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Fire Safety In Student Housings

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Abstract

In Massachusetts, fraternities and sororities are exempted from the need to install automatic sprinklers that are required of all other lodging houses. This project studied the fire safety of college student housing with emphasis on the impact of automatic sprinklers on student safety. The basis of the project involved an identification of the major factors that are important to a fire safety system, an evaluation of selected case studies of actual fires, and a statistical analysis of the interrelated parts.

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1.0 Introduction

According to the U.S. Department of Education, a record number of young adults are currently attending institutions of higher learning. It was estimated that 14.9 million students would enroll for the 1999 fall semester, an increase over 14.6 million in 1998, and a ten percent increase over the past ten years.[1] As more and more young adults enter American colleges and universities, the problem of housing these students is growing. Many two-person rooms are now being used to house three or four students.[2] A majority of dormitories housing students are older buildings built before modern life-safety codes were enacted, and thus lack many of the provisions now in place for newly constructed buildings. This lack of modern code requirements because of "grandfathering" the existing buildings is even more prevalent for fraternity and sorority domiciles.

The increase in student density in older buildings causes a potential increase for deadly or multiple injury fires. When fatal fires occur in student housing they can be particularly devastating to the entire campus. For example, at the University of North Carolina on May 12, 1996, five of eight student occupants were killed while they slept. This fire started immediately following a spring graduation celebration and ended in a funeral service for five residents. A dormitory fire that killed two students at Ohio State University in 1968 is still remembered as the worst tragedy that has occurred on that campus.[3]

Parents send their children to colleges expecting that the community will provide a safe environment for their young. It is because of this expectation that many institutions should consider fire safety a paramount concern in student housing.

In many cases involving student deaths, the factors that have been found to contribute to death are related to a lack of one or more fire safety provisions. In the University of North Carolina fire the NFPA conducted an investigation and found that the following factors significantly contributed to the loss of life[4]:

- The presence of combustible interior finish materials.
- The presence of an open central stairway.
- The lack of fire-rated construction separating the assembly areas from the residential areas of the building.

- The lack of building-wide fire detection and fire alarm systems.
- The lack of automatic sprinkler systems.
- The improper use or disposal of smoking materials.

On September 8, 1990, at the University of California at Berkeley, a fire at a fraternity house killed three students. The NFPA conducted an investigation and found that open stairways, the lack of fire safety training, and fire exit drills were factors that contributed to student deaths[5].

More recently in 2000, two fires occurred that killed three students in each fire. One fire occurred at Seton Hall in a dormitory that was unequipped with sprinkler systems. The dormitory was equipped with fire detection and alarm systems. However, a series of false alarms convinced many residents to ignore the warning, and, as a result, three students died and 54 were injured. In Bloomsburg, PA, a fire occurred at a fraternity house and killed three students. This fire is a recurrence of a similar event that happened on the campus in 1995, killing five students. In this case, fire safety measures in the form of battery-operated smoke detectors and pull-type alarms had been implemented but automatic sprinkler systems were not installed.

Annually there are a reported 1,700 fires in college dormitories, classrooms, and fraternities and sororities. In over two-thirds of these cases, fires damage is limited to the object of origin. In the other one-third however, fire grew to varying degrees, sometimes fatally. When large fires do occur, the result can be crippling financially as well.

Across the nation, various measures have been implemented to improve fire safety in nearly all types of buildings. The Federal Hotel and Motel Fire Safety Act of 1990 mandates that federal employees on travel must stay in public accommodations adhering to life safety requirements that include hard-wired single station smoke detectors in each guest room as well as an automatic sprinkler system with a sprinkler head in each guest room[6]. If federal employees must be provided with a fire safe environment, shouldn't the same ideal hold true for this nation's brightest young adults?

As a result of the recent outbreak of fires in student residencies, many lawmakers have begun address the problem by proposing laws that would require sprinkler systems in student housing (see Appendix C). In Massachusetts, although there are laws governing lodging houses, section 26H chapter 148 of the Massachusetts General Laws specifically exempts fraternity houses, sorority houses, and dormitories from requiring automatic sprinkler systems.

