Fire and Life Safety Evaluation

Hinesville CBOC VA Clinic

(Hinesville MOB)

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Key words: Life Safety Code, RSET, ASET, Performance Based Design, Fire Dynamics Simulator

Overview – Hinesville MOB

The Hinesville MOB is a single story out-patient facility serving veterans residing in the region surrounding Ft. Stewart, Georgia. This clinic developed in response to the inadequate ability of the current Ft. Stewart medical facilities to serve the needs of the ever expanding veteran population. The Hinesville MOB is primarily equipped for non or limited surgical procedures in which patients, at all times, remain in an ambulatory state. Its primary function is to serve as a primary care and referral center to limit crowding of larger, more specialized medical facilities.

The clinic is to be constructed at a stand-alone location as seen below (*Figure 1)*. It has no immediately adjacent structures and is to be bolstered by an asphalt parking lot on all four sides. The clinic provides

Figure 1: Satellite photo of the Hinesville MOB construction site.

multiple examination rooms as well as office space for the various staff that will occupy the building. The clinic boasts one main entrance facing toward the south south-east and 6 additional exits in case of emergency.

Construction of the clinic will start with the formation and pouring of two foot thick concrete footings for each of the main support columns. Then the rest of the slab, averaging nine and three eights an inch thick, will be poured. Following this, the steel columns will be erected and the girders and joists will be hoist into place and secured. Once the framing portion of the structure is complete all the remaining heavy equipment, such as the HVAC units, will be hoist into place and secured on the roof.

The design and construction of the clinic are regulated by both national and local authorities. All designs must be reviewed and accepted in compliance by the proper authority having jurisdiction before any work may begin. Below is a partial list of the governing rules, regulations, and standards relevant to the fire and life safety system which all systems must comply in order to be accepted.

- NFPA 99 “Standards for Health Care Facilities”
- NFPA 101 “Life Safety Code”
- NFPA 13 “Standard for the Installation of Sprinkler Systems”
- NFPA 72 “National Fire Alarm and Signaling Code”
- International Building Code

For this evaluation, the editions of these codes and standards held relevant will be those as approved by the authority having jurisdiction. At the time of acceptance, Georgia recognized only NFPA codes listed prior to 2003. As of this year, Georgia recognizes the newest editions of all NFPA codes and standards published as of January 2014.

Executive Summary

The Hinesville MOB will be analyzed throughout the course of this report to determine if it meets the prescriptive-based requirements set forth by local and national regulating bodies. Further, a performance-based approach will be taken to assess the buildings ability to sustain life while a safe and timely evacuation occurs.

It will be determined that the Hinesville MOB does comply with all regulations set forth for fire and life safety. In some cases its construction and systems may exceed the required minimum standards. It will contain 100% coverage with an automatic sprinkler system, be equipped with adequate emergency notification system, meet or exceed all requirements for structural fire protection, and its egress capabilities will greatly exceed its requirement.

The building will be subjected to multiple simulated fire scenarios to determine if the building can maintain an appropriate tenability while evacuation occurs. Two different scenarios are simulated using computer based software to determine the available time for a safe evacuation. Manual calculations are performed to determine the amount of time that would be required for a safe evacuation to occur. In both scenarios tenability was lost in the building due to failing visibility. The result of these simulations showed that the building was capable of providing ample time for a safe evacuation to occur.

To conclude, the building performs well during performance-based test. The building will remain in a tenable state longer than is required for a safe evacuation. The building meets all code requirements set forth by the local AHJ and national regulating authorities.

Floor Plans and Occupancies

The Hinesville MOB is a single story clinic comprising of multiple exam rooms, conference rooms, office space, a general purpose x-ray room, and an ultrasound examination room. Patients enter through a main entrance into a large atrium which is surrounded by several check-in stations and waiting areas. The building itself is surrounded on all four sides by an asphalt parking lot and landscaping. The sprinkler riser is located in the rear of the building in a purpose built mechanical room. The fire alarm control panel is located on the southeastern side of the building in an electrical room. Shown below (*Figures 2a-2f*) are the floor plans for the building divided into six exploded views. The building is oriented such that "job north" is in relation to the top of the page. Shown first (*Figure 2)* is a diagram defining the location of each view.

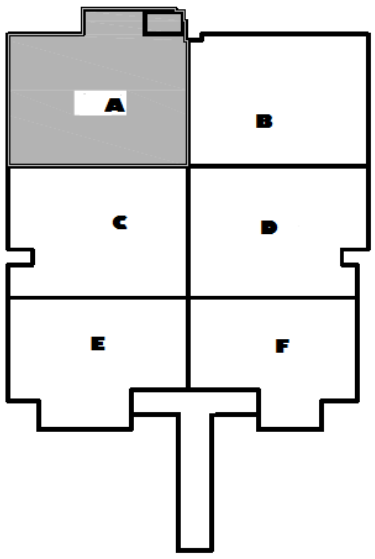

Figure 2 – Reference Diagram for *Figures 2-2f*

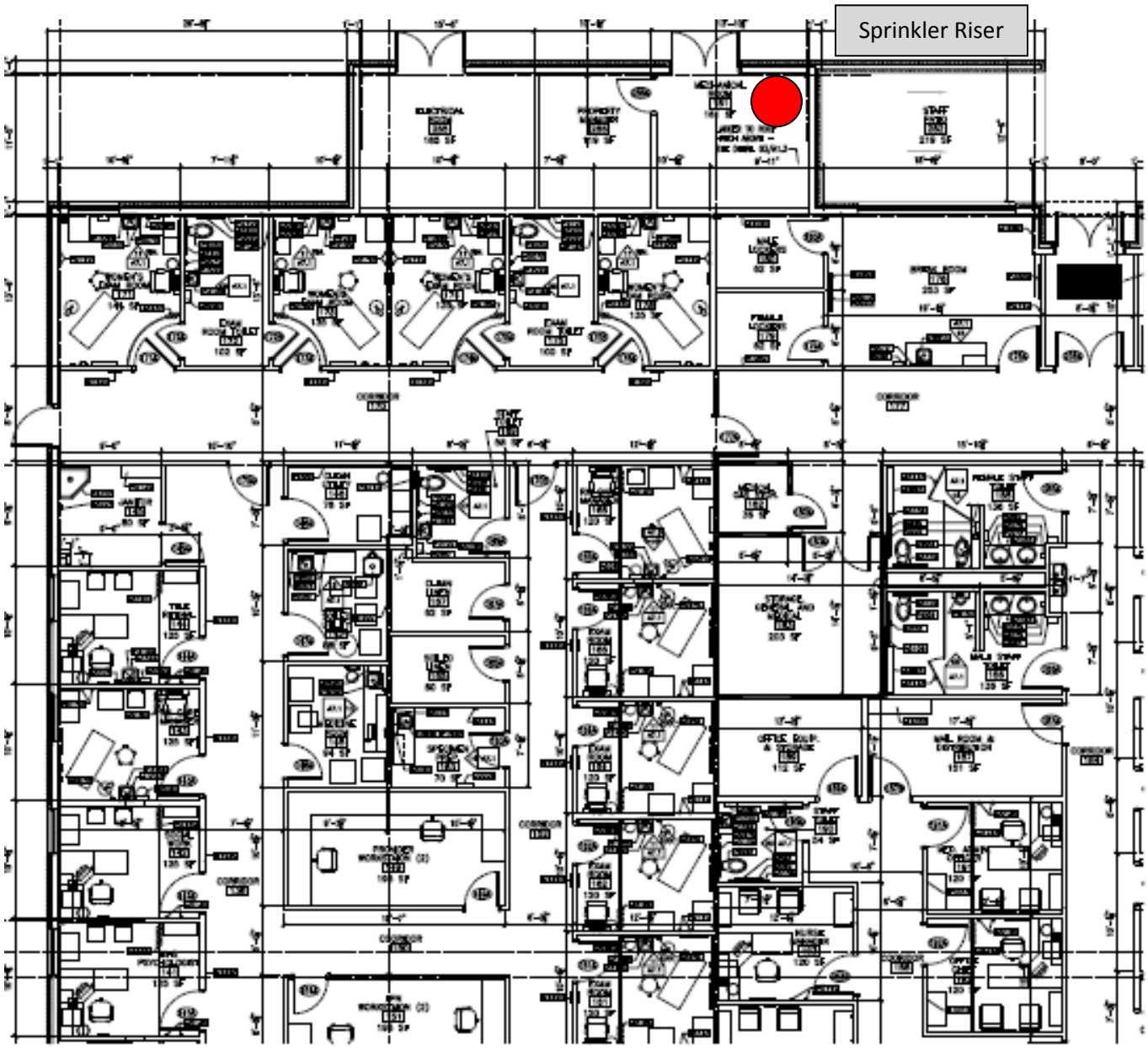

Figure 2a – Northwest Corner of the building.

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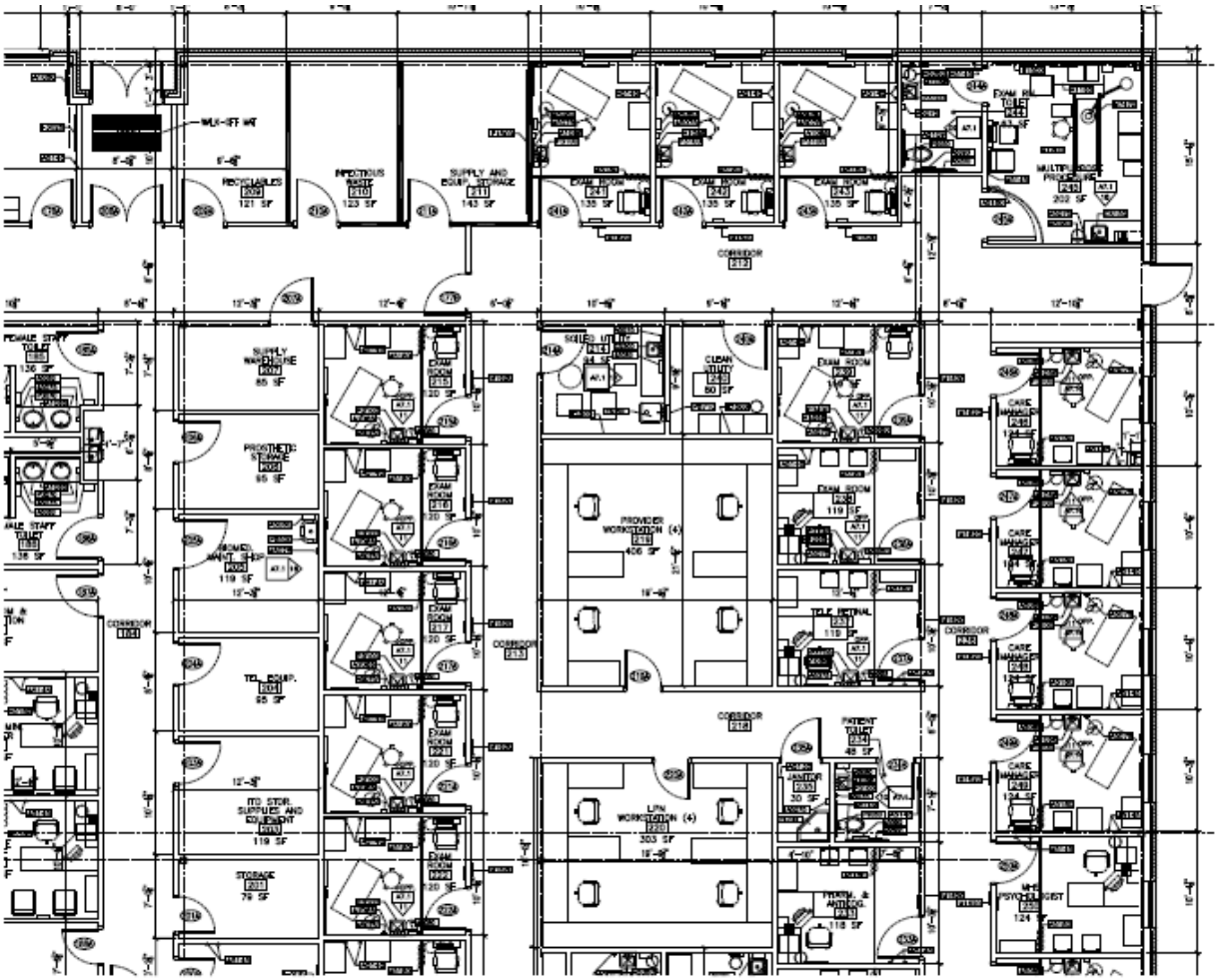


Figure 2b – Northeast Corner of the building

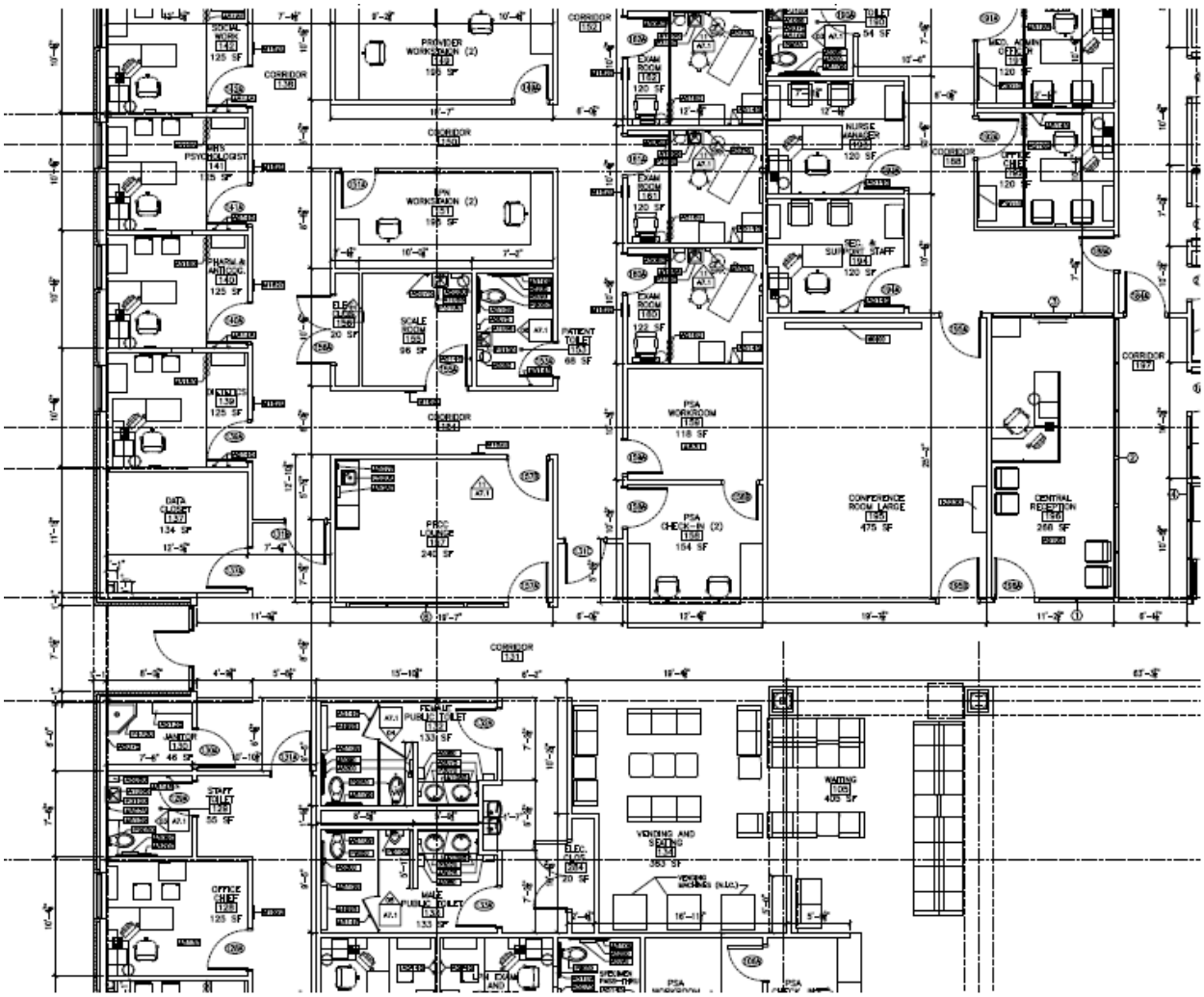


Figure 2c – West center section of the building

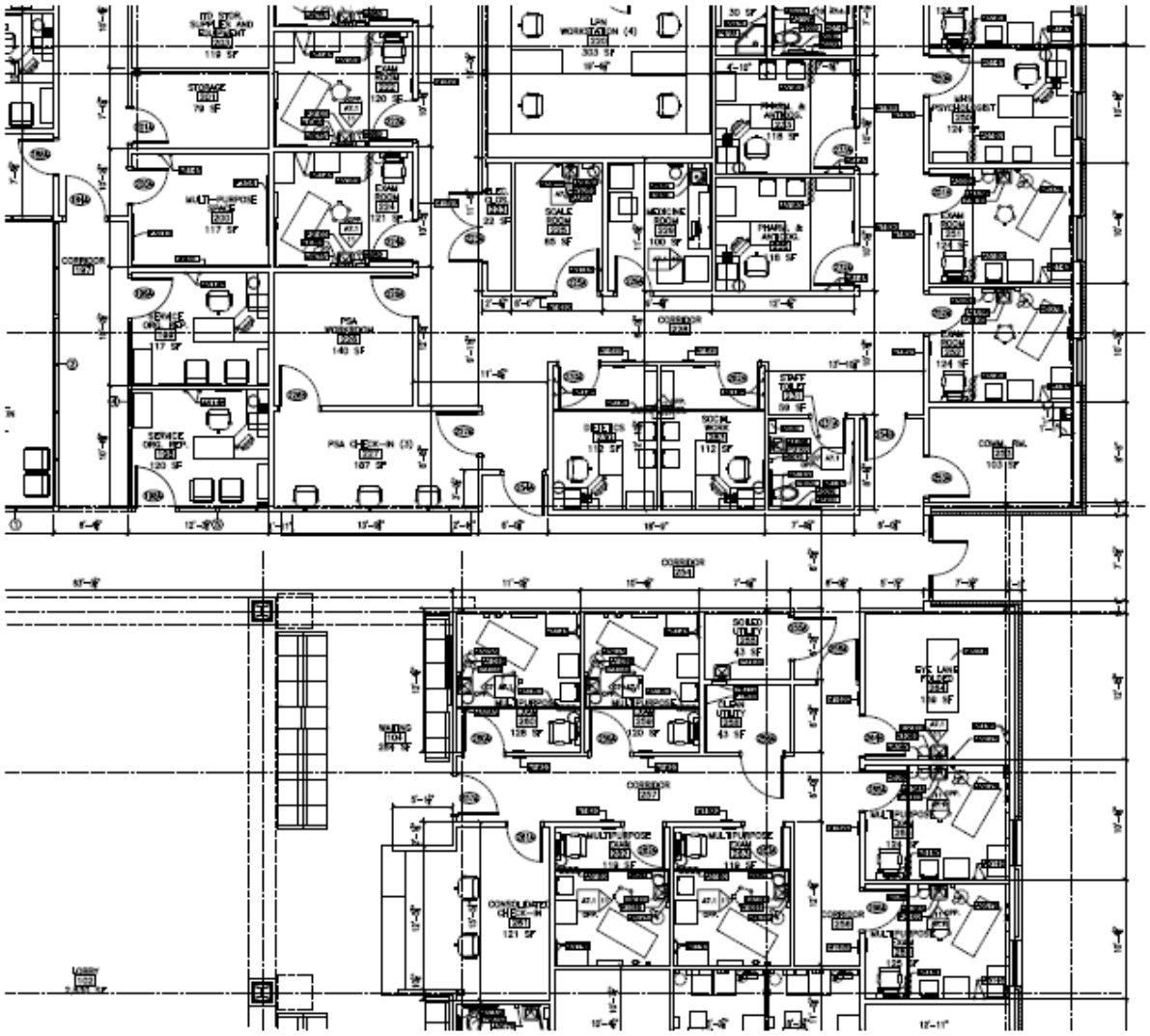


Figure 2d – East center section of the building

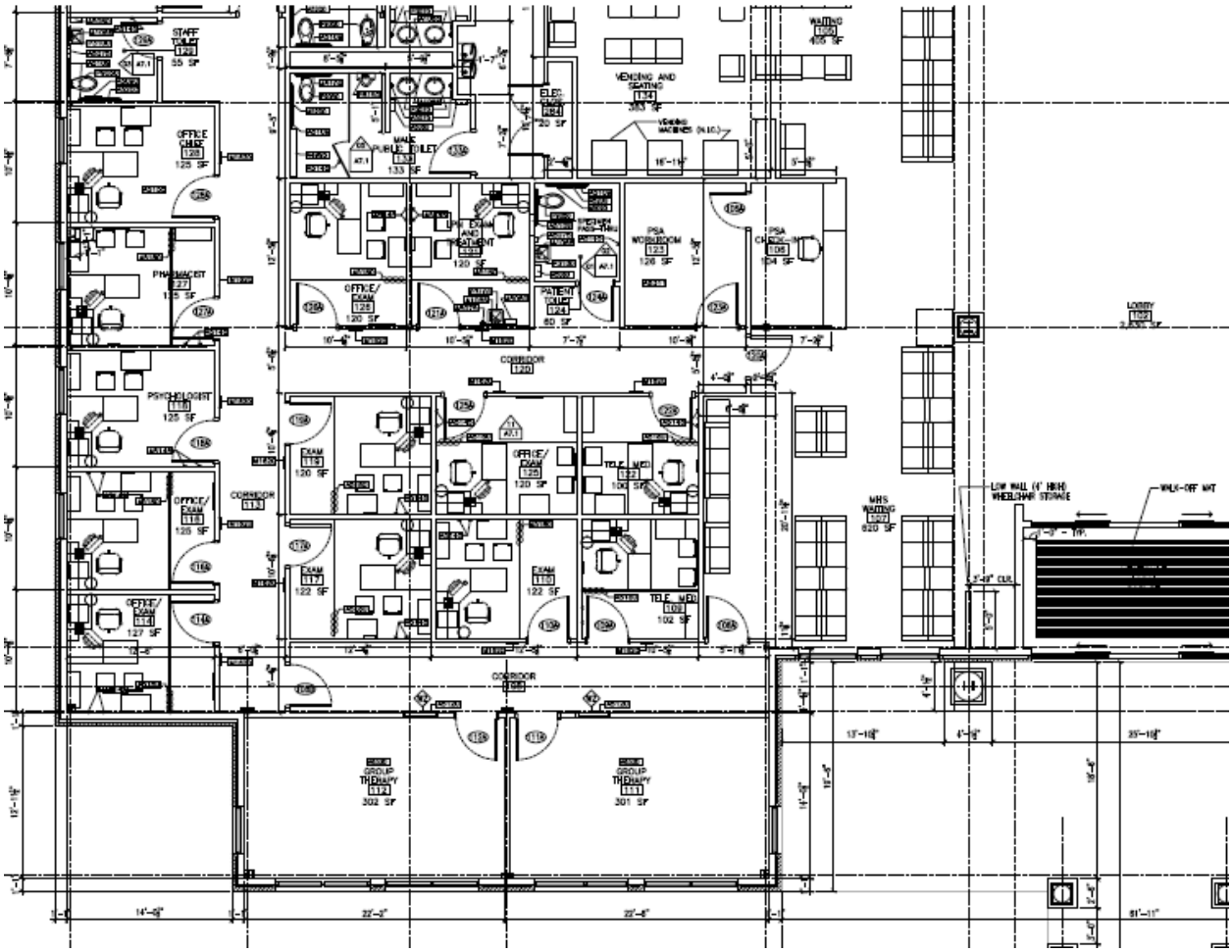


Figure 2e – Southwest corner of the building

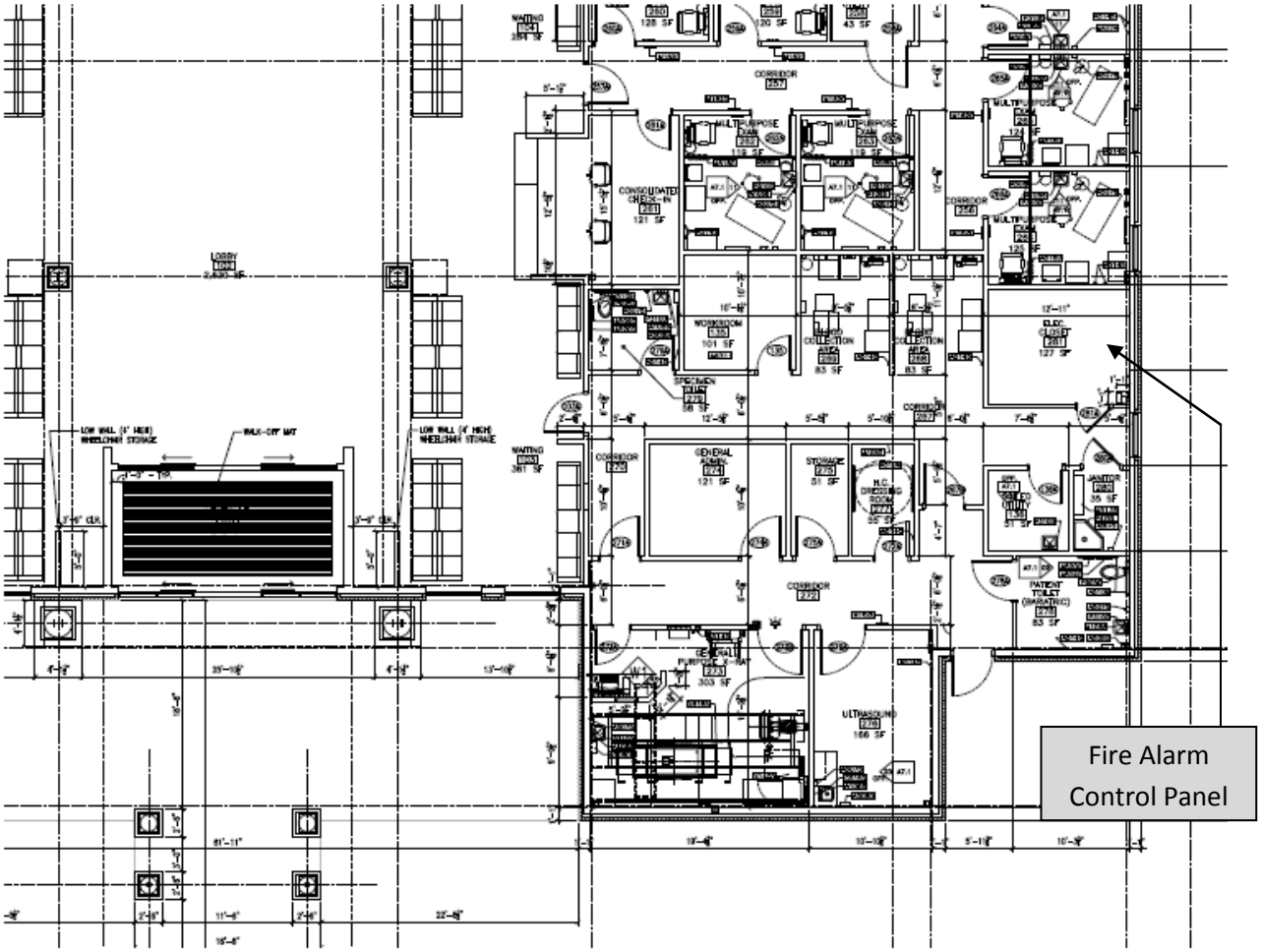


Figure 2f – Southeast corner of the building

The clinic contains 35 offices, 34 exam rooms, several storage and data closets, 3 large conference rooms, as well as 4 main waiting areas located in the front of the building. A large atrium serves these waiting rooms and contains no obstruction other than the structural columns located around the edge.

