Add "P" to model for plain housing. (No "FIRE" marking on cover.)*

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

FSH-751

HARSH™ Hostile-Area Smoke Head Addressable Detector with FlashScan©

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

Notifier's HARSH™ (Hostile-Area Smoke Head) FSH-751 smoke detector provides early warning smoke detection in hostile environments where traditional smoke detectors are not practical. Using a small air intake fan and a high-performance replaceable filter, air and smoke are drawn into a photoelectric sensing chamber, while unwanted airborne particulate and water mist are removed. This feature allows the FSH-751 to operate in difficult applications, such as textile or paper mills, which due to environmental conditions tend to cause nuisance alarms with standard smoke detectors.

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by Notifier Engineering that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within 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.

FSH-751

Features

- Analog intelligent communications.
- High-performance filter removes particulates down to 32 microns (32-micron inner filter and replaceable outer filter).
- Air delivery system is separately powered and fully supervised.
- Filter is easily field replaceable.
- Tolerant of external air velocity.
- Resistant to water vapor in applications where occasional non-direct water spray is performed.
- Optional remote LED annunciator.
- Rotary DECADE address switches. Set 01 – 99 on legacy systems and 01 – 159 on FlashScan® systems (NFS-640, or NFS-3030).
- Dual bi-color (red/green) LEDs flash green when Normal and are steady red in Alarm (systems with FlashScan® only).
- Compatible with the NFS-3030, AM2020, AFP1010, NFS-640, AFP-400, AFP-300, AFP-200, and AFP-100 (all software releases).
- Requires auxiliary 24 VDC from system or remote power supply.

Specifications

Size: 2.875" (7.303 cm) high, 3.375" (8.573 cm) high in base; diameter 4.0" (10.16 cm), 6.125" (15.558 cm) diameter in base.

Weight: 7.3 oz. (207 g).

Current draw, SLC: Detector; 300 µA @ 24 VDC (one communication every 5 seconds with LED enabled).

Current draw, auxiliary 24 VDC: (15 to 30 VDC filtered; ripple voltage may not drop below 15 volts): 123 mA maximum, 27 mA average. For battery calculation purposes, average standby current is 27 mA.

Operating voltage range: 15 – 32 volts DC peak.

Operating temperature range: 0°C to 49°C (32°F to 120°F).

Relative humidity: 10% – 93%, non-condensing.

Air velocity: 4,000 ft/1219.2 meters per minute maximum.

Maximum altitude: 4,000 feet (1219.2 meters).

Detector spacing: Space detectors in compliance with NFPA 72. In low-air-flow applications with smooth ceilings, space detectors 30 feet (9.114 m) apart. For specific information regarding sensor spacing, placement, and special applications, refer to NFPA 72 or the Guide to Proper Use of System Smoke Detectors, available from systemsensor.com.

Agency Listings and Approvals

Listing information not available. Consult panel manuals for lists of compatible UL-Listed devices. 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.

HARSH Operation Overview

Normal Operation

A miniature fan is pulsed on and off under microprocessor control to conserve power, yet provide good smoke response. The system uses two filters (one replaceable) that remove particulates while allowing smoke to pass.

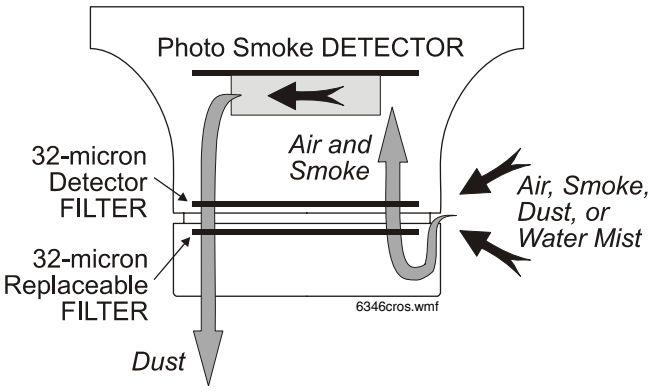
Filter Supervision

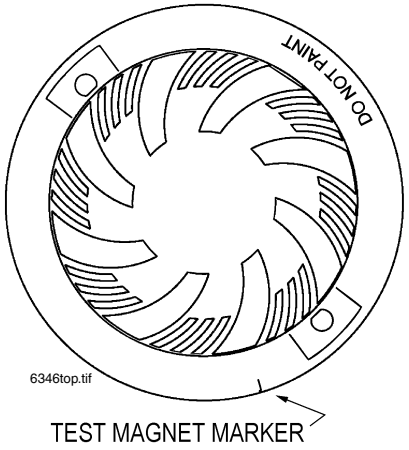
Periodically, the filter system is tested for blockage using a special thermal airflow sensor. In reasonably clean environments, the filter is expected to last at least as long as the smoke-entry test period required by NFPA 72. In very dirty environments, the filter may need replacement more frequently.

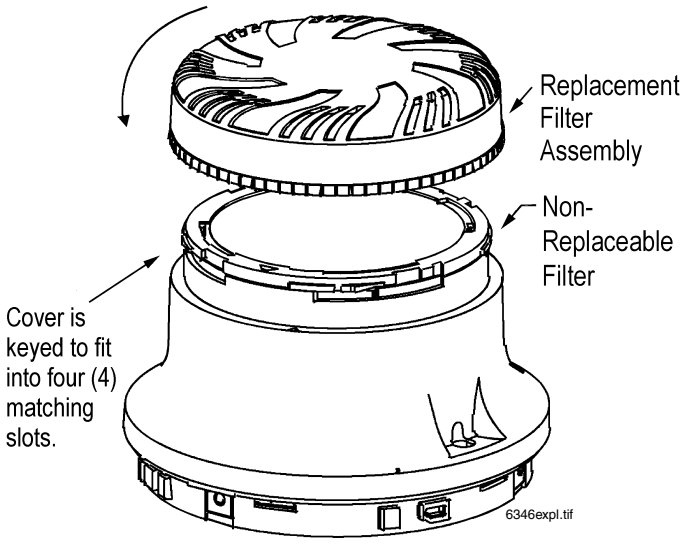
Filter Trouble Reporting

If HARSH determines that filter blockage is imminent, a warning trouble is indicated to the panel, followed by a return to normal. 72 hours after this warning, the detector will disconnect, giving a continuous trouble signal.

OPERATION OVERVIEW DIAGRAM:

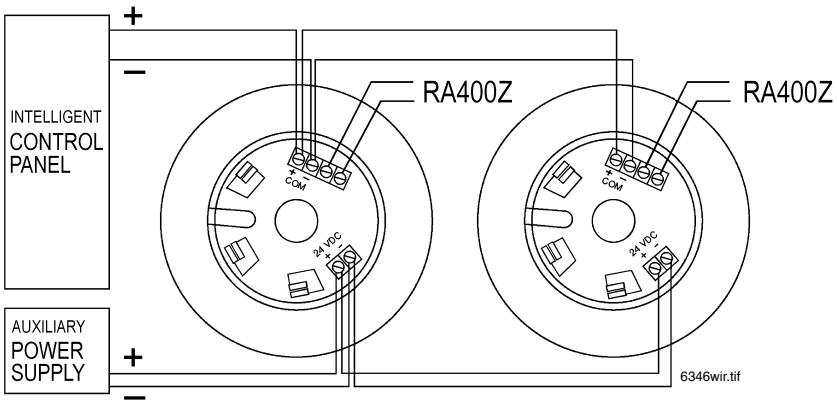






The HARSH detector contains both a permanent and a replaceable filter, a supervised fan, and a photoelectric detector; to fit into a flanged adapter base.

Wiring Diagram



Product Line Information

FSH-751: Hostile-environment smoke detector head.

FSH-751A: Canadian model.

B710HD: Flanged adapter base, 6.125" (15.558 cm) diameter.

RF-FTX: Replacement outer filter cover assembly, box of 6.

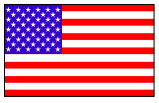
RA400Z: Remote LED annunciator, 3 – 32 VDC, fits U.S. single-gang electrical box.

M02-04-01: Test magnet.

M02-09-00: Test magnet with telescope stick.

ISO 9001 CERTIFIED
ENGINEERING & MANUFACTURING
QUALITY SYSTEMS

This document is not intended to be used for installation purposes.
We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

FSI-851(A)

Intelligent Plug-In Ionization Smoke Detector with FlashScan®

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

The FSI-851(A) intelligent plug-in ion detectors with integral communication has 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 locations for selective maintenance when chamber contamination reaches an unacceptable level.

The FSI-851(A) ionization detector incorporates a unique single-source, dual-chamber design to respond quickly and dependably to a broad range of fires. FSI-851(A) detectors are compatible with ONYX series and CLIP series intelligent Fire Alarm Control Panels (FACPs).

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by NOTIFIER that greatly improves the speed of communication between analog intelligent devices and certain NOTIFIER systems. Intelligent devices communicate in a grouped fashion. If one of the devices within 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 other protocols.

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 systems
- Rotary, decimal addressing (1-99 on CLIP systems, 1-159 on FlashScan systems).
- Optional remote, single-gang LED accessory, RA100Z(A).
- Dual LED design provides 360° viewing angle.
- Visible bicolor LEDs blink green every time the detector is addressed, and illuminate steady red on alarm.
- Remote test feature from the panel.
- Walk test with address display (an address of 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 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, or sounder bases.
- Listed to UL 268.

B210-1951.jpg

FSI-851(A) in B210LP(A) Base

Specifications

Sensitivity: 0.5% to 2.5% per foot obscuration

Size: 2.0" (51 mm) 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.

Shipping Weight: 5.4 oz. (153 g).

Operating Temperature: 0°C to 49°C (32°F to 120°F).

UL/ULC-Listed Velocity Range: ION: 0 – 1200 ft./min. (365.76 m/min.).

Relative Humidity: 10% – 93% noncondensing.

ELECTRICAL SPECIFICATIONS

Voltage Range: 15 - 32 volts DC peak.

Standby Current (max. avg.): 300 µA

LED Current (max.): 6.5 mA @ 24 VDC ("ON").

Installation

FSI-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 the 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 (FSI-851A).
- **CSFM:** 7271-0028:201.
- **MEA:** 321-02-E.
- **Maryland State Fire Marshal:** Permit #2140.
- **BSMI:** CI313066760014.
- **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)).
- **FM Approved.**

Product Line Information

NOTE: *"A" suffix indicates ULC Listed model.*

FSI-851: Low-profile intelligent ionization sensor. Must be mounted to one of the bases listed below.

FSI-851A: Same as FSI-851 but with ULC Listing.

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 base.

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; package contains 10.

WCK-200B: White detector covers; package contains 10.

ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

This document is not intended to be used for installation purposes.
We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.

Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

SpectrAlert® Advance

Selectable Output Notification Appliances

NOTIFIER® by Honeywell

Audio/Visual Devices

General

System Sensor® SpectrAlert® Advance selectable-output horns, strobes and horn/strobes are rich with features guaranteed to cut installation times and maximize profits. The SpectrAlert Advance series of notification appliances is designed to simplify your installations, with features such as: plug-in designs, instant feedback messages to ensure correct installation of individual devices, and eleven field-selectable candela settings for wall and ceiling strobes and horn/strobes.

More specifically, when installing Advance products, first attach a universal mounting plate to a four-inch square, four-inch octagon, or double-gang junction box. The two-wire mounting plate attaches to a single-gang junction box.

Then, connect the notification appliance circuit wiring to the SEMS terminals on the mounting plate.

Finally, attach the horn, strobe, or horn/strobe to the mounting plate by inserting the product's tabs in the mounting plate's grooves. The device will rotate into position, locking the product's pins into the mounting plate's terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

SpectrAlert Advance products allow you to choose:

- 12 or 24 volts.
- 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela by way of a rear-mounted slide switch and front viewing window.
- Horn tones and volume by way of a rotary switch.
- The SpectrAlert Advance series includes outdoor notification appliances. Outdoor strobes and horn/strobes (two-wire and four-wire) are available for wall or ceiling. Outdoor horns are available for wall only. All System Sensor outdoor products are rated between –40°F and 151°F (–40°C and 66°C) in wet or dry applications.

Models available:

- Indoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Indoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.

Features

- Plug-in design.
- Same mounting plate for wall- and ceiling-mount units.
- Shorting spring on mounting plate for continuity check before installation.
- Captive mounting screw.
- Tamper-resistance capability.
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela.
- Outdoor wall and ceiling products.

7087pho1.jpg

Indoor Ceiling Horn/Strobe

7087pho4.jpg

Outdoor Ceiling Strobe

7087pho3.jpg

Indoor Wall Horn/Strobe

7087pho2.jpg

Indoor Ceiling Strobe


7087pho5.jpg

Indoor Wall Horn

7087pho6.jpg

Outdoor Wall Strobe

- Outdoor products rated from –40°F and 151°F (–40°C and 66°C).
- Outdoor products rainproof per UL50 (NEMA 3R) and weatherproof per NEMA 4X, IP56
- Minimal intrusion into the backbox.
- Horn rated at 88+ dbA at 16 volts.
- Rotary switch for tone selection.
- Three horn volume settings.
- Electrically compatible with existing SpectrAlert products.

Engineering Specifications

SpectrAlert Advance horns, strobes, and horn/strobes shall mount to a standard 4.0" x 4.0" x 1.5" (10.16 x 10.16 x 3.81 cm) backbox, 4.0" (10.16 cm) octagonal backbox, or a double-gang backbox. Two-wire products shall also mount to a single-gang 2.0" x 4.0" x 1.875" (5.08 x 10.16 x 4.763 cm) backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32°F and 120°F (0°C and 49°C) from a regulated DC, or full-wave-rectified, unfiltered power supply. Strobes and horn/strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

STROBE

The strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

HORN/STROBE COMBINATION

The horn/strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and UL 464 and shall be approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a Temporal 3 pattern and a Non-Temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

OUTDOOR PRODUCTS

SpectrAlert Advance outdoor horns, strobes and horn/strobes shall be listed for outdoor use by UL and shall operate between –40°F and 151°F (–40°C and 66°C). The products shall be listed for use with a System Sensor outdoor/weatherproof backbox with half-inch and three-fourths-inch conduit entries.

SYNCHRONIZATION MODULE

The module shall be a System Sensor Sync•Circuit MDL3R or MDL3W listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at Temporal 3. Also, while operating the strobes, the module shall silence the horns on horn/strobe models over a single pair of wires. The module shall mount to a 4.688" x 4.688" x 2.125" (11.906 x 11.906 x 5.398 cm) backbox. The module shall also control two Style Y (class B) circuits or one Style Z (Class A) circuit. The module shall synchronize multiple zones. Daisy-chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

Operating Specifications

- **Standard operating temperature:** 32°F to 120°F (0°C to 49°C).
- **K Series operating temperature:** –40°F to 151°F (–40°C to 66°C).
- **Humidity range:** 10% to 93% non-condensing (indoor products).
- **Strobe flash rate:** 1 flash per second.
- **Nominal voltage:** regulated 12 VDC/FWR or regulated 24 VDC/FWR. ***NOTE:*** *Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.*
- **Operating voltage range:** 8 V to 17.5 V (12 V nominal); or 16 V to 33 V (24 V nominal). ***NOTE:*** *P, S, PC, and SC products will operate at 12 V nominal only for 15 cd and 15/75 cd.*
- **Input terminal wire gauge:** 12 to 18 AWG (3.31 to 0.821 mm^2).
- **Ceiling-mount dimensions (including lens):** 6.8" diameter x 2.5" deep (17.3 cm diameter x 6.4 cm deep).
- **Wall-mount dimensions (including lens):** 5.6" H x 4.7" W x 2.5" D (14.2 cm H x 11.9 cm W x 6.4 cm D).
- **Horn dimensions:** 5.6" H x 4.7" W x 1.3" D (14.2 cm H x 11.9 cm W x 3.3 cm D).

Agency Listings and Approvals

The listings and approvals below apply to SpectrAlert Advance Selectable Output Notification Devices. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed: S4011** (HR__, HW__, P2__, P4__, PC2__, PC4__ models); **S5512** (models SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); **S3593** (SCRHK, SCRK, SRHK, SRK).
- **ULC Listed: S4011** (HRA, HRKA); **S5512** (typically "A" models, with exception of outdoor strobes). *See Canadian data sheet for listings and specifications.*
- **FM approved**
- **MEA**: **452-05-E**
- **CSFM: 7125-1653:0186** (SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); **7300-1653:0188** (P2_, P4_, PC2_, PC4_ modules); **7135-1653:0189** (HR, HRK, HW); **7300-1653:0187** (SCRHK, SCRK, SRHK, SRK).

Strobe Current Draw, UL Maximum (mA RMS)

Candela		8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Standard Candela Range	15	123	128	66	71
	15/75	142	148	77	81
	30	NA	N/A	94	96
	75	NA	NA	158	153
	95	NA	NA	181	176
	110	NA	NA	202	195
	115	NA	NA	210	205
High Candela Range	135	NA	NA	228	207
	150	NA	NA	246	220
	177	NA	NA	281	251
	185	NA	NA	286	258

Horn Current Draw, UL Maximum (mA RMS)

Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Temporal	High	57	55	69	75
Temporal	Medium	44	49	58	69
Temporal	Low	38	44	44	48
Non-temporal	High	57	56	69	75
Non-temporal	Medium	42	50	60	69
Non-temporal	Low	41	44	50	50
Coded	High	57	55	69	75
Coded	Medium	44	51	56	69
Coded	Low	40	46	52	50

Horn and Horn/Strobe Rotary Switch Setting

Setting	Repetition Rate	dB Level
1	Temporal horn	High
2	Temporal horn	Medium
3	Temporal horn	Low
4	Normal horn	High
5	Normal horn	Medium
6	Normal horn	Low
7*	Externally coded	High
8*	Externally coded	Medium
9*	Externally coded	Low

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

Horn and Horn/Strobe Output (dBA)

Switch Position	Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
			DC	FWR	DC	FWR
1	Temporal	High	78	78	84	84
2	Temporal	Medium	74	74	80	80
3	Temporal	Low	71	73	76	76
4	Non-temporal	High	82	82	88	88
5	Non-temporal	Medium	78	78	85	85
6	Non-temporal	Low	75	75	81	81
7*	Coded	High	82	82	88	88
8*	Coded	Medium	78	78	85	85
9*	Coded	Low	75	75	81	81

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

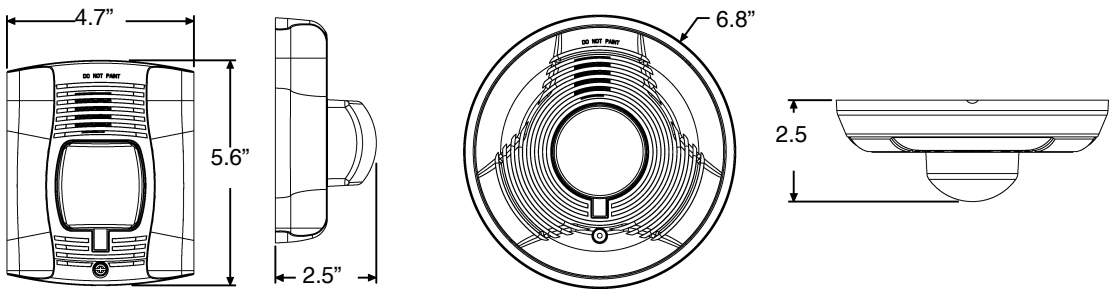
Two-Wire Horn/Strobe, *STANDARD* Candela Range (15 – 115 cd), UL Maximum Current Draw (mA RMS)

Input, Sound Pattern, dB Level	8 – 17.5 V		16 – 33 V						
	15	15/75	15	15/75	30	75	95	110	115
DC Input, Temporal, High	137	147	79	90	107	176	194	212	218
DC Input, Temporal, Medium	132	144	69	80	97	157	182	201	210
DC Input, Temporal, Low	132	143	66	77	93	154	179	198	207
DC Input, Non-temporal, High	141	152	91	100	116	176	201	221	229
DC Input, Non-temporal, Medium	133	145	75	85	102	163	187	207	216
DC Input, Non-temporal, Low	131	144	68	79	96	156	182	201	210
FWR Input, Temporal, High	136	155	88	97	112	168	190	210	218
FWR Input, Temporal, Medium	129	152	78	88	103	160	184	202	206
FWR Input, Temporal, Low	129	151	76	86	101	160	184	194	201
FWR Input, Non-temporal, High	142	161	103	112	126	181	203	221	229
FWR Input, Non-temporal, Medium	134	155	85	95	110	166	189	208	216
FWR Input, Non-temporal, Low	132	154	80	90	105	161	184	202	211

Two-Wire Horn/Strobe, *HIGH* Candela Range (135 – 185 cd), UL Maximum Current Draw (mA RMS)