According to a report conducted by the United States Fire Administration, fires present a myriad of danger situations and as such fire safety is multi-faceted. When considering complete fire-safety, prevention, occupant awareness and training, detection and alarms, and suppression, are all factors that must be considered jointly. In each of the fires resulting in fatalities analyzed in this report, one or more vital pieces of the fire safety puzzle were absent. In all of the fires studied, there were no automatic sprinkler systems present.

This project will use case studies and statistics to identify the fire dangers associated with student housing. The goal of this project is to provide college administrations and legislators an understanding of the dangers that exist in student housing, as well as solutions that exist for improving fire safety in student housing. In particular, the installation of automatic sprinkler systems will be analyzed to show the effect that these systems have in fire safe housing.

2.0 Fire Dangers in Student Housing

When considering fire safety in student housing, an examination of the dangers that exist is necessary before it is possible to identify fire safety measures. It is logical that the dangers are examined first so that fire safety solutions can address the specific dangers that are found to be most prevalent.

The dangers that exist in student housing can be separated into two categories. Dangers that exist that lead to fires and dangers that exist for residents after a fire has been ignited.

This chapter will identify the most prevalent dangers that exist in student housing. The first section will address the issues involved with ignition factors in student housing in an attempt to describe statistically the most common causes of housing fires. The second section will deal with factors that were found to be determinants in fires where there was loss of life or multiple injuries. The purpose is to identify the recurring factors of fatal fires learn of the important ways of avoiding situations that lead to fatalities or injuries in student housing.

2.1 Causes of Student Housing Fires

Every year there are approximately 1700 fires in student housings.[7] The National Fire Protection Agency (NFPA) has conducted research in order to determine ignition factors in fires classified as occurring in dormitories, fraternities, and sororities. The research is based on data collected using the National Fire Incident Reporting System (NFIRS) from 1990 through 1995. The NFIRS system is discussed in greater detail in chapter 5 of this report. It should be noted here that NFIRS data is not inclusive and does not represent every fire during a specific time period. This is due to the fact that only approximately 65 percent of all municipalities participate in this data collection. The data is analyzed, and annual average charts are developed detailing the annual average percentage of fires caused by a variety of ignition factors. The results of the NFPA research are summarized in Tables 2.1 and 2.2 in the form of the annual averages for 1991 through 1995.[8]

Table 2.1 details the percentage of fraternity and sorority fires resulting from different causes and the total dollar loss associated with each cause for one year. Table 2.2 describes the ignition causes for dormitories.

Table 2.1 Causes of Fraternity, Sorority Fires in 1991 through 1995 and Associated Dollar Loss (Annual Average)[9]

Causes of Fires	% of Ignition	Annual Average Dollar Loss	% of Annual Average Dollar Loss
Incendiary, Suspicious	19.5	497,497	20.1
Cooking	14.9	15,759	0.6
Electrical Distribution	9.7	822,738	33.3
Smoking	9	126,790	5.1
Other Equipment	6.9	12,729	0.5
Other Heat, Flame, Spark	5.9	156,178	6.3
Open Flame, Ember, Torch	5.4	19,463	0.8
Heating	5.2	296,958	12
Appliances, Air Condition	4.9	54,364	2.2
Natural Causes	1	179	0
Children Playing	0.5	354	0
Exposure	0.5	0	0
Unknown	16.4	466528	18.9
TOTALS	**100**	**2469538**	**100**

Table 2.2 Causes of Dormitory Fires in 1991 through 1995 and Associated Dollar Loss (Annual Averages)[10]

Causes of Fires	% of Ignition	Annual Average Dollar Loss	% of Annual Average Dollar Loss
Incendiary, Suspicious	29.9	2,231,154	40
Cooking	15.7	116,815	2.1
Smoking	10.8	188,031	3.4
Other Equipment	6	262,063	4.7
Appliances, Air Condition	5.9	663,876	11.9
Electrical distribution	5.4	520,370	9.3
Open Flame, Ember, Torch	5.1	78,778	1.4
Open Heat, Flame, Spark	4.9	210,223	3.8
Heating	2.5	251,368	4.5
Exposure	0.6	3,887	0.1
Natural Causes	0.5	63,422	1.1
Children Playing	0.5	3,834	0.1
Unknown	12.3	980,059	17.6
TOTALS	**100**	**5,573,879**	**100**

Both tables illustrate that the leading cause of fires is incendiary or suspicious. Incendiary and suspicious fires are also referred to as arson fires in all of the other sources used in this report. According to the

College Fire Safety Forum Report, "Motives for juvenile arsons include peer pressure, a cry for help, and struggling with the pressures of the environment. All of these conditions can exist in a college environment where young people often encounter more pressure than they have ever experienced."[11] It is of great importance to recognize that this is a real danger and could affect any campus in this country. Without proper support channels the troubled student may turn to arson for attention or revenge.