Construction and Finishes

Hinesville MOB is classified as a Class B (Business) Occupancy. This is due to the lack of non-ambulatory patients. The clinic is designed and intended to be a primary care facility where no, or minimal, procedures take place but with all occupants remaining in an ambulatory state. This, mixed with the high volume of office space, leads to its classification as a business occupancy. The building is built from non-combustible steel members that are not specifically shielded from a fire scenario. Thus, the building is recognized as Type-II construction for the non-combustibility and, further, Type-II B because the members are not protected. Table 503 of the International Building Code (*Figure 3)* limits the height and square footage of this type of building as defined below. F

GROUP		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
	HEIGHT (feet)	UL	160	65	55	65	55	65	50	40
		STORIES(S) AREA (A								
A-1	S A	UL UL	5 UL	3 15,500	2 8,500	3 14,000	2 8,500	3 15,000	2 11,500	1 5,500
A-2	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-3	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-4	S A	UL UL	11 UL	3 15,500	2 9,500	3 14,000	2 9,500	3 15,000	2 11,500	1 6,000
A-5	S A	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL	UL UL
B	S A	UL UL	11 UL	5 37,500	3 23,000	5 28,500	3 19,000	5 36,000	3 18,000	2 9,000
E	S A	UL UL	5 UL	3 26,500	2 14,500	3 23,500	2 14,500	3 25,500	1 18,500	1 9,500
F-1	S A	UL UL	11 UL	4 25,000	2 15,500	3 19,000	2 12,000	4 33,500	2 14,000	1 8,500
F-2	S A	UL UL	11 UL	5 37,500	3 23,000	4 28,500	3 18,000	5 50,500	3 21,000	2 13,000
H-1	S A	1 21,000	1 16,500	1 11,000	1 7,000	1 9,500	1 7,000	1 10,500	1 7,500	NP NP
H-2	S A	UL 21,000	3 16,500	2 11,000	1 7,000	2 9,500	1 7,000	2 10,500	1 7,500	1 3,000
H-3	S A	UL UL	6 60,000	4 26,500	2 14,000	4 17,500	2 13,000	4 25,500	2 10,000	1 5,000

Figure 3 – Allowable Building Heights and Areas (Source: IBC)

As can be seen, a maximum of 3 stories and 23,000 square feet is listed as the constraints for this type of building. The net usable square footage of the building is 25,567 square feet. However the total building area is 32,260 square feet due to an additional 6,693 square feet making up corridors, mechanical rooms, electrical rooms, and other various rooms not intended for day to day operation. This overage in area demands a sprinkler system in order to use the 300% additional square foot allotment that is allowed when an approved sprinkler system is in place. This brings the total allowed area to 92,000 square feet and places this building in compliance with IBC Table 503 *(Figure 3)*.

All elements of the clinic comply with the International Building Code fire resistance rating code as specified in IBC Table 601 (*Figure 4*). The primary structural frame consists of wide-flange columns, girders, beams, and joist. No fire resistive coating is added to these structural components. The floor is made of poured concrete and the roof is constructed of a metal sheet deck with lightweight concrete. All walls inside the structure are constructed with metal studs, filled with fiberglass insulation, and covered with 5/8” gypsum wall board. The exterior is made of a non load-bearing masonry. No walls are required to have a fire resistance rating greater than zero hours as seen below.

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

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

Figure 4 – Fire resistance rating requirements (Source: IBC)

All interior finishes of the structure are at least class B, having a flame spread of less than 75 and a smoke develop index of less than 450. This includes all gypsum walls and ceiling, acoustical tiles, trim, and molding. This complies with Table 803.5 (*Figure 5),* Interior wall and ceiling finish requirements.

TABLE 803.5
INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY[k]

GROUP	SPRINKLERED[j]			NONSPRINKLERED		
	Exit enclosures and exit passageways[a,b]	Corridors	Rooms and enclosed spaces[c]	Exit enclosures and exit passageways[a,b]	Corridors	Rooms and enclosed spaces[c]
A-1 & A-2	B	B	C	A	A[d]	B[e]
A-3[f], A-4, A-5	B	B	C	A	A[d]	C
B, E, M, R-1, R-4	B	C	C	A	B	C
F	C	C	C	B	C	C
H	B	B	C[g]	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B[h, i]	A	A	B
I-3	A	A[j]	C	A	A	B
I-4	B	B	B[h, i]	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No restrictions			No restrictions		

Figure 5 – Flammability requirements by occupancy (Source: IBC)

Egress Systems

The Hinesville MOB has 7 points of egress. One main entrance located in the front of the building leading to an open non-combustible canopy. There is a single exit to the rear of the building located at the end of the main lateral corridor. On the right side of the building there are two exits at the end of each of the main longitudinal corridors. These exits are mirrored on the left side of the building. The last exit is a small door located in the front right (southeastern corner) of the building and serves a small portion of the building. It is not located along any of the main corridors running throughout the building.

The occupant load for the building shall be determined using the IBC Table 1004.1.2 “Maximum Floor Area Allowance per Occupants.” The occupant load factor for a business class occupancy is 100 ft^2/Person. The Hinesville MOB covers a floor space of 32,260 ft^2. Thus, by the International Building Code, it has a rated occupancy of 333 persons.

Looking at Table 1021.1 of the IBC, the required number of exits per story for a building with a load factor of 1 to 500 is two. The Hinesville MOB contains seven exits and complies with this code. The exit capacity of the building is calculated with a capacity for doors as 0.15 inches per person (exception 1005.3.2 “Other Egress Components”).

Looking at the main entrance, it contains two sets of sliding glass doors with a vestibule area in-between. Each set, when fully open measures 62” across. This leads to an exit capacity of 414 persons. The door at the rear of the building is a set of double doors measuring 62” wide lending another egress point for 414 persons. The isolated exit at the front right of the building is 3’-6” wide allowing for the egress of 254 persons. The two exit doors located on either side of the building mirror each other with the southernmost two allowing for 414 persons between them

and the northernmost allotting for the exit 508 persons combined. When summed the total exit capacity if the Hinesville MOB is 2004 persons. This greatly exceeds the maximum number of occupants allowed and, thus, is in compliance with the occupancy code.

The International Building Code Table 1016.2 illustrates the requirements for maximum exit access distance. For a sprinklered, Class B occupancy, the maximum allowed distance is 300 ft. The Hinesville MOB complies with this standard. An example of one of the longest egress paths *(Figure 6)* would be from the centrally located large conference room to a secondary exit in the northeast corner of the building. This path is roughly 160 ft in length, under the 300 ft required maximum and in compliance.

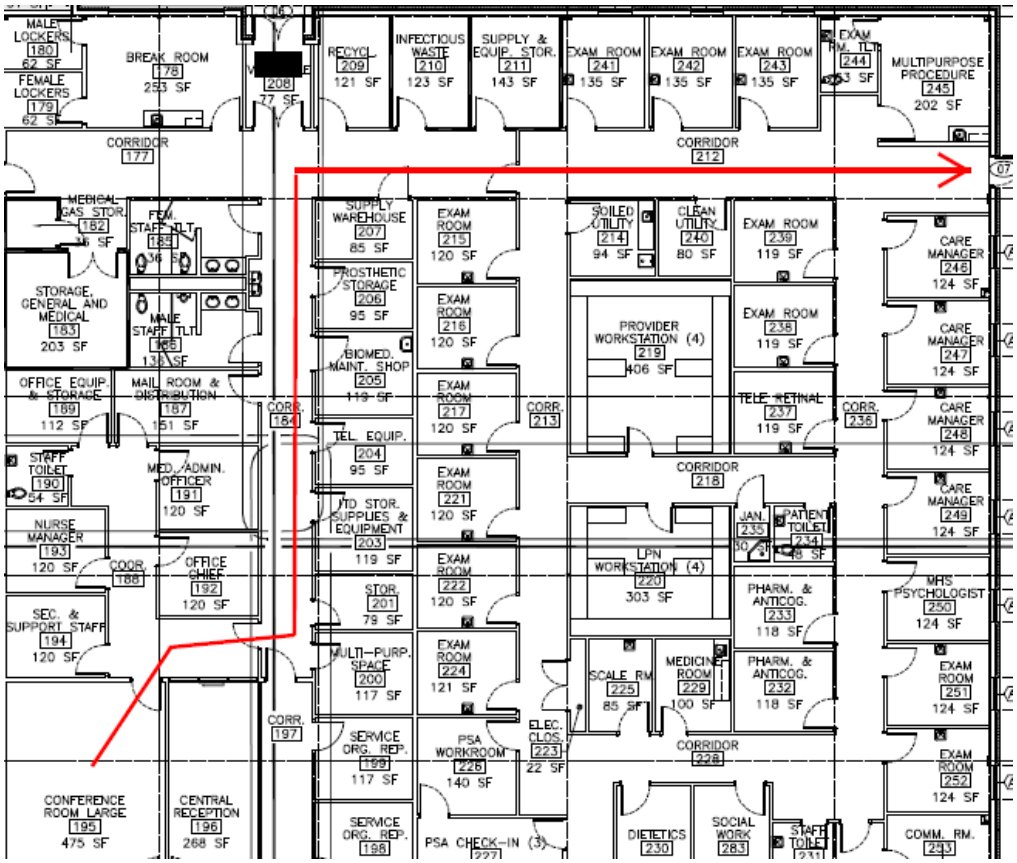


Figure 6 – Maximum Egress Distance

The Hinesville MOB is allowed a 50 ft maximum length for dead end corridors under IBC 1018.4, exception 2. There are a few dead in corridors within the building; however, all satisfy the requirement of this code section. The longest dead end corridor serves several offices in the center of the building and measures 34 ft long.

All means of egress are illuminated in compliance with the IBC section 1006 “Means of Egress Illumination.” Illuminated exit signs are powered on the electrical circuit for the Hinesville MOB’s emergency lighting.

Fire Protection and Fire Alarm System

The Hinesville MOB is protected throughout its entirety by a NFPA compliant wet sprinkler system. It is calculated as a light hazard occupancy with ordinary hazard I incidentals. The system is supplied by roughly 100 ft of 6” underground supply fed by 380 ft of 8” underground supply which taps into the existing city water mains. A 100 gallon per minute outside hose stream is accounted for, which is supplied by a 6” fire hydrant located between the source and the riser for the building.

Water flow data was taken by means of a two hydrant flow test along the existing city water main. This test was performed at the time of design and indicated a static pressure of 48 psi, a residual pressure of 38 psi, and a flow rate of 1095 gpm.

Three areas were calculated on this system to show its adequacy. The AHJ, the city of Hinesville, Georgia, requires a minimum margin of safety of 10 psi. Thus, in order for approval, this system must comply. The first remote area is taken at the southeastern corner of the building where the x-ray and ultrasound rooms are. This remote area is light hazard with the exception of a single storage room. The required coverage for this area is 0.10 gpm/ft^2 over a 1500 ft^2 design area. However, NFPA 13 chapter 11 section 2.3.2.3.1 allows this design area to be reduced by 40% as this system complies with all the requirements of this code section. This reduces the design area to 900 ft^2. This design area has 13 flowing sprinkler heads and allows for a maximum coverage area of 225 ft^2 per sprinkler. The sprinklers used are Viking model VK302 quick response pendents which are used throughout the building. They have a ½” orifice and a K factor of 5.6. The most demanding head in this remote area is flowing 14.82 gpm. The hydraulic calculations table for this design area start with the most demanding head and proceed back to

the base of the riser. These calculations show that the system demand at the base of the riser will be 211.73 gpm at 25.64 psi. A 100 gpm outside hose stream was allotted for in these calculations. It was added directly to the system demand as it would be pulled after the source but before the riser. With this demand, this design area maintains a safety margin of 16.1 psi and is acceptable by the AHJ. Supporting documentation can be found in appendix A, section 1.

The next design area considered is located in the front atrium. This is the highest point of the sprinkler system and needed to be examined to ensure that the pressure and flow are adequate at this elevation. This remote area is also calculated as a light hazard area, however, a design area reduction is not allowed as the ceiling height is over 20 feet. The hydraulic calculations table starts with the most demanding head and leads back to the riser. 17 sprinklers are flowing in this design area with the most demanding head flowing at 14.9 gpms. This creates a demand of 279.19 gpm at 29.8 psi at the base of the riser. Again, a 100 gpm outside hose stream is added into the calculation to create a safety margin of 11.2 psi. Supporting data is located in appendix A, section 2.

While the two design areas already examined show adequate pressure and flow throughout the system. A third design area was calculated. This was due to the change in style of piping. The southernmost half of the building is set up in a tree system while the northern half is a grid. Thus, a third and final design area was calculated to ensure proper sizing of the lines in the grid. This design area was allowed to take the full reduction under NFPA 13 section 11. However, due to the arrangement and spacing of the heads, the actual design calculated was 1167 ft^2. The hydraulic calculations table again starts at the most demanding head, however, due to the complexity of the calculations, the most direct route back to the riser is not necessarily the first path taken by the calculations table. In this design area there are 14 flowing heads similar to the

previous design areas. This design area, unlike the others though, contains one upright sprinkler head. It is a Viking model VK300 with a ½" orifice, 5.6 k-factor, and 155 degree activation temperature. This upright sprinkler head is also the most demanding flowing at 14.82 gpm. For this design area, a demand of 226.98 gpm at 22.4 psi is required at the base of the riser. Also containing a 100 gpm outside hose stream, a safety factor of 19.2 psi is available. Appendix A, section 3, contains supporting data for this calculation.

The transition from the underground water supply comes through the floor in the riser room and is located one foot above the finished floor. It is connected to the system riser via a welded flange. The riser itself is a 4" shot gun style riser *(Figure 7)*. This implying there is no check valve assembly and only a butterfly style shut off and a flow switch on the main riser itself. For this setup, the back flow preventer is designated to act as the check valve assembly. A 4" fire department connection is tee'd in just after the shut-off valve but before the flow switch. The riser pipe continues to 8" above the ceiling where it then serpentines through the building.

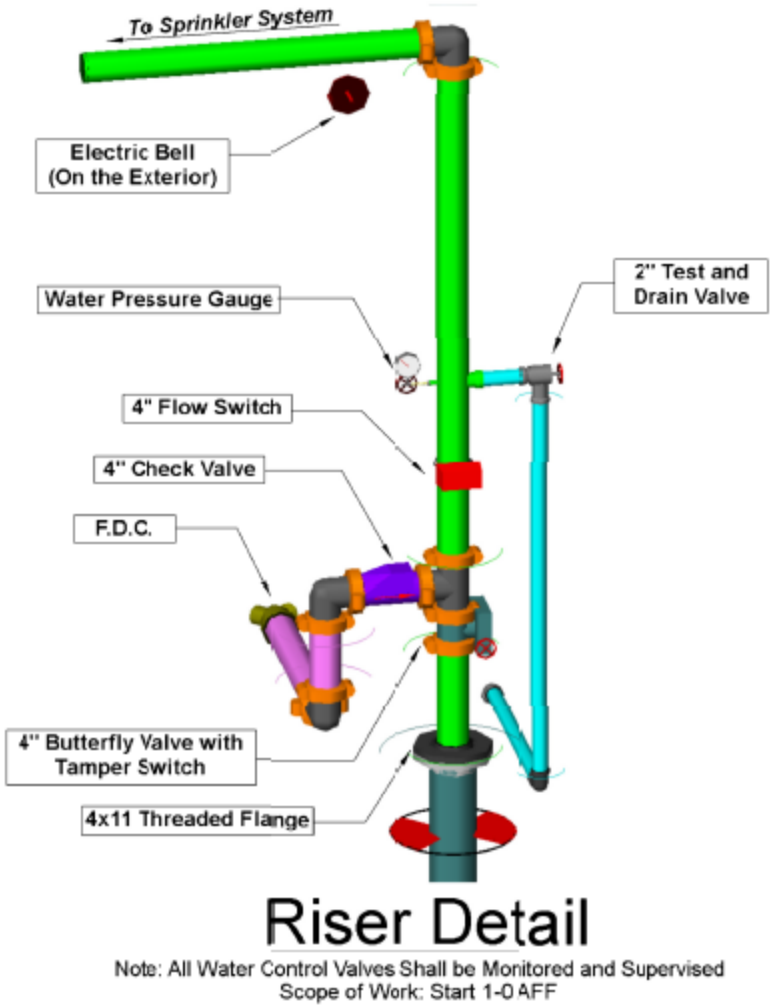


Figure 7 – Hinesville MOB Riser Detail

The cross main running throughout the building consist of 4” schedule 10 grooved pipe with grooved couplings and fittings. Off of this main are 3 smaller mains also made with grooved ends. These 3 mains, however, are 3”. The branch lines throughout the building are scheduled based off of hydraulic calculations and are made of schedule 40 pipe with cast iron threaded fittings. A standard pipe scheduling is created and followed throughout the building with exception to the gridded area and the elevated atrium. In the atrium, due to the demand a more

aggressive pipe schedule was followed. In the gridded section the branch lines are 1¼” schedule 10 pipe with grooved fittings.

The state of Georgia does not mandate seismic bracing. Also, the AHJ, nor the owner, requested such bracing be installed. Thus, no seismic bracing was utilized on the installation of the sprinkler system. The system will be suspended following guidelines in NFPA 13. The system hangers will comprise of band hangers, 3/8” all thread rod, and top beam clamps.

Two different types of sprinklers are utilized in this building with three different mounting styles. The most prevalent is a Viking model 302 quick response pendent sprinkler. It has a chrome finish, a 155 degree activation temperature with a glass bulb element, and a k-factor of 5.6. It is mounted in two different styles. Primarily seen as a semi-recessed head, however, in certain rooms with surface mounted lights, the sprinkler is mounted with a 2-piece escutcheon so that the sprinkler has proper clearance with the light.

The next head, seen less often throughout the building, is a Viking model 300 quick response upright sprinkler. This sprinkler is brass, has a 155 degree activation temperature with a glass bulb element, and a k-factor of 5.6. This sprinkler is utilized in areas with exposed ceiling.

In accordance with the requirements of the International Building Code, section 907.2.2, a manual fire alarm system is not required. This comes from an exception stating that manual activation is not required when an automatic sprinkler system is installed and water flow activates annunciation devices. However, this exception is not allowed by the AHJ and manual pull stations are still placed in accordance with NFPA 72.

The fire alarm control panel is a Notifier SFP-2402 installed in an electrical room located in the southeast corner of the building. The secondary power for this system is supplied by the

Hinesville MOB's emergency generators servicing emergency power functions for the building in the event of a power loss. It is capable of sustaining NFPA 72's required 4 hours of stand-by and 5 minutes of operation in the event of a power failure.

The FACP is secured within a locked electrical room with controlled access as well as being installed within a locked cabinet. Access to these rooms is regulated by the maintenance manager and the building owner. This satisfies NFPA 72's requirement for deactivation of the fire alarm signal. Resetting of the FACP is also regulated under NFPA 72, which stipulates the conditions of how and when the device can be reset.

There are two types of detection utilized in the Hinesville MOB. The first type is wet-pipe fire sprinklers. When thermal conditions activate a sprinkler head, water begins to flow initiating an alarm via a water flow switch located on the system riser. The second type is a manual pull station. When a fire is noticed by personnel a manual initiation of the fire alarm system can be performed with the use of a manual pull station.

Smoke detection is not required throughout the building due to the presence of an automatic fire suppression system. The AHJ does not require one, and the owner did not elect to have one placed in service.

Occupant notification is handled by horns and strobes throughout the building. Both are placed throughout the building in accordance to NFPA 72. There is no public address system, only an audible horn and visual que to notify occupants of an emergency. Such devices are utilized independently as well as in a combined fashion. These notification signals are powered on the Hinesville MOB's emergency power circuit. This circuit powers the FACP, emergency lighting, as well as all other emergency powered equipment.

Performance Based Analysis

This section will challenge the design of the Hinesville MOB by examining a pair of fire scenarios. These scenarios will be modeled and simulated to determine the overall performance of the building in a fire based emergency situation. The evaluation will look at required safe evacuation time for all occupants and hold it against the available evacuation time. In both scenarios, a positive disposition for total evacuation will be determined if the available evacuation time is greater than the required evacuation time. This information will be gathered based off of modeled fire and its effects on the space and occupants involved.

NFPA 101, Life Safety Code, covers the design of performance based life safety systems as an alternative to a prescriptive based approach. Chapter 5, section 5.5 covers the design of fire scenarios and list eight scenarios which are required to be considered under a complete approach in section 5.5.3. This analysis represents the first three scenarios outlined in this code section as well as various elements of several of the other scenarios.

Several computer based simulation tools were used to evaluate the performance of the Hinesville MOB. For the movement of persons within the structure, Thunderhead Engineering's Pathfinder 2012 was used. This software is an emergency egress simulator which allows for the calculation of independent movement of represented persons within the building. It is a 3-D engine allowing a better grasp of the persons within the structure as they migrate to exits in the desired scenario. Pathfinder will calculate travel times and likely movement characteristics. This data can be studied to maximize the effectiveness of the egress system within the building and predict exit times. Pathfinder was used to gain insight to the overall movement of persons within the

building. This was used to determine the likely exit path a person within the structure would take. This modeling software is useful due to the number of persons exiting (333), their randomized location as daily proceedings take place in the structure, and the high number of available exits throughout the building. It was used to determine the exits to likely be effected in the scenarios to follow.