DC Input	16 – 33 V				FWR Input	16 – 33 V			
	135	150	177	185		135	150	177	185
DC, Temporal, High	245	259	290	297	FWR, Temporal, High	215	231	258	265
DC, Temporal, Medium	235	253	288	297	FWR, Temporal, Medium	209	224	250	258
DC, Temporal, Low	232	251	282	292	FWR, Temporal, Low	207	221	248	256
DC, Non-temporal, High	255	270	303	309	FWR, Non-temporal, High	233	248	275	281
DC, Non-temporal, Medium	242	259	293	299	FWR, Non-temporal, Medium	219	232	262	267
DC, Non-temporal, Low	238	254	291	295	FWR, Non-temporal, Low	214	229	256	262

7087dim12009.tif



Ordering Information

Model	Description	Model	Description
WALL HORN/STROBES		***CEILING HORN/STROBES***	
P2R	2-wire horn/strobe, standard cd, red.	**PC2R**	2-wire horn/strobe, standard cd, red.
P2RH	2-wire horn/strobe, high cd, red.	**PC2RH**	2-wire horn/strobe, high cd, red.
P2RK	2-wire horn/strobe, standard cd, red, outdoor.	**PC2RK**	2-wire horn/strobe, standard cd, red, outdoor.
P2RHK	2-wire horn/strobe, high cd, red, outdoor.	**PC2RHK**	2-wire horn/strobe, high cd, red, outdoor.
P2W	2-wire horn/strobe, standard cd, white.	**PC2W**	2-wire horn/strobe, standard cd, white.
P2WH	2-wire horn/strobe, high cd, white.	**PC2WH**	2-wire horn/strobe, high cd, white.
P4R	4-wire horn/strobe, standard cd, red.	**PC4R**	4-wire horn/strobe, standard cd, red.
P4RH	4-wire horn/strobe, high cd, red.	**PC4RH**	4-wire horn/strobe, high cd, red.
P4RK	4-wire horn/strobe, standard cd, red, outdoor.	**PC4RK**	4-wire horn/strobe, standard cd, red, outdoor.
P4RHK	4-wire horn/strobe, high cd, red, outdoor.	**PC4RHK**	4-wire horn/strobe, high cd, red, outdoor.
P4W	4-wire horn/strobe, standard cd, white.	**PC4W**	4-wire horn/strobe, standard cd, white.
P4WH	4-wire horn/strobe, high cd, white.	**PC4WH**	4-wire horn/strobe, high cd, white.
WALL STROBES		***CEILING STROBES***	
SR	Strobe, standard cd, red.	**SCR**	Strobe, standard cd, red.
SRH	Strobe, high cd, red.	**SCRH**	Strobe, high cd, red.
SRK	Strobe, standard cd, red, outdoor.	**SCRK**	Strobe, standard cd, red, outdoor.
SRHK	Strobe, high cd, red, outdoor.	**SCRHK**	Strobe, high cd, red, outdoor.
SW	Strobe, standard cd, white.	**SCW**	Strobe, standard cd, white.
SWH	Strobe, high cd, white.	**SCWH**	Strobe, high cd, white.
ACCESSORIES		***HORNS***	
BBS-2A	Backbox skirt, wall, red.	**HR**	Horn, red.
BBSW-2A	Backbox skirt, wall, white.	**HRK**	Horn, red, outdoor.
BBSC-2A	Backbox skirt, ceiling, red.	**HW**	Horn, white.
BBSCW-2A	Backbox skirt, ceiling, white.	***ACCESSORIES, continued***	
SA-WBB	Weatherproof backbox, wall.	**TR-HS**	Trim Ring, wall, red, package of 5
SA-WBBC	Weatherproof backbox, ceiling.	**TRW-HS**	Trim Ring, wall, white, package of 5
WTP	Weatherproof, flush mount plate, red	**TRC-HS**	Trim Ring, ceiling, red, package of 5
WTPW	Weatherproof, flush mount plate, white	**TRCW-HS**	Trim Ring, ceiling, white, package of 5

NOTE: *"High cd" refers to strobes that include 135, 150, 177, and 185 candela settings. "Standard cd" refers to strobes that include 15, 15/75, 30, 75, 95, 110, and 115 candela settings.*

NOTE: *For strobes and horn/strobes, add suffix "F" for French or "B" for Bilingual.*

NOTE: *All outdoor models ("K(A)" suffix) include a plastic weatherproof backbox.*

NOTE: *Add "-R" to models for weatherproof replacement device (no back box included). Only for use with weatherproof outdoor flush mounting plate, WTP and WTPW.*

NOTE: *Add "P" to model for plain housing. (No "FIRE" marking on cover.)*

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

Series TY-FRB — 2.8, 4.2, 5.6, and 8.0 K-Factor Upright, Pendent, and Recessed Pendent Sprinklers Quick Response, Standard Coverage

General Description

The TYCO Series TY-FRB, 2.8, 4.2, 5.6, and 8.0 K-factor, Upright, Pendent, and Recessed Pendent Sprinklers described in this data sheet are quick response, standard coverage, decorative 3 mm glass bulb-type spray sprinklers designed for use in light or ordinary hazard, commercial occupancies such as banks, hotels, and shopping malls.

The recessed version of the Series TY-FRB Pendent Sprinkler, where applicable, is intended for use in areas with a finished ceiling. This recessed pendent sprinkler uses one of the following:

- A two-piece Style 10 (1/2 inch NPT) or Style 40 (3/4 inch NPT) Recessed Escutcheon with 1/2 inch (12,7 mm) of recessed adjustment or up to 3/4 inch (19,1 mm) of total adjustment from the flush pendent position, or a
- A two-piece Style 20 (1/2 inch NPT) or Style 30 (3/4 inch NPT) Recessed Escutcheon with 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush pendent position.

The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the fixed pipe drops to the sprinklers must be cut.

Corrosion-resistant coatings, where applicable, are utilized to extend the life of copper alloy sprinklers beyond that which would otherwise be obtained when exposed to corrosive atmospheres. Although corrosion-resistant coated sprinklers have passed the standard corrosion tests of the applicable approval agencies, the testing is not representative of all possible corrosive atmospheres. Consequently, it is recommended that the end user be consulted with respect to the suitability of these coatings for any given corrosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity, should be considered, as a minimum, along with the corrosive nature of the chemical to which the sprinklers will be exposed.

An intermediate level of the Series TY-FRB Pendent Sprinklers is detailed in Technical Data Sheet TFP356, and Sprinkler Guards are detailed in Technical Data Sheet TFP780.

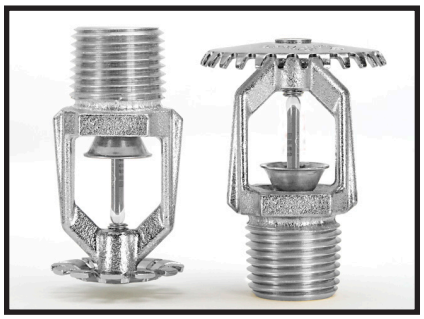
NOTICE

The Series TY-FRB, 2.8, 4.2, 5.6, and 8.0 K-factor, Upright, Pendent, and Recessed Pendent Sprinklers described herein must be installed and maintained in compliance with this document and with the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.



Sprinkler Identification Number (SIN)

TY1131:	Upright	2.8K, 1/2″ NPT
TY1231:	Pendent	2.8K, 1/2″ NPT
TY2131:	Upright	4.2K, 1/2″ NPT
TY2231:	Pendent	4.2K, 1/2″ NPT
TY3131:	Upright	5.6K, 1/2″ NPT
TY3231:	Pendent	5.6K, 1/2″ NPT
TY4131:	Upright	8.0K, 3/4″ NPT
TY4231:	Pendent	8.0K, 3/4″ NPT
TY4831:	Upright	8.0K, 1/2″ NPT
TY4931:	Pendent	8.0K, 1/2″ NPT

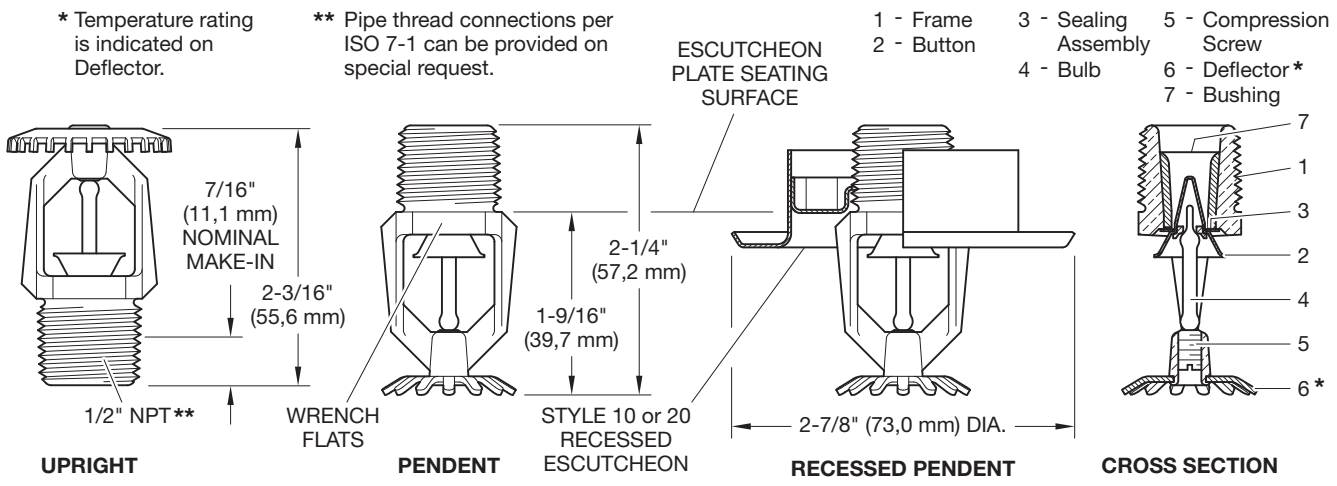


FIGURE 1
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY1131) AND PENDENT (TY1231) SPRINKLERS
2.8 K-FACTOR, 1/2 INCH NPT

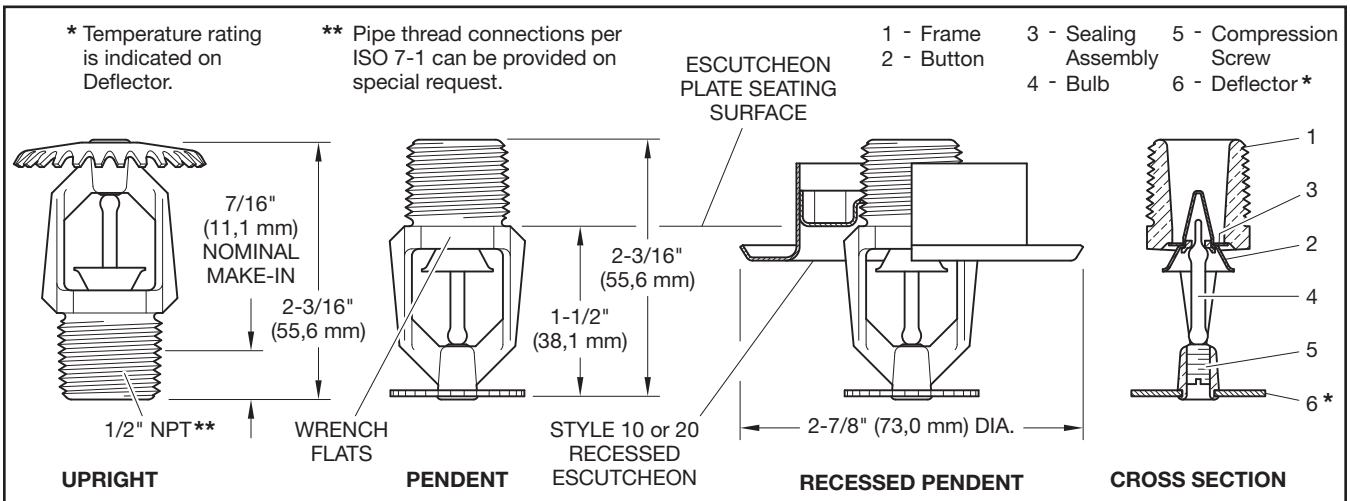


FIGURE 2
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY2131) AND PENDENT (TY2231) SPRINKLERS
4.2 K-FACTOR, 1/2 INCH NPT

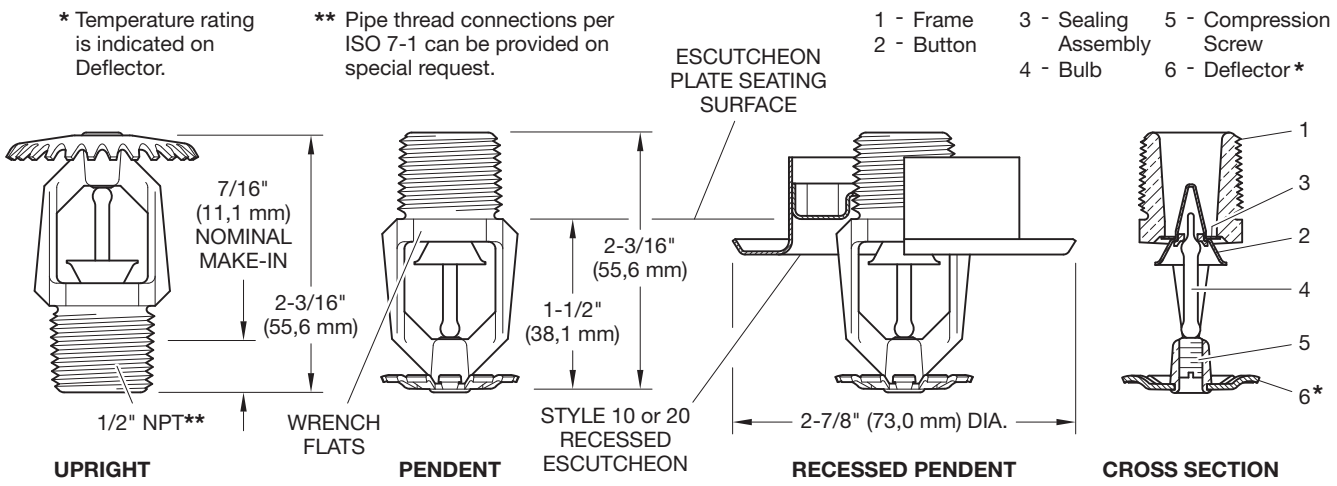


FIGURE 3
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY3131) AND PENDENT (TY3231) SPRINKLERS
5.6 K-FACTOR, 1/2 INCH NPT

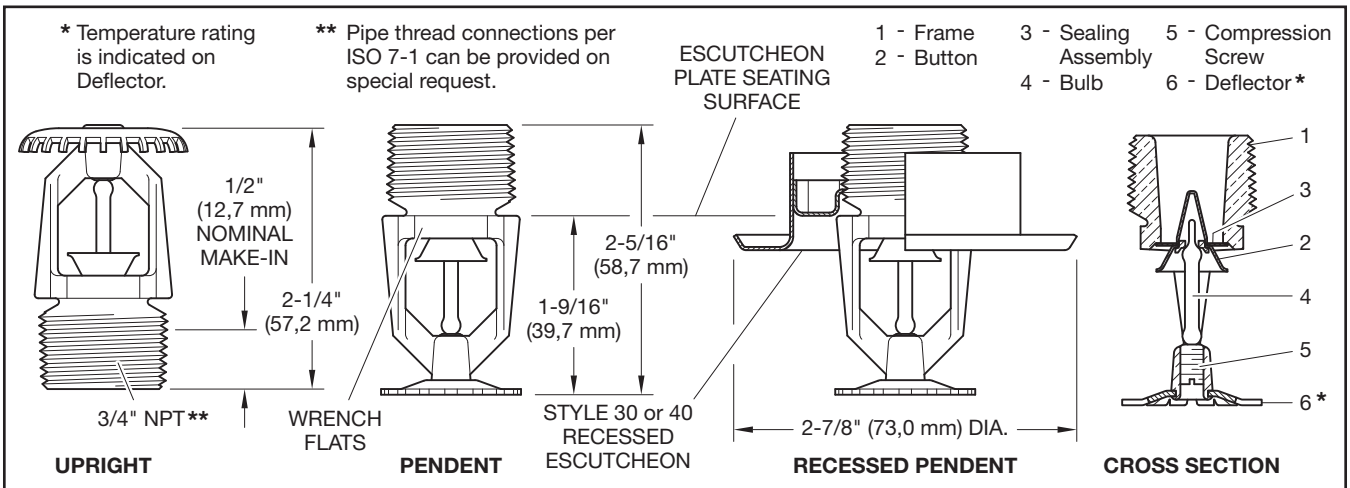


FIGURE 4
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY4131) AND PENDENT (TY4231) SPRINKLERS
8.0 K-FACTOR, 3/4 INCH NPT

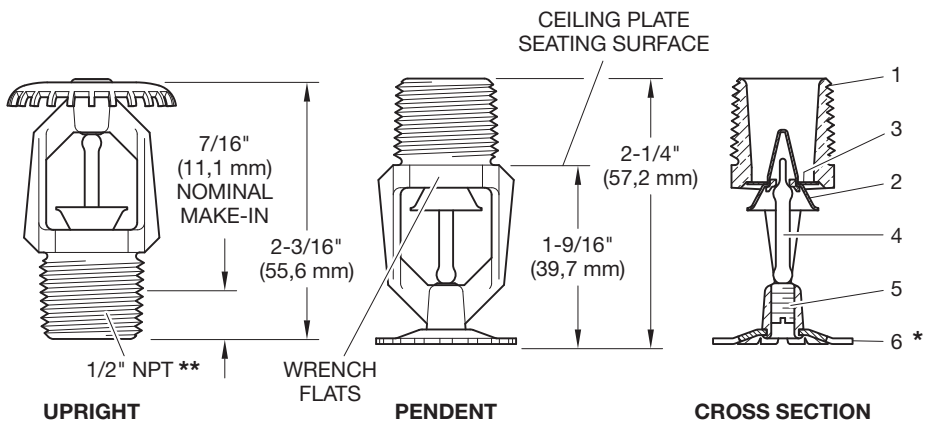


FIGURE 5
QUICK RESPONSE SERIES TY-FRB UPRIGHT (TY4831) AND PENDENT (TY4931) SPRINKLERS
8.0 K-FACTOR, 1/2 INCH NPT

Technical Data

Approvals
UL and C-UL Listed
FM, LPCB, and NYC Approved
Refer to Table A and B for complete approval information including corrosion-resistant status.

Maximum Working Pressure
Refer to Table C.

Discharge Coefficient
K=2.8 GPM/psi$^{1/2}$ (40,3 LPM/bar$^{1/2}$)
K=4.2 GPM/psi$^{1/2}$ (60,5 LPM/bar$^{1/2}$)
K=5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)
K=8.0 GPM/psi$^{1/2}$ (115,2 LPM/bar$^{1/2}$)

Temperature Rating
Refer to Table A and B.

Finishes
Sprinkler: Refer to Table D. Recessed Escutcheon: White Coated, Chrome Plated, or Brass Plated.

Physical Characteristics
Frame . . . . . Bronze
Button. . . . . Brass/Copper
Sealing Assembly. . . . . Beryllium Nickel w/TEFLON
Bulb . . . . . Glass
Compression Screw. . . . . Bronze
Deflector. . . . . Copper/Bronze
Bushing (K=2.8) . . . . . Bronze

Operation

The glass bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass bulb, allowing the sprinkler to activate and water to flow.

Design Criteria

The TYCO Series TY-FRB, 2.8, 4.2, 5.6, and 8.0 K-factor, Upright, Pendent, and Recessed Pendent Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable Listing or Approval agency (such as, UL Listing is based on the requirements of NFPA 13, and FM Approval is based on the requirements of FM's Loss Prevention Data Sheets). Only the Style 10, 20, 30, or 40 Recessed Escutcheon, as applicable, is to be used for recessed pendent installations.

Installation

The TYCO Series TY-FRB, 2.8, 4.2, 5.6, and 8.0 K-factor, Upright, Pendent, and Recessed Pendent Sprinklersmust be installed in accordance with this section.

General Instructions
Do not install any bulb-type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm) for the 135°F (57°C) and 3/32 inch (2,4 mm) for the 286°F (141°C) temperature ratings.

A leak-tight 1/2 inch NPT sprinkler joint shold be obtained by applying a minimum to maximum torque of 7 to 14 ft.-lbs. (9,5 to 19,0 Nm). A leak tight 3/4 inch NPT sprinkler joint should be obtained with a torque of 10 to 20 ft.-lbs. (13,4 to 26,8 Nm). Higher levels of torque can distort the sprinkler Inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in the Escutcheon Plate by under- or over-tightening the sprinkler. Re-adjust the position of the sprinkler fitting to suit.

Series TY-FRB Upright and Pendent Sprinklers
The Series TY-FRB Pendent and Upright Sprinklers must be installed in accordance with the following instructions.