Tables 2.1 and 2.2 show that the second leading cause of fires in student housing is cooking. Although these fires are responsible for approximately 15 percent of all fires annually in student housing, they only account for .6 percent of the annual dollar loss in fraternities and sororities and 2.1 percent of the annual dollar loss for dormitories. This relatively small percentage is most likely due to the fact that cooking fires occur in kitchen areas and that these types of fires usually occur while the occupant is present. Unlike fires caused by other factors (electrical, appliance, heating), cooking fires occur predominantly during the day or early evening thus allowing for faster reaction.

The third leading cause of fires in fraternity and sorority houses is improper electrical distribution, such as overloaded electrical circuits, faulty wiring, and faulty electrical repair. Electrical distribution accounts for 9.7 percent of all fires annually in these residences, but only 5.4 percent of fires in dormitories. This is due to the fact that the students themselves maintain fraternity and sorority houses, as opposed to dormitories where school staff members maintain the buildings, and most students lack the capacity to recognize problems within the electrical system. Because of the lack of outside supervision, it is more likely that unapproved electrical modifications (overloading of circuits) are more common in fraternity and sorority houses than in the dormitories.[12]

In both tables it is evident that cigarette smoking presents real danger to the safety of student housing. Smoking is a factor in nearly 10 percent of fires. It is the third leading cause of fires in college dormitories and the fourth most common cause in fraternities and sororities. These types of fires are most commonly caused by improperly extinguished cigarettes and by smokers who fall asleep without first extinguishing lit cigarettes. The consumption of alcohol compounds the risk of this ignition factor because people under the influence of alcohol may become careless, thus increasing the likelihood of falling asleep with lit cigarettes.

Banning smoking, however, may not be the best method with which to deal with this problem: "Many colleges have forbid smoking in the dormitories in recent years, but this may be counterproductive. This may force students into the closet to smoke, figuratively and literally."[13] There are less drastic measures that can lessen the danger caused by smoking without infringing on the liberty of college students. Common smoking areas stocked with fire resistant furniture, ample numbers of ashtrays, and posters outlining fire safety guidelines are examples of strategies that may decrease the likelihood of fires caused by smoking.

Other major sources of ignition include appliances, air-conditioning, and heating. While the percentages of fires caused by these factors are relatively small, the appliances and air-conditioning ignition accounts for nearly 12 percent of all dollar loss in college dormitories. Many students in dormitories do not have access to kitchen areas, and subsequently use unapproved cooking devices, thus increasing the risk of fires caused by these ignition factors.[14]

Another ignition factor is the improper use of candles and incense, represented in the tables as open flame. Many students burn candles and incense, which can easily cause fires if left unattended. In a recent fire at Southern

Illinois University, for example, an unattended candle was found to be the source of a fire that caused extensive damage.

In summary, the ignition sources of fires in student housings come in a variety of forms. The most common forms of ignition reoccurring in student housing have been determined to be:

- Incindiarism
- Cooking
- Electrical systems
- Smoking materials
- Appliances
- Candles and incense

When considering possible methods of improving fire safety in student housing, it is crucial to recognize these possible ignition sources.

2.2 Factors Contributing to Injury or Death in Student Housing Fires

In order to determine the factors that result in death or injuries, it is essential to examine cases that have resulted in student fatalities. This section will examine several documented fires between 1976 and 2000 for the purpose of identifying the recurring factors in these fires that led to student deaths and injuries. Due to the availability of reports and information pertaining to these fires, this report will concentrate on ten fires.