FDS, or Fire Dynamic Simulator, is a fluid dynamics driven model of fire flow. Together with Smokeview, a 3D representation engine designed to model FDS calculations, and Pyrosim, a GUI designed to ease the building of a FDS model, FDS can model fire growth and spread, temperature patterns, and the movements of the products of combustion throughout the design area. FDS is used in both scenarios, in varying fashions, to model the possible outcomes of different patterns of events. The results are then modeled in Smokeview for a 3D representation and analysis.

Perhaps the most important factor in the building's performance is tenability. It is important to know at what point life is no longer sustainable within the structure as it weighs heavily on the available safe evacuation time. The limits of tenability must be assigned carefully and for this analysis will be temperature, carbon monoxide, and visibility.

Temperature. At what point will the exposure to increased temperatures become detrimental to life within the structure. This area needs to be carefully considered as there are varying degrees at which the body deteriorates under extreme heat. According to the Society of Fire Protection Engineers Handbook of Fire Protection Engineering, Figure 2-6.27 and Table 2-6.17, the human body can tolerate roughly 60 minutes of exposure to 60° C, humid air. Beyond this limit skin burns and respiratory irritation may occur.

Carbon Monoxide. A product of combustion, as a fire progresses carbon monoxide levels begin to rise within an effected space. Tenability of that space is assumed to exist at a carbon monoxide concentration below 1400 ppm. Once these limits have been breached, loss of consciousness may occur to occupants within the effected space.

Visibility. This parameter greatly affects the ability of a person to exit the area in a safe and timely manner. Without proper training of how to operate in low visibility areas, such as that given to firefighters while training to perform search and rescue in burning buildings, escape become less likely and may almost be impossible. Since this building will contain a mix of personnel, familiar and un-familiar with the space, a universal acceptable distance of 13 meters at eye level is chosen as the tenability limit.

Fire Scenario 1 – The Atrium

Fire Design Scenario 1 under NFPA 101 captures the most likely type of fire to occur in a given occupancy. For this scenario, the front atrium will be examined. This area was chosen due to its high ceilings and its ability to cut off the most common and well known path of egress. However, this area lacks a large fuel load. According to the intent of the area, it only exists as an entryway to service four waiting rooms adjacent to it. Thus, the waiting rooms adjacent will serve as the area of fire origin and emphasis will be placed on how the atrium reacts. The waiting rooms are open to the atrium but are divided by large cased openings. In the waiting rooms a typical fuel load exists (i.e. chairs, end tables, floral arrangements, etc…). For this scenario, it will be assumed a fire starts in a trash can which will ignite the nearby chairs.

Throughout the day, the waiting area is populated with patients who are coming in for scheduled appointments as well as family members who may be accompanying them, caseworkers, and

other clinic staff that may be traversing through the waiting area. For the purpose of this study, an occupant count of 30 will be used. This is based off the projected number of chairs to be located in the waiting room. Since the actual area of study is the atrium, all four waiting rooms will be included in the occupant count since they all surround the atrium. This brings the occupant load to 120 persons for the area. The average walking speed was taken from the NFPA Fire Protection Handbook as .88 m/sec. This is the average walking speed of an older adult. This number was used primarily because the highest demographic of persons occupying the clinic will be older veterans during standard operating hours. A fire in the atrium will cut off the primary exit forcing those in the waiting areas to exit through secondary means. The longest path to the next nearest exit measures just over 35 meters. This would result in a travel time of roughly 40 seconds to evacuate the building. Since, it is expected that most occupants will be unfamiliar with the building itself, they may travel along the central corridor to an exit directly opposing the one above. This adds an additional 12 meters to their path resulting in a travel time of 54 seconds.

The design fire is an upholstered chair, one of many located in the waiting area. The SFPE Handbook for Fire Protection Engineering shows that this type of material has a medium fire growth rate and a peak heat release rate (HRR) of 2000kW. A soot yield of 0.10 kg per kg of fuel is used in the FDS model to simulate the somewhat sooty smoke that would be produced by the burning of polyurethane upholstery foam and synthetic polyurethane fabrics. To approximate the carbon monoxide yield of a well ventilated fire, a CO yield of 0.028 kg per kg of fuel is used.

To determine the actual safe evacuation time for the Hinesville MOB, this fire scenario was modeled and simulated in FDS. An image of the design space is located below *(Figure 8)* as well

as the coding for the simulation which can be found in appendix B. The model includes nine automatic sprinklers which are located based off of their actual positioning in the building.

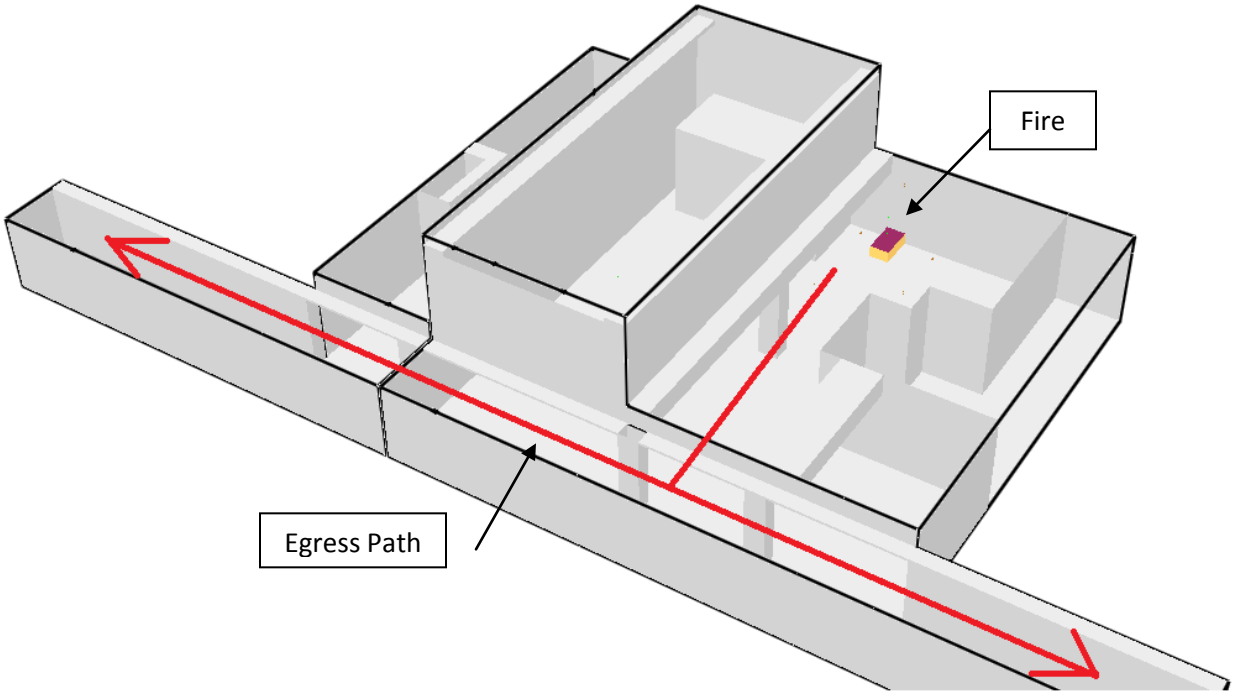


Figure 8 – Scenario 1 Design Model

The model is allowed to run for 600 seconds. The heat release rate (HRR) of the design fire is ramped during this time to mimic the HRR profile obtained from furniture calorimeter fire tests. For convenience, a comparison of the calorimeter model and the FDS model is located below *(Figure 9)*. Since the location of the fire's point of origin could vary, as chairs are spread throughout the waiting room, the activation of one sprinkler head may not give the best representation of a broad range of possible fire models. Because of this, looking at the activation of multiple sprinkler heads may lead to a result with a greater factor of safety. From the FDS simulation, the first sprinkler head will open roughly 226 seconds after ignition. Below is a chart

(Figure 9) displaying the activation time for the sprinklers in the design area. It is important to note that none of the sprinkler heads located in the atrium ever reach activation temperature.

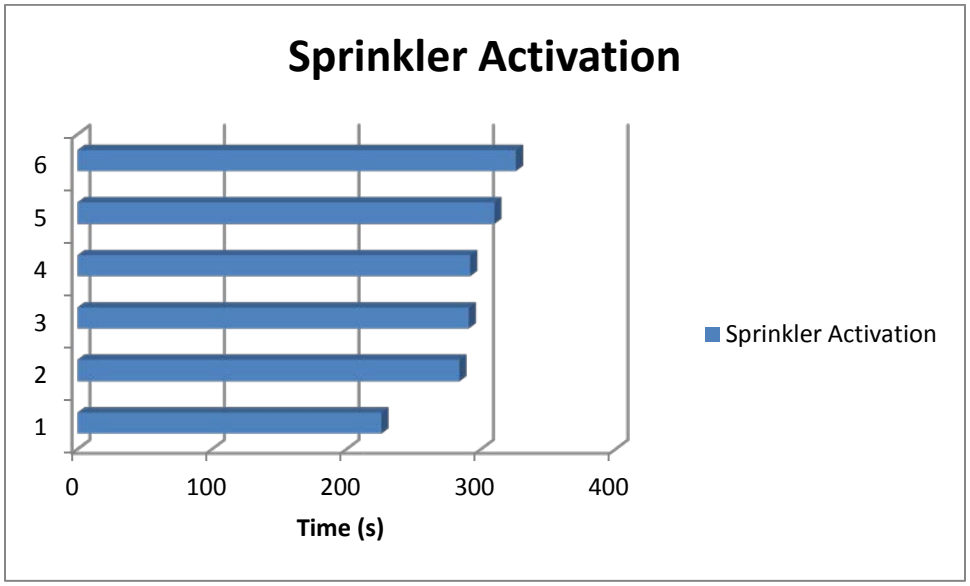


Figure 9 - Sprinkler Activation Times

The fire model does not reach its peak HRR rate until roughly 300 seconds after ignition *(Figure 10)*. By this point, four sprinklers will have activated and with the activation of multiple heads, it is assumed that their combined suppression capabilities will limit the spread of the fire to other fuels.

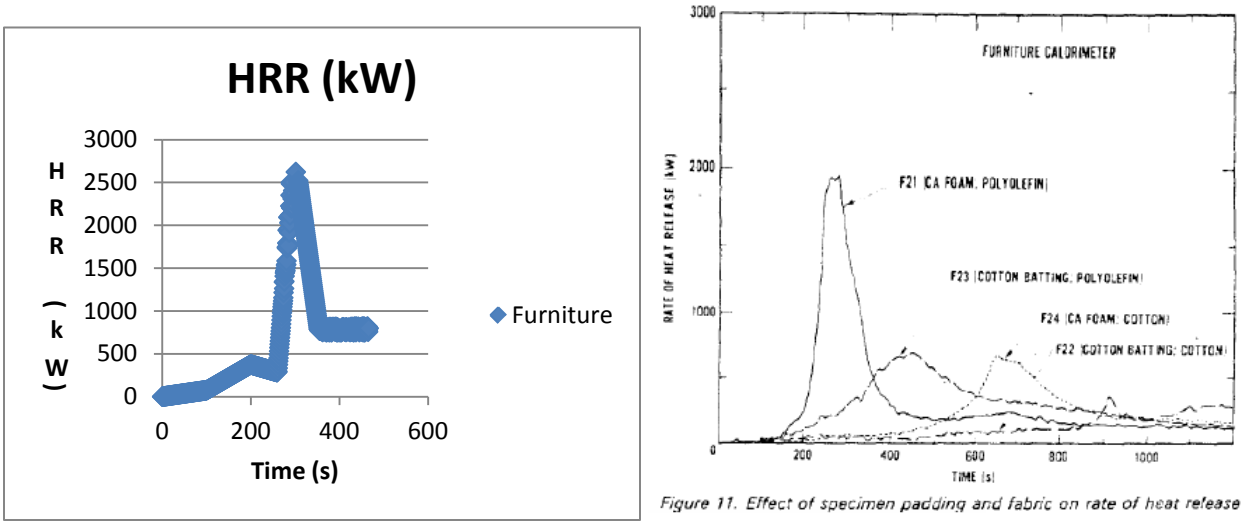


Figure 10 – HRR for Scenario 1, Left: FDS Results Right: Furniture Calorimeter Test

The smokeview results suggest that the tenability limits are reached within the structure around 240 seconds after ignition. In the atrium, the main area of focus, visibility becomes the limiting factor. Visibility falls below 13 meters at this time step. It is important to note that visibility also falls below the threshold in both of the alternate exits by this point. Below is a smokeview image of the visibility within the structure *(Figure 11)*. It takes roughly 475 seconds before the thermal limit is reached in the atrium and the CO count never exceeds it prescribed limits throughout the duration of the simulation. This thermal sampling is taken at 1.8 meters above the finished floor. This would be around the facial region of an average height person. It is also important to note, that the tenability limits are breached at relatively the same time in the waiting area. However, here the thermal barrier becomes the limiting factor. Thus, the available safe evacuation time for this scenario is 240 seconds.

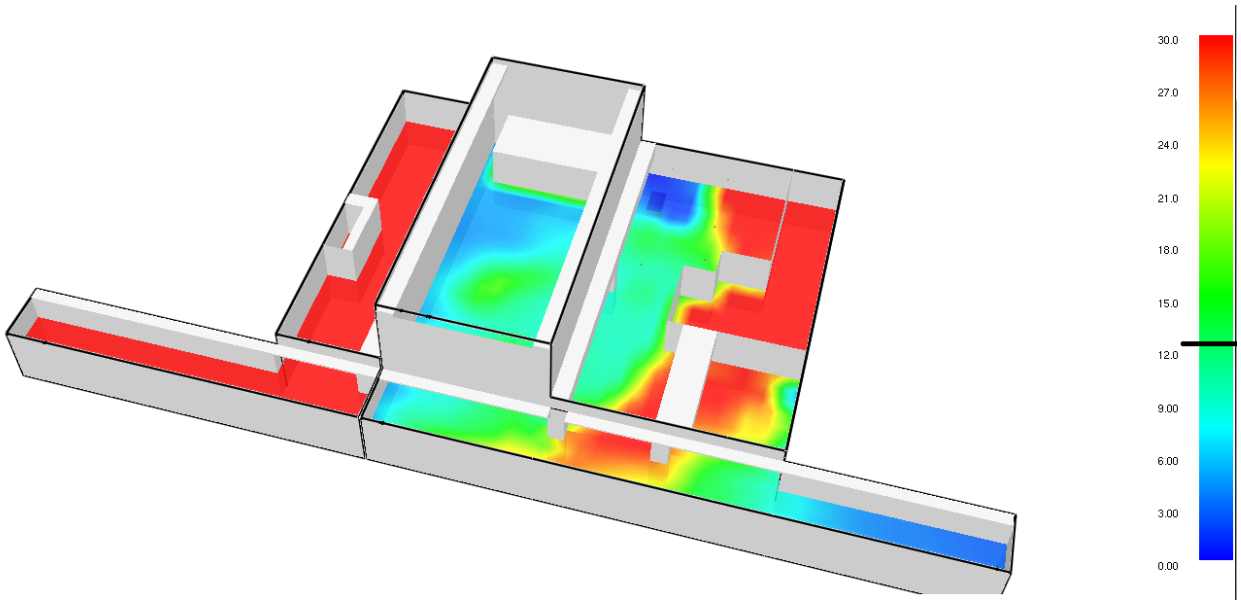


Figure 11 – FDS Results for visibility at 1.8 meters

Four factors are utilized to determine the required safe evacuation time. They are: notification, reaction time, pre-evacuation activity time, and travel time. Notification time is the amount of time elapsed between the ignition of the fire and the occupant becoming aware that a fire exists. In this scenario, the involved fuel sources are in close proximity to many occupants. A notification time of 15 seconds will be set for this scenario.

Reaction time is the amount of time it takes occupants to determine an appropriate course of action. During this time things such as hazard assessment, questioning of the scenario, planning of escape, and deciding to take action take place. A reaction time of 10 seconds is used in this scenario.

Pre-evacuation activity time is the time during which occupants may gather their belongings. During this time, occupants prepare for their evacuation after they have decided to take action. For this scenario, a pre-evacuation activity time of 20 seconds will be used.

Together with a travel time of 54 seconds to the farthest possible exit, a total evacuation time of 99 seconds is required for safe evacuation. This falls well within the available 240 second parameter that the scenario can sustain. Taking into account the main route of evacuation, a required safe evacuation would take 85 seconds. A comparison of the evacuation process can be seen below *(Figure 12)*.

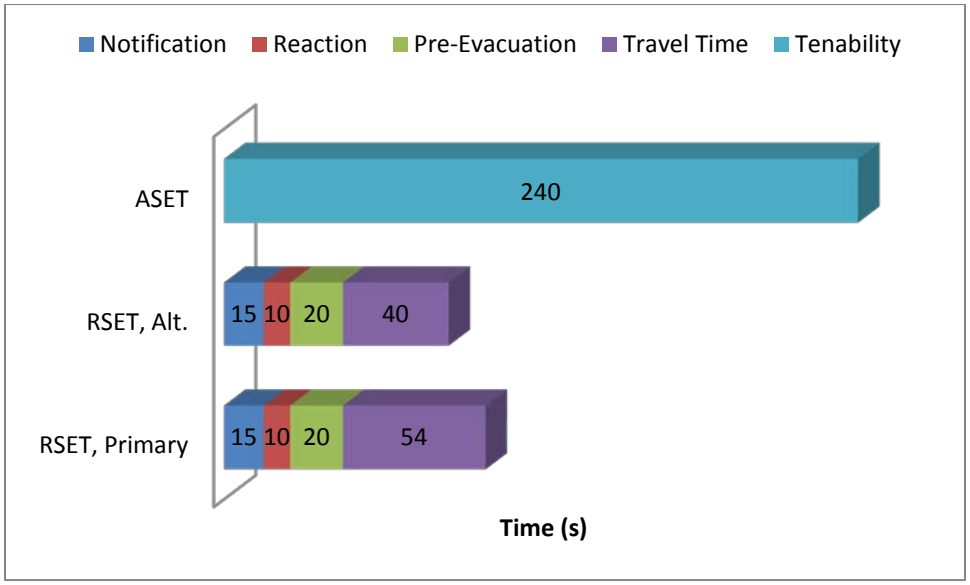


Figure 12 – Comparison of Evacuation Times

Fire Scenario 2

This fire scenario takes into account Design Fire Scenario 2 in NFPA 101. The idea of this fire scenario is to produces a large amount of smoke and toxic products in the primary means of egress. This scenario, similar to scenario one, will cut off a major point of egress, however, it will be at the result of an ultra-fast fire. For this scenario the fire will start in a recyclable medical waste room. This room is likely to contain a high volume of light weight plastics and paper products which will burn rapidly. It needs to be noted that this scenario will assume the door to this room is propped open. Since there is an automatic sprinkler system, a compartment fire would likely be easily contained by the sprinklers within the room and the products of combustion would likely not emanate out of the room at an alarming rate if the door were to be closed. Thus, with the door open, the products of combustion will flow more freely into the adjoining spaces simulating a more serious fire scenario.

Though the room itself has an occupancy load, it is very unlikely any person will occupy the room unless there to drop off/remove the waste products that will be sheltered in it. Because of this, the design area will be expanded to the surrounding corridors to contain the rooms which will most likely be affected by the fire. Since the area is surrounded by mostly exam rooms, storage and offices, the slowest moving person will set the pace for evacuation. For the purpose of this evaluation, it is assumed that all storage room doors, excluding the room with the design fire, are closed and all exam room, offices, and corridor doors are left open. As in the above example an occupant movement speed of .88 m/sec will be used. Two travel distances will be used as the fire will divide the occupant's path of egress. A distance of 23.5 meters and 22 meters will be required for exit. This creates an exit travel time of 20.6 seconds and 19.3 seconds respectively. Below is a diagram displaying both exit paths *(Figure 14).*

A peak heat release rate of 350kW will be used for this fire based on test burn data. While the exact mix of materials is not known, The Society of Fire Protection Engineers has modeled several fires similar to what may be contained. Fires modeled containing train or airline trash and household garbage all showed peak HRR in the 275-350kW range. The soot yield and CO yield will mimic the values used in Fire Scenario 1.

As in fire scenario 1, the available safe evacuation time will be determined by modeling the design fire in FDS. A model of the space is shown below *(Figure 13)* and the input coding is available in appendix B. In this model, there are two sprinklers located within the room and a third located just outside the door. The placement of these heads is set to mimic that of the actual building.

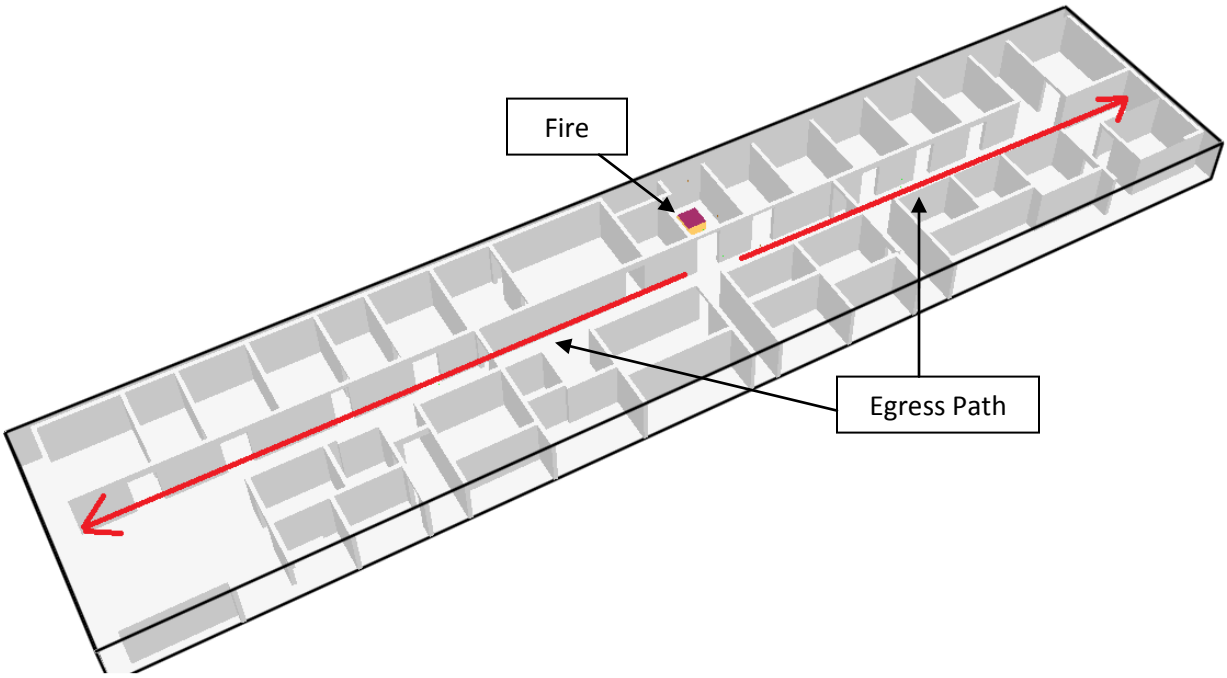


Figure 13 – Model of Fire Scenario 2 with Egress Paths Shown

The FDS simulation is run for 600 seconds, with the heat release rate (HRR) of burning plastic bags ramped to mimic that which has been found in calorimeter tests. A comparison of the calorimeter test and the simulated HRR is shown below *(Figure 14)*. From the FDS simulation it is estimated that the first sprinkler will activate roughly 40 seconds after ignition. The second sprinkler head activates 66 seconds after the ignition of the fire and the head in the hallway never reaches its activation temperature. The profile for the HRR shows that the peak HRR is achieved roughly around 60 seconds. By this time two sprinkler heads in the compartment are flowing and it is assumed they prevent the spread of the fire to any new fuel sources.