Step 1. Install Pendent sprinklers in the pendent position. Install upright sprinklers in the upright position.

Step 2. With pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Figure 14). With reference to Figures 1 through 5, apply the W-Type 6 Sprinkler Wrench to the sprinkler wrench flats.

Series TY-FRB Recessed Pendent Sprinklers
The Series TY-FRB Recessed Pendent Sprinklers must be installed in accordance with the following instructions.

Step A. After installing the Style 10, 20, 30, or 40 Mounting Plate, as applicable, over the sprinkler threads and with pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.

Step B. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Figure

K FACTOR	TYPE	TEMPERATURE	SPRINKLER FINISH (See Note 5) BULB LIQUID COLOR	NATURAL BRASS	CHROME PLATED	SIGNAL*** WHITE
2.8 1/2" NPT	PENDENT (TY1231) and UPRIGHT (TY1131)	135°F (57°C)	Orange	1, 2, 3, 4		
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			
		286°F (141°C)	Blue			
	RECESSED PENDENT (TY1231)* Figure 6	135°F (57°C)	Orange	1, 2, 4		
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			
	RECESSED PENDENT (TY1231)** Figure 7	135°F (57°C)	Orange			
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			
4.2 1/2" NPT	PENDENT (TY2231) and UPRIGHT (TY2131)	135°F (57°C)	Orange	1, 2		
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			
		286°F (141°C)	Blue			
	RECESSED PENDENT (TY2231)* Figure 8	135°F (57°C)	Orange			
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			
	RECESSED PENDENT (TY2231)** Figure 9	135°F (57°C)	Orange			
		155°F (68°C)	Red			
		175°F (79°C)	Yellow			
		200°F (93°C)	Green			

NOTES:
1. Listed by Underwriters Laboratories, Inc., (UL) as Quick Response Sprinklers.
2. Listed by Underwriters Laboratories, Inc., for use in Canada (C-UL) as Quick Response Sprinklers.
3. Approved by Factory Mutual Research Corporation (FM) as Quick Response Sprinklers.
4. Approved by the City of New York under MEA 354-01-E.
5. Where Polyester Coated Sprinklers are noted to be UL and C-UL Listed, the sprinklers are UL and C-UL Listed as Corrosion-Resistant Sprinklers.

* Installed with Style 10 (1/2" NPT) or Style 40 (3/4" NPT) 3/4" Total Adjustment Recessed Escutcheon, as applicable.

** Installed with Style 20 (1/2" NPT) or Style 30 (3/4" NPT) 1/2" Total Adjustment Recessed Escutcheon, as applicable.

*** Frame and Deflector only. Listings and approvals apply to color (Special Order).

N/A: Not Available

TABLE A
LABORATORY LISTINGS AND APPROVALS FOR
2.8 AND 4.2 K-FACTOR SPRINKLERS

15). With reference to Figures 1 to 4, apply the W-Type 7 Recessed Sprinkler Wrench to the sprinkler wrench flats.

Step C. After ceiling installation and finishing, slide on the Style 10, 20, 30, or 40 Closure over the Series TY-FRB Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

K FACTOR	TYPE	TEMPERATURE	SPRINKLER FINISH (See Note 8)				
			BULB LIQUID COLOR	NATURAL BRASS	CHROME PLATED	SIGNAL*** WHITE	LEAD COATED
5.6 1/2" NPT	PENDENT (TY3231) and UPRIGHT (TY3131)	135°F (57°C)	Orange	1, 2, 3, 4, 5, 6, 7			1, 2, 3, 5
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
	RECESSED PENDENT (TY3231)* Figure 10	135°F (57°C)	Orange	1, 2, 4, 5			N/A
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
	RECESSED PENDENT (TY3231)** Figure 11	135°F (57°C)	Orange	1, 2, 3, 4, 5			N/A
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
8.0 3/4" NPT	PENDENT (TY4231) and UPRIGHT (TY4131)	135°F (57°C)	Orange	1, 2, 3, 4, 5, 6, 7			1, 2, 5
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
	RECESSED PENDENT (TY4231)* Figure 12	135°F (57°C)	Orange	1, 2, 5			N/A
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
	RECESSED PENDENT (TY4231)** Figure 13	135°F (57°C)	Orange	1, 2, 3, 5			N/A
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				
8.0 1/2" NPT	PENDENT (TY4931) and UPRIGHT (TY4831)	135°F (57°C)	Orange	1, 2, 4, 5, 6			1, 2, 5
		155°F (68°C)	Red				
		175°F (79°C)	Yellow				
		200°F (93°C)	Green				
		286°F (141°C)	Blue				

NOTES:

1. Listed by Underwriters Laboratories, Inc., (UL) as Quick Response Sprinklers.
2. Listed by Underwriters Laboratories, Inc., for use in Canada (C-UL) as Quick Response Sprinklers.
3. Approved by Factory Mutual Research Corporation (FM) as Quick Response Sprinklers.
4. Approved by the Loss Prevention Certification Board (LPCB Ref. No. 007k/04) as Quick Response Sprinklers. However, LPCB does not rate the thermal sensitivity of recessed sprinklers.
5. Approved by the City of New York under MEA 354-01-E.
6. VdS Approved (For details, contact Tyco Fire Suppression & Building Products, Enschede, Netherlands, Tel. 31-53-428-4444/Fax 31-53-428-3377.)
7. Approved by the Loss Prevention Certification Board (LPCB Ref. No. 094a/06) as Quick Response Sprinklers.
8. Where Polyester Coated and Lead-Coated Sprinklers are noted to be UL and C-UL Listed, the sprinklers are UL and C-UL Listed as Corrosion-Resistant Sprinklers. Where Lead-Coated Sprinklers are noted to be FM Approved, the sprinklers are FM Approved as a Corrosion-Resistant Sprinklers.

* Installed with Style 10 (1/2" NPT) or Style 40 (3/4" NPT) 3/4" Total Adjustment Recessed Escutcheon, as applicable.

** Installed with Style 20 (1/2" NPT) or Style 30 (3/4" NPT) 1/2" Total Adjustment Recessed Escutcheon, as applicable.

*** Frame and Deflector only. Listings and approvals apply to color (Special Order).

N/A: Not Available

TABLE B
LABORATORY LISTINGS AND APPROVALS FOR
5.6 AND 8.0 K-FACTOR SPRINKLERS

K FACTOR	TYPE	SPRINKLER FINISH			
		NATURAL BRASS	CHROME PLATED	SIGNAL WHITE	LEAD COATED
2.8 1/2" NPT	PENDENT (TY1231) and UPRIGHT (TY1131)	175 PSI (12,1 BAR)			N/A
	RECESSED PENDENT (TY1231)				
4.2 1/2" NPT	PENDENT (TY2231) and UPRIGHT (TY2131)	175 PSI (12,1 BAR)			N/A
	RECESSED PENDENT (TY2231)				
5.6 1/2" NPT	PENDENT (TY3231) and UPRIGHT (TY3131)	250 PSI (17,2 BAR) OR 175 PSI (12,1 BAR) (SEE NOTE 1)			175 PSI (12,1 BAR)
	RECESSED PENDENT (TY3231)				N/A
8.0 3/4" NPT	PENDENT (TY4231) and UPRIGHT (TY4131)	175 PSI (12,1 BAR)			175 PSI (12,1 BAR)
	RECESSED PENDENT (TY4231)				N/A
8.0 1/2" NPT	PENDENT (TY4931) and UPRIGHT (TY4831)	175 PSI (12,1 BAR)			175 PSI (12,1 BAR)

NOTES:
1. The maximum working pressure of 250 psi (17,2 bar) only applies to the Listing by Underwriters Laboratories Inc. (UL); the Listing by Underwriters Laboratories, Inc. for use in Canada (C-UL); and, the Approval by the City of New York.

TABLE C
MAXIMUM WORKING PRESSURE

Care and Maintenance

The TYCO Series TY-FRB must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection systems from the proper authorities and notify all personnel who may be affected by this action.

Absence of the outer piece of an escutcheon, which is used to cover a clearance hole, can delay sprinkler operation in a fire situation.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section.)

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Care must be exercised to avoid damage to the sprinklers -before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

Initial and frequent visual inspections of random samples are recommended for corrosion-resistant sprinklers to verify the integrity of the corrosion-resistant material of construction. Thereafter, annual inspections per NFPA 25 should suffice.

Inspections of corrosion-resistant sprinklers are recommended at close range, instead of from the floor level per NFPA. Inspection at close range can better determine the exact sprinkler condition and the long-term integrity of the corrosion-resistant material, which can be affected by the corrosive conditions present.

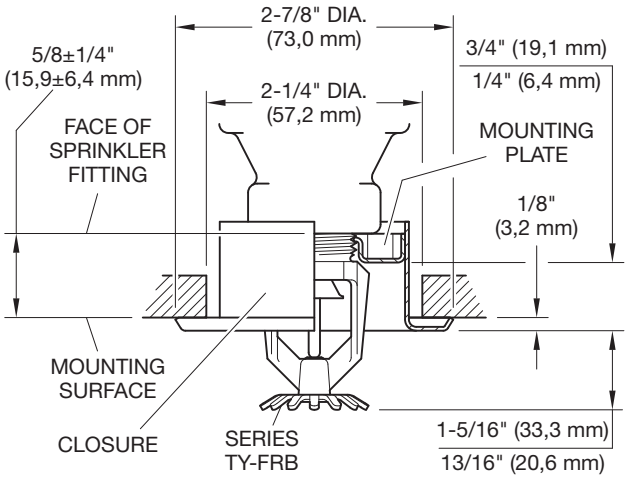


FIGURE 6
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT
STYLE 10 RECESSED ESCUTCHEON
2.8 K-FACTOR, 1/2 INCH NPT

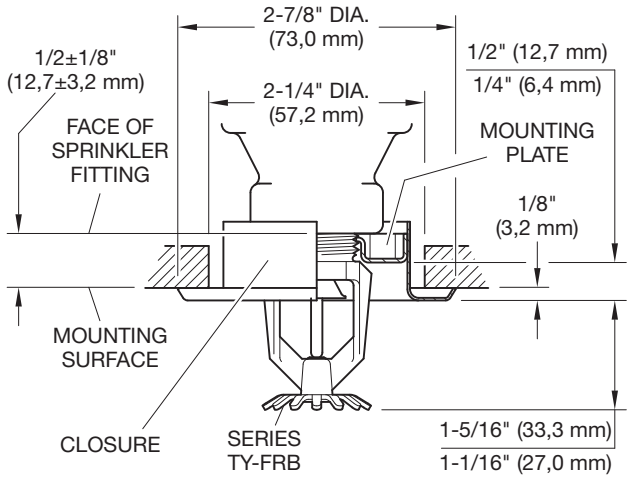


FIGURE 7
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT
STYLE 20 RECESSED ESCUTCHEON
2.8 K-FACTOR, 1/2 INCH NPT

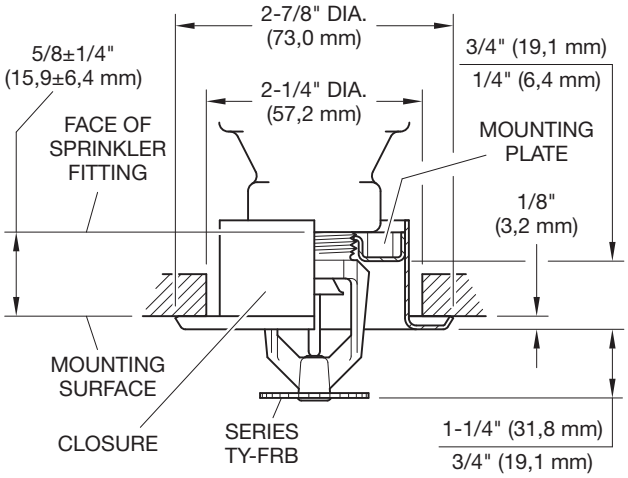


FIGURE 8
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT
STYLE 10 RECESSED ESCUTCHEON
4.2 K-FACTOR, 1/2 INCH NPT

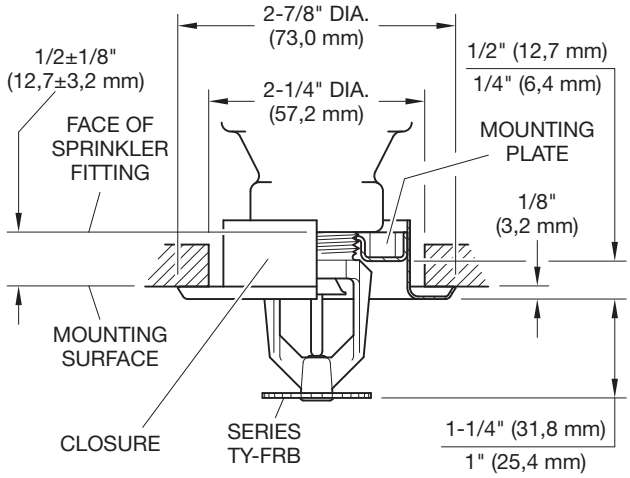


FIGURE 9
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT
STYLE 20 RECESSED ESCUTCHEON
4.2 K-FACTOR, 1/2 INCH NPT

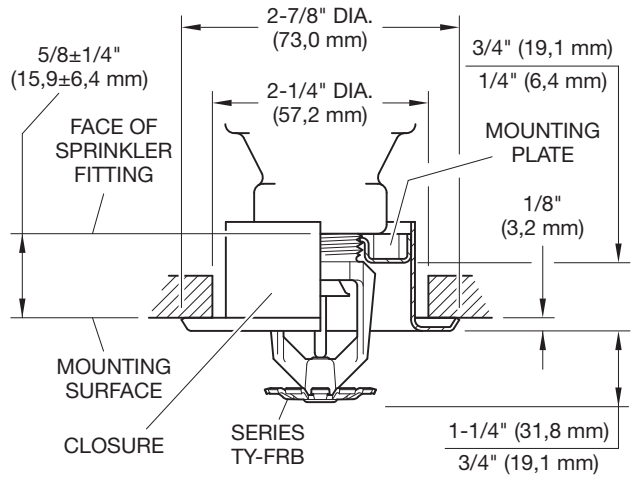


FIGURE 10
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT
STYLE 10 RECESSED ESCUTCHEON
5.6 K-FACTOR, 1/2 INCH NPT

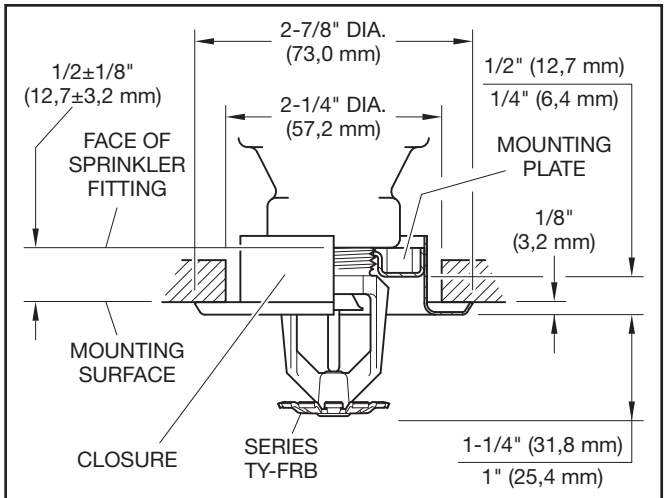


FIGURE 11
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT
STYLE 20 RECESSED ESCUTCHEON
5.6 K-FACTOR, 1/2 INCH NPT

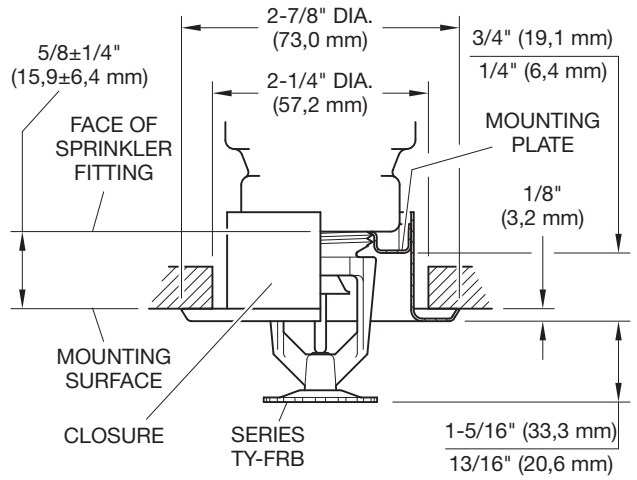


FIGURE 12
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT
STYLE 40 RECESSED ESCUTCHEON
8.0 K-FACTOR, 3/4 INCH NPT

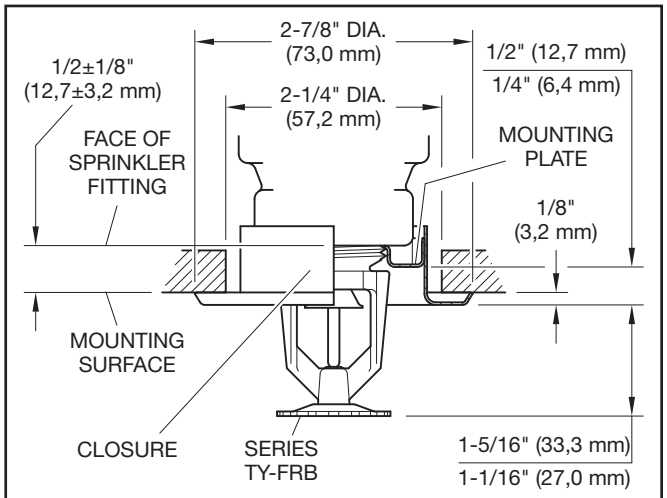


FIGURE 13
SERIES TY-FRB RECESSED PENDENT
WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT
STYLE 30 RECESSED ESCUTCHEON
8.0 K-FACTOR, 3/4 INCH NPT

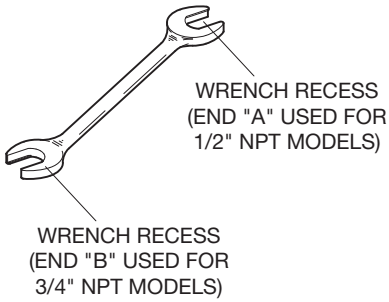


FIGURE 14
W-TYPE 6 SPRINKLER
WRENCH

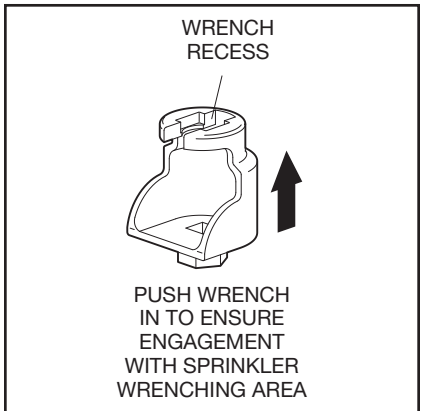


FIGURE 15
W-TYPE 7 RECESSED
SPRINKLER WRENCH

P/N 57 – XXX – X – XXX

		SIN
330	2.8K UPRIGHT (1/2"NPT)	TY1131
331	2.8K PENDENT (1/2"NPT)	TY1231
340	4.2K UPRIGHT (1/2"NPT)	TY2131
341	4.2K PENDENT (1/2"NPT)	TY2231
370	5.6K UPRIGHT (1/2"NPT)	TY3131
371	5.6K PENDENT (1/2"NPT)	TY3231
390	8.0K UPRIGHT (3/4"NPT)	TY4131
391	8.0K PENDENT (3/4"NPT)	TY4231
360	8.0K UPRIGHT (1/2"NPT)	TY4831*
361	8.0K PENDENT (1/2"NPT)	TY4931*

	SPRINKLER FINISH
1	NATURAL BRASS
3	PURE WHITE (RAL9010)*
4	SIGNAL WHITE (RAL9003)
5	JET BLACK (RAL9005)**
7	LEAD COATED
9	CHROME PLATED

	TEMPERATURE RATINGS
135	135°F (57°C)
155	155°F (68°C)
175	175°F (79°C)
200	200°F (93°C)
286	286°F (141°C)

* Eastern Hemisphere sales only.