Table 2.3 represents fraternity, sorority, and dormitory fires from 1976 to 2000 that resulted in death. This information was compiled from reports obtained from the following sources: The NFPA[15,16,17], the Federal Emergency Management Agency (FEMA)[18], and Campus-Firewatch[19] (a web site dedicated to campus fire safety). This is by no means a complete list since several fires have not been recorded in the reports that were used to collect the data. Data regarding recent fires has not yet been analyzed by the NFPA or FEMA and older data is difficult to obtain. The ten fires used for this section are highlighted in bold print in Table 2.3.

Table 2.3 Table of fatal fires from 1976-2000

(Note: This table represents the majority of fires but is not complete due to lack of information)

University or City	Date of Fire	Housing Type	Cause of Fire	Fatalities	Injuries
Bloomsburg State (PA)	**3/19/00**	**Fraternity**	**Unknown**	**3**	**0**
Seton Hall University	**1/19/00**	**Dormitory**	**Unknown**	**3**	**54**
Nebraska Wesleyan Univ.	10/8/98	Off-Campus Housing	Cigarette	1	0
Murray State (KY)	9/18/98	Dormitory	Arson	1	16
Greenville College (IL)	12/9/97	Dormitory	Unknown	1	7
John Hopkins U. (MD)	8/31/97	Off-Campus Housing	Cigarette	1	0
School of Visual Arts (NY)	2/21/97	Dormitory	Cigarette	1	0
Central Missouri St.	1/3/97	Dormitory	Arson	1	0
Ohio Wesleyan U.	10/19/97	Fraternity	Unknown	1	0
Univ. Of N.C.	**5/12/96**	**Fraternity**	**Cigarette**	**5**	**3**
Mesa St. (CO)	12/21/95	Off-Campus Housing	Unknown	1	3
Bloomsburg (PA)	**10/21/94**	**Fraternity**	**Cigarette**	**5**	**0**

Univ. Of Wisconsin	10/26/93	Sorority	Unknown	1	2
California PA	2/13/92	Fraternity	Unknown	1	0
Erie PA	12/8/90	Fraternity	Unknown	1	4
U of C Berkeley (CA)	**9/8/90**	**Fraternity**	**Incendiary**	**3**	**0**
Wesley College	**4/12/87**	**Dormitory**	**Incendiary**	**1**	**4**
Danville, KY	4/19/86	Fraternity	Unknown	1	0
San Jose, CA	3/3/85	Fraternity	Unknown	1	1
Geneseo, NY	12/20/84	Fraternity	Unknown	1	0
Indiana U	10/22/84	Fraternity	Arson	1	32
Lexington, VA	4/11/84	Fraternity	Unknown	1	0
Thibodaux, LA	1/6/84	Fraternity	Unknown	1	0
Austin, TX	12/11/83	Fraternity	Unknown	1	1
Bridgewater State	5/28/83	Fraternity	Unknown	1	1
Philadelphia, PA	9/9/82	Fraternity	Unknown	1	8
Eugene, OR	4/5/80	Fraternity	Unknown	1	1
University Park, TX	1/14/78	Fraternity	Unknown	1	2
Providence College	**12/13/77**	**Dormitory**	**Undetermined**	**10**	**12**
Baker State, KA	**8/29/76**	**Fraternity**	**Cigarette**	**5**	**2**
Skidmore College	**4/5/76**	**Dormitory**	**Undetermined**	**1**	**60**
Ohio State	**1/8/76**	**Fraternity**	**Incendiary**	**2**	**6**
			TOTALS=	60	219

It is interesting to note that in these 32 fires the majority of injuries occurred in dormitories. Out of 219 reported injuries, 153 injuries occurred in dormitory fires. This is possibly due to the fact that more students are housed in dormitories than in fraternities and sororities. It should also be noted that a majority of all fire injuries occur when students jump out of windows to escape fire and smoke.[20]

The ten fires studied occurred at several institutions and resulted in 38 deaths and 151 injuries. The factors contributing to the deaths include how the fires grew as well as how the students reacted to the fires. Directly related to fire growth are building construction, room content, and fire suppression systems. Student reaction is related to building construction and alarm/notification systems.

2.2.1 Building Construction

When looking at how building construction affects fire growth or student behavior, there are several relevant factors to consider: construction type, stairways, and fire escape routes. Construction type refers to the materials used to build the structure and the age of the building. The examination of stairways reveals the relationship between stairway structure and fire growth. Looking at fire escape routes is essential to understanding the correlation between the types of escape routes available to students and injuries occurring during the fire.