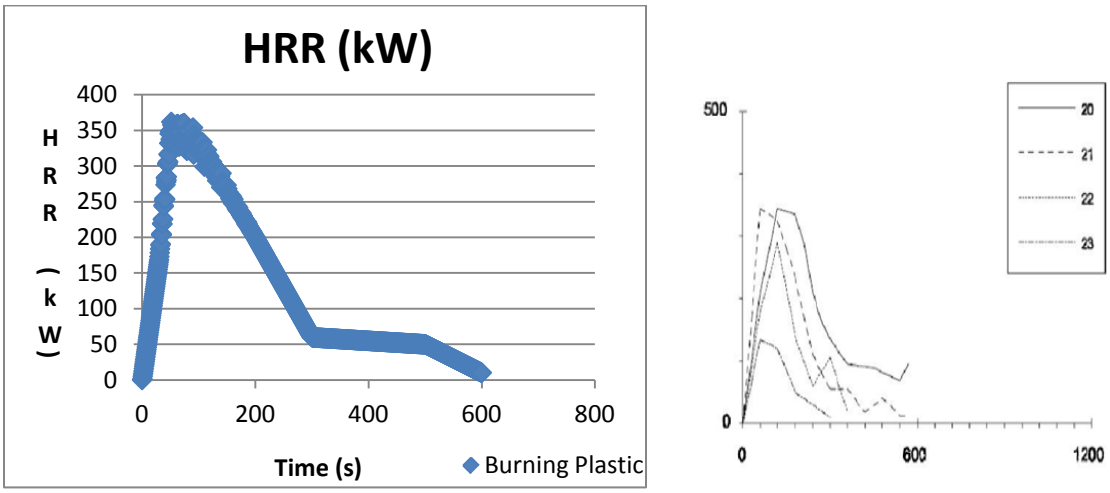


Figure 14 – HRR Scenario 2, Left: FDS Results Right: Calorimeter Test - Burning Trash Bags

The FDS results suggest that the tenability of the room deteriorates relatively quickly. The Thermal barrier is broken only 29 seconds after ignition and the visibility factor degrades past its limits only 14 seconds after ignition. However, since it is unlikely that this room is to be occupied, the adjoining spaces are examined to determine the tenability limits of the area. Thermocouples were placed throughout the hallways to check heat signatures. Immediately

outside the room, at 1.5 meters above the finished floor, temperatures peak at 30 degrees centigrade and never ascend past this point. Because of this, temperature is not a limiting factor in this analysis. Further, the sprinkler head outside the room never activates throughout the duration of the test. This can be attributed to the effectiveness of the sprinklers within the fire room. Visibility in the hallway adjoining the fire room degrades fast. As time continues, the entire corridor becomes filled with smoke and tenability limits for visibility are breached around 126 seconds after ignition. The CO concentration never reaches its threshold throughout the course of the evaluation. Thus, it can be seen that visibility *(Figure 15)* is the limiting factor and the available safe evacuation time is 126 seconds.

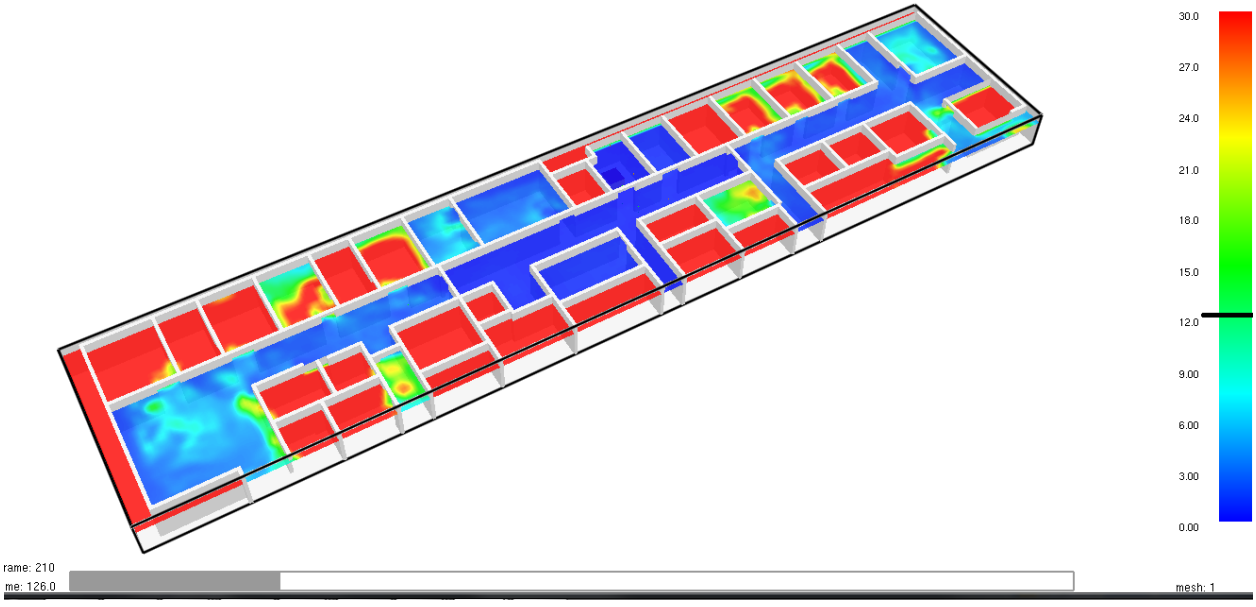


Figure 15 – Visibility for Fire Scenario 2 at 126s

As stated above, there are four factors for determining the required safe evacuation time. In the scenario, a notification time of 30 seconds is set. As the fire develops a large amount of smoke

is produced. At this time frame enough smoke will have protruded into the hallway to be very noticeable by the occupants. A reaction time of 5 seconds is used. In this area a fire is most likely to be recognized by staff which should be trained and prepared in case of such emergency. A Pre-evacuation activity time of 10 seconds is placed. This would allot for staff and patients to gather any immediate belongs and begin an evacuation.

Summing the allotted pre-evacuation times and combining them with the travel time, the required safe evacuation time would be 64-67 seconds depending on which side of the fire a person is located. This falls well within the available 126 seconds that the design area can support. A graphical comparison can be seen below *(Figure 16).*

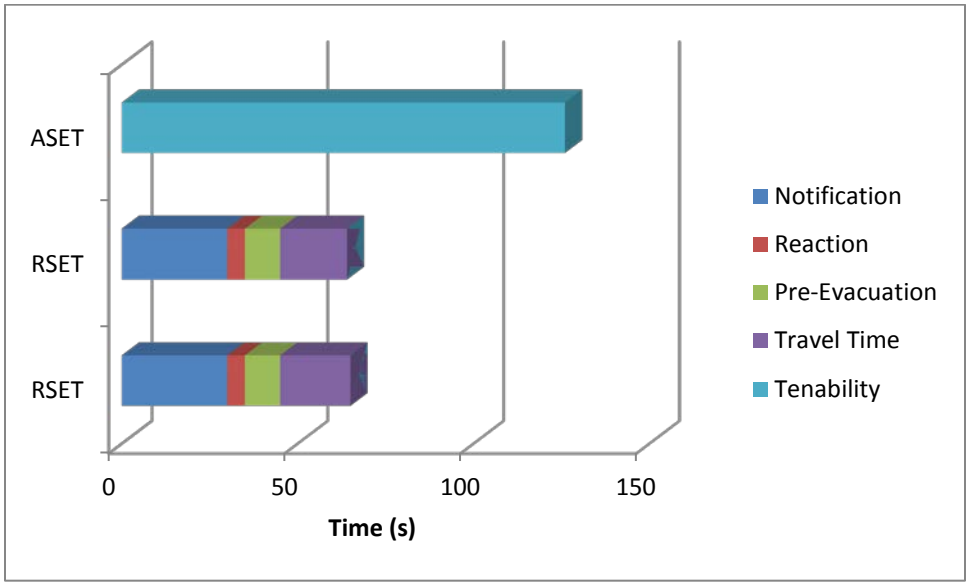


Figure 16 – Comparison of Evacuation Times

Conclusions and Summary

Like most buildings built today, with a high standard of regulation and periodic maintenance, the Hinesville MOB is capable of sustaining its occupants for an adequate amount of time until evacuation is possible. The buildings constructions, finishes, compartmentalization, and structural fire protection provide ample means to protect occupants as they exit in an emergency scenario. The means of egress for exiting the building are ample, well distributed to allow for multiple safe routes and of ample size to accommodate the number of occupants that may need to evacuate the building.

The buildings fire suppression and notification systems meet prescriptive requirements and shall be maintained and inspected regularly. The staff will be trained to address a fire situation as well as how to direct patients to the appropriate means of egress. The AHJ requires an annual inspection performed by the fire marshal where any violations will be tagged and fixed.

In this study, the performance of the Hinesville MOB has been challenged in two likely fire scenarios. While each scenario contained a fire growing at different rates, both block a primary exit route which may have caused ample problems for the occupants inside. In both scenarios the available safe evacuation time met or exceeded the required safe evacuation time this giving enough time for all occupants to escape the untenable conditions. This shows that the prescriptively designed building should perform well in an actual fire.

Recommendations to the building’s owners and operators would be to remain vigilant in proper training of staff as well as standard fire prevention techniques. Also, to continually monitor the operational status of the automatic fire suppression system and perform regular testing and maintenance.

Appendix A

Hydraulic Calculations

- Section 1 – X-ray/Ultrasound Design Area
- Section 2 – PSA Check-in (Atrium) Design Area
- Section 3 – Office Space Design Area

Section 1

XRay/Ultrasound Design Area

Hydraulic Summary

Job Number: 13-1278
Report Description: X-Ray/Ultrasound

Job

Job Number: 13-1278	Design Engineer:
Job Name: Hinesville MOB VA	State Certification/License Number:
Address 1: Corner of Memorial Dr. and Oglethorpe Hwy	AHJ:
Address 2: Hinesville, GA	Job Site/Building:
Address 3:	Drawing Name: Hinesville MOB.cad

System

Most Demanding Sprinkler Data: 5.6K K-Factor 14.82gpm at 7.000psi

Hose Allowance At Source: 0.00gpm

Additional Hose Supplies

Node	Flow(gpm)
Hydrant At Node 3	100.00gpm

Total Hose Streams: 100.00gpm

System Flow Demand	Total Water Required (Including Hose Allowance)
311.73gpm	311.73gpm

Maximum Pressure Unbalance In Loops: 0.000psi

Maximum Velocity Above Ground: 13.62fps between nodes 1363 and 1361

Maximum Velocity Under Ground	
2.33fps between nodes 6 and 14	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
2024.96gal	

Remote Area(s)

Occupancy	Job Suffix
Light Hazard	

Density	Area of Application
0.10gpm/ft²	900.00ft² (Actual 1040.38ft²)

Number Of Sprinklers Calculated	Coverage Per Sprinkler
13	100.00ft²

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area

Left: 30.929psi Right: 30.929psi

Supplies

Node	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		48.000psi	38.000psi		1095.00gpm	47.021psi		311.73gpm	30.929psi	16.092psi

Contractor

	Contractor Number	Contact Name	Contact Title
		BN	

Name of Contractor:	Phone	Extension
Champion Fire Protection, Inc	912-234-0111	

Address 1	FAX
825 Wheaton Street	912-236-1303

Address 2	E-mail

Address 3	Web-Site
Savannah, GA 31401	

Node Analysis

Job Number: 13-1278
Report Description: X-Ray/Ultrasound

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	-3-0	S	30.929psi	311.73gpm	
3	4-0	Hyd	27.604psi	100.00gpm	
101	9-0	Spr(-7.000psi)	7.000psi	14.82gpm	
102	9-0	Spr(-8.543psi)	8.543psi	16.37gpm	
103	9-0	Spr(-7.399psi)	7.399psi	15.23gpm	
104	9-0	Spr(-7.489psi)	7.489psi	15.33gpm	
105	9-0	Spr(-7.498psi)	7.498psi	15.33gpm	
106	9-0	Spr(-7.512psi)	7.512psi	15.35gpm	
107	9-0	Spr(-8.001psi)	8.001psi	15.84gpm	
108	9-0	Spr(-8.010psi)	8.010psi	15.85gpm	
109	9-0	Spr(-8.409psi)	8.409psi	16.24gpm	
110	9-0	Spr(-9.277psi)	9.277psi	17.06gpm	
111	9-0	Spr(-10.111psi)	10.111psi	17.81gpm	
112	9-0	Spr(-10.122psi)	10.122psi	17.82gpm	
113	9-0	Spr(-11.146psi)	11.146psi	18.70gpm	
4	-3-0		30.649psi		
5	-3-0		30.650psi		
6	-3-0	T(46-2½)	30.651psi		
14	-3-0		27.416psi		
18	1-0		25.639psi		
57	9-8	E(6-9½)	21.610psi		
115	9-8	PO(7-5)	21.162psi		
126	9-8	T(7-5)	20.528psi		
127	9-8	T(7-5)	20.358psi		
135	9-8	PO(20-2)	19.799psi		
166	9-8	PO(5-0)	19.791psi		
171	9-8	PO(7-5)	21.042psi		
245	9-8	PO(7-5)	20.509psi		
272	9-8	PO(7-5)	19.782psi		
311	9-8	PO(7-5)	19.775psi		
315	9-8	PO(7-5)	20.448psi		
377	9-8	PO(7-5)	20.377psi		
427	9-8	PO(7-5)	19.749psi		
458	9-8	PO(7-5)	19.734psi		
474	9-8	PO(7-5)	20.291psi		
493	9-8	T(7-5)	19.786psi		
511	9-8	PO(7-5)	19.710psi		
520	9-8	PO(7-5)	20.234psi		
572	9-8	PO(7-5)	19.690psi		
599	9-8	PO(5-0)	20.185psi		
655	9-8	PO(7-5)	19.659psi		
698	9-8	PO(7-5)	20.117psi		
787	9-8	PO(7-5)	19.599psi		
790	9-8	PO(7-5)	19.582psi		
799	9-8	PO(7-5)	20.066psi		
924	11-10	PO(16-5½)	18.673psi		
931	11-10	PO(16-5½)	18.536psi		
941	11-10	PO(20-2)	18.321psi		
942	11-10	PO(26-4)	18.368psi		
1357	9-8	T(5-0)	9.070psi		
1359	9-8	T(5-0)	10.494psi		
1361	9-8	T(5-0)	11.405psi		
1363	9-8	PO(6-0)	14.732psi		
1393	9-8	T(5-0)	10.327psi		
1395	9-8	PO(5-0)	14.621psi		
1426	9-8	T(5-0)	9.831psi		
1428	9-8	T(5-0)	12.453psi		
1430	9-8	PO(6-0)	14.553psi		
1448	9-8	T(5-0)	9.819psi		
1450	9-8	T(5-0)	12.439psi		
1452	9-8	PO(6-0)	14.536psi		

Hydraulic Analysis

Job Number: 13-1278
Report Description: X-Ray/Ultrasound

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •							
DR	1.0490	14.82gpm	5.50fps	120	0.074703	25-7	Pf 2.359psi
101	9-0	14.82gpm	5.6K	7.000psi	Sprinkler,	6-0	Pe -0.289psi
1357	9-8			9.070psi	3E(2-0)	31-7	Pv
BL	1.0490	30.05gpm	11.15fps	120	0.276347	5-2	Pf 1.423psi
1357	9-8	15.23gpm		9.070psi	Flow (q) from Route 3		Pe
1359	9-8			10.494psi		5-2	Pv
BL	1.3800	46.42gpm	9.96fps	120	0.162478	5-7½	Pf 0.912psi
1359	9-8	16.37gpm		10.494psi	Flow (q) from Route 2		Pe
1361	9-8			11.405psi		5-7½	Pv
BL	1.3800	63.47gpm	13.62fps	120	0.289897	5-5½	Pf 3.326psi
1361	9-8	17.06gpm		11.405psi	Flow (q) from Route 10	6-0	Pe
1363	9-8			14.732psi	PO(6-0)	11-5½	Pv
CM	3.2600	211.73gpm	8.14fps	120	0.040924	60-6	Pf 4.529psi
1363	9-8	148.25gpm		14.732psi	Flow (q) from Route 4	50-2	Pe -0.939psi
941	11-10			18.321psi	6E(5-0), PO(20-2)	110-8	Pv
CM	4.2600	76.62gpm	1.72fps	120	0.001696	1-3½	Pf 0.047psi
941	11-10			18.321psi		26-4	Pe
942	11-10			18.368psi	PO(26-4)	27-7½	Pv
CM	3.2600	76.62gpm	2.95fps	120	0.006242	23-11½	Pf 0.274psi
942	11-10			18.368psi		20-0	Pe 0.939psi
790	9-8			19.582psi	4E(5-0)	43-11½	Pv
CM	3.2600	71.03gpm	2.73fps	120	0.005426	3-1½	Pf 0.017psi
790	9-8			19.582psi			Pe
787	9-8			19.599psi		3-1½	Pv
CM	3.2600	65.03gpm	2.50fps	120	0.004609	13-2	Pf 0.061psi
787	9-8			19.599psi			Pe
655	9-8			19.659psi		13-2	Pv
CM	3.2600	59.26gpm	2.28fps	120	0.003880	7-10	Pf 0.030psi
655	9-8			19.659psi			Pe
572	9-8			19.690psi		7-10	Pv
CM	3.2600	52.98gpm	2.04fps	120	0.003155	6-5	Pf 0.020psi
572	9-8			19.690psi			Pe
511	9-8			19.710psi		6-5	Pv
CM	3.2600	49.16gpm	1.89fps	120	0.002746	8-7	Pf 0.024psi
511	9-8			19.710psi			Pe
458	9-8			19.734psi		8-7	Pv
CM	3.2600	46.04gpm	1.77fps	120	0.002432	6-2½	Pf 0.015psi
458	9-8			19.734psi			Pe
427	9-8			19.749psi		6-2½	Pv
CM	3.2600	39.14gpm	1.50fps	120	0.001802	14-5½	Pf 0.026psi
427	9-8			19.749psi			Pe
311	9-8			19.775psi		14-5½	Pv
CM	3.2600	32.17gpm	1.24fps	120	0.001254	5-7½	Pf 0.007psi
311	9-8			19.775psi			Pe
272	9-8			19.782psi		5-7½	Pv
CM	3.2600	24.97gpm	0.96fps	120	0.000784	11-8½	Pf 0.009psi
272	9-8			19.782psi			Pe
166	9-8			19.791psi		11-8½	Pv
CM	3.2600	13.34gpm	0.51fps	120	0.000246	11-4	Pf 0.008psi
166	9-8			19.791psi		20-2	Pe
135	9-8			19.799psi	PO(20-2)	31-6	Pv
OR	1.4420	13.34gpm	2.62fps	120	0.013067	35-5	Pf 0.560psi
135	9-8			19.799psi		7-5	Pe
127	9-8			20.358psi	T(7-5)	42-10	Pv
OR	1.4420	6.67gpm	1.31fps	120	0.003625	34-4	Pf 0.169psi
127	9-8			20.358psi		12-4½	Pe
126	9-8			20.528psi	2LtE(2-5½), T(7-5)	46-8½	Pv
OR	1.4420	13.34gpm	2.62fps	120	0.013067	41-1	Pf 0.634psi
126	9-8			20.528psi		7-5	Pe
115	9-8			21.162psi	PO(7-5)	48-6½	Pv
CM	4.2600	211.73gpm	4.77fps	120	0.011120	26-8½	Pf 0.448psi
115	9-8	198.39gpm		21.162psi	Flow (q) from Route 15	13-7	Pe
57	9-8			21.610psi	2E(6-9½)	40-3½	Pv
FR	4.2600	211.73gpm	4.77fps	120	0.011120	8-8	Pf 0.272psi
57	9-8			21.610psi		15-9½	Pe 3.757psi
18	1-0			25.639psi	f(-0.000psi), BV(15-9½)	24-5½	Pv
UG	6.3400	211.73gpm	2.15fps	140	0.001206	12-0	Pf 0.042psi
18	1-0			25.639psi		23-1½	Pe 1.734psi
14	-3-0			27.416psi	E(23-1½)	35-1½	Pv
UG	6.0900	211.73gpm	2.33fps	150	0.001291	98-10	Pf 3.235psi
14	-3-0			27.416psi		83-2½	Pe

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
6	-3-0			30.651psi	E(21-7), PIV(4-7½), EE(10-9½), BFP(-3.000psi), T(46-2½)	182-0½	Pv
UG	7.9800	311.73gpm	2.00fps	150	0.000708	380-1½	Pf 0.279psi
6	-3-0	100.00gpm		30.651psi	Supply,	13-7	Pe
1	-3-0			30.929psi	EE(13-7), S	393-8	Pv
		0.00gpm			Hose Allowance At Source		
1		311.73gpm					
• • • • • Route 2 • • • • •							
DR	1.0490	16.37gpm	6.08fps	120	0.089822	15-11	Pf 2.240psi
102	9-0	16.37gpm	5.6K	8.543psi	Sprinkler,	9-0	Pe -0.289psi
1359	9-8			10.494psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 3 • • • • •							
DR	1.0490	15.23gpm	5.65fps	120	0.078633	15-11	Pf 1.961psi
103	9-0	15.23gpm	5.6K	7.399psi	Sprinkler,	9-0	Pe -0.289psi
1357	9-8			9.070psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 4 • • • • •							
DR	1.0490	15.33gpm	5.69fps	120	0.079523	23-11	Pf 2.619psi
104	9-0	15.33gpm	5.6K	7.489psi	Sprinkler,	9-0	Pe -0.289psi
1448	9-8			9.819psi	2E(2-0), T(5-0)	32-11	Pv
BL	1.0490	31.17gpm	11.57fps	120	0.295646	8-10½	Pf 2.619psi
1448	9-8	15.84gpm		9.819psi	Flow (q) from Route 7		Pe
1450	9-8			12.439psi		8-10½	Pv
BL	1.3800	48.97gpm	10.50fps	120	0.179408	5-8½	Pf 2.098psi
1450	9-8	17.81gpm		12.439psi	Flow (q) from Route 11	6-0	Pe
1452	9-8			14.536psi	PO(6-0)	11-8½	Pv
CM	3.2600	48.97gpm	1.88fps	120	0.002727	6-0	Pf 0.016psi
1452	9-8			14.536psi			Pe
1430	9-8			14.553psi		6-0	Pv
CM	3.2600	97.97gpm	3.77fps	120	0.009836	6-11	Pf 0.068psi
1430	9-8	49.00gpm		14.553psi	Flow (q) from Route 5		Pe
1395	9-8			14.621psi		6-11	Pv
CM	3.2600	148.25gpm	5.70fps	120	0.021166	5-3	Pf 0.111psi
1395	9-8	31.59gpm		14.621psi	Flow (q) from Route 6		Pe
1363	9-8			14.732psi		5-3	Pv
• • • • • Route 5 • • • • •							
DR	1.0490	15.33gpm	5.69fps	120	0.079607	23-11	Pf 2.622psi
105	9-0	15.33gpm	5.6K	7.498psi	Sprinkler,	9-0	Pe -0.289psi
1426	9-8			9.831psi	2E(2-0), T(5-0)	32-11	Pv
BL	1.0490	31.18gpm	11.58fps	120	0.295959	8-10½	Pf 2.622psi
1426	9-8	15.85gpm		9.831psi	Flow (q) from Route 8		Pe
1428	9-8			12.453psi		8-10½	Pv
BL	1.3800	49.00gpm	10.51fps	120	0.179598	5-8½	Pf 2.100psi
1428	9-8	17.82gpm		12.453psi	Flow (q) from Route 12	6-0	Pe
1430	9-8			14.553psi	PO(6-0)	11-8½	Pv
• • • • • Route 6 • • • • •							
DR	1.0490	15.35gpm	5.70fps	120	0.079739	29-11	Pf 3.105psi
106	9-0	15.35gpm	5.6K	7.512psi	Sprinkler,	9-0	Pe -0.289psi
1393	9-8			10.327psi	2E(2-0), T(5-0)	38-11	Pv
BL	1.0490	31.59gpm	11.73fps	120	0.303089	9-2	Pf 4.294psi
1393	9-8	16.24gpm		10.327psi	Flow (q) from Route 9	5-0	Pe
1395	9-8			14.621psi	PO(5-0)	14-2	Pv
• • • • • Route 7 • • • • •							
DR	1.0490	15.84gpm	5.88fps	120	0.084532	15-11	Pf 2.108psi
107	9-0	15.84gpm	5.6K	8.001psi	Sprinkler,	9-0	Pe -0.289psi
1448	9-8			9.819psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 8 • • • • •							
DR	1.0490	15.85gpm	5.88fps	120	0.084622	15-11	Pf 2.110psi
108	9-0	15.85gpm	5.6K	8.010psi	Sprinkler,	9-0	Pe -0.289psi
1426	9-8			9.831psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 9 • • • • •							
DR	1.0490	16.24gpm	6.03fps	120	0.088515	15-11	Pf 2.207psi
109	9-0	16.24gpm	5.6K	8.409psi	Sprinkler,	9-0	Pe -0.289psi
1393	9-8			10.327psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 10 • • • • •							
DR	1.0490	17.06gpm	6.33fps	120	0.096938	15-11	Pf 2.417psi
110	9-0	17.06gpm	5.6K	9.277psi	Sprinkler,	9-0	Pe -0.289psi
1361	9-8			11.405psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 11 • • • • •							
DR	1.0490	17.81gpm	6.61fps	120	0.104964	15-11	Pf 2.617psi
111	9-0	17.81gpm	5.6K	10.111psi	Sprinkler,	9-0	Pe -0.289psi
1450	9-8			12.439psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 12 • • • • •							