** Available in only 2.8K, 4.2K, and 8.0K, 155°F (68°C) and 200°F (93°C); requires lead time to manufacture.

TABLE D
SERIES TY-FRB PENDENT AND UPRIGHT SPRINKLERS
PART NUMBER SELECTION

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

Sprinkler Assemblies with NPT Thread Connections
Specify: Series TY-FRB (Specify SIN), (specify K-factor), (specify Pendent or Upright) Sprinkler (specify) temperature rating, (specify) finish or coating, P/N (specify from Table D)

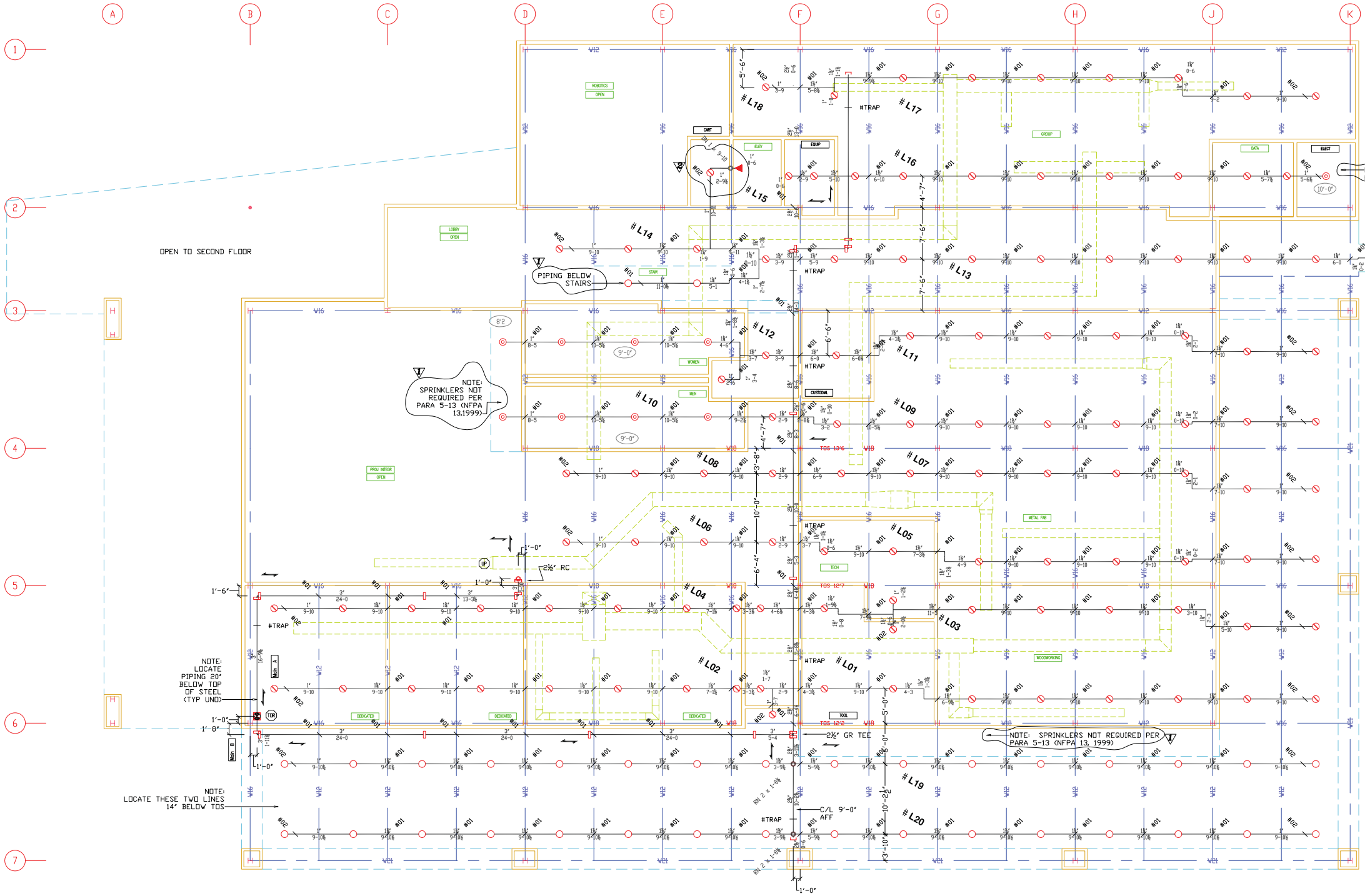
Recessed Escutcheon:
Specify: Style (10, 20, 30, or 40) Recessed Escutcheon with (specify*) finish, P/N (specify*)

Sprinkler Wrench
Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387

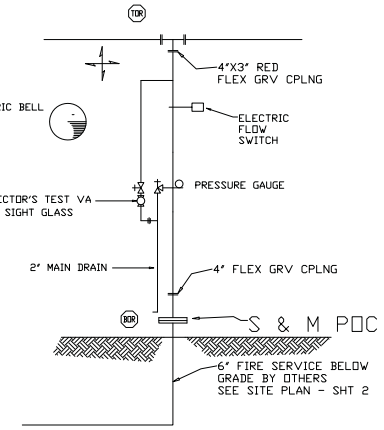
Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001

* Refer to Technical Data Sheet TFP770

tyco Fire Protection Products



GROUND LEVEL FLOOR PLAN FF = 0'-0"
SCALE: 1/8" = 1'-0"



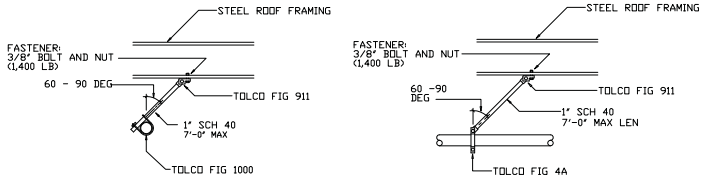
4" RISER ASSY
NO SCALE

DESIGN

PUBLIC AREAS, CLASSROOMS — STORAGE, EQUIPMENT,MAINTAINANCE

OCCUPANACY: LIGHT HAZARD — ORD HAZARD GP 1
DENSITY: .10 GPM/SF — .15 GPM/SF
MAX HEAD SPACING: 225 SF — 130 GPM/SF
REMOTE AREA: SEE FLOOR PLAN (PARA 7-2.3.2.4)

PIPING: 2 1/2"-4" - SCHED 10 WITH GRVD FITTINGS
1"-2" - SCHED 30 WITH C I THREADED FITTINGS



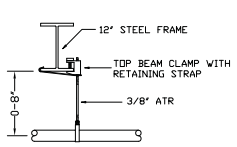
LATERAL BRACE — MAX SPACING 40 FT
LONGITUDINAL BRACE — MAX SPACING 80 FT

SWAY BRACING
NO SCALE
"FIG C" - TABLE 4-14.4.3.5.6

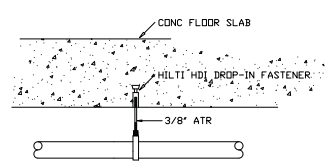
SPRINKLER PIPING LOADS

DIA	TYPE	LENGTH	1/2 WT/FT	1/2 TOTAL WT
1 "	SCH 30	50 FT	1.03 LB	51.5 LB
1¼ "	SCH 30	50 FT	1.47 LB	73.5 LB
1½ "	SCH 30	100 FT	1.81 LB	181 LB
2½ "	SCH 10	60 FT	2.95 LB	177 LB

TOTAL 1/2 WT OF PIPING 483 LB
FITTINGS ALLOW 15% 73 LB
TOTAL 556 LB



HANGER 01
NO SCALE



HANGER 02
NO SCALE

GENERAL NOTES

1. THE SPACING AND DETAILS OF THE SUPPORT AND BRACING OF THE FIRE SPRINKLER PIPING SHALL COMPLY WITH THE 1999 EDITION OF NFPA 13.
2. INSTALLATION OF THE SPRINKLER SYSTEM SHALL NOT BE STARTED UNTIL COMPLETE PLANS AND SPECIFICATIONS (INCLUDING WATER SUPPLY INFORMATION) HAVE BEEN APPROVED BY THE STATE FIRE MARSHAL. DRAWINGS AND CALCULATIONS SHALL BE STAMPED AND SIGNED BY A LICENSED C-16 FIRE PROTECTION CONTRACTOR.
3. AT VARIOUS STAGES AND UPON COMPLETION, THE SYSTEM MUST BE TESTED IN THE PRESENCE OF THE ENFORCING AGENCY.
4. PENETRATIONS OF RATED ASSEMBLIES SHALL BE FIRE-STOPPED. FIRE STOPPING SHALL BE AN APPROVED MATERIAL AS PRESCRIBED IN CALIFORNIA BUILDING CODE, SECTION 714.
5. ALL FIRE SPRINKLER DESIGN AND INSTALLATION SHALL COMPLY WITH THE 1999 EDITION OF NFPA 13
6. HEADS LOCATED ON PLAN ARE FOR VISUAL REFERENCE ONLY AND ARE NOT NECESSARILY CENTER LINE OF TILE.
7. THE LENGTH OF AN UNSUPPORTED ARMOVER TO A SPRINKLER SHALL NOT EXCEED 24 IN.
8. ALL PIPING SHALL BE HYDROSTATICALLY TESTED AT 200 PSI FOR 2 HRS PER NFPA 13 (1999) PARA 10-2.2.1
9. A SUPPLY OF SPARE SPRINKLERS SHALL BE PROVIDED PER NFPA 13 (1999) PARA 3-2.9

CSFM NO. 18-40-03-0001-000-370-0

HANGERS

- HANGER - SEE DETAIL

NOTE: THESE DRAWINGS ARE THE PROPERTY OF S & M FIRE PROTECTION, INC. ALL DESIGN, HYDRAULIC CALCULATIONS AND OTHER INFORMATION ON THE DRAWINGS ARE FOR USE ON THE SPECIFIED PROJECT BY S & M FIRE PROTECTION ONLY, AND SHALL NOT BE USED OTHERWISE.

REVISIONS

NO.	DATE	BY	REVISION
1	6 Oct,2005	TPL	Per South Coast Engr Plan Review
2	15 Mar,2006	TPL	Per 1/10/06 Plan Review
3			
4			
5			

SYMBOLS

- UPRIGHT ON LINE
- PENDANT ON LINE
- UPRIGHT ON 1' SPRIG
- PENDANT ON 1' DROP
- UPRIGHT OVER PENDANT
- OTHER
- SIDEWALL ON 1/2" OUTLET
- 1/2" DRY PENDANT

SYMBOLS

- SWAY BRACING

SYMBOLS

- PIPE UP/DOWN
- GRVD COUPLING (FLEX)
- GRVD COUPLING (RIGID)
- SPRINKLER RISER
- HYDRAULIC CALC NODE PT
- LINE NO
- MAIN PIECE NO

SPRINKLERS

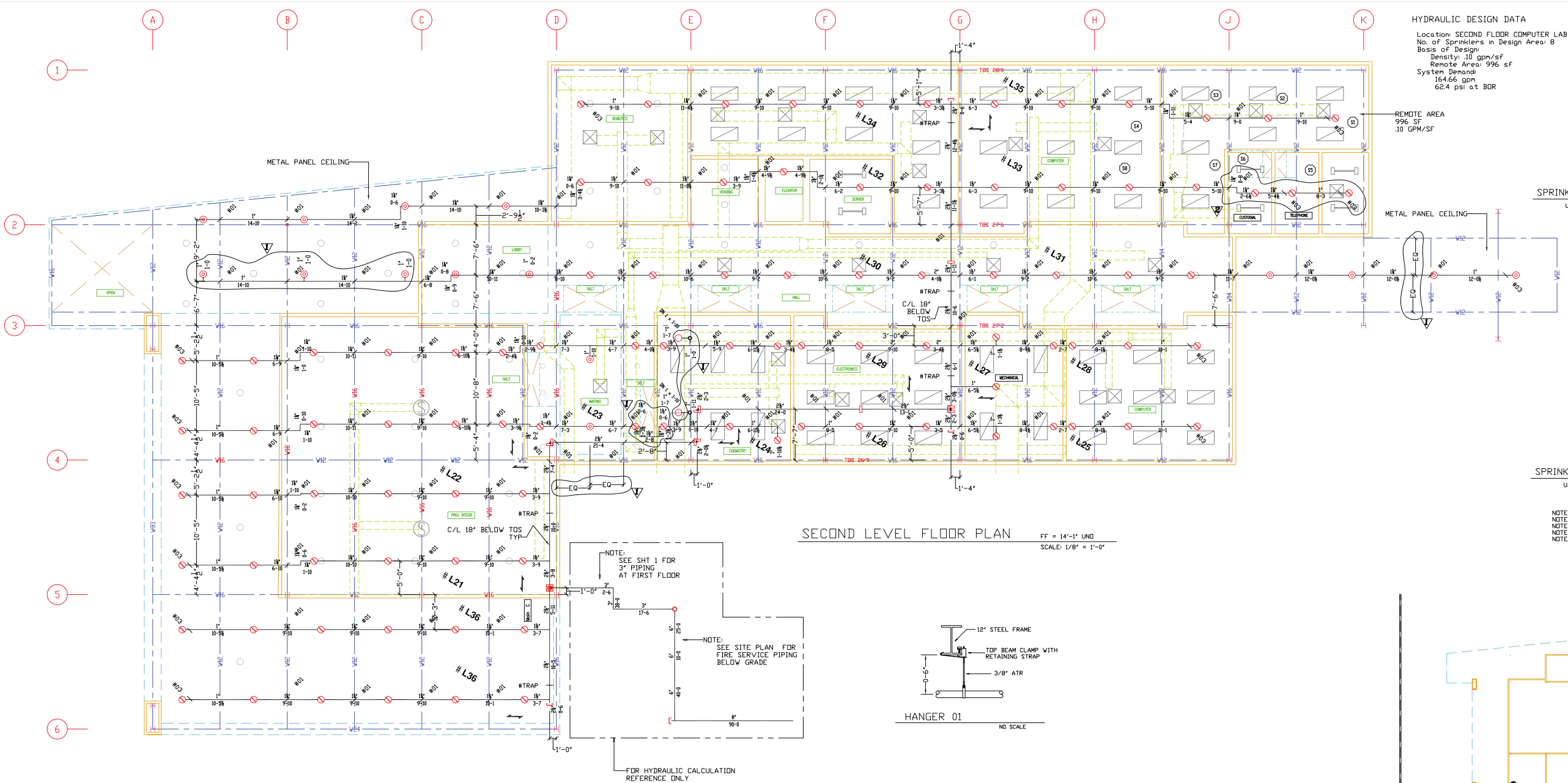
MFG / MODEL	SIN	FINISH	K	SYMB	DEGREE	QTY
1/2" TYCO TY-FRB UPRIGHT	TY3131	BRASS	5.6	○	200	36
1/2" TYCO TY-FRB PENDANT ON 1" DROP	TY3231	CHROME	5.6	◎	155	9
1/2" TYCO TY-FRB UPRIGHT ON 26" SPRIG	TY3131	BRASS	5.6	⊘	200	111
1/2" TYCO TY-FRB HORIZ SIDEWALL	TY3331	BRASS	5.6	◁	155	1
TOTAL SPRINKLERS THIS SHEET:						157

BONDERSON PROJECTS CENTER
COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA

JTA JOB NO: 0309
PROJECT NO: PR 04-600

S & M FIRE PROTECTION, INC.
3523 S. Higuera St. Unit D
San Luis Obispo, CA 93401
C-16 713250
PHONE: (805) 541-4566

JOB: 05C- 728
DRAWN BY: LOVERIN | SCALE: NOTED | DATE: 8 July 2005
1 OF 2

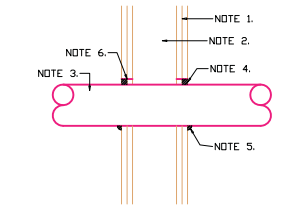


SECOND LEVEL FLOOR PLAN

FF = 14'-1" UNO
SCALE: 1/8" = 1'-0"

HYDRAULIC DESIGN DATA

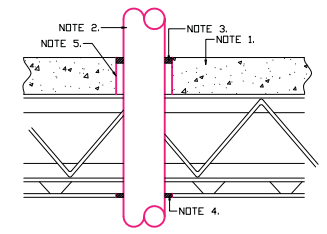
Location: SECOND FLOOR COMPUTER LAB
No. of Sprinklers in Design Area: 8
Basis of Design:
Density: .10 gpm/sf
Remote Area: 996 sf
System Demand:
164.66 gpm
62.4 psi at BDR



SPRINKLER PIPE THROUGH 1 HR OR 2 HR GYPSUM WALL ASSY

U.L. SYSTEM NO. W-L-1290 — NO SCALE

NOTE 1. GYPSUM WALL ASSY (1 HR OR 2 HR FIRE RATING)
NOTE 2. WOOD OR STEEL WALL STUDS
NOTE 3. MAX 4" NOM DIA STEEL PIPE (SCHED 10 OR HEAVIER)
NOTE 4. MINIMUM 5/8" DEPTH HILTI CP 606 FIRESTOP SEALANT
NOTE 5. MINIMUM 1/2" BEAD HILTI CP 606 FIRESTOP SEALANT
NOTE 6. MAX DIA OF OPENING 5" - MAX ANNULAR SPACE 1/2"



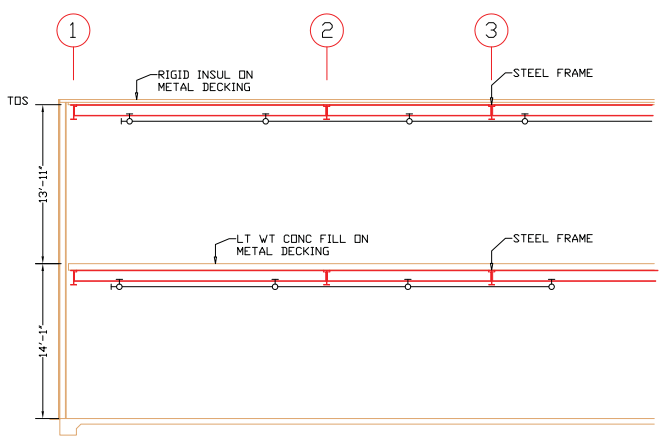
SPRINKLER PIPE THROUGH 1 HR CONC FLOOR/CEILING ASSY

U.L. SYSTEM NO. F-E-1004 — NO SCALE

NOTE 1. CONCRETE AND STEEL FLOOR/CEILING ASSY (1 HR FIRE RATING)
NOTE 2. MAX 6" NOM DIA STEEL PIPE (SCHED 40)
NOTE 3. MINIMUM 1/2" DEPTH HILTI FS-ONE FIRESTOP SEALANT
NOTE 4. MINIMUM 5/8" DEPTH HILTI FS-ONE FIRESTOP SEALANT
NOTE 5. DIAMETER OF OPENING TO BE MAX 1" LARGER THAT OD OF STEEL PIPE
ANNULAR SPACE = MIN 1/4", MAX 3/4"

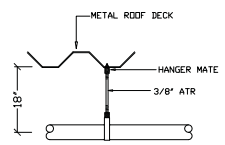
HANGER 01

NO SCALE



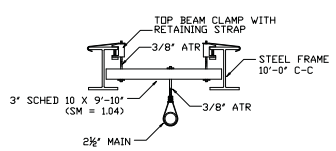
SECTION

SCALE: 1/8" = 1'-0"



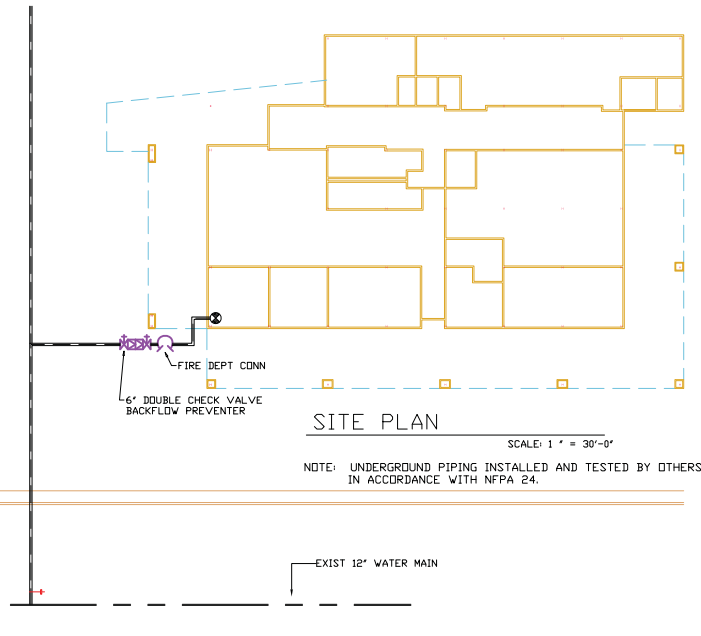
HANGER 03

NO SCALE



TRAPEZE ASSY

NO SCALE



SITE PLAN

SCALE: 1 " = 30'-0"

NOTE: UNDERGROUND PIPING INSTALLED AND TESTED BY OTHERS IN ACCORDANCE WITH NFPA 24.