2.2.1.1 Construction Type

The construction types in the ten fires varied. Table 2.4 shows the building construction in each of the ten fires as well as the number of fatalities and injuries.

Table 2.4 Construction Types in 10 Fatal Fires

University or City	Housing Type	Building Age	Construction Type	Stories	Fatalities	Injuries
Bloomsburg State (PA)	Fraternity	Not Reported	Wood Frame	2	3	0
Seton Hall University	Dormitory	48	Not Reported	6	3	54
Univ. Of N.C.	Fraternity	70	Ordinary Materials	3 and a Basement	5	3
Bloomsburg State (PA)	Fraternity	Not Reported	Wood Frame	2	5	0
U of C Berkeley (CA)	Fraternity	33	Wood Frame	3 and a Basement	3	0
Wesley College	Dormitory	18	Fire Resistive	3 and a Basement	1	4
Providence College	Dormitory	39	Fire Resistive	4	10	12
Baker State, (KA)	Fraternity	59	Ordinary Materials	3 and a Basement	5	2
Skidmore College	Dormitory	10	Fire Resistive	3 and a Basement	1	60
Ohio State	Fraternity	Not Reported	Ordinary Materials	2 and a attic	2	6

Of the ten fires studied, three occurred in buildings made of ordinary construction materials (i.e. wood, concrete, metal studs, etc.). These fires combined accounted for 12 deaths. Three fires occurred in buildings with wood frames and accounted for 11 deaths. Another three fires occurred in buildings made of fire-resistant materials and accounted for twelve deaths.

In the fire at the University of North Carolina,[21] the lack of fire-rated construction in the form of opening protectives was found to be a factor that contributed significantly to the loss of life. At Baker State,[22] a flaw in the wall of the room where the fire originated was sited as a major factor. The fire spread through the wall to an unprotected (open) stairway causing fast smoke spread and blocking escape.

Ten of the twelve deaths that occurred in fire-resistant housings occurred at Providence College in 1977.

These deaths occurred when the Rhode Island building codes did not regulated dead-end hallways shorter than 75 feet (the length of the stairways at the Providence College dormitory was 61 feet). All ten students died as a result of the dead-end hallways, the fire-resistant materials used to construct the building were not a factor in the student deaths. It should also be noted that these materials were not factors in fire growth but, rather, hallway contents in the form of flammable Christmas decorations were major influences.

These cases suggest that use of fire resistant construction materials will result in fewer fatalities than buildings built with wood frames or ordinary materials. It is important to remember that the contents of student rooms are as much a factor in fire growth as are the materials from which a building is made. Although the building may not be a factor in the size or lethality of the fire, room contents are of great significance. Room content as contributors to fire deaths will be discussed further in section 2.2.2 of this report.

2.2.1.2 Stairways

Stairways are often considered a major factor in rapid-fire growth because they allow the heat to rise from between floors without having to first burn through ceiling or floor materials. Enclosed stairways with fire doors prevent fires from moving rapidly from one floor to the next. Fire doors fall into a variety of classifications that designate rated burn time. The rate time is the time it would take for a fire to burn through the door and proceed to the next floor. Paragraph 5-1.3.1 of the Life Safety Code[23] Chapter 5, Means of Egress, requires one-hour rated doors for stairways of three stories or less.

Table 2.5 shows the presence or absence of open stairs in the ten fires studied.

Table 2.5 Exit Stairways

University or City	Housing Type	Exit Stairways	Fatalities	Injuries
Bloomsburg State (PA)	Fraternity	not reported	3	0
Seton Hall University	Dormitory	not reported	3	54
Univ. Of N.C.	Fraternity	1 open stair	5	3
Bloomsburg State (PA)	Fraternity	1 open stair	5	0
U of C Berkeley (CA)	Fraternity	3 enclosed stairs, with open doors	3	0
Wesley College	Dormitory	2 enclosed stairs	1	4
Providence College	Dormitory	3 enclosed stairs	10	12
Baker State, (KA)	Fraternity	1 enclosed stair, with door open, 1 open stair	5	2
Skidmore College	Dormitory	2 enclosed stairs	1	60
Ohio State	Fraternity	2 enclosed stairs	2	6