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
DR	1.0490	17.82gpm	6.61fps	120	0.105074	15-11	Pf 2.620psi
112	9-0	17.82gpm	5.6K	10.122psi	Sprinkler,	9-0	Pe -0.289psi
1428	9-8			12.453psi	2E(2-0), T(5-0)	24-11	Pv
• • • • • Route 13 • • • • •							
DR	1.0490	18.70gpm	6.94fps	120	0.114870	18-9	Pf 3.764psi
113	9-0	18.70gpm	5.6K	11.146psi	Sprinkler,	14-0	Pe -0.289psi
1395	9-8			14.621psi	2E(2-0), T(5-0), PO(5-0)	32-9	Pv
• • • • • Route 14 • • • • •							
UG	6.3400	100.00gpm	1.02fps	140	0.000301	11-4½	Pf 0.010psi
3	4-0	100.00gpm		27.604psi	Hydrant,	23-1½	Pe 3.035psi
4	-3-0			30.649psi	E(23-1½)	34-5½	Pv
UG	6.0900	100.00gpm	1.10fps	150	0.000322	2-9½	Pf 0.001psi
4	-3-0			30.649psi			Pe
5	-3-0			30.650psi		2-9½	Pv
UG	7.9800	100.00gpm	0.64fps	150	0.000086	4-6	Pf 0.000psi
5	-3-0			30.650psi			Pe
6	-3-0			30.651psi		4-6	Pv
• • • • • Route 15 • • • • •							
CM	4.2600	135.11gpm	3.04fps	120	0.004844	73-2½	Pf 0.453psi
924	11-10	121.66gpm		18.673psi	Flow (q) from Route 16	20-5	Pe 0.939psi
799	9-8			20.066psi	3E(6-9½)	93-7	Pv
CM	4.2600	140.70gpm	3.17fps	120	0.005221	9-10	Pf 0.051psi
799	9-8	5.59gpm		20.066psi	Flow (q) from Route 17		Pe
698	9-8			20.117psi		9-10	Pv
CM	4.2600	146.70gpm	3.30fps	120	0.005640	12-2	Pf 0.069psi
698	9-8	6.00gpm		20.117psi	Flow (q) from Route 19		Pe
599	9-8			20.185psi		12-2	Pv
CM	4.2600	152.47gpm	3.43fps	120	0.006058	8-0	Pf 0.048psi
599	9-8	5.78gpm		20.185psi	Flow (q) from Route 20		Pe
520	9-8			20.234psi		8-0	Pv
CM	4.2600	158.74gpm	3.57fps	120	0.006527	8-8½	Pf 0.057psi
520	9-8	6.27gpm		20.234psi	Flow (q) from Route 21		Pe
474	9-8			20.291psi		8-8½	Pv
CM	4.2600	165.69gpm	3.73fps	120	0.007065	12-2	Pf 0.086psi
474	9-8	6.95gpm		20.291psi	Flow (q) from Route 22		Pe
377	9-8			20.377psi		12-2	Pv
CM	4.2600	172.59gpm	3.88fps	120	0.007619	9-4	Pf 0.071psi
377	9-8	6.90gpm		20.377psi	Flow (q) from Route 24		Pe
315	9-8			20.448psi		9-4	Pv
CM	4.2600	179.55gpm	4.04fps	120	0.008198	7-5½	Pf 0.061psi
315	9-8	6.97gpm		20.448psi	Flow (q) from Route 25		Pe
245	9-8			20.509psi		7-5½	Pv
CM	4.2600	186.76gpm	4.20fps	120	0.008816	46-10½	Pf 0.533psi
245	9-8	7.20gpm		20.509psi	Flow (q) from Route 26	13-7	Pe
171	9-8			21.042psi	2E(6-9½)	60-6	Pv
CM	4.2600	198.39gpm	4.47fps	120	0.009859	12-2	Pf 0.120psi
171	9-8	11.63gpm		21.042psi	Flow (q) from Route 27		Pe
115	9-8			21.162psi		12-2	Pv
• • • • • Route 16 • • • • •							
CM	4.2600	135.11gpm	3.04fps	120	0.004844	44-5	Pf 0.215psi
941	11-10			18.321psi			Pe
931	11-10			18.536psi		44-5	Pv
CM	4.2600	121.66gpm	2.74fps	120	0.003990	34-3	Pf 0.137psi
931	11-10			18.536psi			Pe
924	11-10			18.673psi		34-3	Pv
• • • • • Route 17 • • • • •							
OR	1.4420	5.59gpm	1.10fps	120	0.002612	150-7	Pf 0.484psi
790	9-8			19.582psi	PO(7-5)	34-8	Pe
799	9-8			20.066psi	8LtE(2-5½), PO(7-5)	185-3	Pv
• • • • • Route 18 • • • • •							
OR	1.4420	6.00gpm	1.18fps	120	0.002977	144-4	Pf 0.518psi
787	9-8			19.599psi	PO(7-5)	29-8½	Pe
698	9-8			20.117psi	6LtE(2-5½), PO(7-5)	174-1	Pv
• • • • • Route 19 • • • • •							
OR	1.4420	5.78gpm	1.13fps	120	0.002777	154-9½	Pf 0.526psi
655	9-8			19.659psi	PO(7-5)	34-8	Pe
599	9-8			20.185psi	8LtE(2-5½), PO(7-5)	189-5½	Pv
• • • • • Route 20 • • • • •							
OR	1.4420	6.27gpm	1.23fps	120	0.003234	143-6½	Pf 0.544psi
572	9-8			19.690psi	PO(7-5)	24-9½	Pe
520	9-8			20.234psi	4LtE(2-5½), PO(7-5)	168-3½	Pv
• • • • • Route 21 • • • • •							

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
OR	1.4420	3.83gpm	0.75fps	120	0.001296	40-11½	Pf 0.076psi
511	9-8			19.710psi	PO(7-5)	17-4	Pe
493	9-8			19.786psi	LtE(2-5½), T(7-5)	58-3½	Pv
OR	1.4420	6.95gpm	1.37fps	120	0.003909	111-11	Pf 0.505psi
493	9-8	3.12gpm		19.786psi	Flow (q) from Route 23	17-4	Pe
474	9-8			20.291psi	4LtE(2-5½), PO(7-5)	129-3	Pv
• • • • • Route 22 • • • • •							
OR	1.4420	3.12gpm	0.61fps	120	0.000890	41-1½	Pf 0.052psi
458	9-8			19.734psi	PO(7-5)	17-4	Pe
493	9-8			19.786psi	LtE(2-5½), T(7-5)	58-5½	Pv
• • • • • Route 23 • • • • •							
OR	1.4420	6.90gpm	1.35fps	120	0.003853	143-2	Pf 0.628psi
427	9-8			19.749psi	PO(7-5)	19-10	Pe
377	9-8			20.377psi	2LtE(2-5½), PO(7-5)	163-0	Pv
• • • • • Route 24 • • • • •							
OR	1.4420	6.97gpm	1.37fps	120	0.003926	146-7½	Pf 0.673psi
311	9-8			19.775psi	PO(7-5)	24-9½	Pe
315	9-8			20.448psi	4LtE(2-5½), PO(7-5)	171-5	Pv
• • • • • Route 25 • • • • •							
OR	1.4420	7.20gpm	1.42fps	120	0.004177	149-3½	Pf 0.727psi
272	9-8			19.782psi	PO(7-5)	24-9½	Pe
245	9-8			20.509psi	4LtE(2-5½), PO(7-5)	174-0½	Pv
• • • • • Route 26 • • • • •							
OR	1.4420	11.63gpm	2.28fps	120	0.010134	103-7½	Pf 1.251psi
166	9-8			19.791psi	PO(7-5)	19-10	Pe
171	9-8			21.042psi	2LtE(2-5½), PO(7-5)	123-5½	Pv
• • • • • Route 27 • • • • •							
CM	2.6350	13.45gpm	0.79fps	120	0.000704	75-2	Pf 0.137psi
931	11-10			18.536psi	PO(16-5½)	118-10½	Pe -0.000psi
924	11-10			18.673psi	14E(4-3½), 2T(10-9½), Ee2(4-1½), PO(16-5½)	194-0	Pv
• • • • • Route 28 • • • • •							
OR	1.4420	6.67gpm	1.31fps	120	0.003625	34-4	Pf 0.169psi
127	9-8			20.358psi		12-4½	Pe
126	9-8			20.528psi	2LtE(2-5½), T(7-5)	46-8½	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend

AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

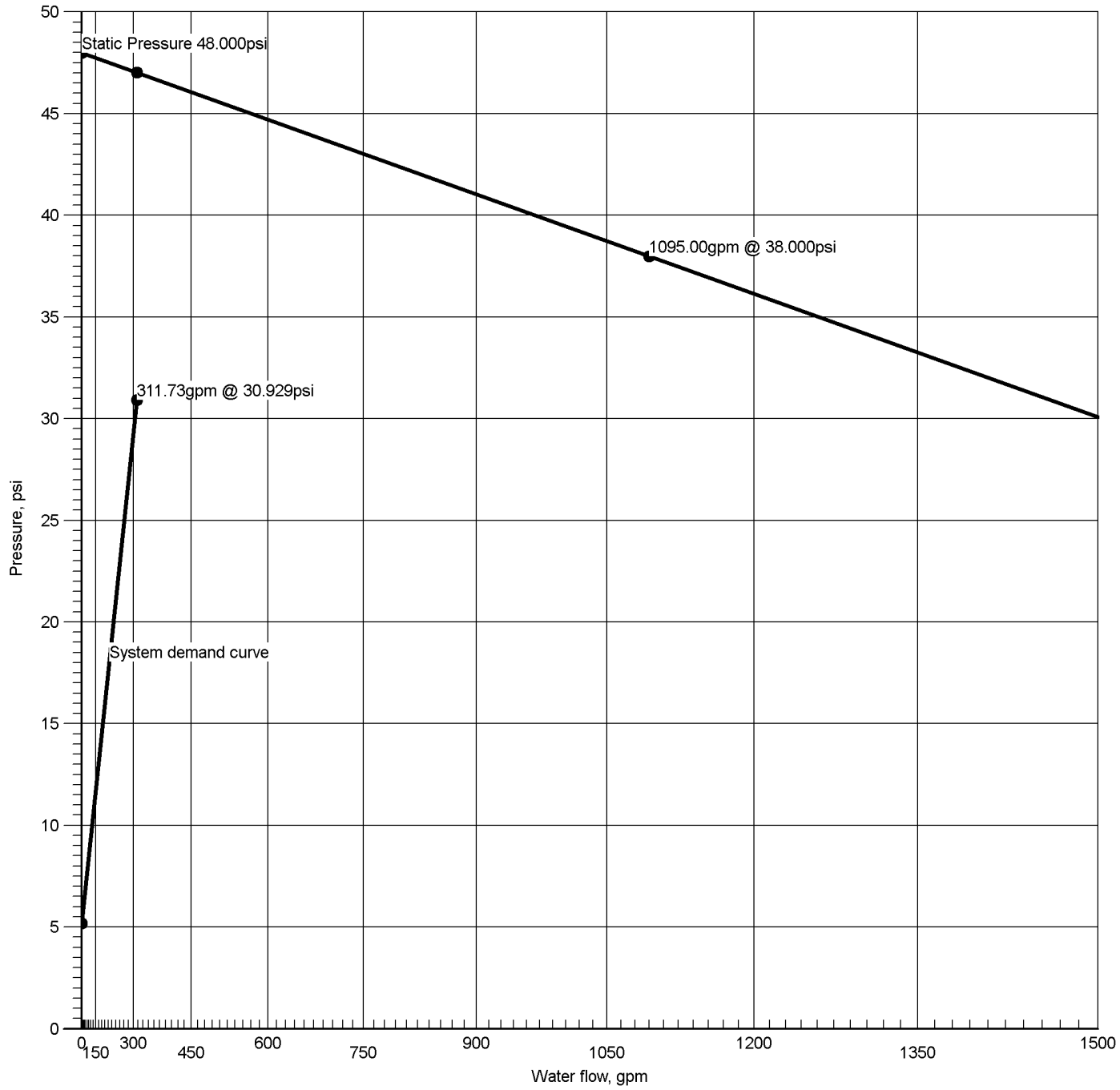
Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PRV	Pressure Reducing Valve
PrV	Pressure Relief Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap

Supply at Node 1



Hydraulic Graph
Supply at Node 1

Static: Pressure
48.000psi

Residual: Pressure
38.000psi @ 1095.00gpm

Available Pressure at Time of Test
38.000psi @ 1095.00gpm

System Demand
30.929psi @ 311.73gpm

System Demand (Including Hose Allowance at Source)
30.929psi @ 311.73gpm

Section 2

Front Lobby (Atrium) Design Area

Hydraulic Summary

Job Number: 13-1278
Report Description: Front Lobby

Job

Job Number: 13-1278	Design Engineer:
Job Name: Hinesville MOB VA	State Certification/License Number:
Address 1: Corner of Memorial Dr. and Oglethorpe Hwy	AHJ:
Address 2: Hinesville, GA	Job Site/Building:
Address 3:	Drawing Name: Hinesville MOB.cad

System

Most Demanding Sprinkler Data: 5.6K K-Factor 14.90gpm at 7.083psi

Hose Allowance At Source: 0.00gpm

Additional Hose Supplies

Node	Flow(gpm)
Hydrant At Node 3	100.00gpm

Total Hose Streams: 100.00gpm

System Flow Demand	Total Water Required (Including Hose Allowance)
379.17gpm	379.17gpm

Maximum Pressure Unbalance In Loops: 0.000psi

Maximum Velocity Above Ground: 8.56fps between nodes 931 and 996

Maximum Velocity Under Ground	
3.07fps between nodes 6 and 14	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
2024.96gal	

Remote Area(s)

Occupancy	Job Suffix
Light Hazard	
Density	**Area of Application**
0.10gpm/ft²	1500.00ft² (Actual 1582.95ft²)
Number Of Sprinklers Calculated	**Coverage Per Sprinkler**
17	149.04ft²

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area

Supplies

Node	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		48.000psi	38.000psi		1095.00gpm	46.594psi		379.17gpm	35.439psi	11.155psi

Contractor

	Contractor Number	Contact Name	Contact Title
		BN	

Name of Contractor:	Phone	Extension
Champion Fire Protection, Inc	912-234-0111	

Address 1	FAX
825 Wheaton Street	912-236-1303
Address 2	**E-mail**
Address 3	**Web-Site**
Savannah, GA 31401	

Node Analysis

Job Number: 13-1278
Report Description: Front Lobby

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	-3-0	S	35.439psi	379.17gpm	
3	4-0	Hyd	31.992psi	100.00gpm	
301	27-10	Spr(-7.083psi)	7.083psi	14.90gpm	
302	27-10	Spr(-7.085psi)	7.085psi	14.91gpm	
303	27-10	Spr(-7.096psi)	7.096psi	14.92gpm	
304	27-10	Spr(-7.097psi)	7.097psi	14.92gpm	
305	27-10	Spr(-7.881psi)	7.881psi	15.72gpm	
306	27-10	Spr(-7.882psi)	7.882psi	15.72gpm	
307	24-4	Spr(-8.191psi)	8.191psi	16.03gpm	
308	24-4	Spr(-8.206psi)	8.206psi	16.04gpm	
309	24-4	Spr(-8.242psi)	8.242psi	16.08gpm	
310	24-4	Spr(-8.257psi)	8.257psi	16.09gpm	
312	27-10	Spr(-8.692psi)	8.692psi	16.51gpm	
313	27-10	Spr(-8.693psi)	8.693psi	16.51gpm	
314	24-4	Spr(-9.096psi)	9.096psi	16.89gpm	
316	24-4	Spr(-9.152psi)	9.152psi	16.94gpm	
317	24-4	Spr(-10.016psi)	10.016psi	17.72gpm	
318	24-4	Spr(-10.078psi)	10.078psi	17.78gpm	
319	13-6	Spr(-14.729psi)	14.729psi	21.49gpm	
4	-3-0		35.037psi		
5	-3-0		35.038psi		
6	-3-0	T(46-2½)	35.038psi		
14	-3-0		31.646psi		
18	1-0		29.842psi		
57	9-8	E(6-9½)	25.631psi		
115	9-8	PO(7-5)	24.883psi		
126	9-8	T(7-5)	23.940psi		
127	9-8	T(7-5)	23.688psi		
135	9-8	PO(20-2)	22.855psi		
166	9-8	PO(5-0)	22.843psi		
171	9-8	PO(7-5)	24.682psi		
245	9-8	PO(7-5)	23.779psi		
272	9-8	PO(7-5)	22.830psi		
311	9-8	PO(7-5)	22.820psi		
315	9-8	PO(7-5)	23.674psi		
377	9-8	PO(7-5)	23.551psi		
427	9-8	PO(7-5)	22.783psi		
458	9-8	PO(7-5)	22.762psi		
474	9-8	PO(7-5)	23.401psi		
493	9-8	T(7-5)	22.820psi		
511	9-8	PO(7-5)	22.730psi		
520	9-8	PO(7-5)	23.300psi		
572	9-8	PO(7-5)	22.703psi		
599	9-8	PO(5-0)	23.212psi		
655	9-8	PO(7-5)	22.663psi		
698	9-8	PO(7-5)	23.085psi		
787	9-8	PO(7-5)	22.584psi		
790	9-8	PO(7-5)	22.563psi		
799	9-8	PO(7-5)	22.988psi		
924	11-10	PO(16-5½)	21.169psi		
931	11-10	PO(16-5½)	21.133psi		
942	11-10	PO(26-4)	21.284psi		
988	26-0	PO(10-0)	11.754psi		
993	26-0	PO(10-0)	11.679psi		
996	14-2	T(10-9½)	18.300psi		
997	14-2	PO(10-0)	18.281psi		
1005	28-6	PO(10-0)	10.383psi		
1007	28-6	PO(10-0)	10.382psi		
1135	14-2	T(5-0)	18.144psi		
1142	26-0	T(5-0)	10.617psi		
1146	26-0	T(5-0)	10.548psi		
1148	28-6	T(5-0)	9.414psi		

Node Analysis

Job Number: 13-1278
Report Description: Front Lobby

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1152	28-6	T(5-0)	9.413psi		
1207	26-0	T(5-0)	9.585psi		
1211	26-0	T(5-0)	9.522psi		
1213	28-6	T(5-0)	8.517psi		
1217	28-6	T(5-0)	8.515psi		
1282	26-0	T(5-0)	8.585psi		
1286	26-0	T(5-0)	8.528psi		
1288	28-6	T(5-0)	7.647psi		
1292	28-6	T(5-0)	7.646psi		
1374	26-0	E(2-0)	8.308psi		
1378	26-0	E(2-0)	8.253psi		
1380	28-6	E(2-0)	7.407psi		
1384	28-6	E(2-0)	7.405psi		

Hydraulic Analysis

Job Number: 13-1278
Report Description: Front Lobby

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •							
DR	1.0490	14.90gpm	5.53fps	120	0.075526	1-11½	Pf 0.602psi
301	27-10	14.90gpm	5.6K	7.083psi	Sprinkler,	6-0	Pe -0.280psi
1384	28-6			7.405psi	3E(2-0)	7-11½	Pv
BL	1.3800	14.90gpm	3.20fps	120	0.019864	12-1½	Pf 0.241psi
1384	28-6			7.405psi			Pe
1292	28-6			7.646psi		12-1½	Pv
BL	1.3800	29.82gpm	6.40fps	120	0.071669	12-1½	Pf 0.869psi
1292	28-6	14.92gpm		7.646psi	Flow (q) from Route 3		Pe
1217	28-6			8.515psi		12-1½	Pv
BL	1.6100	45.54gpm	7.18fps	120	0.074043	12-1½	Pf 0.898psi
1217	28-6	15.72gpm		8.515psi	Flow (q) from Route 5		Pe
1152	28-6			9.413psi		12-1½	Pv
BL	2.0670	62.05gpm	5.93fps	120	0.038864	14-11	Pf 0.969psi
1152	28-6	16.51gpm		9.413psi	Flow (q) from Route 11	10-0	Pe
1007	28-6			10.382psi	PO(10-0)	24-11	Pv
CM	2.6350	57.29gpm	3.37fps	120	0.010277	8-8½	Pf 0.222psi
1007	28-6			10.382psi		12-11	Pe 1.075psi
993	26-0			11.679psi	3E(4-3½)	21-7½	Pv
CM	2.6350	123.97gpm	7.29fps	120	0.042862	15-4½	Pf 1.491psi
993	26-0	66.68gpm		11.679psi	Flow (q) from Route 7	19-5	Pe 5.130psi
996	14-2			18.300psi	2E(4-3½), T(10-9½)	34-9½	Pv
CM	2.6350	145.46gpm	8.56fps	120	0.057614	6-6½	Pf 1.821psi
996	14-2	21.49gpm		18.300psi	Flow (q) from Route 17	25-1	Pe 1.012psi
931	11-10			21.133psi	2E(4-3½), PO(16-5½)	31-7½	Pv
CM	4.2600	59.56gpm	1.34fps	120	0.001064	34-3	Pf 0.036psi
931	11-10			21.133psi			Pe
924	11-10			21.169psi		34-3	Pv
CM	4.2600	193.27gpm	4.35fps	120	0.009394	73-2½	Pf 0.879psi
924	11-10	133.71gpm		21.169psi	Flow (q) from Route 2	20-5	Pe 0.939psi
799	9-8			22.988psi	3E(6-9½)	93-7	Pv
CM	4.2600	198.49gpm	4.47fps	120	0.009868	9-10	Pf 0.097psi
799	9-8	5.21gpm		22.988psi	Flow (q) from Route 23		Pe
698	9-8			23.085psi		9-10	Pv
CM	4.2600	204.38gpm	4.60fps	120	0.010416	12-2	Pf 0.127psi
698	9-8	5.89gpm		23.085psi	Flow (q) from Route 25		Pe
599	9-8			23.212psi		12-2	Pv
CM	4.2600	210.29gpm	4.73fps	120	0.010981	8-0	Pf 0.088psi
599	9-8	5.91gpm		23.212psi	Flow (q) from Route 26		Pe
520	9-8			23.300psi		8-0	Pv
CM	4.2600	216.88gpm	4.88fps	120	0.011626	8-8½	Pf 0.101psi
520	9-8	6.59gpm		23.300psi	Flow (q) from Route 27		Pe
474	9-8			23.401psi		8-8½	Pv
CM	4.2600	224.38gpm	5.05fps	120	0.012380	12-2	Pf 0.150psi
474	9-8	7.50gpm		23.401psi	Flow (q) from Route 28		Pe
377	9-8			23.551psi		12-2	Pv
CM	4.2600	232.07gpm	5.22fps	120	0.013177	9-4	Pf 0.123psi
377	9-8	7.69gpm		23.551psi	Flow (q) from Route 30		Pe
315	9-8			23.674psi		9-4	Pv
CM	4.2600	239.99gpm	5.40fps	120	0.014021	7-5½	Pf 0.104psi
315	9-8	7.93gpm		23.674psi	Flow (q) from Route 31		Pe
245	9-8			23.779psi		7-5½	Pv
CM	4.2600	248.31gpm	5.59fps	120	0.014934	46-10½	Pf 0.903psi
245	9-8	8.32gpm		23.779psi	Flow (q) from Route 32	13-7	Pe
171	9-8			24.682psi	2E(6-9½)	60-6	Pv
CM	4.2600	262.63gpm	5.91fps	120	0.016566	12-2	Pf 0.201psi
171	9-8	14.32gpm		24.682psi	Flow (q) from Route 33		Pe
115	9-8			24.883psi		12-2	Pv
CM	4.2600	279.17gpm	6.28fps	120	0.018547	26-8½	Pf 0.747psi
115	9-8	16.54gpm		24.883psi	Flow (q) from Route 19	13-7	Pe
57	9-8			25.631psi	2E(6-9½)	40-3½	Pv
FR	4.2600	279.17gpm	6.28fps	120	0.018547	8-8	Pf 0.454psi
57	9-8			25.631psi		15-9½	Pe 3.757psi
18	1-0			29.842psi	f(-0.000psi), BV(15-9½)	24-5½	Pv
UG	6.3400	279.17gpm	2.84fps	140	0.002011	12-0	Pf 0.071psi
18	1-0			29.842psi		23-1½	Pe 1.734psi
14	-3-0			31.646psi	E(23-1½)	35-1½	Pv
UG	6.0900	279.17gpm	3.07fps	150	0.002153	98-10	Pf 3.392psi
14	-3-0			31.646psi		83-2½	Pe
6	-3-0			35.038psi	E(21-7), PIV(4-7½), EE(10-9½), BFP(-3.000psi), T(46-2½)	182-0½	Pv