FIRE HYDRANT TEST DATA

Location: 26
Hydrant No.: I-05-06
Static Pressure: 80 psi
Residual Pressure: 60 psi
Observed Flow: 1,210 gpm
Calculated Flow at 20 psi: 2,190 gpm
Test Date: 9/3/02
Data Provided By: F.P.C.P. - Cal Poly

BUILDING CODE ANALYSIS

BUILDING	OCCUPANCY GROUP	CONST TYPE	HEIGHT	AREA
FIRST FLOOR	B/F	II-N SPRINK	14'-1"	12,240 SF
SECOND FLOOR	B/F	II-N SPRINK	29'	6,335 SF

CSFM NO. 18-40-03-0001-000-370-0

HANGERS

- HANGER - SEE DETAIL

REVISIONS

NO.	DATE	BY	REVISION
1	6 Oct, 2005	TPL	Per South Coast Engr Plan Review
2	15 Mar, 2006	TPL	Per 1/10/06 Plan Review
3			
4			
5			

SYMBOLS

- UPRIGHT ON LINE
- PENDANT ON LINE
- UPRIGHT ON 1' SPRIG
- PENDANT ON 1' DROP
- UPRIGHT OVER PENDANT
- OTHER
- SIDEWALL ON 1/2" OUTLET
- 1/2" DRY PENDANT

SYMBOLS

- SWAY BRACING

SYMBOLS

- PIPE UP/DOWN
- GRVD COUPLING (FLEX)
- GRVD COUPLING (RIGID)
- SPRINKLER RISER
- HYDRAULIC CALC NODE PT
- LINE NO
- MAIN PIECE NO

SPRINKLERS

MFG / MODEL	SIN	FINISH	K	SYMB	DEGREE	QTY
1/2" TYCO TY-FRB PENDANT ON 1" DROP	TY3231	CHR	5.6	◎	155	15
1/2" TYCO TY-FRB UPRIGHT ON 8" SPRIG	TY3131	BRASS	5.6	⊘	200	97
1/2" TYCO TY-FRB UPRIGHT	TY3131	BRASS	5.6	○	200	2

TOTAL SPRINKLERS THIS SHEET: 114

BONDERSON PROJECTS CENTER

COLLEGE OF ENGINEERING
SAN LUIS OBISPO, CA

JTA JOB NO: 0309
PROJECT NO: PR 04-600

S & M FIRE PROTECTION, INC.
3523 S. Higuera St. Unit D
San Luis Obispo, CA 93401
C-16 713250
PHONE: (805) 541-4566

JOB: 05C- 728
DRAWN BY: LOVERIN | SCALE: NOTED | DATE: 8 July 2005

Contract Name Brian Sackett - Bonderson LHO Floor 2 Sheet 1 Of 2

Step No.	Nozzle Ident. and Location	Flow in gpm	Pipe Size	Pipe Fittings and Devices	Equiv. Pipe Length	Friction Loss psi Foot	Pressure Summary	Normal Pressure	NOTES	Ref. Step
1	S1	q 12	1"n		L 9.8	C=120	P_t 4.59	P_t	$Q = A \times D = 120\ ft^2 \times 0.1 gpm/ft^2$	
	BL1				F		P_e	P_v	$P_f = 4.52 Q^{1.85} / C^{1.85} D^{4.87}$	
		Q 12	1.049		T 9.8	0.05	P_f 0.49	P_n	$P = (12/5.6)^2 = 4.59$ PSI	
2	S2	q 12.6	1¼"		L 9	C=120	P_t 5.08	P_t	$q = 5.6\sqrt{P_t}$	
	BL1				F		P_e	P_v	$P_f = 4.52 Q^{1.85} / C^{1.85} D^{4.87}$	
		Q 24.6	1.38		T 9	0.05	P_f 0.45	P_n	$P_f = L \times P_f$	
	S3	q 13.2	1¼"	2 90°	L 13.1	C=120	P_t 5.53	P_t		
	BL1			Elbow	F 6		P_e	P_v	Repeat above calculations	
		Q 37.8	1.38	2(3ft)	T 19.1	0.11	P_f 2.1	P_n		
	S4	q 15.5	1¼"		L 9.8	C=120	P_t 7.63	P_t		
	BL1				F		P_e	P_v	Repeat above calculations	
		Q 53.3	1.38		T 9.8	0.21	P_f 2.1	P_n		
	S5	q 17.5	1.5"	1 Tee	L 16.1	C=120	P_t 9.73	P_t		
	BL1 → CM			1(8ft)	F 8		P_e	P_v	Repeat above calculations	
		Q 70.8	1.61		T 24.1	0.17	P_f 4.1	P_n		
	BL1	q			L		P_t 13.8	P_t		
	K-Fac				F		P_e	P_v	$K_F = (Q/\sqrt{P_t}) = 19.1$	
		Q 70.8			T		P_f	P_n		
	B1	q	2.5"		L 12.4	C=120	P_t 13.8	P_t		
	→ B2 (CM)				F		P_e	P_v		
		Q 70.8	2.47		T 12.4	0.02	P_f 0.2	P_n		
	S1	q 12	1"		L 8.25		P_t 4.59	P_t		
	BL2				F		P_e	P_v	$Q = A \times D = 12$ gpm	
		Q 12	1.049		T 8.25		P_f 0.41	P_n	$P_f = 4.52 Q^{1.85} / C^{1.85} D^{4.87}$	
	S2	q 12.5			L 5.4	C=120	P_t 5.0	P_t	$P_t = (Q/K)^2$	
	BL2				F		P_e	P_v	$q = 5.6\sqrt{P_t}$	
		Q 24.5			T 5.4	0.05	P_f 0.27	P_n	$P_f = 4.52 Q^{1.85} / C^{1.85} D^{4.87}$	
	S3	q 12.9	1.25"	2 90	L 8.4	C=120	P_t 5.27	P_t	$P_E = L \times P_f$	
	BL2			Elbow	F 6		P_e	P_v	Repeat above calculations	
		Q 37.4	1.38	2(3ft)	T 14.4	0.11	P_f 1.6	P_n		
	S4	q 14.7	1.25"		L 9.8	C=120	P_t 6.87	P_t		
	BL2				F		P_e	P_v	Repeat above calculations	
		Q 52.1	1.38		T 9.8	0.20	P_f 1.96	P_n		
							P_t			

Contract Name Brian Sackett - Bonderson LHO Floor 2 Sheet 2 Of 2

Step No.	Nozzle Ident. and Location	Flow in gpm	Pipe Size	Pipe Fittings and Devices	Equiv. Pipe Length	Friction Loss psi Foot	Pressure Summary	Normal Pressure	NOTES $k=\frac{q}{\sqrt{P}}$ $q=k\sqrt{P}$ $P=\left(\frac{q}{k}\right)^2$	Ref. Step
	S5	q 16.6	1.25"		L 9.8	C=120	P_t 8.83	P_t	Repeat above calculations	
					F		P_e	P_v		
	BL2	Q 68.7	1.38		T 9.8	0.33	P_f 3.23	P_n		
	S6	q 19.4	1.5"		L 16.1	C=120	P_t 12.06	P_t	Repeat above calculations	
				1 Tee	F 8		P_e	P_v		
	BL2 → CM	Q 88.1	1.61	1(8ft)	T 24.1	0.25	P_f 6.03	P_n		
	BL2	q			L		P_t 18.09	P_t	$K_F = Q/\sqrt{P_t} = 88.1/\sqrt{18.1} = 20.7$	
					F		P_e	P_v		
	K-Fac	Q 88.1			T		P_f	P_n		
		q 70.8			L		P_t 18.09	P_t		
					F		P_e	P_v		
		Q 70.8			T		P_f	P_n	$K = 70.8/\sqrt{19.1} = 16.2$	
		q 88.04			L		P_t 18.09	P_t		
					F		P_e	P_v	$P = (70.8/16.2)^2 = 19.1$	
		Q 158.8			T		P_f 19.1	P_n		
	CM →	q	2.5"	4 90° E	L 114		P_t 37.19	P_t	$K_{BL2} = 20.7$	
				4(6)	F 24		P_e	P_v		
		Q 158.8	2.47	24	T 138	0.09	P_f ~~24.79~~ 12.42	P_n	$q_{BL2} = K_{BL2} \times P_{t_{BL2}} = 88.04$	
	CM →	q	3"	2T	L 55.9		P_t 49.61	P_t	Step 2 Calculations	
				2 E 1b	F 44		P_e	P_v		
		Q 158.8	3.07	14+30	T 99.9	0.03	P_f 2.9	P_n		
	Riser	q	4"		L 13		P_t 52.51	P_t		
					F		P_e 11.6	P_v		
		Q 158.8	4.03		T 13	0.008	P_f 0.1	P_n	$P_e = 26.9 \times .433 = 11.6$	
		q			L		P_t 64.2	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
							P_t			

Contract Name Brian Sackett - Bonderson OH-2 1st Floor — Sheet 1 Of 3

Step No.	Nozzle Ident. and Location	Flow in gpm	Pipe Size	Pipe Fittings and Devices	Equiv. Pipe Length	Friction Loss psi Foot	Pressure Summary	Normal Pressure	NOTES $k=\frac{q}{\sqrt{P}}$ $q=k\sqrt{P}$ $P=\left(\frac{q}{k}\right)^2$	Ref. Step
1	S1	q 20	1"		L 9.8	C=120	P_t 12.8	P_t	$Q = A \times D = .100 \times .2 = 20$	
	BL1				F		P_e	P_v	$4.52\,Q^{1.85}/C^{1.85}D^{4.87}$	
		Q 20	1.049		T 9.8	0.13	P_f 1.27	P_n	$P = (20/5.6)^2 = 12.8$	
2	S2	q 21	1.25"		L 8.6		P_t 14.07	P_t	$q = 5.6\sqrt{P_t}$	
	BL1			2 Elbow	F 6		P_e	P_v	$P_f = 4.52Q^{1.85}/C^{1.85}D^{4.87}$	
		Q 41	1.38	2(3ft)	T 14.6	0.13	P_f 1.89	P_n	$P_f = L \times Pf$	
	S3	q 22.4	1.25"		L 9.8		P_t 15.96	P_t		
	BL1				F		P_e	P_v	Repeat above calculations	
		Q 63.4	1.38		T 9.8	0.29	P_f 2.84	P_n		
	S4	q 24.3	1.25"		L 9.8		P_t 18.8	P_t		
	BL1				F		P_e	P_v	Repeat above calculations	
		Q 87.7	1.38		T 9.8	0.52	P_f 5	P_n		
	To	q	1.5		L 38.5		P_t 23.8	P_t		
	CM			2 90°	F 8		P_e	P_v	Above pressure loss calc	
		Q 87.7	1.61	Elbow	T 46.5	0.24	P_f 11.16	P_n		
		q		[illegible]	L		P_t 34.96	P_t		
	BL1			[illegible]	F		P_e	P_v	$K_F = Q/\sqrt{P_t} = 14.8$	
	K-Fac	Q 87.7			T		P_f	P_n		
	S1	q 20	1"		L 9.8	C=120	P_t 12.8	P_t		
	BL2				F		P_e	P_v	Step 1 Calculations	
		Q 20	1.049		T 9.8	0.13	P_f 1.27	P_n		
	S2	q 21	1.25"		L 8.8		P_t 14.07	P_t		
	BL2			2 90°	F 6		P_e	P_v	Step 2 Calculations	
		Q 41	1.38	Elbow	T 14.8	0.13	P_f 1.92	P_n		
	S3	q 22.4	1.25"		L 9.8		P_t 15.99	P_t		
	BL2				F		P_e	P_v	Repeat above calculations	
		Q 63.4	1.38		T 9.8	0.29	P_f 2.84	P_n		
	S4	q 24.3	1.25"		L 9.8		P_t 18.83	P_t		
	BL2		1.38"		F		P_e	P_v	Repeat above calculations	
		Q 87.7			T 9.8	0.52	P_f 5.1	P_n		
	To	q	1.5"		L 35.9		P_t 23.93	P_t		
	CM			2 90°	F 8		P_e	P_v	Repeat above calculation	
		Q 87.7	1.61	Elbow	T 43.9	0.24	P_f 10.5	P_n		
							P_t 34.43			

Contract Name Brian Sackett - Bonderson OH-2 1st Floor Sheet 2 Of 3

Step No.	Nozzle Ident. and Location	Flow in gpm	Pipe Size	Pipe Fittings and Devices	Equiv. Pipe Length	Friction Loss psi Foot	Pressure Summary	Normal Pressure	NOTES $k=\frac{q}{\sqrt{P}}$ $q=k\sqrt{P}$ $P=\left(\frac{q}{k}\right)^2$	Ref. Step
	BL2	q			L		P_t 34.43	P_t	$K_f = Q/\sqrt{P_t} = 14.94$	
	K-F				F		P_e	P_v		
		Q 87.7			T		P_f	P_n		
	BL1	q 87.7	2.5		L 8.5		P_t 35.11	P_t	$K_1 = 14.8$	
	BL2				F		P_e	P_v	$q = 87.7$	
	→CM	Q 87.7	2.47		T 8.5	0.03	P_f 0.26	P_n	$P_t = 35.11$	
	BL2	q	2.5		L 8.25		P_t 35.37	P_t		
	→BL3				F		P_e	P_v	Step 2 Calculations	
		Q 175.4	2.47		T 8.25	0.1	P_f 0.825	P_n		
		q			L		P_t 36.2	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
	S1	q 20	1"		L 9.8		P_t 12.8	P_t		
	BL3				F		P_e	P_v	Step 1 Calcs	
		Q 20	1.049		T 9.8	0.13	P_f 1.27	P_n		
	S2	q 21	1.25"		L 8.6		P_t 14.07	P_t		
	BL3			2 Elbows	F 6		P_e	P_v	Step 2 Calcs	
		Q 41	1.38"		T 14.6	0.13	P_f 1.89	P_n		
	S3	q 22.4	1.25		L 9.8		P_t 15.96	P_t		
	BL3				F		P_e	P_v	Step 2 Calcs	
		Q 63.4	1.38		T 9.8	0.28	P_f 2.74	P_n		
	S4	q 24.2	1.25		L 9.8		P_t 18.7	P_t		
	BL3				F		P_e	P_v	Step 2 Calcs	
		Q 87.6	1.38		T 9.8	0.5	P_f 4.9	P_n		
	BL3	q	1.5		L 36.15		P_t 23.6	P_t		
	→CM				F		P_e	P_v	Step 2 Calcs	
		Q 87.6	1.61		T 36.15	0.24	P_f 8.6	P_n		
	BL 3@	q 175.4			L		P_t 32.2	P_t		
	CM				F		P_e	P_v	Pressure Calc	
		Q 263			T		P_f	P_n		
	CM	q	2.5		L 37.5		P_t 32.2	P_t		
	→D				F		P_e	P_v	Pressure Calc	
		Q 263	2.47		T 37.5	0.23	P_f 8.6	P_n		
							P_t 40.8			

Contract Name Brian Sackett - Bonderson OH-2 1st Floor Sheet 3 Of 3

Step No.	Nozzle Ident. and Location	Flow in gpm	Pipe Size	Pipe Fittings and Devices	Equiv. Pipe Length	Friction Loss psi Foot	Pressure Summary	Normal Pressure	NOTES $k=\frac{q}{\sqrt{P}}$ $q=k\sqrt{P}$ $p=\left(\frac{q}{k}\right)^2$	Ref. Step
	CM	q	3"	1 T	L 79.3		P_t 40.8	P_t		
	→			2 90 E	F 19		P_e	P_v		
	Riser	Q 263	3.07		T	0.08	P_f 7.8	P_n		
		q	4"		L 13'		P_t 48.6	P_t		
	Riser				F		P_e 5.6	P_v		
	B.O.R	Q 263	4.03		T 13	0.02	P_f 0.26	P_n	P_E = 13 × 0.433 = 5.6	
		q			L		P_t 54.46	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
		q			L		P_t	P_t		
					F		P_e	P_v		
		Q			T		P_f	P_n		
							P_t			

CHAPTER 3: ESTIMATING BURNING CHARACTERISTICS OF LIQUID POOL FIRE, HEAT RELEASE RATE, BURNING DURATION, AND FLAME HEIGHT

Version 1805.1 (English Units)

The following calculations estimate the hot gas layer temperature and smoke layer height in enclosure fire.
Parameters in YELLOW CELLS are Entered by the User.
Parameters in GREEN CELLS are Automatically Selected from the DROP DOWN MENU for the Material Selected.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s). The chapter in the NUREG should be read before an analysis is made.

Project / Inspection Title:

INPUT PARAMETERS

Fuel Spill Volume (V)	5.00	gallons
Fuel Spill Area or Dike Area (A_{dike})	25.00	ft^2
Mass Burning Rate of Fuel (m")	0.041	kg/m^2-sec
Effective Heat of Combustion of Fuel ($\Delta H_{c,eff}$)	25800	kJ/kg
Fuel Density (ρ)	791	kg/m^3
Empirical Constant ($k\beta$)	1.9	m^{-1}
Ambient Air Temperature (T_a)	77.00	°F
Gravitational Acceleration (g)	9.81	m/sec^2
Ambient Air Density (ρ_a)	1.18	kg/m^3

Calculate

Note: Air density will automatically correct with Ambient Air Temperature (T_a) Input

THERMAL PROPERTIES DATA

BURNING RATE DATA FOR LIQUID HYDROCARBON FUELS

Fuel	Mass Burning Rate m" (kg/m^2-sec)	Heat of Combustion $\Delta H_{c,eff}$ (kJ/kg)	Density ρ (kg/m^3)	Empirical Constant $k\beta$ (m^{-1})
Methanol	0.017	20,000	796	100
Ethanol	0.015	26,800	794	100
Butane	0.078	45,700	573	2.7
Benzene	0.085	40,100	874	2.7
Hexane	0.074	44,700	650	1.9
Heptane	0.101	44,600	675	1.1
Xylene	0.09	40,800	870	1.4
Acetone	0.041	25,800	791	1.9
Dioxane	0.018	26,200	1035	5.4
Diethy Ether	0.085	34,200	714	0.7
Benzine	0.048	44,700	740	3.6
Gasoline	0.055	43,700	740	2.1
Kerosine	0.039	43,200	820	3.5
Diesel	0.045	44,400	918	2.1
JP-4	0.051	43,500	760	3.6
JP-5	0.054	43,000	810	1.6
Transformer Oil, Hydrocarbon	0.039	46,000	760	0.7
561 Silicon Transformer Fluid	0.005	28,100	960	100
Fuel Oil, Heavy	0.035	39,700	970	1.7
Crude Oil	0.0335	42,600	855	2.8
Lube Oil	0.039	46,000	760	0.7
User Specified Value	Enter Value	Enter Value	Enter Value	Enter Value

Select Fuel Type
Acetone
Scroll to desired fuel type
Click on selection

Reference: *SFPE Handbook of Fire Protection Engineering*, 3rd Edition, 2002, *Page 3-26.*

ESTIMATING POOL FIRE HEAT RELEASE RATE

Reference: *SFPE Handbook of Fire Protection Engineering* , 3rd Edition, 2002, *Page 3-25.*

$$Q = m''\Delta H_{c,eff}\,(1 - e^{-k\beta D})\,A_{dike}$$

Where
- Q = pool fire heat release rate (kW)
- m'' = mass burning rate of fuel per unit surface area (kg/m^2-sec)
- $DH_{c,eff}$ = effective heat of combustion of fuel (kJ/kg)
- $A_f = A_{dike}$ = surface area of pool fire (area involved in vaporization) (m^2)
- kb = empirical constant (m^{-1})
- D = diameter of pool fire (diameter involved in vaporization, circular pool is assumed) (m)

Pool Fire Diameter Calculation

$$A_{dike} = \pi D^2/4$$

Where
- Adike = surface area of pool fire (m^2)
- D = pool fire diameter (m)

$$D = \sqrt{(4A_{dike}/\pi)}$$

D = 1.720 m

Heat Release Rate Calculation

(Liquids with relatively high flash point, like transformer oil, require localized heating to achieve ignition)

$$Q = m''\Delta H_{c,eff}\,(1-e^{-k\beta D})\,A_{dike}$$

Q = 2239.89 Btu/sec 2363.20 kW

ESTIMATING POOL FIRE BURNING DURATION

Reference: *SFPE Handbook of Fire Protection Engineering* , 2nd Edition, 1995, Page 3-197.

$$t_b = 4V / \pi D^2 \nu$$

Where
- t_b = burning duration of pool fire (sec)
- V = volume of liquid (m^3)
- D = pool diameter (m)
- ν = regression rate (m/sec)

Calculation for Regression Rate

$$\nu = m''/\rho$$

Where
- ν = regression rate (m/sec)
- m" = mass burning rate of fuel (kg/m^2-sec)
- ρ = liquid fuel density (kg/m^3)

ν = 0.000052 m/sec

Burning Duration Calculation

$$t_b = 4V/\pi D^2 \nu$$

t_b = 157.20 sec 2.62 minutes

Note that a liquid pool fire with a given amount of fuel can burn for long periods of time over small area or for short periods of time over a large area.

ESTIMATING POOL FIRE FLAME HEIGHT

METHOD OF HESKESTAD

Reference: *SFPE Handbook of Fire Protection Engineering* , 2nd Edition, 1995, Page 2-10.

$$H_f = 0.235\ Q^{2/5} - 1.02\ D$$

Where
H_f = pool fire flame height (m)
Q = pool fire heat release rate (kW)
D = pool fire diameter (m)

Pool Fire Flame Height Calculation

$$H_f = 0.235\ Q^{2/5} - 1.02\ D$$

H_f = 11.48 ft 3.50 m

METHOD OF THOMAS

Reference: *SFPE Handbook of Fire Protection Engineering* , 2nd Edition, 1995, Page 3-204.

$$H_f = 42\ D\ (m''/\rho_a\ \sqrt{(g\ D)})^{0.61}$$

Where
H_f = pool fire flame height (m)
m'' = mass burning rate of fuel per unit surface area (kg/m^2-sec)
ρ_a = ambient air density (kg/m^3)
D = pool fire diameter (m)
g = gravitational acceleration (m/sec^2)

Pool Fire Flame Height Calculation

$$H_f = 42\ D\ (m''/(\rho_a\ \sqrt{(g\ D)}))^{0.61}$$

H_f = 12.86 ft 3.92 m

CHAPTER 3: ESTIMATING BURNING CHARACTERISTICS OF LIQUID POOL FIRE, HEAT RELEASE RATE, BURNING DURATION, AND FLAME HEIGHT

Version 1805.1 (English Units)

Summary of Results

Heat Release Rate Calculation

(Liquids with relatively high flash point, like transformer oil, require localized heating to achieve ignition)

$$Q = m''\Delta H_{c,eff}\,(1-e^{-k\beta\,D})\,A_{dike}$$

Answer	Q=	2239.89 Btu/sec	2363.20 kW

Burning Duration Calculation

$$t_b = 4V/\pi D^2 \nu$$

Answer	t_b=	157.20 sec	2.62 minutes

Flame Height Calculation

Method of Heskestad

$$H_f = 0.235\,Q^{2/5} - 1.02\,D$$

Method of Thomas

$$H_f = 42\,D\,(m''/(\rho_a\,\sqrt{(g\,D)}))^{0.61}$$

Answer		
	METHOD OF HESKESTAD	11.48 ft
	METHOD OF THOMAS	12.86 ft

ESTIMATING POOL FIRE RESULTS FOR RANDOM SIZE SPILLS USING INPUT PARAMETERS

Area (ft^2)	Area (m^2)	Diameter (m)	Q (kW)	t_b (sec)	H_f (ft) (Heskestad)	H_f (ft) (Thomas)
1	0.09	0.34	47.15	3930.05	2.45	4.20
2	0.19	0.49	118.54	1965.03	3.58	5.35
3	0.28	0.60	199.76	1310.02	4.42	6.16
4	0.37	0.69	286.70	982.51	5.11	6.80
5	0.46	0.77	377.39	786.01	5.70	7.35
6	0.56	0.84	470.67	655.01	6.22	7.83
7	0.65	0.91	565.82	561.44	6.69	8.26
8	0.74	0.97	662.35	491.26	7.11	8.66
9	0.84	1.03	759.92	436.67	7.50	9.02
10	0.93	1.09	858.28	393.01	7.86	9.36
11	1.02	1.14	957.24	357.28	8.19	9.67
12	1.11	1.19	1056.67	327.50	8.50	9.97
13	1.21	1.24	1156.45	302.31	8.80	10.25
14	1.30	1.29	1256.51	280.72	9.08	10.52
15	1.39	1.33	1356.77	262.00	9.35	10.77
20	1.86	1.54	1859.71	196.50	10.51	11.90
25	2.32	1.72	2363.20	157.20	11.48	12.86
50	4.65	2.43	4865.26	78.60	14.87	16.37
75	6.97	2.98	7344.77	52.40	17.16	18.84
100	9.29	3.44	9813.01	39.30	18.95	20.82

Caution! The purpose of this random spill size chart is to aid the user in evaluating the hazard of random sized spills. Please note that the calculation does not take into account the viscosity or volatility of the liquid, or the absorptivity of the surface. The results generated for small volume spills over large areas should be used with extreme caution.

NOTE:

The above calculations are based on principles developed in the Structural Design for Fire Safety, 2001. Calculations are based on certain assumptions and have inherent limitations. The results of such calculations may or may not have reasonable predictive capabilities for a given situation and should only be interpreted by an informed user. Although each calculation in the spreadsheet has been verified with the results of hand calculation, there is no absolute guarantee of the accuracy of these calculations. Any questions, comments, concerns and suggestions or to report an error(s) in the spreadsheet, please send an email to David.Stroup@nrc.gov or Naeem.Iqbal@nrc.gov.

Prepared by: Date: Organization:

Checked by: Date: Organization:

Additional Information:

Lobby Acetone Fire FDS Input File

Latest_Lobby_Ace.fds

Generated by PyroSim - Version 2014.1.0331

Jun 5, 2014 12:17:41 PM

```
&HEAD CHID='Latest_Lobby_Ace'/
&TIME T_END=190.0/
&DUMP RENDER_FILE='Latest_Lobby_Ace.ge1', DT_RESTART=300.0/
&RADI RADTMP=900.0/

&MESH ID='Mesh01', IJK=150,48,45, XB=-1.2,37.0,-7.00001,5.0,-1.0,10.2/

&SPEC ID='WATER VAPOR'/

&PART ID='Water',
    SPEC_ID='WATER VAPOR',
    DIAMETER=500.0,
    MONODISPERSE=.TRUE.,
    COLOR='BLUE',
    AGE=60.0,
    SAMPLING_FACTOR=1/

&REAC ID='POLYURETHANE_REAC',
    FYI='SFPE Handbook, Acetone',
```

```
    FUEL='ACETONE',
    CO_YIELD=0.003,
    SOOT_YIELD=0.014/

&PROP ID='Cleary Ionization I1',
    QUANTITY='CHAMBER OBSCURATION',
    ALPHA_E=2.5,
    BETA_E=-0.7,
    ALPHA_C=0.8,
    BETA_C=-0.9/
&PROP ID='Default_Water Spray',
    QUANTITY='SPRINKLER LINK TEMPERATURE',
    ACTIVATION_TEMPERATURE=68.3333,
    RTI=40.0,
    PART_ID='Water',
    FLOW_RATE=1.0,
    PARTICLE_VELOCITY=5.0/
&DEVC ID='SD', PROP_ID='Cleary Ionization I1', XYZ=3.048,2.01168,8.4582/
&DEVC ID='SPRK', PROP_ID='Default_Water Spray', XYZ=1.3,2.011,8.2296/
&DEVC ID='THCP', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,4.76104/
&DEVC ID='THCP01', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,5.06584/
&DEVC ID='THCP02', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,5.37064/
&DEVC ID='THCP03', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,5.67544/
&DEVC ID='THCP04', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,5.98024/
&DEVC ID='THCP05', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,6.28504/
```

```
&DEVC ID='THCP06', QUANTITY='THERMOCOUPLE', XYZ=36.4236,2.1336,6.58984/


&SURF ID='Fire',
    COLOR='RED',
    HRRPUA=1017.0,
    RAMP_Q='Fire_RAMP_Q'/
&RAMP ID='Fire_RAMP_Q', T=0.0, F=0.0/
&RAMP ID='Fire_RAMP_Q', T=30.0, F=0.42/
&RAMP ID='Fire_RAMP_Q', T=43.0, F=0.58/
&RAMP ID='Fire_RAMP_Q', T=50.0, F=0.67/
&RAMP ID='Fire_RAMP_Q', T=60.0, F=0.25/
&RAMP ID='Fire_RAMP_Q', T=189.0, F=0.25/
&RAMP ID='Fire_RAMP_Q', T=190.0, F=0.0/


&OBST XB=14.6304,16.764,-0.6096,-0.4096,0.0,4.2672, COLOR='GRAY 94', SURF_ID='INERT'/
Obstruction
&OBST XB=2.7432,3.9624,-0.3048,0.9144,0.0,1.2192, SURF_ID='INERT'/ Obstruction
&OBST XB=8.66594,8.86594,-6.5769,4.572,8.2296,8.5344, SURF_ID='INERT'/ Obstruction
&OBST XB=11.6605,11.8605,-0.0405998,4.58273,8.2296,8.5344, SURF_ID='INERT'/ Obstruction
&OBST XB=26.6822,26.8822,-0.00973398,4.55087,8.2296,8.5344, SURF_ID='INERT'/ Obstruction
&OBST XB=2.5,2.7,-0.653705,4.5,8.2296,8.5344, SURF_ID='INERT'/ Obstruction
&OBST XB=24.384,24.584,-6.51507,-0.2,4.2672,8.5344, COLOR='GRAY 94', SURF_ID='INERT'/
Obstruction
&OBST XB=29.156,29.356,-6.5319,-0.2,4.2672,8.5344, COLOR='WHITE', SURF_ID='INERT'/ Obstruction
&OBST XB=16.8318,17.0318,-6.53587,-0.2,4.2672,8.5344, COLOR='GRAY 94', SURF_ID='INERT'/
Obstruction
```

&OBST XB=-0.181333,0.0733333,-0.750005,4.5,-0.00444444,8.45778, COLOR='GRAY 94', OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction

&OBST XB=-0.181333,36.4907,4.5,4.75,-0.00444444,8.45778, COLOR='GRAY 94', OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction

&OBST XB=16.8813,36.7453,-0.250004,-4.16667E-6,-0.00444444,4.22667, COLOR='GRAY 94', OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction

&OBST XB=36.4907,36.7453,-4.16667E-6,4.75,-0.00444444,4.22667, COLOR='GRAY 94', OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction

&OBST XB=16.8813,16.8813,-0.500005,-0.250004,-0.00444444,4.22667, COLOR='GRAY 94', OUTLINE=.TRUE., SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,36.7453,-6.75001,-4.16667E-6,8.45778,8.70667, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,11.2787,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,13.316,-4.16667E-6,0.249996,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,13.316,0.999997,1.25,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=11.2787,13.316,0.249996,0.999997,9.70222,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=17.6453,17.9,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=17.6453,20.192,-4.16667E-6,0.249996,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=17.6453,20.192,0.999997,1.25,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=17.9,19.9373,0.249996,0.999997,9.70222,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=19.9373,20.192,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=24.2667,24.5213,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=24.2667,26.8133,-4.16667E-6,0.249996,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=24.2667,26.8133,0.999997,1.25,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=24.5213,26.5587,0.249996,0.999997,9.70222,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=26.5587,26.8133,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=31.1427,31.3973,0.249996,0.999997,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=31.1427,33.4347,-4.16667E-6,0.249996,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=31.1427,33.4347,0.999997,1.25,8.45778,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=31.3973,33.4347,0.249996,0.999997,9.70222,9.95111, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=13.316,13.316,0.249996,0.999997,8.45778,9.70222, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=33.4347,33.4347,0.249996,0.999997,8.45778,9.70222, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=-0.181333,5.676,-0.750005,-0.250004,-0.253333,-0.00444444, COLOR='GRAY 60', SURF_ID='INERT'/ Foundation

&OBST XB=-0.181333,36.7453,-0.250004,4.75,-0.253333,-0.00444444, COLOR='GRAY 60', SURF_ID='INERT'/ Foundation

&OBST XB=14.3347,16.8813,-0.500005,-0.250004,-0.253333,-0.00444444, COLOR='GRAY 60', SURF_ID='INERT'/ Foundation

&OBST XB=-0.181333,5.676,-0.750005,-0.500005,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=0.0733333,5.676,-0.750005,-0.500005,4.22667,8.45778, COLOR='GRAY 94', SURF_ID='INERT'/ Obstruction

&OBST XB=5.42133,5.676,-0.500005,-0.250004,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=5.42133,5.676,-6.50001,-0.750005,4.22667,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=5.42133,5.676,-0.500005,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=5.42133,10.7693,-6.75001,-6.50001,4.22667,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=5.42133,14.5893,-0.250004,-4.16667E-6,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,11.024,-6.75001,-6.50001,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,11.024,-6.50001,-0.250004,4.22667,4.47556, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,11.024,-6.75001,-0.250004,4.47556,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,14.5893,-0.250004,-4.16667E-6,4.22667,4.47556, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=10.7693,36.7453,-0.250004,-4.16667E-6,4.47556,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,36.4907,-6.50001,-0.250004,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,36.7453,-6.75001,-6.50001,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=11.024,36.7453,-6.75001,-6.50001,4.47556,8.45778, COLOR='GRAY 94', SURF_ID='INERT'/ Obstruction

&OBST XB=14.3347,14.5893,-0.500005,-0.250004,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=14.5893,14.844,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=14.5893,16.8813,-0.250004,-4.16667E-6,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=16.8813,17.3907,-0.250004,-4.16667E-6,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=16.8813,36.7453,-0.250004,-4.16667E-6,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=17.3907,36.7453,-0.250004,-4.16667E-6,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=17.6453,17.9,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=20.7013,20.956,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=23.7573,24.012,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=29.8693,30.124,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=32.9253,33.18,-4.16667E-6,4.5,8.20889,8.45778, SURF_ID='INERT'/ Obstruction

&OBST XB=36.4907,36.7453,-4.16667E-6,4.5,-0.00444444,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=36.4907,36.7453,-6.50001,-0.250004,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ Obstruction

&OBST XB=36.4907,36.7453,4.5,4.75,4.22667,8.45778, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=36.4907,36.7453,-6.50001,-0.250004,4.47556,8.45778, COLOR='GRAY 94', SURF_ID='INERT'/ Obstruction

&OBST XB=16.8813,16.8813,-0.500005,-0.250004,-0.00444444,4.22667, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=-0.181333,11.024,-0.750005,-0.250004,8.45778,8.70667, COLOR='INVISIBLE', SURF_ID='INERT'/ Roof

&OBST XB=-0.181333,36.7453,-0.250004,4.75,8.45778,8.70667, COLOR='INVISIBLE', SURF_ID='INERT'/ Roof

&OBST XB=5.42133,11.024,-6.75001,-0.750005,8.45778,8.70667, COLOR='INVISIBLE', SURF_ID='INERT'/ Roof

&OBST XB=5.42133,11.024,-6.75001,-0.250004,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ 2nd Floor

&OBST XB=5.42133,36.7453,-0.250004,-4.16667E-6,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ 2nd Floor

&OBST XB=6.18533,36.7453,-4.16667E-6,4.75,4.22667,4.47556, COLOR='GRAY 60', SURF_ID='INERT'/ 2nd Floor

```
&HOLE XB=14.6304,16.764,-0.6096,-0.4096,0.0,2.1336/ Hole

&HOLE XB=15.7684,16.6828,-0.2,-1.77636E-15,4.2672,6.5008/ Hole

&HOLE XB=17.4856,18.4,-0.2,-2.66454E-15,4.2672,6.5008/ Hole

&HOLE XB=24.7947,26.6235,-0.2,-2.38698E-15,4.2672,6.5008/ Hole

&HOLE XB=34.7935,35.7079,-0.2,-3.10862E-15,4.2672,6.5008/ Hole

&HOLE XB=11.2787,13.316,-4.16667E-6,0.999997,8.45778,8.70667, COLOR='INVISIBLE'/ Hole

&HOLE XB=17.9,19.9373,-4.16667E-6,0.999997,8.45778,8.70667, COLOR='INVISIBLE'/ Hole

&HOLE XB=24.5213,26.5587,-4.16667E-6,0.999997,8.45778,8.70667, COLOR='INVISIBLE'/ Hole

&HOLE XB=31.3973,33.4347,-4.16667E-6,0.999997,8.45778,8.70667, COLOR='INVISIBLE'/ Hole

&HOLE XB=10.7693,11.024,-3.50001,-2.50001,4.22667,6.46667/ Hole

&HOLE XB=9.75067,14.3347,0.249996,1.5,4.22667,4.47556/ Hole

&VENT SURF_ID='Fire', XB=0.3048,1.8288,-0.3048,1.2192,0.0,0.0/ Vent

&SLCF QUANTITY='TEMPERATURE', PBY=3.9624/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBY=3.9624/

&SLCF QUANTITY='VISIBILITY', PBY=3.9624/

&SLCF QUANTITY='TEMPERATURE', PBZ=6.096/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBZ=6.096/

&SLCF QUANTITY='VISIBILITY', PBZ=6.096/

&SLCF QUANTITY='TEMPERATURE', PBZ=1.8288/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBZ=1.8288/

&SLCF QUANTITY='VISIBILITY', PBZ=1.8288/

&SLCF QUANTITY='TEMPERATURE', PBZ=8.382/


&TAIL /
```

Room 104 Fire – Both Exits

B197_R104_PU_Fire.fds

Generated by PyroSim - Version 2014.1.0331

Jun 6, 2014 11:22:10 PM

```
&HEAD CHID='B197_R104_PU_Fire'/
&TIME T_END=300.0/
&DUMP RENDER_FILE='B197_R104_PU_Fire.ge1', DT_RESTART=300.0/

&MESH ID='Mesh', COLOR='WHITE', IJK=146,64,24, XB=-13.25,16.0,-7.45,5.35,-0.342593,4.34259/



&REAC ID='POLYURETHANE_REAC',
    FYI='SFPE Handbook, Polyester',
    FUEL='REAC_FUEL',
    FORMULA='C6H10O6',
    CO_YIELD=0.08,
    SOOT_YIELD=0.091/

&RAMP ID='Open/Close 72"_RAMP', T=36.75, F=1.0/
&RAMP ID='Open/Close 72"_RAMP', T=37.25, F=-1.0/
&RAMP ID='Open/Close 72"_RAMP', T=106.75, F=-1.0/
&RAMP ID='Open/Close 72"_RAMP', T=107.25, F=1.0/
```

```
&RAMP ID='Open/Close 36"_RAMP', T=36.75, F=1.0/

&RAMP ID='Open/Close 36"_RAMP', T=37.25, F=-1.0/

&RAMP ID='Open/Close 36"_RAMP', T=106.75, F=-1.0/

&RAMP ID='Open/Close 36"_RAMP', T=107.25, F=1.0/

&DEVC ID='TIME', QUANTITY='TIME', XYZ=-13.25,-7.45,-0.342593/

&CTRL ID='Open/Close 72"', FUNCTION_TYPE='CUSTOM', RAMP_ID='Open/Close 72"_RAMP',
LATCH=.FALSE., INPUT_ID='TIME'/

&CTRL ID='Open/Close 36"', FUNCTION_TYPE='CUSTOM', RAMP_ID='Open/Close 36"_RAMP',
LATCH=.FALSE., INPUT_ID='TIME'/


&MATL ID='CONCRETE',
    FYI='NBSIR 88-3752 - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=1.04,
    CONDUCTIVITY=1.8,
    DENSITY=2280.0/
&MATL ID='STEEL',
    FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=0.46,
    CONDUCTIVITY=45.8,
    DENSITY=7850.0,
    EMISSIVITY=0.95/
&MATL ID='GLASS',
    FYI='EngineeringToolBox.com',
    SPECIFIC_HEAT=0.83736,
    CONDUCTIVITY=1.05,
    DENSITY=2723.14,
```

```
    ABSORPTION_COEFFICIENT=0.15,
    EMISSIVITY=0.92/
&MATL ID='GYPSUM',
    FYI='NBSIR 88-3752 - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=1.09,
    CONDUCTIVITY=0.17,
    DENSITY=930.0/

&SURF ID='CONCRETE',
    RGB=146,202,166,
    MATL_ID(1,1)='CONCRETE',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.2,
    LAYER_DIVIDE=0.0/
&SURF ID='STEEL',
    RGB=146,202,166,
    MATL_ID(1,1)='STEEL',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.2,
    LAYER_DIVIDE=0.0/
&SURF ID='GLASS_WALL',
    COLOR='GRAY 80',
    MATL_ID(1,1)='GLASS',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.048768/
```

```
&SURF ID='GypsumWallBoard',
    RGB=146,202,166,
    MATL_ID(1,1)='GYPSUM',
    MATL_ID(2,1)='CONCRETE',
    MATL_ID(3,1)='GYPSUM',
    MATL_MASS_FRACTION(1,1)=1.0,
    MATL_MASS_FRACTION(2,1)=1.0,
    MATL_MASS_FRACTION(3,1)=1.0,
    THICKNESS(1:3)=0.0158749,0.16825,0.0158749/
&SURF ID='Fire',
    FYI='Polyurethan Plastic Backing - Metal Framed Chairs',
    COLOR='RED',
    HRRPUA=5269.0,
    RAMP_Q='Fire_RAMP_Q'/
&RAMP ID='Fire_RAMP_Q', T=0.0, F=0.0/
&RAMP ID='Fire_RAMP_Q', T=10.0, F=0.0/
&RAMP ID='Fire_RAMP_Q', T=20.0, F=0.01/
&RAMP ID='Fire_RAMP_Q', T=30.0, F=0.01/
&RAMP ID='Fire_RAMP_Q', T=40.0, F=0.03/
&RAMP ID='Fire_RAMP_Q', T=50.0, F=0.04/
&RAMP ID='Fire_RAMP_Q', T=60.0, F=0.06/
&RAMP ID='Fire_RAMP_Q', T=70.0, F=0.08/
&RAMP ID='Fire_RAMP_Q', T=80.0, F=0.1/
&RAMP ID='Fire_RAMP_Q', T=90.0, F=0.13/
&RAMP ID='Fire_RAMP_Q', T=100.0, F=0.16/
```