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
UG	7.9800	379.17gpm	2.43fps	150	0.001017	380-1½	Pf 0.401psi
6	-3-0	100.00gpm		35.038psi	Supply,	13-7	Pe
1	-3-0			35.439psi	EE(13-7), S	393-8	Pv
		0.00gpm			Hose Allowance At Source		
1		379.17gpm					
• • • • • Route 2 • • • • •							
DR	1.0490	14.91gpm	5.53fps	120	0.075538	1-11½	Pf 0.603psi
302	27-10	14.91gpm	5.6K	7.085psi	Sprinkler,	6-0	Pe -0.281psi
1380	28-6			7.407psi	3E(2-0)	7-11½	Pv
BL	1.3800	14.91gpm	3.20fps	120	0.019867	12-1½	Pf 0.241psi
1380	28-6			7.407psi			Pe
1288	28-6			7.647psi		12-1½	Pv
BL	1.3800	29.82gpm	6.40fps	120	0.071680	12-1½	Pf 0.869psi
1288	28-6	14.92gpm		7.647psi	Flow (q) from Route 4		Pe
1213	28-6			8.517psi		12-1½	Pv
BL	1.6100	45.55gpm	7.18fps	120	0.074054	12-1½	Pf 0.898psi
1213	28-6	15.72gpm		8.517psi	Flow (q) from Route 6		Pe
1148	28-6			9.414psi		12-1½	Pv
BL	2.0670	62.06gpm	5.93fps	120	0.038870	14-11	Pf 0.969psi
1148	28-6	16.51gpm		9.414psi	Flow (q) from Route 12	10-0	Pe
1005	28-6			10.383psi	PO(10-0)	24-11	Pv
CM	2.6350	66.82gpm	3.93fps	120	0.013664	8-8½	Pf 0.295psi
1005	28-6	4.77gpm		10.383psi	Flow (q) from Route 34	12-11	Pe 1.075psi
988	26-0			11.754psi	3E(4-3½)	21-7½	Pv
CM	2.6350	133.71gpm	7.87fps	120	0.049301	21-11	Pf 3.274psi
988	26-0	66.89gpm		11.754psi	Flow (q) from Route 9	44-5½	Pe 6.142psi
924	11-10			21.169psi	4E(4-3½), T(10-9½), PO(16-5½)	66-5	Pv
• • • • • Route 3 • • • • •							
DR	1.0490	14.92gpm	5.54fps	120	0.075653	1-11½	Pf 0.830psi
303	27-10	14.92gpm	5.6K	7.096psi	Sprinkler,	9-0	Pe -0.280psi
1292	28-6			7.646psi	2E(2-0), T(5-0)	10-11½	Pv
• • • • • Route 4 • • • • •							
DR	1.0490	14.92gpm	5.54fps	120	0.075665	1-11½	Pf 0.831psi
304	27-10	14.92gpm	5.6K	7.097psi	Sprinkler,	9-0	Pe -0.281psi
1288	28-6			7.647psi	2E(2-0), T(5-0)	10-11½	Pv
• • • • • Route 5 • • • • •							
DR	1.0490	15.72gpm	5.84fps	120	0.083358	1-11½	Pf 0.915psi
305	27-10	15.72gpm	5.6K	7.881psi	Sprinkler,	9-0	Pe -0.280psi
1217	28-6			8.515psi	2E(2-0), T(5-0)	10-11½	Pv
• • • • • Route 6 • • • • •							
DR	1.0490	15.72gpm	5.84fps	120	0.083371	1-11½	Pf 0.915psi
306	27-10	15.72gpm	5.6K	7.882psi	Sprinkler,	9-0	Pe -0.281psi
1213	28-6			8.517psi	2E(2-0), T(5-0)	10-11½	Pv
• • • • • Route 7 • • • • •							
DR	1.0490	16.03gpm	5.95fps	120	0.086390	2-11½	Pf 0.775psi
307	24-4	16.03gpm	5.6K	8.191psi	Sprinkler,	6-0	Pe -0.714psi
1378	26-0			8.253psi	3E(2-0)	8-11½	Pv
BL	1.3800	16.03gpm	3.44fps	120	0.022721	12-1½	Pf 0.275psi
1378	26-0			8.253psi			Pe
1286	26-0			8.528psi		12-1½	Pv
BL	1.3800	32.07gpm	6.88fps	120	0.081977	12-1½	Pf 0.994psi
1286	26-0	16.04gpm		8.528psi	Flow (q) from Route 8		Pe
1211	26-0			9.522psi		12-1½	Pv
BL	1.6100	48.96gpm	7.72fps	120	0.084642	12-1½	Pf 1.026psi
1211	26-0	16.89gpm		9.522psi	Flow (q) from Route 13		Pe
1146	26-0			10.548psi		12-1½	Pv
BL	2.0670	66.68gpm	6.38fps	120	0.044397	15-5½	Pf 1.131psi
1146	26-0	17.72gpm		10.548psi	Flow (q) from Route 15	10-0	Pe
993	26-0			11.679psi	PO(10-0)	25-5½	Pv
• • • • • Route 8 • • • • •							
DR	1.0490	16.04gpm	5.96fps	120	0.086532	2-11½	Pf 1.036psi
308	24-4	16.04gpm	5.6K	8.206psi	Sprinkler,	9-0	Pe -0.714psi
1286	26-0			8.528psi	2E(2-0), T(5-0)	11-11½	Pv
• • • • • Route 9 • • • • •							
DR	1.0490	16.08gpm	5.97fps	120	0.086887	2-11½	Pf 0.780psi
309	24-4	16.08gpm	5.6K	8.242psi	Sprinkler,	6-0	Pe -0.714psi
1374	26-0			8.308psi	3E(2-0)	8-11½	Pv
BL	1.3800	16.08gpm	3.45fps	120	0.022852	12-1½	Pf 0.277psi
1374	26-0			8.308psi			Pe
1282	26-0			8.585psi		12-1½	Pv

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure	
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary	
Upstream							Total Length		
BL	1.3800	32.17gpm	6.90fps	120		0.082449	12-1½	Pf	1.000psi
1282	26-0	16.09gpm		8.585psi		Flow (q) from Route 10		Pe	
1207	26-0			9.585psi			12-1½	Pv	
BL	1.6100	49.11gpm	7.74fps	120		0.085128	12-1½	Pf	1.032psi
1207	26-0	16.94gpm		9.585psi		Flow (q) from Route 14		Pe	
1142	26-0			10.617psi			12-1½	Pv	
BL	2.0670	66.89gpm	6.40fps	120		0.044651	15-5½	Pf	1.137psi
1142	26-0	17.78gpm		10.617psi		Flow (q) from Route 16	10-0	Pe	
988	26-0			11.754psi		PO(10-0)	25-5½	Pv	
• • • • • Route 10 • • • • •									
DR	1.0490	16.09gpm	5.97fps	120		0.087031	2-11½	Pf	1.042psi
310	24-4	16.09gpm	5.6K	8.257psi		Sprinkler,	9-0	Pe	-0.714psi
1282	26-0			8.585psi		2E(2-0), T(5-0)	11-11½	Pv	
• • • • • Route 11 • • • • •									
DR	1.0490	16.51gpm	6.13fps	120		0.091263	1-11½	Pf	1.002psi
312	27-10	16.51gpm	5.6K	8.692psi		Sprinkler,	9-0	Pe	-0.280psi
1152	28-6			9.413psi		2E(2-0), T(5-0)	10-11½	Pv	
• • • • • Route 12 • • • • •									
DR	1.0490	16.51gpm	6.13fps	120		0.091277	1-11½	Pf	1.002psi
313	27-10	16.51gpm	5.6K	8.693psi		Sprinkler,	9-0	Pe	-0.281psi
1148	28-6			9.414psi		2E(2-0), T(5-0)	10-11½	Pv	
• • • • • Route 13 • • • • •									
DR	1.0490	16.89gpm	6.27fps	120		0.095184	2-11½	Pf	1.140psi
314	24-4	16.89gpm	5.6K	9.096psi		Sprinkler,	9-0	Pe	-0.714psi
1211	26-0			9.522psi		2E(2-0), T(5-0)	11-11½	Pv	
• • • • • Route 14 • • • • •									
DR	1.0490	16.94gpm	6.29fps	120		0.095728	2-11½	Pf	1.146psi
316	24-4	16.94gpm	5.6K	9.152psi		Sprinkler,	9-0	Pe	-0.714psi
1207	26-0			9.585psi		2E(2-0), T(5-0)	11-11½	Pv	
• • • • • Route 15 • • • • •									
DR	1.0490	17.72gpm	6.58fps	120		0.104056	2-11½	Pf	1.246psi
317	24-4	17.72gpm	5.6K	10.016psi		Sprinkler,	9-0	Pe	-0.714psi
1146	26-0			10.548psi		2E(2-0), T(5-0)	11-11½	Pv	
• • • • • Route 16 • • • • •									
DR	1.0490	17.78gpm	6.60fps	120		0.104648	2-11½	Pf	1.253psi
318	24-4	17.78gpm	5.6K	10.078psi		Sprinkler,	9-0	Pe	-0.714psi
1142	26-0			10.617psi		2E(2-0), T(5-0)	11-11½	Pv	
• • • • • Route 17 • • • • •									
DR	1.0490	21.49gpm	7.98fps	120		0.148655	15-11	Pf	3.704psi
319	13-6	21.49gpm	5.6K	14.729psi		Sprinkler,	9-0	Pe	-0.289psi
1135	14-2			18.144psi		2E(2-0), T(5-0)	24-11	Pv	
BL	2.0670	21.49gpm	2.05fps	120		0.005466	15-1	Pf	0.137psi
1135	14-2			18.144psi			10-0	Pe	
997	14-2			18.281psi		PO(10-0)	25-1	Pv	
CM	2.6350	21.49gpm	1.26fps	120		0.001676	0-10	Pf	0.019psi
997	14-2			18.281psi			10-9½	Pe	
996	14-2			18.300psi		T(10-9½)	11-7½	Pv	
• • • • • Route 18 • • • • •									
UG	6.3400	100.00gpm	1.02fps	140		0.000301	11-4½	Pf	0.010psi
3	4-0	100.00gpm		31.992psi		Hydrant,	23-1½	Pe	3.035psi
4	-3-0			35.037psi		E(23-1½)	34-5½	Pv	
UG	6.0900	100.00gpm	1.10fps	150		0.000322	2-9½	Pf	0.001psi
4	-3-0			35.037psi				Pe	
5	-3-0			35.038psi			2-9½	Pv	
UG	7.9800	100.00gpm	0.64fps	150		0.000086	4-6	Pf	0.000psi
5	-3-0			35.038psi				Pe	
6	-3-0			35.038psi			4-6	Pv	
• • • • • Route 19 • • • • •									
CM	3.2600	85.90gpm	3.30fps	120		0.007712	23-11½	Pf	0.339psi
942	11-10			21.284psi			20-0	Pe	0.939psi
790	9-8			22.563psi		4E(5-0)	43-11½	Pv	
CM	3.2600	80.68gpm	3.10fps	120		0.006868	3-1½	Pf	0.022psi
790	9-8			22.563psi				Pe	
787	9-8			22.584psi			3-1½	Pv	
CM	3.2600	74.79gpm	2.87fps	120		0.005970	13-2	Pf	0.079psi
787	9-8			22.584psi				Pe	
655	9-8			22.663psi			13-2	Pv	
CM	3.2600	68.88gpm	2.65fps	120		0.005126	7-10	Pf	0.040psi
655	9-8			22.663psi				Pe	
572	9-8			22.703psi			7-10	Pv	
CM	3.2600	62.29gpm	2.39fps	120		0.004255	6-5	Pf	0.027psi
572	9-8			22.703psi				Pe	
511	9-8			22.730psi			6-5	Pv	

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
CM	3.2600	58.09gpm	2.23fps	120	0.003740	8-7	Pf 0.032psi
511	9-8			22.730psi			Pe
458	9-8			22.762psi		8-7	Pv
CM	3.2600	54.79gpm	2.11fps	120	0.003357	6-2½	Pf 0.021psi
458	9-8			22.762psi			Pe
427	9-8			22.783psi		6-2½	Pv
CM	3.2600	47.10gpm	1.81fps	120	0.002538	14-5½	Pf 0.037psi
427	9-8			22.783psi			Pe
311	9-8			22.820psi		14-5½	Pv
CM	3.2600	39.18gpm	1.51fps	120	0.001805	5-7½	Pf 0.010psi
311	9-8			22.820psi			Pe
272	9-8			22.830psi		5-7½	Pv
CM	3.2600	30.86gpm	1.19fps	120	0.001161	11-8½	Pf 0.014psi
272	9-8			22.830psi			Pe
166	9-8			22.843psi		11-8½	Pv
CM	3.2600	16.54gpm	0.64fps	120	0.000366	11-4	Pf 0.012psi
166	9-8			22.843psi		20-2	Pe
135	9-8			22.855psi	PO(20-2)	31-6	Pv
OR	1.4420	16.54gpm	3.25fps	120	0.019444	35-5	Pf 0.833psi
135	9-8			22.855psi		7-5	Pe
127	9-8			23.688psi	T(7-5)	42-10	Pv
OR	1.4420	8.27gpm	1.62fps	120	0.005394	34-4	Pf 0.252psi
127	9-8			23.688psi		12-4½	Pe
126	9-8			23.940psi	2LtE(2-5½), T(7-5)	46-8½	Pv
OR	1.4420	16.54gpm	3.25fps	120	0.019444	41-1	Pf 0.944psi
126	9-8			23.940psi		7-5	Pe
115	9-8			24.883psi	PO(7-5)	48-6½	Pv
• • • • • Route 20 • • • • •							
CM	4.2600	85.90gpm	1.93fps	120	0.002096	45-8½	Pf 0.151psi
931	11-10			21.133psi		26-4	Pe
942	11-10			21.284psi	PO(26-4)	72-0½	Pv
• • • • • Route 21 • • • • •							
OR	1.4420	5.21gpm	1.02fps	120	0.002297	150-7	Pf 0.426psi
790	9-8			22.563psi	PO(7-5)	34-8	Pe
799	9-8			22.988psi	8LtE(2-5½), PO(7-5)	185-3	Pv
• • • • • Route 22 • • • • •							
OR	1.4420	5.89gpm	1.16fps	120	0.002878	144-4	Pf 0.501psi
787	9-8			22.584psi	PO(7-5)	29-8½	Pe
698	9-8			23.085psi	6LtE(2-5½), PO(7-5)	174-1	Pv
• • • • • Route 23 • • • • •							
OR	1.4420	5.91gpm	1.16fps	120	0.002899	154-9½	Pf 0.549psi
655	9-8			22.663psi	PO(7-5)	34-8	Pe
599	9-8			23.212psi	8LtE(2-5½), PO(7-5)	189-5½	Pv
• • • • • Route 24 • • • • •							
OR	1.4420	6.59gpm	1.30fps	120	0.003547	143-6½	Pf 0.597psi
572	9-8			22.703psi	PO(7-5)	24-9½	Pe
520	9-8			23.300psi	4LtE(2-5½), PO(7-5)	168-3½	Pv
• • • • • Route 25 • • • • •							
OR	1.4420	4.20gpm	0.82fps	120	0.001538	40-11½	Pf 0.090psi
511	9-8			22.730psi	PO(7-5)	17-4	Pe
493	9-8			22.820psi	LtE(2-5½), T(7-5)	58-3½	Pv
OR	1.4420	7.50gpm	1.47fps	120	0.004496	111-11	Pf 0.581psi
493	9-8	3.30gpm		22.820psi	Flow (q) from Route 29	17-4	Pe
474	9-8			23.401psi	4LtE(2-5½), PO(7-5)	129-3	Pv
• • • • • Route 26 • • • • •							
OR	1.4420	3.30gpm	0.65fps	120	0.000985	41-1½	Pf 0.058psi
458	9-8			22.762psi	PO(7-5)	17-4	Pe
493	9-8			22.820psi	LtE(2-5½), T(7-5)	58-5½	Pv
• • • • • Route 27 • • • • •							
OR	1.4420	7.69gpm	1.51fps	120	0.004714	143-2	Pf 0.768psi
427	9-8			22.783psi	PO(7-5)	19-10	Pe
377	9-8			23.551psi	2LtE(2-5½), PO(7-5)	163-0	Pv
• • • • • Route 28 • • • • •							
OR	1.4420	7.93gpm	1.56fps	120	0.004986	146-7½	Pf 0.855psi
311	9-8			22.820psi	PO(7-5)	24-9½	Pe
315	9-8			23.674psi	4LtE(2-5½), PO(7-5)	171-5	Pv
• • • • • Route 29 • • • • •							
OR	1.4420	8.32gpm	1.63fps	120	0.005452	149-3½	Pf 0.949psi
272	9-8			22.830psi	PO(7-5)	24-9½	Pe
245	9-8			23.779psi	4LtE(2-5½), PO(7-5)	174-0½	Pv
• • • • • Route 30 • • • • •							

Hydraulic Analysis

Job Number: 13-1278
Report Description: Front Lobby

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
OR	1.4420	14.32gpm	2.81fps	120	0.014893	103-7½	Pf 1.839psi
166	9-8			22.843psi	PO(7-5)	19-10	Pe
171	9-8			24.682psi	2LtE(2-5½), PO(7-5)	123-5½	Pv
• • • • • Route 31 • • • • •							
CM	2.6350	4.77gpm	0.28fps	120	0.000103	13-10	Pf 0.002psi
1007	28-6			10.382psi		4-1½	Pe -0.000psi
1005	28-6			10.383psi	Ee2(4-1½)	17-11½	Pv
• • • • • Route 32 • • • • •							
OR	1.4420	8.27gpm	1.62fps	120	0.005394	34-4	Pf 0.252psi
127	9-8			23.688psi		12-4½	Pe
126	9-8			23.940psi	2LtE(2-5½), T(7-5)	46-8½	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type Legend

AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

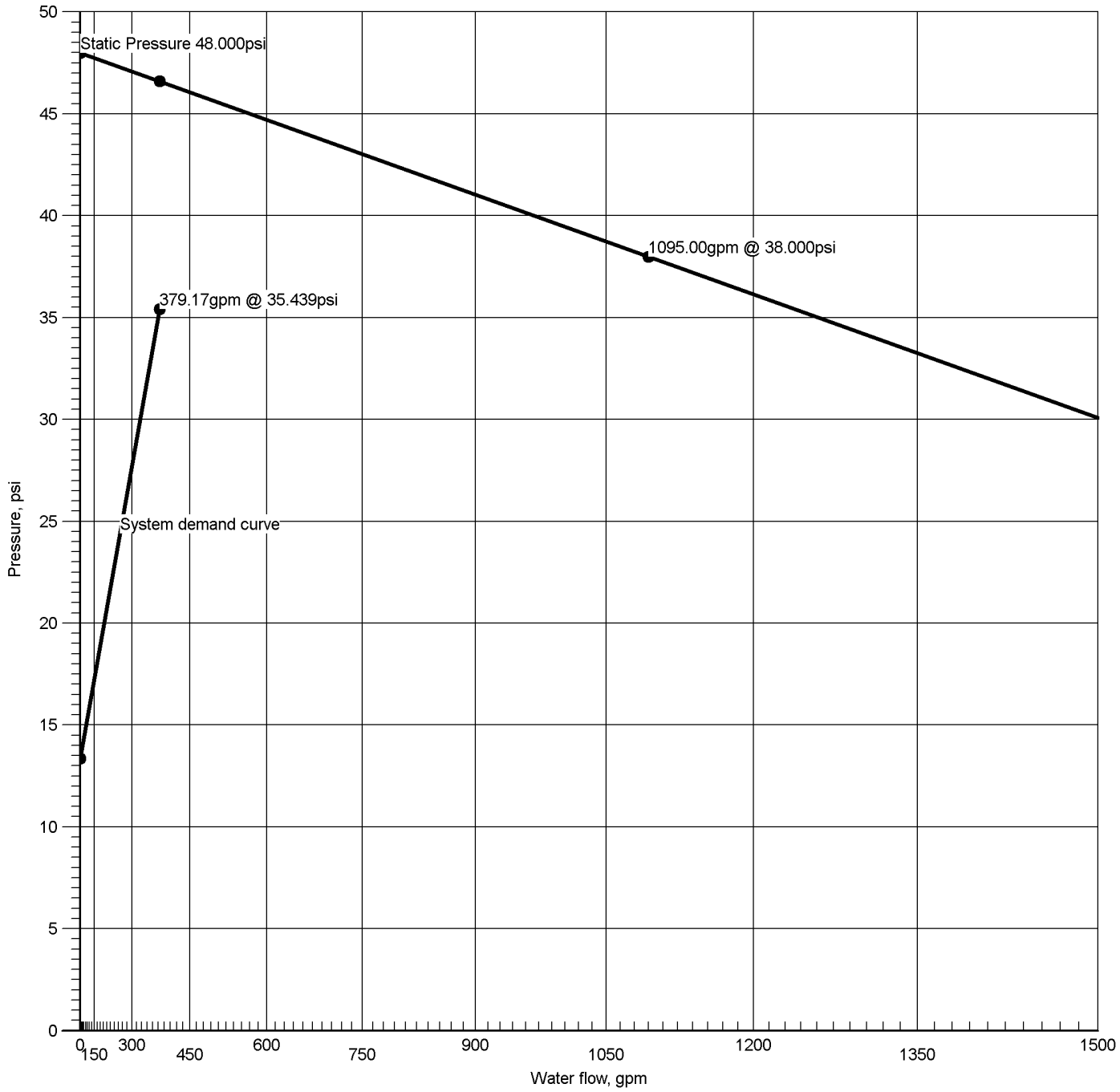
Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PRV	Pressure Reducing Valve
PrV	Pressure Relief Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap

Supply at Node 1



Hydraulic Graph
Supply at Node 1

Static: Pressure
48.000psi

Residual: Pressure
38.000psi @ 1095.00gpm

Available Pressure at Time of Test
38.000psi @ 1095.00gpm

System Demand
35.439psi @ 379.17gpm

System Demand (Including Hose Allowance at Source)
35.439psi @ 379.17gpm

Section 3

PSA Check-in Design Area

Hydraulic Summary

Job Number: 13-1278
Report Description: PSA Check-In (3)

Job

Job Number: 13-1278	Design Engineer:
Job Name: Hinesville MOB VA	State Certification/License Number:
Address 1: Corner of Memorial Dr. and Oglethorpe Hwy	AHJ:
Address 2: Hinesville, GA	Job Site/Building:
Address 3:	Drawing Name: Hinesville MOB.cad

System

Most Demanding Sprinkler Data: 5.6K K-Factor 14.82gpm at 7.000psi

Hose Allowance At Source: 0.00gpm

Additional Hose Supplies

Node	Flow(gpm)
Hydrant At Node 3	100.00gpm

Total Hose Streams: 100.00gpm

System Flow Demand	Total Water Required (Including Hose Allowance)
326.98gpm	326.98gpm

Maximum Pressure Unbalance In Loops: 0.000psi

Maximum Velocity Above Ground: 9.60fps between nodes 655 and 662

Maximum Velocity Under Ground	
2.50fps between nodes 6 and 14	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
2024.96gal	

Remote Area(s)

Occupancy	Job Suffix
Light Hazard	
Density	**Area of Application**
0.10gpm/ft²	900.00ft² (Actual 1167.54ft²)
Number Of Sprinklers Calculated	**Coverage Per Sprinkler**
14	100.00ft²

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area: Left: 27.756psi

Supplies

Node	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1		48.000psi	38.000psi		1095.00gpm	46.931psi		326.98gpm	27.756psi	19.175psi

Contractor

	Contractor Number	Contact Name	Contact Title
		BN	

Name of Contractor:	Phone	Extension
Champion Fire Protection, Inc	912-234-0111	

Address 1	FAX
825 Wheaton Street	912-236-1303
Address 2	**E-mail**
Address 3	**Web-Site**
Savannah, GA 31401	