&RAMP ID='Fire_RAMP_Q', T=110.0, F=0.2/

&RAMP ID='Fire_RAMP_Q', T=120.0, F=0.23/

&RAMP ID='Fire_RAMP_Q', T=130.0, F=0.27/

&RAMP ID='Fire_RAMP_Q', T=140.0, F=0.32/

&RAMP ID='Fire_RAMP_Q', T=150.0, F=0.37/

&RAMP ID='Fire_RAMP_Q', T=300.0, F=0.37/

&OBST XB=-13.0,15.6512,5.0,5.2,0.0,4.2672, OUTLINE=.TRUE., SURF_ID='GLASS_WALL'/ Obstruction

&OBST XB=13.0,13.2,-2.72247,0.727899,0.0,4.2672, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=-9.88095,-9.68095,-7.2396,-6.7824,0.0,4.2672, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-12.1194,-9.68095,-6.9824,-6.7824,0.0,4.2672, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-12.1194,-11.9194,-7.2396,-6.7824,0.0,4.2672, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.2004,-12.1194,-7.2396,-7.0396,0.0,4.2672, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-7.18975,-5.36095,-2.9248,-2.7248,0.0,2.07264, SURF_ID='INERT', CTRL_ID='Open/Close 72"'/ 72" Door - R

&OBST XB=7.94278,8.85718,-2.9248,-2.7248,0.0,2.07264, SURF_ID='INERT', CTRL_ID='Open/Close 36"'/ 32" Door - R

&OBST XB=-10.3937,-9.72312,3.99288,4.60248,0.6096,0.64008, SURF_IDS='Fire','INERT','INERT'/ Obstruction

&OBST XB=-10.3937,-10.3632,4.60248,4.63296,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-9.7536,-9.72312,4.60248,4.63296,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-9.7536,-9.72312,3.9624,3.99288,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-10.3937,-10.3632,3.9624,3.99288,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-10.4182,-10.3937,3.99288,4.60248,0.6096,1.2596, SURF_ID='INERT'/ Obstruction

&OBST XB=-13.25,-11.8476,-7.25,-7.05,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/ Floor

&OBST XB=-13.25,9.98973,-7.05,-2.85,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/ Floor

&OBST XB=-13.25,15.7997,-2.85,5.15,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/ Floor

&OBST XB=-9.84418,9.98973,-7.25,-7.05,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/ Floor

&OBST XB=-9.64384,9.98973,-7.25,-7.05,0.0478389,4.34259, COLOR='INVISIBLE', SURF_ID='INERT'/ Obstruction

&OBST XB=-7.03938,-6.83904,-2.65,4.95,3.95216,4.34259, RGB=255,255,153, REMOVABLE=.FALSE., SURF_ID='STEEL'/ Obstruction

&OBST XB=-13.25,-11.8476,-7.25,-7.05,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,9.98973,-7.05,-2.85,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,15.7997,-2.85,5.15,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-9.84418,9.98973,-7.25,-7.05,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,-13.0497,-7.05,-2.45,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-13.0497,-2.25,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-13.0497,0.95,5.15,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-9.04281,-2.45,-2.25,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-7.44007,0.75,0.95,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-10.4452,-10.2449,-2.25,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=-10.2449,-10.0445,0.95,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=-9.24315,-9.04281,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-9.24315,-4.83562,-2.85,-2.65,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-7.64041,-7.44007,-2.65,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-5.03596,-4.83562,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-5.03596,7.78596,-2.45,-2.25,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-3.8339,-3.63356,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=-0.428082,-0.22774,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=2.7774,2.97774,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=5.98288,6.18322,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=7.58562,7.78596,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=7.58562,9.78938,-2.85,-2.65,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.18836,9.3887,-2.65,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=9.58904,9.78938,-2.65,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.58904,15.7997,0.75,0.95,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.78938,9.98973,-7.05,-2.85,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.78938,15.7997,-2.85,-2.65,0.0478389,4.34259, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=12.3938,12.5942,0.95,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/
Obstruction

&OBST XB=15.5993,15.7997,-2.65,0.75,0.0478389,4.34259, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=15.5993,15.7997,0.95,5.15,0.0478389,4.34259, COLOR='WHITE',
SURF_ID='GypsumWallBoard'/ Obstruction

&HOLE XB=-11.9194,-9.88095,-6.9824,-6.7824,0.0,2.07264/ Hole

&HOLE XB=9.78938,9.98973,-5.85,-4.05,0.0478389,2.0, COLOR='WHITE'/ Hole

&HOLE XB=-13.27,-13.0497,-7.05,-2.45,0.0478389,2.78086, COLOR='GRAY 94'/ Hole

&SLCF QUANTITY='TEMPERATURE', PBZ=1.8288/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBZ=1.8288/

&SLCF QUANTITY='VISIBILITY', PBZ=1.8288/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBY=1.3/

&SLCF QUANTITY='VISIBILITY', PBY=1.3/

&SLCF QUANTITY='TEMPERATURE', PBY=1.3/

&SLCF QUANTITY='TEMPERATURE', PBY=-5.0/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBY=-5.0/

&SLCF QUANTITY='VISIBILITY', PBY=-5.0/

&SLCF QUANTITY='TEMPERATURE', PBZ=4.1/

&TAIL /

Room 104 – Single Exit

B197_R104_PU_Fire_36_Open.fds

Generated by PyroSim - Version 2014.1.0331

Jun 7, 2014 11:46:06 PM

```
&HEAD CHID='B197_R104_PU_Fire_36_Open'/
&TIME T_END=200.0/
&DUMP RENDER_FILE='B197_R104_PU_Fire_36_Open.ge1', DT_RESTART=300.0/

&MESH ID='Mesh', COLOR='WHITE', IJK=146,64,24, XB=-13.25,16.0,-7.45,5.35,-0.342593,4.34259/



&REAC ID='POLYURETHANE_REAC',
    FYI='SFPE Handbook, Polyester',
    FUEL='REAC_FUEL',
    FORMULA='C6H10O6',
    CO_YIELD=0.08,
    SOOT_YIELD=0.091/

&RAMP ID='Open/Close 36"_RAMP', T=36.75, F=1.0/
&RAMP ID='Open/Close 36"_RAMP', T=37.25, F=-1.0/
&RAMP ID='Open/Close 36"_RAMP', T=170.75, F=-1.0/
&RAMP ID='Open/Close 36"_RAMP', T=171.25, F=1.0/
&DEVC ID='TIME', QUANTITY='TIME', XYZ=-13.25,-7.45,-0.342593/
```

```
&CTRL ID='Open/Close 36"', FUNCTION_TYPE='CUSTOM', RAMP_ID='Open/Close 36"_RAMP',
LATCH=.FALSE., INPUT_ID='TIME'/


&MATL ID='CONCRETE',
    FYI='NBSIR 88-3752 - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=1.04,
    CONDUCTIVITY=1.8,
    DENSITY=2280.0/
&MATL ID='STEEL',
    FYI='Drysdale, Intro to Fire Dynamics - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=0.46,
    CONDUCTIVITY=45.8,
    DENSITY=7850.0,
    EMISSIVITY=0.95/
&MATL ID='GLASS',
    FYI='EngineeringToolBox.com',
    SPECIFIC_HEAT=0.83736,
    CONDUCTIVITY=1.05,
    DENSITY=2723.14,
    ABSORPTION_COEFFICIENT=0.15,
    EMISSIVITY=0.92/
&MATL ID='GYPSUM',
    FYI='NBSIR 88-3752 - ATF NIST Multi-Floor Validation',
    SPECIFIC_HEAT=1.09,
    CONDUCTIVITY=0.17,
    DENSITY=930.0/
```

```
&SURF ID='CONCRETE',
    RGB=146,202,166,
    MATL_ID(1,1)='CONCRETE',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.2,
    LAYER_DIVIDE=0.0/
&SURF ID='STEEL',
    RGB=146,202,166,
    MATL_ID(1,1)='STEEL',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.2,
    LAYER_DIVIDE=0.0/
&SURF ID='GLASS_WALL',
    COLOR='GRAY 80',
    MATL_ID(1,1)='GLASS',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.048768/
&SURF ID='GypsumWallBoard',
    RGB=146,202,166,
    MATL_ID(1,1)='GYPSUM',
    MATL_ID(2,1)='CONCRETE',
    MATL_ID(3,1)='GYPSUM',
    MATL_MASS_FRACTION(1,1)=1.0,
    MATL_MASS_FRACTION(2,1)=1.0,
```

```
    MATL_MASS_FRACTION(3,1)=1.0,
    THICKNESS(1:3)=0.0158749,0.16825,0.0158749/
&SURF ID='Fire',
    FYI='Polyurethan Plastic Backing - Metal Framed Chairs',
    COLOR='RED',
    HRRPUA=5269.0,
    RAMP_Q='Fire_RAMP_Q'/
&RAMP ID='Fire_RAMP_Q', T=0.0, F=0.0/
&RAMP ID='Fire_RAMP_Q', T=10.0, F=0.0/
&RAMP ID='Fire_RAMP_Q', T=20.0, F=0.01/
&RAMP ID='Fire_RAMP_Q', T=30.0, F=0.01/
&RAMP ID='Fire_RAMP_Q', T=40.0, F=0.03/
&RAMP ID='Fire_RAMP_Q', T=50.0, F=0.04/
&RAMP ID='Fire_RAMP_Q', T=60.0, F=0.06/
&RAMP ID='Fire_RAMP_Q', T=70.0, F=0.08/
&RAMP ID='Fire_RAMP_Q', T=80.0, F=0.1/
&RAMP ID='Fire_RAMP_Q', T=90.0, F=0.13/
&RAMP ID='Fire_RAMP_Q', T=100.0, F=0.16/
&RAMP ID='Fire_RAMP_Q', T=110.0, F=0.2/
&RAMP ID='Fire_RAMP_Q', T=120.0, F=0.23/
&RAMP ID='Fire_RAMP_Q', T=130.0, F=0.27/
&RAMP ID='Fire_RAMP_Q', T=140.0, F=0.32/
&RAMP ID='Fire_RAMP_Q', T=150.0, F=0.37/
&RAMP ID='Fire_RAMP_Q', T=300.0, F=0.37/
```

&OBST XB=-13.0,15.6512,5.0,5.2,0.0,4.2672, OUTLINE=.TRUE., SURF_ID='GLASS_WALL'/ Obstruction

&OBST XB=13.0,13.2,-2.72247,0.727899,0.0,4.2672, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=-9.88095,-9.68095,-7.2396,-6.7824,0.0,4.2672, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-12.1194,-9.68095,-6.9824,-6.7824,0.0,4.2672, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-12.1194,-11.9194,-7.2396,-6.7824,0.0,4.2672, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.2004,-12.1194,-7.2396,-7.0396,0.0,4.2672, COLOR='GRAY 94',
SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-7.18975,-5.36095,-2.9248,-2.7248,0.0,2.07264, SURF_ID='INERT'/ 72" Door - R

&OBST XB=7.94278,8.85718,-2.9248,-2.7248,0.0,2.07264, SURF_ID='INERT', CTRL_ID='Open/Close 36"'/
32" Door - R

&OBST XB=-10.3937,-9.72312,3.99288,4.60248,0.6096,0.64008, SURF_IDS='Fire','INERT','INERT'/
Obstruction

&OBST XB=-10.3937,-10.3632,4.60248,4.63296,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-9.7536,-9.72312,4.60248,4.63296,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-9.7536,-9.72312,3.9624,3.99288,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-10.3937,-10.3632,3.9624,3.99288,0.0,0.64008, SURF_ID='INERT'/ Obstruction

&OBST XB=-10.4182,-10.3937,3.99288,4.60248,0.6096,1.2596, SURF_ID='INERT'/ Obstruction

&OBST XB=-13.25,-11.8476,-7.25,-7.05,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/
Floor

&OBST XB=-13.25,9.98973,-7.05,-2.85,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/
Floor

&OBST XB=-13.25,15.7997,-2.85,5.15,-0.342593,0.0478389, COLOR='GRAY 80', SURF_ID='CONCRETE'/
Floor

&OBST XB=-9.84418,9.98973,-7.25,-7.05,-0.342593,0.0478389, COLOR='GRAY 80',
SURF_ID='CONCRETE'/ Floor

&OBST XB=-9.64384,9.98973,-7.25,-7.05,0.0478389,4.34259, COLOR='INVISIBLE', SURF_ID='INERT'/
Obstruction

&OBST XB=-7.03938,-6.83904,-2.65,4.95,3.95216,4.34259, RGB=255,255,153, REMOVABLE=.FALSE., SURF_ID='STEEL'/ Obstruction

&OBST XB=-13.25,-11.8476,-7.25,-7.05,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,9.98973,-7.05,-2.85,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,15.7997,-2.85,5.15,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-9.84418,9.98973,-7.25,-7.05,4.34259,4.34259, COLOR='GRAY 60', OUTLINE=.TRUE., SURF_ID='STEEL'/ Roof

&OBST XB=-13.25,-13.0497,-7.05,-2.45,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-13.0497,-2.25,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-13.0497,0.95,5.15,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-9.04281,-2.45,-2.25,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-13.25,-7.44007,0.75,0.95,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-10.4452,-10.2449,-2.25,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='INERT'/ Obstruction

&OBST XB=-10.2449,-10.0445,0.95,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=-9.24315,-9.04281,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-9.24315,-4.83562,-2.85,-2.65,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-7.64041,-7.44007,-2.65,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-5.03596,-4.83562,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-5.03596,7.78596,-2.45,-2.25,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=-3.8339,-3.63356,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=-0.428082,-0.22774,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=2.7774,2.97774,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=5.98288,6.18322,-2.25,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=7.58562,7.78596,-2.65,-2.45,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=7.58562,9.78938,-2.85,-2.65,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.18836,9.3887,-2.65,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=9.58904,9.78938,-2.65,0.75,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.58904,15.7997,0.75,0.95,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.78938,9.98973,-7.05,-2.85,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=9.78938,15.7997,-2.85,-2.65,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=12.3938,12.5942,0.95,4.95,3.95216,4.34259, RGB=255,255,153, SURF_ID='STEEL'/ Obstruction

&OBST XB=15.5993,15.7997,-2.65,0.75,0.0478389,4.34259, COLOR='GRAY 94', SURF_ID='GypsumWallBoard'/ Obstruction

&OBST XB=15.5993,15.7997,0.95,5.15,0.0478389,4.34259, COLOR='WHITE', SURF_ID='GypsumWallBoard'/ Obstruction

```
&HOLE XB=-11.9194,-9.88095,-6.9824,-6.7824,0.0,2.07264/ Hole

&HOLE XB=9.78938,9.98973,-5.85,-4.05,0.0478389,2.0, COLOR='WHITE'/ Hole

&HOLE XB=-13.27,-13.0497,-7.05,-2.45,0.0478389,2.78086, COLOR='GRAY 94'/ Hole


&SLCF QUANTITY='TEMPERATURE', PBZ=1.8288/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBZ=1.8288/

&SLCF QUANTITY='VISIBILITY', PBZ=1.8288/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBY=1.3/

&SLCF QUANTITY='VISIBILITY', PBY=1.3/

&SLCF QUANTITY='TEMPERATURE', PBY=1.3/

&SLCF QUANTITY='TEMPERATURE', PBY=-5.0/

&SLCF QUANTITY='AEROSOL VOLUME FRACTION', SPEC_ID='CARBON MONOXIDE', PBY=-5.0/

&SLCF QUANTITY='VISIBILITY', PBY=-5.0/

&SLCF QUANTITY='TEMPERATURE', PBZ=4.1/


&TAIL /
```

PATHFINDER NORMAL EGRESS (ALL EXITS AVAILIBLE) - STEERING

SUMMARYSUMMARY***SUMMARY***SUMMARY***SUMMARY***

Simulation: Bonderson 1st Floor

Mode: Steering

Total Occupants: 383

Exit Times (s):

Min: 1.5

Max: 70.4

Average: 29.3

StdDev: 16.0

[Components] All: 76

[Components] Doors: 47

Triangles: 815

Startup Time: 0.0s

CPU Time: 6.7s

ROOM/DOOR	FIRST IN (s)	LAST OUT (s)	TOTAL USE (pers)	FLOW AVG. (pers/s)
Floor 0.0 ft->R102	0.0	8.8	14	
Floor 0.0 ft->R104	0.0	68.7	120	
Floor 0.0 ft->R114	0.0	13.1	25	
Floor 0.0 ft->R115	0.0	7.7	8	

Floor 0.0 ft->T117	0.0	5.0	3	
Floor 0.0 ft->R116	0.0	0.0	0	
Floor 0.0 ft->R107	0.0	16.2	26	
Floor 0.0 ft->R110	0.0	12.1	13	
Floor 0.0 ft->R109	0.0	6.3	4	
Floor 0.0 ft->R108	0.0	9.6	8	
Floor 0.0 ft->Room11	1.7	70.4	200	
Floor 0.0 ft->R112	0.0	0.0	0	
Floor 0.0 ft->R111	0.0	0.0	0	
Floor 0.0 ft->Door00	1.7	68.7	47	0.70
Floor 0.0 ft->Door01	0.0	0.0	0	
Floor 0.0 ft->Door02	0.0	0.0	0	
Floor 0.0 ft->Door03	2.0	4.1	3	1.46
Floor 0.0 ft->Door04	0.0	0.0	0	
Floor 0.0 ft->Door05	1.2	6.7	6	1.10
Floor 0.0 ft->CWA	0.0	45.8	141	
Floor 0.0 ft->Door08	3.7	70.4	112	1.68
Floor 0.0 ft->Door12	2.1	12.0	10	1.02
Floor 0.0 ft->Door13	8.4	16.2	7	0.90
Floor 0.0 ft->Door14	1.4	7.5	5	0.82
Floor 0.0 ft->Door15	1.6	13.1	20	1.74
Floor 0.0 ft->Door17	2.5	7.7	7	1.34
Floor 0.0 ft->Door18	1.7	8.8	14	1.97
Floor 0.0 ft->Door19	1.3	5.1	3	0.80
Floor 0.0 ft->Door20	1.5	12.1	10	0.94

Floor 0.0 ft->Door21	2.6	6.3	4	1.07
Floor 0.0 ft->Door22	2.7	9.6	8	1.15
Floor 0.0 ft->Door23	2.3	18.9	16	0.96
Floor 0.0 ft->Door24	1.7	22.6	21	1.00
Floor 0.0 ft->Door25	3.8	39.7	37	1.03
Floor 0.0 ft->Door26	2.2	5.0	3	1.08
Floor 0.0 ft->Door27	0.0	0.0	0	
Floor 0.0 ft->Door29	4.9	29.7	20	0.81
Floor 0.0 ft->Door30	1.5	45.8	47	1.06
Floor 0.0 ft->R113	0.0	0.0	0	
Floor 0.0 ft->Door55	0.0	0.0	0	
Floor 0.0 ft->Door56	2.2	2.2	1	
Floor 0.0 ft->Room42	0.0	0.0	0	
Floor 0.0 ft->Door58	0.0	0.0	0	
Floor 0.0 ft->Room48	14.9	55.8	42	
Floor 0.0 ft->Door65	0.0	0.0	0	
Floor 0.0 ft->Door66	1.8	53.5	73	1.41
Floor 0.0 ft->Stair21	4.7	56.1	56	
Stair21 door 1	4.7	45.1	56	1.39
Stair21 door 2	15.6	56.1	56	1.38
Floor 0.0 ft->Door67	7.3	60.9	78	1.45
Floor 0.0 ft->Door68	5.5	15.6	10	0.99
Floor 14.0 ft->R205	0.0	7.5	5	
Floor 14.0 ft->R204	0.0	13.5	25	
Floor 14.0 ft->R203	0.0	26.4	44	