Node Analysis

Job Number: 13-1278
Report Description: PSA Check-In (3)

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	-3-0	S	27.756psi	326.98gpm	
3	4-0	Hyd	24.406psi	100.00gpm	
201	14-8	Spr(-7.000psi)	7.000psi	14.82gpm	
202	9-0	Spr(-7.603psi)	7.603psi	15.44gpm	
203	9-0	Spr(-7.801psi)	7.801psi	15.64gpm	
204	9-0	Spr(-7.802psi)	7.802psi	15.64gpm	
205	9-0	Spr(-7.909psi)	7.909psi	15.75gpm	
206	9-0	Spr(-7.937psi)	7.937psi	15.78gpm	
207	9-0	Spr(-8.071psi)	8.071psi	15.91gpm	
208	9-0	Spr(-8.122psi)	8.122psi	15.96gpm	
209	9-0	Spr(-8.210psi)	8.210psi	16.05gpm	
210	9-0	Spr(-9.222psi)	9.222psi	17.01gpm	
211	9-0	Spr(-9.415psi)	9.415psi	17.18gpm	
212	9-0	Spr(-9.420psi)	9.420psi	17.19gpm	
213	9-0	Spr(-9.425psi)	9.425psi	17.19gpm	
214	9-0	Spr(-9.685psi)	9.685psi	17.43gpm	
4	-3-0		27.451psi		
5	-3-0		27.451psi		
6	-3-0	T(46-2½)	27.452psi		
14	-3-0		24.185psi		
18	1-0		22.402psi		
57	9-8	E(6-9½)	18.336psi		
115	9-8	PO(7-5)	17.826psi		
126	9-8	T(7-5)	17.072psi		
127	9-8	T(7-5)	16.870psi		
135	9-8	PO(20-2)	16.204psi		
166	9-8	PO(5-0)	16.195psi		
171	9-8	PO(7-5)	17.690psi		
245	9-8	PO(7-5)	17.088psi		
272	9-8	PO(7-5)	16.184psi		
311	9-8	PO(7-5)	16.176psi		
315	9-8	PO(7-5)	17.019psi		
377	9-8	PO(7-5)	16.939psi		
427	9-8	PO(7-5)	16.144psi		
458	9-8	PO(7-5)	16.126psi		
474	9-8	PO(7-5)	16.844psi		
493	9-8	T(7-5)	16.193psi		
511	9-8	PO(7-5)	16.097psi		
520	9-8	PO(7-5)	16.781psi		
572	9-8	PO(7-5)	16.072psi		
599	9-8	PO(5-0)	16.727psi		
655	9-8	PO(7-5)	16.034psi		
662	9-8	PO(5-0)	11.334psi		
679	9-8	PO(5-0)	10.103psi		
681	9-8	PO(5-0)	9.939psi		
683	9-8	PO(5-0)	9.940psi		
698	9-8	PO(7-5)	16.673psi		
702	9-8	PO(5-0)	10.228psi		
787	9-8	PO(7-5)	16.029psi		
788	9-8	PO(5-0)	11.618psi		
790	9-8	PO(7-5)	16.031psi		
791	9-8	PO(5-0)	11.534psi		
793	9-8	PO(5-0)	11.574psi		
795	9-8	PO(5-0)	11.909psi		
799	9-8	PO(7-5)	16.644psi		
844	9-8	PO(5-0)	9.728psi		
846	9-8	PO(5-0)	9.559psi		
848	9-8	PO(5-0)	9.559psi		
850	9-8	PO(5-0)	9.715psi		
852	9-8	PO(5-0)	9.781psi		
924	11-10	PO(16-5½)	15.562psi		
931	11-10	PO(16-5½)	15.520psi		

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
942	11-10	PO(20-2)	15.450psi		

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •							
SP	1.0490	14.82gpm	5.50fps	120	0.074703	7-1½	Pf 1.054psi
201	14-8	14.82gpm	5.6K	7.000psi	Sprinkler,	7-0	Pe 2.174psi
702	9-8			10.228psi	E(2-0), PO(5-0)	14-1½	Pv
OR	1.4420	31.85gpm	6.26fps	120	0.065353	11-11½	Pf 1.106psi
702	9-8	17.03gpm		10.228psi	Flow (q) from Route 7	4-11½	Pe
662	9-8			11.334psi	2LtE(2-5½)	16-11	Pv
OR	1.4420	48.86gpm	9.60fps	120	0.144215	25-2	Pf 4.700psi
662	9-8	17.01gpm		11.334psi	Flow (q) from Route 10	7-5	Pe
655	9-8			16.034psi	PO(7-5)	32-7	Pv
CM	3.2600	66.47gpm	2.55fps	120	0.004798	7-10	Pf 0.038psi
655	9-8	17.61gpm		16.034psi	Flow (q) from Route 11		Pe
572	9-8			16.072psi		7-10	Pv
CM	3.2600	59.23gpm	2.28fps	120	0.003877	6-5	Pf 0.025psi
572	9-8			16.072psi			Pe
511	9-8			16.097psi		6-5	Pv
CM	3.2600	54.86gpm	2.11fps	120	0.003365	8-7	Pf 0.029psi
511	9-8			16.097psi			Pe
458	9-8			16.126psi		8-7	Pv
CM	3.2600	51.27gpm	1.97fps	120	0.002968	6-2½	Pf 0.018psi
458	9-8			16.126psi			Pe
427	9-8			16.144psi		6-2½	Pv
CM	3.2600	43.43gpm	1.67fps	120	0.002184	14-5½	Pf 0.032psi
427	9-8			16.144psi			Pe
311	9-8			16.176psi		14-5½	Pv
CM	3.2600	35.56gpm	1.37fps	120	0.001509	5-7½	Pf 0.008psi
311	9-8			16.176psi			Pe
272	9-8			16.184psi		5-7½	Pv
CM	3.2600	27.46gpm	1.06fps	120	0.000935	11-8½	Pf 0.011psi
272	9-8			16.184psi			Pe
166	9-8			16.195psi		11-8½	Pv
CM	3.2600	14.66gpm	0.56fps	120	0.000293	11-4	Pf 0.009psi
166	9-8			16.195psi		20-2	Pe
135	9-8			16.204psi	PO(20-2)	31-6	Pv
OR	1.4420	14.66gpm	2.88fps	120	0.015547	35-5	Pf 0.666psi
135	9-8			16.204psi		7-5	Pe
127	9-8			16.870psi	T(7-5)	42-10	Pv
OR	1.4420	7.33gpm	1.44fps	120	0.004313	34-4	Pf 0.201psi
127	9-8			16.870psi		12-4½	Pe
126	9-8			17.072psi	2LtE(2-5½), T(7-5)	46-8½	Pv
OR	1.4420	14.66gpm	2.88fps	120	0.015547	41-1	Pf 0.755psi
126	9-8	7.33gpm		17.072psi	Flow (q) from Route 26	7-5	Pe
115	9-8			17.826psi	PO(7-5)	48-6½	Pv
CM	4.2600	226.98gpm	5.11fps	120	0.012647	26-8½	Pf 0.510psi
115	9-8	212.32gpm		17.826psi	Flow (q) from Route 2	13-7	Pe
57	9-8			18.336psi	2E(6-9½)	40-3½	Pv
FR	4.2600	226.98gpm	5.11fps	120	0.012647	8-8	Pf 0.309psi
57	9-8			18.336psi		15-9½	Pe 3.757psi
18	1-0			22.402psi	f(-0.000psi), BV(15-9½)	24-5½	Pv
UG	6.3400	226.98gpm	2.31fps	140	0.001371	12-0	Pf 0.048psi
18	1-0			22.402psi		23-1½	Pe 1.734psi
14	-3-0			24.185psi	E(23-1½)	35-1½	Pv
UG	6.0900	226.98gpm	2.50fps	150	0.001468	98-10	Pf 3.267psi
14	-3-0			24.185psi		83-2½	Pe
6	-3-0			27.452psi	E(21-7), PIV(4-7½), EE(10-9½), BFP(-3.000psi), T(46-2½)	182-0½	Pv
UG	7.9800	326.98gpm	2.10fps	150	0.000774	380-1½	Pf 0.305psi
6	-3-0	100.00gpm		27.452psi	Supply,	13-7	Pe
1	-3-0			27.756psi	EE(13-7), S	393-8	Pv
		0.00gpm			Hose Allowance At Source		
1		326.98gpm					
• • • • • Route 2 • • • • •							
DR	1.0490	15.44gpm	5.73fps	120	0.080636	19-7	Pf 2.467psi
202	9-0	15.44gpm	5.6K	7.603psi	Sprinkler,	11-0	Pe -0.289psi
852	9-8			9.781psi	3E(2-0), PO(5-0)	30-7	Pv
OR	1.4420	47.31gpm	9.29fps	120	0.135885	33-7½	Pf 6.251psi
852	9-8	31.87gpm		9.781psi	Flow (q) from Route 3	12-4½	Pe
790	9-8			16.031psi	2LtE(2-5½), PO(7-5)	46-0	Pv
CM	3.2600	72.16gpm	2.77fps	120	0.005586	23-11½	Pf 0.358psi
790	9-8	24.85gpm		16.031psi	Flow (q) from Route 24	40-2	Pe -0.939psi
942	11-10			15.450psi	4E(5-0), PO(20-2)	64-1½	Pv

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
CM	4.2600	72.16gpm	1.62fps	120	0.001518	45-8½	Pf 0.069psi
942	11-10			15.450psi			Pe
931	11-10			15.520psi		45-8½	Pv
CM	4.2600	64.98gpm	1.46fps	120	0.001250	34-3	Pf 0.043psi
931	11-10			15.520psi			Pe
924	11-10			15.562psi		34-3	Pv
CM	4.2600	72.16gpm	1.62fps	120	0.001518	73-2½	Pf 0.142psi
924	11-10	7.18gpm		15.562psi	Flow (q) from Route 16	20-5	Pe 0.939psi
799	9-8			16.644psi	3E(6-9½)	93-7	Pv
CM	4.2600	103.10gpm	2.32fps	120	0.002937	9-10	Pf 0.029psi
799	9-8	30.94gpm		16.644psi	Flow (q) from Route 6		Pe
698	9-8			16.673psi		9-10	Pv
CM	4.2600	129.63gpm	2.92fps	120	0.004487	12-2	Pf 0.055psi
698	9-8	26.53gpm		16.673psi	Flow (q) from Route 12		Pe
599	9-8			16.727psi		12-2	Pv
CM	4.2600	160.51gpm	3.61fps	120	0.006662	8-0	Pf 0.053psi
599	9-8	30.88gpm		16.727psi	Flow (q) from Route 9		Pe
520	9-8			16.781psi		8-0	Pv
CM	4.2600	167.75gpm	3.78fps	120	0.007228	8-8½	Pf 0.063psi
520	9-8	7.23gpm		16.781psi	Flow (q) from Route 17		Pe
474	9-8			16.844psi		8-8½	Pv
CM	4.2600	175.71gpm	3.96fps	120	0.007876	12-2	Pf 0.096psi
474	9-8	7.96gpm		16.844psi	Flow (q) from Route 18		Pe
377	9-8			16.939psi		12-2	Pv
CM	4.2600	183.54gpm	4.13fps	120	0.008538	9-4	Pf 0.080psi
377	9-8	7.83gpm		16.939psi	Flow (q) from Route 20		Pe
315	9-8			17.019psi		9-4	Pv
CM	4.2600	191.41gpm	4.31fps	120	0.009227	7-5½	Pf 0.069psi
315	9-8	7.87gpm		17.019psi	Flow (q) from Route 21		Pe
245	9-8			17.088psi		7-5½	Pv
CM	4.2600	199.51gpm	4.49fps	120	0.009963	46-10½	Pf 0.603psi
245	9-8	8.10gpm		17.088psi	Flow (q) from Route 22	13-7	Pe
171	9-8			17.690psi	2E(6-9½)	60-6	Pv
CM	4.2600	212.32gpm	4.78fps	120	0.011178	12-2	Pf 0.136psi
171	9-8	12.81gpm		17.690psi	Flow (q) from Route 23		Pe
115	9-8			17.826psi		12-2	Pv
• • • • • Route 3 • • • • •							
DR	1.0490	15.64gpm	5.81fps	120	0.082581	15-9½	Pf 2.047psi
203	9-0	15.64gpm	5.6K	7.801psi	Sprinkler,	9-0	Pe -0.289psi
846	9-8			9.559psi	2E(2-0), PO(5-0)	24-9½	Pv
OR	1.4420	0.48gpm	0.09fps	120	0.000028	8-0	Pf 0.000psi
846	9-8			9.559psi			Pe
848	9-8			9.559psi		8-0	Pv
OR	1.4420	16.12gpm	3.17fps	120	0.018543	8-5	Pf 0.156psi
848	9-8	15.64gpm		9.559psi	Flow (q) from Route 4		Pe
850	9-8			9.715psi		8-5	Pv
OR	1.4420	31.87gpm	6.26fps	120	0.065426	1-0	Pf 0.065psi
850	9-8	15.75gpm		9.715psi	Flow (q) from Route 5		Pe
852	9-8			9.781psi		1-0	Pv
• • • • • Route 4 • • • • •							
DR	1.0490	15.64gpm	5.81fps	120	0.082583	15-9½	Pf 2.047psi
204	9-0	15.64gpm	5.6K	7.802psi	Sprinkler,	9-0	Pe -0.289psi
848	9-8			9.559psi	2E(2-0), PO(5-0)	24-9½	Pv
• • • • • Route 5 • • • • •							
DR	1.0490	15.75gpm	5.85fps	120	0.083633	16-0½	Pf 2.096psi
205	9-0	15.75gpm	5.6K	7.909psi	Sprinkler,	9-0	Pe -0.289psi
850	9-8			9.715psi	2E(2-0), PO(5-0)	25-0½	Pv
• • • • • Route 6 • • • • •							
DR	1.0490	15.78gpm	5.86fps	120	0.083908	15-9½	Pf 2.080psi
206	9-0	15.78gpm	5.6K	7.937psi	Sprinkler,	9-0	Pe -0.289psi
844	9-8			9.728psi	2E(2-0), PO(5-0)	24-9½	Pv
OR	1.4420	30.94gpm	6.08fps	120	0.061931	89-4½	Pf 6.916psi
844	9-8			9.728psi		22-3½	Pe
799	9-8			16.644psi	6LtE(2-5½), PO(7-5)	111-8	Pv
• • • • • Route 7 • • • • •							
DR	1.0490	15.91gpm	5.91fps	120	0.085220	16-3½	Pf 2.157psi
207	9-0	15.91gpm	5.6K	8.071psi	Sprinkler,	9-0	Pe -0.289psi
681	9-8			9.939psi	2E(2-0), PO(5-0)	25-3½	Pv
OR	1.4420	1.08gpm	0.21fps	120	0.000124	8-3	Pf 0.001psi
681	9-8			9.939psi			Pe
683	9-8			9.940psi		8-3	Pv

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure	
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary	
Upstream							Total Length		
OR	1.4420	17.03gpm	3.35fps	120		0.020533	9-1	Pf	0.288psi
683	9-8	15.96gpm		9.940psi		Flow (q) from Route 8	4-11½	Pe	
702	9-8			10.228psi		2LtE(2-5½)	14-0½	Pv	
• • • • • Route 8 • • • • •									
DR	1.0490	15.96gpm	5.92fps	120		0.085713	15-7	Pf	2.107psi
208	9-0	15.96gpm	5.6K	8.122psi		Sprinkler,	9-0	Pe	-0.289psi
683	9-8			9.940psi		2E(2-0), PO(5-0)	24-7	Pv	
• • • • • Route 9 • • • • •									
DR	1.0490	16.05gpm	5.96fps	120		0.086578	16-2½	Pf	2.182psi
209	9-0	16.05gpm	5.6K	8.210psi		Sprinkler,	9-0	Pe	-0.289psi
679	9-8			10.103psi		2E(2-0), PO(5-0)	25-2½	Pv	
OR	1.4420	30.88gpm	6.07fps	120		0.061716	90-0	Pf	6.624psi
679	9-8	14.83gpm		10.103psi		Flow (q) from Route 27	17-4	Pe	
599	9-8			16.727psi		4LtE(2-5½), PO(7-5)	107-4	Pv	
• • • • • Route 10 • • • • •									
DR	1.0490	17.01gpm	6.31fps	120		0.096407	15-11	Pf	2.400psi
210	9-0	17.01gpm	5.6K	9.222psi		Sprinkler,	9-0	Pe	-0.289psi
662	9-8			11.334psi		2E(2-0), PO(5-0)	24-11	Pv	
• • • • • Route 11 • • • • •									
DR	1.0490	17.18gpm	6.38fps	120		0.098266	15-11	Pf	2.448psi
211	9-0	17.18gpm	5.6K	9.415psi		Sprinkler,	9-0	Pe	-0.289psi
793	9-8			11.574psi		2E(2-0), PO(5-0)	24-11	Pv	
OR	1.4420	25.03gpm	4.92fps	120		0.041841	8-0	Pf	0.335psi
793	9-8	7.85gpm		11.574psi		Flow (q) from Route 13		Pe	
795	9-8			11.909psi			8-0	Pv	
OR	1.4420	42.46gpm	8.34fps	120		0.111220	29-7½	Pf	4.120psi
795	9-8	17.43gpm		11.909psi		Flow (q) from Route 14	7-5	Pe	
787	9-8			16.029psi		PO(7-5)	37-0½	Pv	
CM	3.2600	17.61gpm	0.68fps	120		0.000411	13-2	Pf	0.005psi
787	9-8			16.029psi				Pe	
655	9-8			16.034psi			13-2	Pv	
• • • • • Route 12 • • • • •									
DR	1.0490	17.19gpm	6.38fps	120		0.098312	16-3½	Pf	2.487psi
212	9-0	17.19gpm	5.6K	9.420psi		Sprinkler,	9-0	Pe	-0.289psi
788	9-8			11.618psi		2E(2-0), PO(5-0)	25-3½	Pv	
OR	1.4420	26.53gpm	5.21fps	120		0.046612	86-2	Pf	5.055psi
788	9-8	9.35gpm		11.618psi		Flow (q) from Route 28	22-3½	Pe	
698	9-8			16.673psi		6LtE(2-5½), PO(7-5)	108-5½	Pv	
• • • • • Route 13 • • • • •									
DR	1.0490	17.19gpm	6.38fps	120		0.098360	15-4½	Pf	2.398psi
213	9-0	17.19gpm	5.6K	9.425psi		Sprinkler,	9-0	Pe	-0.289psi
791	9-8			11.534psi		2E(2-0), PO(5-0)	24-4½	Pv	
OR	1.4420	7.85gpm	1.54fps	120		0.004893	8-3	Pf	0.040psi
791	9-8			11.534psi				Pe	
793	9-8			11.574psi			8-3	Pv	
• • • • • Route 14 • • • • •									
DR	1.0490	17.43gpm	6.47fps	120		0.100869	15-11	Pf	2.513psi
214	9-0	17.43gpm	5.6K	9.685psi		Sprinkler,	9-0	Pe	-0.289psi
795	9-8			11.909psi		2E(2-0), PO(5-0)	24-11	Pv	
• • • • • Route 15 • • • • •									
UG	6.3400	100.00gpm	1.02fps	140		0.000301	11-4½	Pf	0.010psi
3	4-0	100.00gpm		24.406psi		Hydrant,	23-1½	Pe	3.035psi
4	-3-0			27.451psi		E(23-1½)	34-5½	Pv	
UG	6.0900	100.00gpm	1.10fps	150		0.000322	2-9½	Pf	0.001psi
4	-3-0			27.451psi				Pe	
5	-3-0			27.451psi			2-9½	Pv	
UG	7.9800	100.00gpm	0.64fps	150		0.000086	4-6	Pf	0.000psi
5	-3-0			27.451psi				Pe	
6	-3-0			27.452psi			4-6	Pv	
• • • • • Route 16 • • • • •									
OR	1.4420	7.23gpm	1.42fps	120		0.004211	143-6½	Pf	0.709psi
572	9-8			16.072psi		PO(7-5)	24-9½	Pe	
520	9-8			16.781psi		4LtE(2-5½), PO(7-5)	168-3½	Pv	
• • • • • Route 17 • • • • •									
OR	1.4420	4.37gpm	0.86fps	120		0.001655	40-11½	Pf	0.096psi
511	9-8			16.097psi		PO(7-5)	17-4	Pe	
493	9-8			16.193psi		LtE(2-5½), T(7-5)	58-3½	Pv	
OR	1.4420	7.96gpm	1.56fps	120		0.005031	111-11	Pf	0.650psi
493	9-8	3.60gpm		16.193psi		Flow (q) from Route 19	17-4	Pe	
474	9-8			16.844psi		4LtE(2-5½), PO(7-5)	129-3	Pv	
• • • • • Route 18 • • • • •									

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt / Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
OR	1.4420	3.60gpm	0.71fps	120	0.001157	41-1½	Pf 0.068psi
458	9-8			16.126psi	PO(7-5)	17-4	Pe
493	9-8			16.193psi	LtE(2-5½), T(7-5)	58-5½	Pv
• • • • • Route 19 • • • • •							
OR	1.4420	7.83gpm	1.54fps	120	0.004879	143-2	Pf 0.795psi
427	9-8			16.144psi	PO(7-5)	19-10	Pe
377	9-8			16.939psi	2LtE(2-5½), PO(7-5)	163-0	Pv
• • • • • Route 20 • • • • •							
OR	1.4420	7.87gpm	1.55fps	120	0.004920	146-7½	Pf 0.843psi
311	9-8			16.176psi	PO(7-5)	24-9½	Pe
315	9-8			17.019psi	4LtE(2-5½), PO(7-5)	171-5	Pv
• • • • • Route 21 • • • • •							
OR	1.4420	8.10gpm	1.59fps	120	0.005191	149-3½	Pf 0.904psi
272	9-8			16.184psi	PO(7-5)	24-9½	Pe
245	9-8			17.088psi	4LtE(2-5½), PO(7-5)	174-0½	Pv
• • • • • Route 22 • • • • •							
OR	1.4420	12.81gpm	2.52fps	120	0.012111	103-7½	Pf 1.495psi
166	9-8			16.195psi	PO(7-5)	19-10	Pe
171	9-8			17.690psi	2LtE(2-5½), PO(7-5)	123-5½	Pv
• • • • • Route 23 • • • • •							
CM	3.2600	24.85gpm	0.96fps	120	0.000777	3-1½	Pf 0.002psi
787	9-8			16.029psi			Pe
790	9-8			16.031psi		3-1½	Pv
• • • • • Route 24 • • • • •							
CM	2.6350	7.18gpm	0.42fps	120	0.000221	75-2	Pf 0.043psi
931	11-10			15.520psi	PO(16-5½)	118-10½	Pe -0.000psi
924	11-10			15.562psi	14E(4-3½), 2T(10-9½), Ee2(4-1½), PO(16-5½)	194-0	Pv
• • • • • Route 25 • • • • •							
OR	1.4420	7.33gpm	1.44fps	120	0.004313	34-4	Pf 0.201psi
127	9-8			16.870psi		12-4½	Pe
126	9-8			17.072psi	2LtE(2-5½), T(7-5)	46-8½	Pv
• • • • • Route 26 • • • • •							
OR	1.4420	14.83gpm	2.91fps	120	0.015897	10-4	Pf 0.164psi
681	9-8			9.939psi			Pe
679	9-8			10.103psi		10-4	Pv
• • • • • Route 27 • • • • •							
OR	1.4420	9.35gpm	1.84fps	120	0.006763	12-4	Pf 0.083psi
791	9-8			11.534psi			Pe
788	9-8			11.618psi		12-4	Pv
• • • • • Route 28 • • • • •							
OR	1.4420	15.16gpm	2.98fps	120	0.016553	10-2	Pf 0.169psi
846	9-8			9.559psi			Pe
844	9-8			9.728psi		10-2	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend

AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

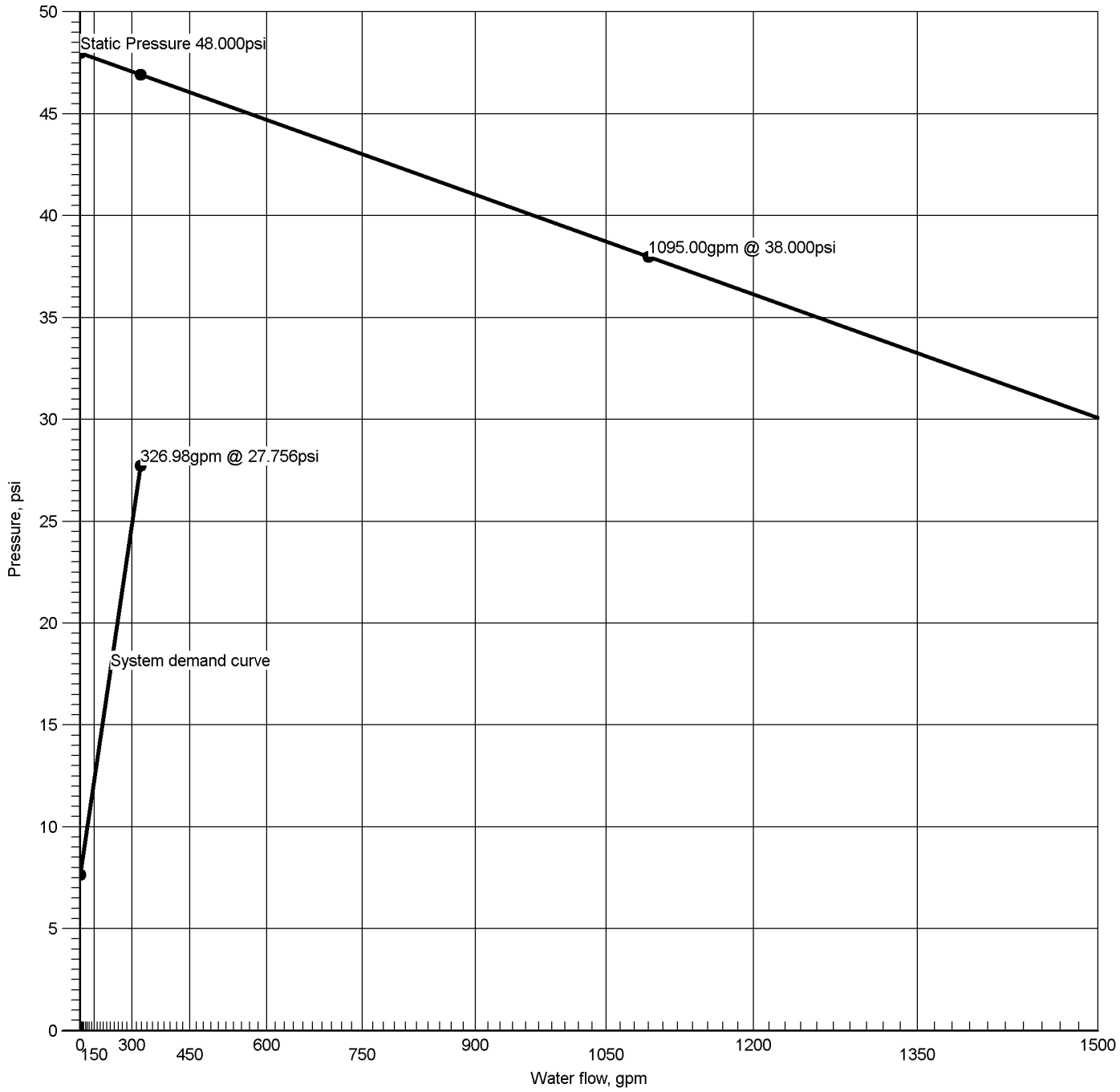
Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PRV	Pressure Reducing Valve
PrV	Pressure Relief Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap

Supply at Node 1



Hydraulic Graph	Supply at Node 1
Static: Pressure	48.000psi
Residual: Pressure	38.000psi @ 1095.00gpm
Available Pressure at Time of Test	38.000psi @ 1095.00gpm
System Demand	27.756psi @ 326.98gpm
System Demand (Including Hose Allowance at Source)	27.756psi @ 326.98gpm

Appendix B

FDS Input Files

Fire Scenario 1

```
MOB.fds
Generated by PyroSim - Version 2014.1.0331
May 5, 2014 5:14:00 PM

&HEAD CHID='MOB Thermocouples', TITLE='Atrium Fire'/
&TIME T_END=600.0/
&DUMP RENDER_FILE='MOB.ge1', DT_RESTART=300.0/

&MISC INITIAL_UNMIXED_FRACTION=0

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12.2,5.8,0.0,8.0/

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&MESH ID='Corridor', IJK=20,5,33, XB=-12.5,4.1,5.8,8.8,0.0,3.3/
&MESH ID='Waiting Left', IJK=5,24,41, XB=-15.2,-12.5,-12.2,5.8,0.0,4.1/
&MESH ID='Corridor Left', IJK=5,5,33, XB=-15.2,-12.5,5.8,8.8,0.0,3.3/
&MESH ID='Far Left', IJK=10,5,33, XB=-25.5,-15.2,5.8,8.8,0.0,3.3/
&MESH ID='Waiting Rh', IJK=10,24,41, XB=4.2,9.5,-12.5,5.8,0.0,4.1/
&MESH ID='Corridor Rh', IJK=10,5,33, XB=4.2,9.5,5.8,8.8,0.0,3.3/
&MESH ID='Far Right', IJK=10,5,33, XB=9.5,22.5,5.8,8.8,0.0,3.3/


&SPEC ID='WATER VAPOR'/

&PART ID='Water_PART',
      SPEC_ID='WATER VAPOR',
      DIAMETER=500.0,
      MONODISPERSE=.TRUE.,
      COLOR='BLUE',
      AGE=4.0/



&REAC FUEL = 'POLYURETHANE',
      FYI = 'C_6.3 H_7.1 N O_2.1, NFPA Handbook, Babrauskas',
      SOOT_YIELD = 0.10,
      CO_YIELD = 0.028,
      N = 1.0
      C = 6.3
      H = 7.1
      O = 2.1 /


&SURF ID ='BURNER',
      HRRPUA =2000.,
      COLOR ='RASPBERRY',
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&RAMP ID='chair', T= 200.0, F=0.125 /
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/&RAMP ID='chair', T= 320.0, F=0.65 /
/&RAMP ID='chair', T= 350.0, F=0.40 /
/&RAMP ID='chair', T= 400.0, F=0.375 /
/&RAMP ID='chair', T= 500.0, F=0.350 /
/&RAMP ID='chair', T= 600.0, F=0.425 /

&PROP ID='k-5.6',
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      C_FACTOR=0.7
      ACTIVATION_TEMPERATURE=68.0,
      PART_ID='Water_PART',
      FLOW_RATE=70.3,
      PARTICLE_VELOCITY=10.0,
      SPRAY_ANGLE=30.,80./


&DEVC ID='GAS', QUANTITY='MIXTURE FRACTION', XYZ=0.0,0.0,1.8/


Source of Ignition
&DEVC ID='FireTHCP1.0', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,1.0/
&DEVC ID='FireTHCP1.5', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,1.5/
&DEVC ID='FireTHCP1.8', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,1.8/
&DEVC ID='FireTHCP2.3', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,2.3/
&DEVC ID='FireTHCP2.8', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,2.8/
&DEVC ID='FireTHCP3.2', QUANTITY='THERMOCOUPLE', XYZ=-5.5,-11.2,3.2/


In Atrium
&DEVC ID='AtriumTHCP0.5', QUANTITY='THERMOCOUPLE', XYZ=0.0,0.0,0.5/
&DEVC ID='AtriumTHCP1.0', QUANTITY='THERMOCOUPLE', XYZ=0.0,0.0,1.0/
&DEVC ID='AtriumTHCP1.5', QUANTITY='THERMOCOUPLE', XYZ=0.0,0.0,1.5/
&DEVC ID='AtriumTHCP1.8', QUANTITY='THERMOCOUPLE', XYZ=0.0,0.0,1.8/
&DEVC ID='AtriumTHCP4.0', QUANTITY='THERMOCOUPLE', XYZ=0.0,0.0,4.0/


Sprinklers as actual existence
&DEVC ID='Sprinkler1', PROP_ID='k-5.6', XYZ=-9.3,-10.7,4.0/
&DEVC ID='Sprinkler2', PROP_ID='k-5.6', XYZ=-6.3,-10.7,4.0/
&DEVC ID='Sprinkler3', PROP_ID='k-5.6', XYZ=-9.3,-7.1,4.0/
&DEVC ID='Sprinkler4', PROP_ID='k-5.6', XYZ=-6.3,-7.1,4.0/
&DEVC ID='Sprinkler5', PROP_ID='k-5.6', XYZ=-9.3,-4.7,4.0/
&DEVC ID='Sprinkler6', PROP_ID='k-5.6', XYZ=-6.3,-3.5,4.0/
&DEVC ID='Sprinkler7', PROP_ID='k-5.6', XYZ=-3.9,-10.4,7.34/
&DEVC ID='Sprinkler8', PROP_ID='k-5.6', XYZ=-3.9,-6.75,7.34/
&DEVC ID='Sprinkler9', PROP_ID='k-5.6', XYZ=-3.9,-3.1,7.34/
```

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&MATL ID='GYPSUM PLASTER',
      FYI='Quintiere, Fire Behavior',
      SPECIFIC_HEAT=0.84,
      CONDUCTIVITY=0.48,
      DENSITY=1440.0/



&SURF ID='WALL',
      RGB=200,200,200,
      DEFAULT=.TRUE.,
      MATL_ID='GYPSUM PLASTER',
      THICKNESS=0.012/


&OBST XB=-6.0,-5.,-12.0,-10.5,0.00,0.50,
SURF_ID6='INERT','INERT','INERT','INERT','INERT','BURNER'/ Design Fire


&OBST XB=-10.27,-9.4,6.4,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #1
&OBST XB=-10.27,-9.4,5.8,6.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #2
&OBST XB=-10.27,-10.07,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #3
&OBST XB=-9.6,-9.4,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #4
&OBST XB=-5.0,-4.2,6.4,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #5
&OBST XB=-5.0,-4.2,5.8,6.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #6
&OBST XB=-5.0,-4.8,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #7
&OBST XB=-4.4,-4.2,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #8
&OBST XB=-9.4,-5.0,5.8,6.6,3.2,3.3, SURF_ID='WALL'/ Obstruction #9
&OBST XB=-9.4,-5.0,5.8,6.0,3.2,4.11, SURF_ID='WALL'/ Obstruction #10
&OBST XB=-4.2,4.1,5.8,6.6,3.2,3.3, SURF_ID='WALL'/ Obstruction #11
&OBST XB=-4.2,4.1,5.8,6.0,3.2,7.4, SURF_ID='WALL'/ Obstruction #12
&OBST XB=-5.0,-4.2,-12.2,5.8,3.2,4.11, SURF_ID='WALL'/ Obstruction #13
&OBST XB=-4.4,-4.2,-12.2,5.8,3.2,7.4, SURF_ID='WALL'/ Obstruction #14
&OBST XB=4.1,5.0,-12.2,5.8,3.2,4.11, SURF_ID='WALL'/ Obstruction #15
&OBST XB=4.1,4.3,-12.2,5.8,3.2,7.4, SURF_ID='WALL'/ Obstruction #16
&OBST XB=4.1,9.5,5.8,6.6,3.2,3.3, SURF_ID='WALL'/ Obstruction #17
&OBST XB=4.1,9.5,5.8,6.0,3.2,4.11, SURF_ID='WALL'/ Obstruction #18
&OBST XB=-15.2,-10.27,5.8,6.6,3.2,3.3, SURF_ID='WALL'/ Obstruction #19
&OBST XB=-15.2,-10.27,5.8,6.0,3.2,4.11, SURF_ID='WALL'/ Obstruction #20
&OBST XB=-10.7,-9.4,0.0,5.8,3.2,4.11, SURF_ID='WALL'/ Obstruction #21
&OBST XB=4.1,5.0,6.4,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #22
&OBST XB=4.1,5.0,5.8,6.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #23
&OBST XB=4.8,5.0,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #24
&OBST XB=4.1,4.3,5.8,6.6,0.0,3.3, SURF_ID='WALL'/ Obstruction #25
&OBST XB=-5.0,-4.2,-4.2,-4.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #26
&OBST XB=-5.0,-4.2,-3.7,-3.5,0.0,4.11, SURF_ID='WALL'/ Obstruction #27
&OBST XB=-5.0,-4.8,-4.2,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #28
&OBST XB=-4.4,-4.2,-4.2,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #29
&OBST XB=4.1,5.0,-4.2,-4.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #30
&OBST XB=4.1,5.0,-3.7,-3.5,0.0,4.11, SURF_ID='WALL'/ Obstruction #31
&OBST XB=4.8,5.0,-4.2,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #32
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&OBST XB=4.1,4.3,-4.2,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #33
&OBST XB=-4.2,-3.6,-12.2,5.8,7.4,7.55, SURF_ID='WALL'/ Obstruction #34
&OBST XB=3.5,4.1,-12.2,5.8,7.4,7.55, SURF_ID='WALL'/ Obstruction #35
&OBST XB=-25.5,22.3,8.8,9.0,0.0,3.3, SURF_ID='WALL'/ Obstruction #36
&OBST XB=-25.7,-25.5,6.3,8.8,0.0,3.3, SURF_ID='WALL'/ Obstruction #37
&OBST XB=22.3,22.5,6.3,8.8,0.0,3.3, SURF_ID='WALL'/ Obstruction #38
&OBST XB=-25.5,-15.2,6.1,6.3,0.0,3.3, SURF_ID='WALL'/ Obstruction #39
&OBST XB=9.5,22.3,6.1,6.3,0.0,3.3, SURF_ID='WALL'/ Obstruction #40
&OBST XB=-15.4,-15.2,0.0,6.3,0.0,4.11, SURF_ID='WALL'/ Obstruction #41
&OBST XB=-15.2,-8.16,-0.2,0.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #42
&OBST XB=9.5,9.7,0.0,6.3,0.0,4.11, SURF_ID='WALL'/ Obstruction #43
&OBST XB=8.15,9.5,-0.2,0.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #44
&OBST XB=-8.36,-8.16,-3.9,0.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #45
&OBST XB=8.15,8.36,-3.9,0.0,0.0,4.11, SURF_ID='WALL'/ Obstruction #46
&OBST XB=-9.6,-8.16,-3.9,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #47
&OBST XB=-9.8,-9.6,-5.7,-3.9,0.0,4.11, SURF_ID='WALL'/ Obstruction #48
&OBST XB=8.15,9.5,-3.9,-3.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #49
&OBST XB=9.5,9.7,-12.2,-3.9,0.0,4.11, SURF_ID='WALL'/ Obstruction #50
&OBST XB=3.15,9.5,-12.4,-12.2,0.0,4.11, SURF_ID='WALL'/ Obstruction #51
&OBST XB=2.95,3.15,-12.2,-8.9,0.0,4.14, SURF_ID='WALL'/ Obstruction #52
&OBST XB=-3.15,3.15,-9.1,-8.9,0.0,4.14, SURF_ID='WALL'/ Obstruction #53
&OBST XB=-3.15,-2.95,-12.2,-8.9,0.0,4.14, SURF_ID='WALL'/ Obstruction #54
&OBST XB=-3.15,3.15,-12.2,-8.9,4.1,4.14, SURF_ID='WALL'/ Obstruction #55
&OBST XB=-12.1,-3.15,-12.4,-12.2,0.0,4.11, SURF_ID='WALL'/ Obstruction #56
&OBST XB=-12.3,-12.1,-12.2,-5.7,0.0,4.11, SURF_ID='WALL'/ Obstruction #57
&OBST XB=-12.1,-9.6,-5.7,-5.5,0.0,4.11, SURF_ID='WALL'/ Obstruction #58

&SLCF QUANTITY='TEMPERATURE', PBY=0.0/
&SLCF QUANTITY='TEMPERATURE', PBY=-6.0/

&SLCF QUANTITY='VISIBILITY', PBZ=1.8/
&SLCF QUANTITY='VISIBILITY', PBZ=0.7/

&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBY=-10.7/
&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBX=-6.3 /
&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBZ=4.0 /

&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBX=-3.9 /
&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBZ=7.0 /

&TAIL /
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Fire Scenario 2

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Scenario 2.fds
Generated by PyroSim - Version 2014.1.0331
May 8, 2014 1:05:20 PM

&HEAD CHID='Scenario_2'/
&TIME T_END=600.0/
&DUMP RENDER_FILE='Scenario_2.ge1', DT_RESTART=300.0/

&MESH ID='Mesh01', IJK=280,56,12, XB=-28.0,28.0,16.0,28.0,0.0,2.4/

&MISC TMPA = 20.0/
&MISC INITIAL_UNMIXED_FRACTION=0

&SPEC ID='WATER VAPOR'/

&PART ID='Water_PART',
      SPEC_ID='WATER VAPOR',
      DIAMETER=500.0,
      MONODISPERSE=.TRUE.,
      COLOR='BLUE',
      AGE=4.0/



&REAC FUEL = 'POLYURETHANE',
      FYI = 'C_6.3 H_7.1 N O_2.1, NFPA Handbook, Babrauskas',
      SOOT_YIELD = 0.10,
      CO_YIELD = 0.028,
      N = 1.0
      C = 6.3
      H = 7.1
      O = 2.1 /


&SURF ID ='BURNER',
      HRRPUA =350,
      COLOR ='RASPBERRY',
      RAMP_Q ='Trash' /

&RAMP ID='Trash', T= 0.0, F=0.00 /
&RAMP ID='Trash', T= 30.0, F=0.486 /
&RAMP ID='Trash', T= 50.0, F=1.00 /
&RAMP ID='Trash', T= 100.0, F=0.943 /
&RAMP ID='Trash', T= 200.0, F=0.571 /
&RAMP ID='Trash', T= 300.0, F=0.171 /
&RAMP ID='Trash', T= 400.0, F=0.157 /
&RAMP ID='Trash', T= 500.0, F=0.143 /
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&RAMP ID='Trash', T= 600.0, F=0.029 /


&PROP ID='k-5.6',
      QUANTITY='SPRINKLER LINK TEMPERATURE',
      RTI = 50
      C_FACTOR=0.7
      ACTIVATION_TEMPERATURE=68.0,
      PART_ID='Water_PART',
      FLOW_RATE=70.3,
      PARTICLE_VELOCITY=10.0,
      SPRAY_ANGLE=30.,80./

&MATL ID='GYPSUM PLASTER',
      FYI='Quintiere, Fire Behavior',
      SPECIFIC_HEAT=0.84,
      CONDUCTIVITY=0.48,
      DENSITY=1440.0/



&SURF ID='WALL',
      RGB=200,200,200,
      DEFAULT=.TRUE.,
      MATL_ID='GYPSUM PLASTER',
      THICKNESS=0.012/


&DEVC ID='Room-THCP.5', QUANTITY='THERMOCOUPLE', XYZ=3.46644,23.8599,0.5/
&DEVC ID='Room-THCP1.5', QUANTITY='THERMOCOUPLE', XYZ=3.46644,23.8599,1.5/
&DEVC ID='Room-THCP2', QUANTITY='THERMOCOUPLE', XYZ=3.46644,23.8599,2/



&DEVC ID='HallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=3.4,22.0,0.5/
&DEVC ID='HallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=3.4,22.0,1.5/
&DEVC ID='HAllTHCP01', QUANTITY='THERMOCOUPLE', XYZ=3.4,22.0,2.0/

&DEVC ID='LHallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=-11,22.0,0.5/
&DEVC ID='LHallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=-11,22.0,1.5/
&DEVC ID='LHAllTHCP01', QUANTITY='THERMOCOUPLE', XYZ=-11,22.0,2.0/

&DEVC ID='RHallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=13.4,22.0,0.5/
&DEVC ID='RHallTHCP01', QUANTITY='THERMOCOUPLE', XYZ=13.4,22.0,1.5/
&DEVC ID='RHAllTHCP01', QUANTITY='THERMOCOUPLE', XYZ=13.4,22.0,2.0/



&DEVC ID='Sprinkler1', PROP_ID='k-5.6', XYZ=4.3,24.0,2.39/
&DEVC ID='Sprinkler1', PROP_ID='k-5.6', XYZ=4.3,26.7,2.39/

&DEVC ID='Sprinkler1', PROP_ID='k-5.6', XYZ=5,21.4,2.39/
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&OBST XB=3.6,4.6,25.5,26.5,0.00,0.50,
SURF_ID6='INERT','INERT','INERT','INERT','INERT','BURNER'/ Design Fire


&OBST XB=23.539,27.7698,22.5217,22.7217,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=23.5025,23.7025,22.6598,27.4473,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=18.0506,18.2506,23.291,27.2556,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=14.8788,15.0788,23.2812,27.2556,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=11.6395,11.8395,23.3403,27.2588,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=8.29586,8.49586,23.2907,27.2588,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=5.37267,5.57267,23.3465,27.2588,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-26.9279,2.48333,23.2567,23.4567,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-23.1662,-22.9662,23.3386,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-20.7671,-20.5671,23.3211,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-17.6174,-17.4174,23.2986,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-14.4212,-14.2212,23.3657,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-12.0577,-11.8577,23.3687,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-8.84582,-8.64582,23.3894,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-5.80112,-5.60112,23.3639,27.5263,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=18.1415,18.3415,17.548,20.8485,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-16.701,-16.501,18.1659,20.8044,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-17.5668,-17.3668,15.5162,18.1647,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-3.9946,1.23118,17.7116,17.9116,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-8.57295,-8.37295,14.5048,20.8399,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-8.37295,-6.52289,18.6338,18.8338,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-12.4719,-8.42945,17.2394,17.4394,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=6.45115,6.65115,18.6269,20.7994,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=12.0696,12.2696,15.1827,18.313,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-8.57295,-8.37295,20.8399,23.3675,0.0,2.75, SURF_ID='WALL'/
Obstruction
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&OBST XB=21.7229,21.9229,16.6643,17.548,0.0,2.75, SURF_ID='WALL'/
Obstruction
&OBST XB=-20.2,-20.0,16.0,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-20.2,-17.4,20.7143,20.9286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-20.0,-18.2,18.1429,18.3571,0.2,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-18.2,-14.2,18.1429,18.3571,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-16.2,-14.2,20.5,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-14.4,-14.2,16.0,18.1429,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-14.4,-14.2,18.3571,19.4286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-14.4,-14.2,19.6429,20.5,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-14.4,-12.4,19.4286,19.6429,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-12.6,-12.4,16.0,19.4286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-12.6,-12.4,19.6429,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-12.6,-6.4,20.7143,20.9286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-6.6,-6.4,18.5714,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-6.6,-4.0,18.3571,18.5714,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-4.2,-4.0,16.0,18.3571,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-4.2,-4.0,18.5714,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-4.2,1.4,20.7143,20.9286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=1.2,1.4,16.0,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-17.4,-16.2,20.7143,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=12.0,12.2,18.3571,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=12.0,18.4,18.1429,18.3571,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=12.0,22.0,20.7143,20.9286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=15.2,15.4,18.3571,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=18.2,18.4,17.7143,18.1429,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=18.2,22.0,17.5,17.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=21.8,22.0,17.7143,20.7143,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-27.0,-26.8,16.6429,27.5714,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-27.0,-22.4,16.4286,16.6429,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-27.0,0.2,27.5714,27.7857,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-22.6,-22.4,16.0,16.4286,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=-6.60028E-14,0.2,23.2857,26.2857,0.0,2.4, SURF_ID='WALL'/
Obstruction
&OBST XB=-6.60028E-14,0.2,26.5,27.5714,0.0,2.4, SURF_ID='WALL'/
Obstruction
&OBST XB=-6.60028E-14,3.2,26.2857,26.5,0.0,2.4, SURF_ID='WALL'/
Obstruction
&OBST XB=2.4,2.6,23.5,26.2857,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=2.4,21.4,23.2857,23.5,0.0,2.4, SURF_ID='WALL'/ Obstruction
&OBST XB=2.6,2.8,16.0,18.5714,0.0,2.4, SURF_ID='WALL'/ Obstruction
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  .
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Vita

James J. Dew (Jeff) was born and raised in Savannah, Georgia. Upon graduating high school, he became a firefighter for his home town. During this time he attended Armstrong Atlantic State University where he gained an Associate's Degree in Engineering Studies and Bachelors of Science in Physics. His experience as a firefighter lead him to the graduate program at Calpoly where he was accepted into the program in the winter of 2012.

Jeff resigned from the fire department in May of 2013 after a catastrophic shoulder injury. He then began work with a sprinkler contractor as a fire suppression system designer. In June of 2014 he will be leaving his current employer to start a new position with Burns & McDonnell as an Assistant Fire Protection Engineer.