Floor 14.0 ft->R209	0.0	29.3	11	
Floor 14.0 ft->R210	0.0	12.8	10	
Floor 14.0 ft->R211	0.0	0.0	0	
Floor 14.0 ft->R212	0.0	7.0	5	
Floor 14.0 ft->Room23	0.0	0.0	0	
Floor 14.0 ft->Door32	0.0	0.0	0	
Floor 14.0 ft->Door33	4.5	12.8	10	1.21
Floor 14.0 ft->Door34	2.5	29.3	11	0.41
Floor 14.0 ft->Door35	0.0	0.0	0	
Floor 14.0 ft->Door37	1.9	20.9	18	0.95
Floor 14.0 ft->Door38	0.9	7.5	5	0.75
Floor 14.0 ft->Door39	4.5	7.0	5	1.96
Floor 14.0 ft->Door40	1.0	13.5	25	2.00
Floor 14.0 ft->Door41	0.0	0.0	0	
Floor 14.0 ft->Door44	1.5	26.4	26	1.04
Floor 14.0 ft->Room24	0.9	45.1	98	
Floor 14.0 ft->Room35	2.8	47.6	42	
Floor 14.0 ft->Door51	2.8	39.1	42	1.16
Floor 14.0 ft->Stair20	8.2	54.3	42	
Stair20 door 1	8.2	47.6	42	1.07
Stair20 door 2	14.9	54.3	42	1.06
Floor 14.0 ft->Door64	16.3	55.8	42	1.06

---	---	---	---	---

PATHFINDER LOBBY FIRE – STEERING

SUMMARYSUMMARY***SUMMARY***SUMMARY***SUMMARY***

Simulation: Bonderson 1st Floor

Mode: Steering

Total Occupants: 383

Exit Times (s):

Min: 1.5

Max: 125.0

Average: 39.5

StdDev: 28.0

[Components] All: 71

[Components] Doors: 43

Triangles: 807

Startup Time: 0.1s

CPU Time: 11.5s

ROOM/DOOR	FIRST IN (s)	LAST OUT (s)	TOTAL USE (pers)	FLOW AVG. (pers/s)
Floor 0.0 ft->R102	0.0	8.5	14	
Floor 0.0 ft->R104	0.0	71.1	120	
Floor 0.0 ft->R114	0.0	13.1	25	
Floor 0.0 ft->R115	0.0	7.7	8	
Floor 0.0 ft->T117	0.0	5.0	3	

Floor 0.0 ft->R116	0.0	0.0	0	
Floor 0.0 ft->R107	0.0	16.2	26	
Floor 0.0 ft->R110	0.0	15.5	16	
Floor 0.0 ft->R109	0.0	11.7	7	
Floor 0.0 ft->R108	0.0	16.8	12	
Floor 0.0 ft->Room11	1.7	75.6	134	
Floor 0.0 ft->R112	0.0	0.0	0	
Floor 0.0 ft->R111	0.0	0.0	0	
Floor 0.0 ft->Door00	1.7	71.1	48	0.69
Floor 0.0 ft->Door01	0.0	0.0	0	
Floor 0.0 ft->Door02	0.0	0.0	0	
Floor 0.0 ft->Door03	2.0	11.4	7	0.75
Floor 0.0 ft->Door04	4.2	6.3	3	1.43
Floor 0.0 ft->Door05	1.2	10.1	9	1.02
Floor 0.0 ft->CWA	0.0	45.8	151	
Floor 0.0 ft->Door08	3.7	75.6	134	1.86
Floor 0.0 ft->Door12	0.0	0.0	0	
Floor 0.0 ft->Door13	8.4	16.2	7	0.90
Floor 0.0 ft->Door14	1.4	7.5	5	0.82
Floor 0.0 ft->Door15	1.6	13.1	20	1.74
Floor 0.0 ft->Door17	2.5	7.7	7	1.34
Floor 0.0 ft->Door18	1.7	8.5	14	2.06
Floor 0.0 ft->Door19	1.3	5.1	3	0.80
Floor 0.0 ft->Door20	1.5	15.5	13	0.93
Floor 0.0 ft->Door21	2.6	11.7	7	0.77
Floor 0.0 ft->Door22	2.7	16.8	12	0.85
Floor 0.0 ft->Door23	2.3	25.0	22	0.97
Floor 0.0 ft->Door24	1.7	28.0	25	0.95

Floor 0.0 ft->Door25	3.8	39.7	37	1.03
Floor 0.0 ft->Door26	2.2	5.0	3	1.08
Floor 0.0 ft->Door27	0.0	0.0	0	
Floor 0.0 ft->Door29	4.9	29.7	20	0.81
Floor 0.0 ft->Door30	1.5	45.8	47	1.06
Floor 0.0 ft->R113	0.0	0.0	0	
Floor 0.0 ft->Door55	0.0	0.0	0	
Floor 0.0 ft->Door56	2.2	2.2	1	
Floor 0.0 ft->Room42	0.0	0.0	0	
Floor 0.0 ft->Door58	0.0	0.0	0	
Floor 0.0 ft->Room48	14.9	125.0	98	
Floor 0.0 ft->Door65	0.0	0.0	0	
Floor 0.0 ft->Door66	1.8	61.4	72	1.21
Floor 14.0 ft->R205	0.0	7.5	5	
Floor 14.0 ft->R204	0.0	16.4	25	
Floor 14.0 ft->R203	0.0	36.8	44	
Floor 14.0 ft->R209	0.0	9.7	9	
Floor 14.0 ft->R210	0.0	12.8	10	
Floor 14.0 ft->R211	12.0	22.8	4	
Floor 14.0 ft->R212	0.0	7.0	5	
Floor 14.0 ft->Room23	0.0	0.0	0	
Floor 14.0 ft->Door32	0.0	0.0	0	
Floor 14.0 ft->Door33	4.5	12.8	10	1.21
Floor 14.0 ft->Door34	2.5	9.7	9	1.25
Floor 14.0 ft->Door35	0.0	0.0	0	
Floor 14.0 ft->Door37	1.9	36.8	34	0.98
Floor 14.0 ft->Door38	0.9	7.5	5	0.75
Floor 14.0 ft->Door39	4.5	7.0	5	1.96

Floor 14.0 ft->Door40	1.0	16.4	25	1.62
Floor 14.0 ft->Door41	12.0	22.8	4	0.37
Floor 14.0 ft->Door44	1.5	11.0	10	1.06
Floor 14.0 ft->Room24	0.9	111.2	98	
Floor 14.0 ft->Room35	2.8	116.9	98	
Floor 14.0 ft->Door51	2.8	111.2	98	0.90
Floor 14.0 ft->Stair20	8.2	123.6	98	
Stair20 door 1	8.2	116.9	98	0.90
Stair20 door 2	14.9	123.6	98	0.90
Floor 14.0 ft->Door64	16.3	125.0	98	0.90

PATHFINDER – STEERING R104 FIRE 2 EXITS AVAILIBLE

SUMMARYSUMMARY***SUMMARY***SUMMARY***SUMMARY***

Simulation: Bonderson 1st Floor

Mode: Steering

Total Occupants: 120

Exit Times (s):

Min: 2.9

Max: 69.1

Average: 38.8

StdDev: 16.4

[Components] All: 71

[Components] Doors: 43

Triangles: 807

Startup Time: 0.1s

CPU Time: 3.5s

ROOM/DOOR	FIRST IN (s)	LAST OUT (s)	TOTAL USE (pers)	FLOW AVG. (pers/s)
Floor 0.0 ft->R102	0.0	0.0	0	
Floor 0.0 ft->R104	0.0	67.1	120	
Floor 0.0 ft->R114	0.0	0.0	0	
Floor 0.0 ft->R115	0.0	0.0	0	
Floor 0.0 ft->T117	0.0	0.0	0	
Floor 0.0 ft->R116	0.0	0.0	0	
Floor 0.0 ft->R107	0.0	0.0	0	
Floor 0.0 ft->R110	0.0	0.0	0	
Floor 0.0 ft->R109	0.0	0.0	0	
Floor 0.0 ft->R108	0.0	0.0	0	
Floor 0.0 ft->Room11	1.1	69.1	120	
Floor 0.0 ft->R112	0.0	0.0	0	
Floor 0.0 ft->R111	0.0	0.0	0	
Floor 0.0 ft->Door00	1.1	67.1	42	0.64
Floor 0.0 ft->Door01	0.0	0.0	0	
Floor 0.0 ft->Door02	0.0	0.0	0	
Floor 0.0 ft->Door03	0.0	0.0	0	
Floor 0.0 ft->Door04	0.0	0.0	0	
Floor 0.0 ft->Door05	0.0	0.0	0	
Floor 0.0 ft->CWA	0.0	0.0	0	
Floor 0.0 ft->Door08	2.9	69.1	120	1.81
Floor 0.0 ft->Door12	0.0	0.0	0	

Floor 0.0 ft->Door13	0.0	0.0	0	
Floor 0.0 ft->Door14	0.0	0.0	0	
Floor 0.0 ft->Door15	0.0	0.0	0	
Floor 0.0 ft->Door17	0.0	0.0	0	
Floor 0.0 ft->Door18	0.0	0.0	0	
Floor 0.0 ft->Door19	0.0	0.0	0	
Floor 0.0 ft->Door20	0.0	0.0	0	
Floor 0.0 ft->Door21	0.0	0.0	0	
Floor 0.0 ft->Door22	0.0	0.0	0	
Floor 0.0 ft->Door23	0.0	0.0	0	
Floor 0.0 ft->Door24	0.0	0.0	0	
Floor 0.0 ft->Door25	0.0	0.0	0	
Floor 0.0 ft->Door26	0.0	0.0	0	
Floor 0.0 ft->Door27	0.0	0.0	0	
Floor 0.0 ft->Door29	0.0	0.0	0	
Floor 0.0 ft->Door30	0.0	0.0	0	
Floor 0.0 ft->R113	0.0	0.0	0	
Floor 0.0 ft->Door55	0.0	0.0	0	
Floor 0.0 ft->Door56	0.0	0.0	0	
Floor 0.0 ft->Room42	0.0	0.0	0	
Floor 0.0 ft->Door58	0.0	0.0	0	
Floor 0.0 ft->Room48	0.0	0.0	0	
Floor 0.0 ft->Door65	0.0	0.0	0	
Floor 0.0 ft->Door66	2.0	51.5	78	1.58
Floor 14.0 ft->R205	0.0	0.0	0	
Floor 14.0 ft->R204	0.0	0.0	0	
Floor 14.0 ft->R203	0.0	0.0	0	
Floor 14.0 ft->R209	0.0	0.0	0	

Floor 14.0 ft->R210	0.0	0.0	0
Floor 14.0 ft->R211	0.0	0.0	0
Floor 14.0 ft->R212	0.0	0.0	0
Floor 14.0 ft->Room23	0.0	0.0	0
Floor 14.0 ft->Door32	0.0	0.0	0
Floor 14.0 ft->Door33	0.0	0.0	0
Floor 14.0 ft->Door34	0.0	0.0	0
Floor 14.0 ft->Door35	0.0	0.0	0
Floor 14.0 ft->Door37	0.0	0.0	0
Floor 14.0 ft->Door38	0.0	0.0	0
Floor 14.0 ft->Door39	0.0	0.0	0
Floor 14.0 ft->Door40	0.0	0.0	0
Floor 14.0 ft->Door41	0.0	0.0	0
Floor 14.0 ft->Door44	0.0	0.0	0
Floor 14.0 ft->Room24	0.0	0.0	0
Floor 14.0 ft->Room35	0.0	0.0	0
Floor 14.0 ft->Door51	0.0	0.0	0
Floor 14.0 ft->Stair20	0.0	0.0	0
Stair20 door 1	0.0	0.0	0
Stair20 door 2	0.0	0.0	0
Floor 14.0 ft->Door64	0.0	0.0	0

---	---	---	---	---

PATHFINDER – STEERING R104 FIRE 36” DOOR AVAILIBLE

SUMMARYSUMMARY***SUMMARY***SUMMARY***SUMMARY***

Simulation: Bonderson 1st Floor

Mode: Steering

Total Occupants: 120

Exit Times (s):

Min: 2.9

Max: 135.7

Average: 70.9

StdDev: 37.8

[Components] All: 70

[Components] Doors: 42

Triangles: 801

Startup Time: 0.0s

CPU Time: 5.3s

ROOM/DOOR	FIRST IN (s)	LAST OUT (s)	TOTAL USE (pers)	FLOW AVG. (pers/s)
Floor 0.0 ft->R102	0.0	0.0	0	
Floor 0.0 ft->R104	0.0	133.5	120	
Floor 0.0 ft->R114	0.0	0.0	0	
Floor 0.0 ft->R115	0.0	0.0	0	
Floor 0.0 ft->T117	0.0	0.0	0	
Floor 0.0 ft->R116	0.0	0.0	0	
Floor 0.0 ft->R107	0.0	0.0	0	

Floor 0.0 ft->R110	0.0	0.0	0	
Floor 0.0 ft->R109	0.0	0.0	0	
Floor 0.0 ft->R108	0.0	0.0	0	
Floor 0.0 ft->Room11	1.1	135.7	120	
Floor 0.0 ft->R112	0.0	0.0	0	
Floor 0.0 ft->R111	0.0	0.0	0	
Floor 0.0 ft->Door00	1.1	133.5	120	0.91
Floor 0.0 ft->Door01	0.0	0.0	0	
Floor 0.0 ft->Door02	0.0	0.0	0	
Floor 0.0 ft->Door03	0.0	0.0	0	
Floor 0.0 ft->Door04	0.0	0.0	0	
Floor 0.0 ft->Door05	0.0	0.0	0	
Floor 0.0 ft->CWA	0.0	0.0	0	
Floor 0.0 ft->Door08	2.9	135.7	120	0.90
Floor 0.0 ft->Door12	0.0	0.0	0	
Floor 0.0 ft->Door13	0.0	0.0	0	
Floor 0.0 ft->Door14	0.0	0.0	0	
Floor 0.0 ft->Door15	0.0	0.0	0	
Floor 0.0 ft->Door17	0.0	0.0	0	
Floor 0.0 ft->Door18	0.0	0.0	0	
Floor 0.0 ft->Door19	0.0	0.0	0	
Floor 0.0 ft->Door20	0.0	0.0	0	
Floor 0.0 ft->Door21	0.0	0.0	0	
Floor 0.0 ft->Door22	0.0	0.0	0	
Floor 0.0 ft->Door23	0.0	0.0	0	
Floor 0.0 ft->Door24	0.0	0.0	0	
Floor 0.0 ft->Door25	0.0	0.0	0	
Floor 0.0 ft->Door26	0.0	0.0	0	

Floor 0.0 ft->Door27	0.0	0.0	0
Floor 0.0 ft->Door29	0.0	0.0	0
Floor 0.0 ft->Door30	0.0	0.0	0
Floor 0.0 ft->R113	0.0	0.0	0
Floor 0.0 ft->Door55	0.0	0.0	0
Floor 0.0 ft->Door56	0.0	0.0	0
Floor 0.0 ft->Room42	0.0	0.0	0
Floor 0.0 ft->Door58	0.0	0.0	0
Floor 0.0 ft->Room48	0.0	0.0	0
Floor 0.0 ft->Door65	0.0	0.0	0
Floor 14.0 ft->R205	0.0	0.0	0
Floor 14.0 ft->R204	0.0	0.0	0
Floor 14.0 ft->R203	0.0	0.0	0
Floor 14.0 ft->R209	0.0	0.0	0
Floor 14.0 ft->R210	0.0	0.0	0
Floor 14.0 ft->R211	0.0	0.0	0
Floor 14.0 ft->R212	0.0	0.0	0
Floor 14.0 ft->Room23	0.0	0.0	0
Floor 14.0 ft->Door32	0.0	0.0	0
Floor 14.0 ft->Door33	0.0	0.0	0
Floor 14.0 ft->Door34	0.0	0.0	0
Floor 14.0 ft->Door35	0.0	0.0	0
Floor 14.0 ft->Door37	0.0	0.0	0
Floor 14.0 ft->Door38	0.0	0.0	0
Floor 14.0 ft->Door39	0.0	0.0	0
Floor 14.0 ft->Door40	0.0	0.0	0
Floor 14.0 ft->Door41	0.0	0.0	0
Floor 14.0 ft->Door44	0.0	0.0	0

Floor 14.0 ft->Room24	0.0	0.0	0	
Floor 14.0 ft->Room35	0.0	0.0	0	
Floor 14.0 ft->Door51	0.0	0.0	0	
Floor 14.0 ft->Stair20	0.0	0.0	0	
Stair20 door 1	0.0	0.0	0	
Stair20 door 2	0.0	0.0	0	
Floor 14.0 ft->Door64	0.0	0.0	0	

O:\Planroom\Database\building_Floor_Plans\Plan_Book\Building 197-0_Bonderson Engineering Projects Center.dwg

CAL POLY
SAN LUIS OBISPO
Facility Services Facilities Planning and Capital Projects

Bonderson Engineering Projects Center

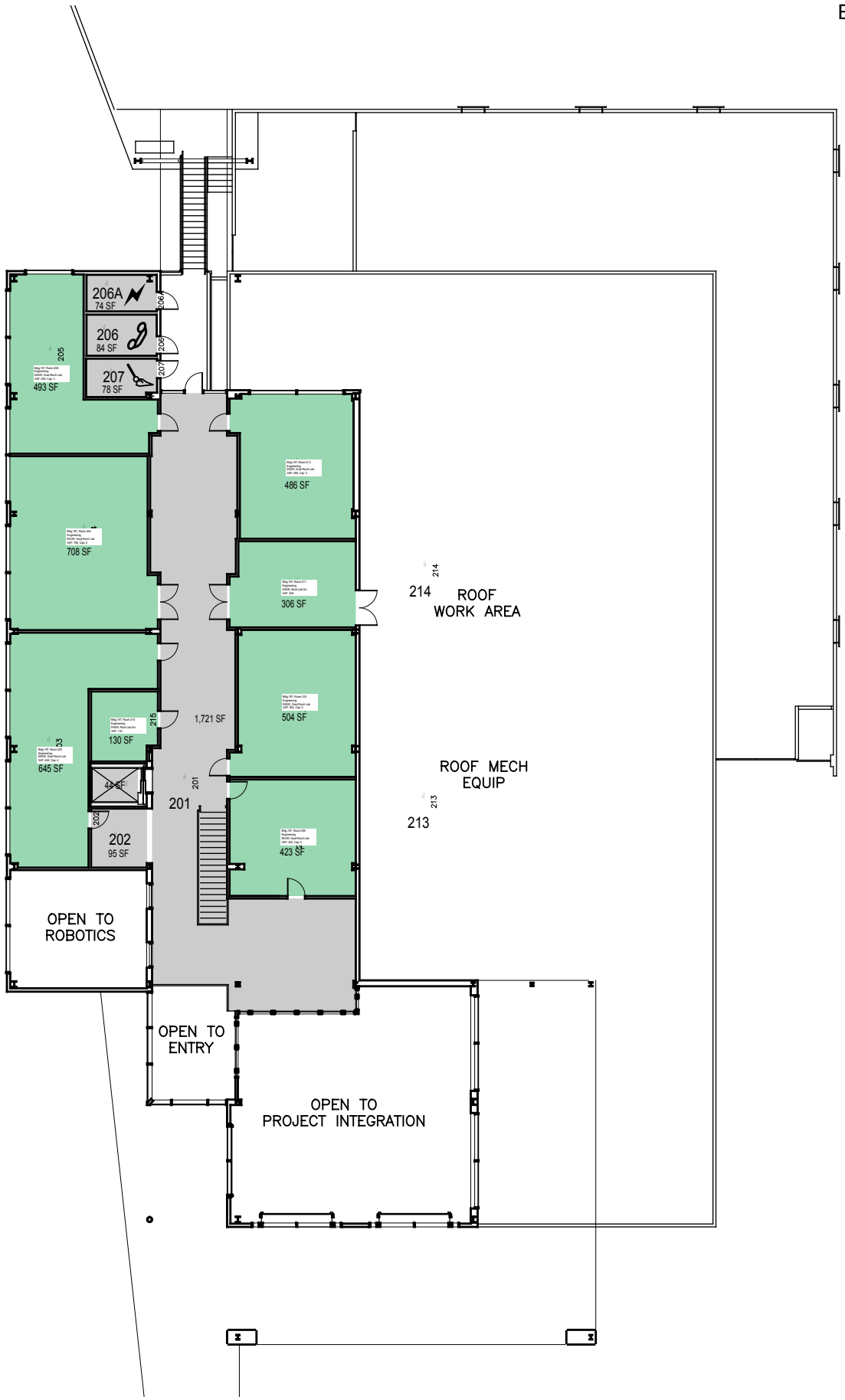
www.facilities.calpoly.edu

Floor 1

CAGR	CLA	
CARCH	CSM	UNIV
CBUS		ADMIN
CENGR	NON STATE	NON ASSIGNABLE

August 2013

1"=25'



O:\Planroom\Database\building_Floor_Plans\Plan_Book\Building 197-0_Bonderson Engineering Projects Center.dwg

CAL POLY
SAN LUIS OBISPO
Facility Services Facilities Planning and Capital Projects

Bonderson Engineering Projects Center

www.facilities.calpoly.edu

Floor 2

CAGR	CLA	
CARCH	CSM	UNIV
CBUS		ADMIN
CENGR	NON STATE	NON ASSIGNABLE

August 2013

1"=25'