In the fires at both the University of North Carolina[24] and University of California Berkeley[25], open stairways were sited as "having significantly contributing to the loss of life and property."[18,19]

The fire at the University of California started in a lobby area located on the first floor. When the occupants first noticed the fire, the fraternity president ran upstairs to notify residents to evacuate the building. By the time he had reached the third floor the fire had grown from the first floor to the third floor via the stairway he had climbed. The stairway was equipped with fire doors on all levels but all of the doors were left open, thus providing no fire protection. This case demonstrates the importance of the proper use of fire doors. Had the doors been closed properly, "Stairway enclosures that met the code requirements would have provided occupants with more time for escape or potential rescue by fire fighters."[26]

The importance of properly equipped enclosed stairways cannot be stressed enough. In each of the cases where open stairways existed, fires spread rapidly from floor to floor and resulted in catastrophe.[27]

2.2.1.3 Fire Escape Routes

Fire escape routes are an important aspect of fire-safety. The overall objective when designing fire escape routes is the safe and fast evacuation of a burning building. In several of the cases studied, the lack of easily accessible fire escape routes directly contributed to loss of life.

In the Providence College fire (noted in section 2.2.1.2.), eight of the ten students died due to the lack of an easily accessible escape route, and the other two died when they were forced to jump from their windows. In the case of Baker State, there were no exits from the third floor (where three deaths occurred) other than the open stairway that was consumed by fire. At the University of California, one of the fire exits was padlocked from the outside, thus preventing use of this stairway as an exit.

Whenever exit from a burning building is restricted the results can be horrific. Since many of the fires occurred, building codes have been updated to require fire exits in fraternities and dormitories. In the case of the Seton Hall fire, although there were adequate fire escapes, many students failed to exit because they disregarded the alarm. It is important to implement proper fire evacuation drills to teach students the proper manner to exit a burning building. Without the knowledge of proper evacuation procedures, fire safety measures are ineffective.

2.2.2 Room Contents

The contents of a room involved in a fire contribute greatly to fire growth as well as heat and smoke generation. Contents have not only been linked to rapid-fire growth, but also to difficulty in early extinguishments. Upholstered furniture containing polyurethane foam is often involved in rapid fire growth.[28] Other room contents linked to the early stages of fire development are draperies and wall coverings. In some cases, students have many posters or pictures lining the walls of a room, thus presenting an easy source of ignition. These fast burning sources can quickly raise room temperature, creating potential for flashover.

Other contents that must be considered are wall, ceiling, and floor finishes. A variety of finishes are used in dormitories and fraternity and sorority houses; many of these finishes have the potential for promulgating a fire. Since many finishes cover large areas and can contain highly flammable materials, they must be considered a danger in student housing. Although it is unrealistic to prevent this hazard completely, the use of other fire safety measures can greatly limit dangerous contributions from wall, floor and ceiling finishes. Fire safety measures will be discussed further in Chapter 3 of this report.

In the ten cases studied, the room contents involved in the fires represented a variety of the aforementioned materials. Table 2.6 is a table of the ten fires and the room contents involved in each fire.

Table 2.6 Room Contents

University or City	Housing Type	Room Contents	Fatalities	Injuries
Bloomsburg State (PA)	Fraternity	Not Reported	3	0
Seton Hall University	Dormitory	Not Reported	3	54
Univ. Of N.C.	Fraternity	Trash, Wood Paneling	5	3
Bloomsburg State (PA)	Fraternity	Sofa	5	0
U of C Berkeley (CA)	Fraternity	Sofa, Wood Paneling	3	0
Wesley College	Dormitory	Typical Room Furnishings	1	4
Providence College	Dormitory	X-mas Decorations (Highly Flammable)	10	12
Baker State, (KA)	Fraternity	Sofa, Wood Paneling	5	2
Skidmore College	Dormitory	Trash, Vinyl Wall Covering	1	60
Ohio State	Fraternity	Decorations, Sofas, Trash	2	6

Information about room contents was available for eight of the ten cases. Of these eight cases, sofas were found to be a factor in four of the fires, wood paneling was a factor in three of the fires, and decorations were involved in two fires. All of these room contents have been identified as being potential fire hazards. Room content often acts as a determinant to the growth and intensity of a fire. Therefore, when considering fire safety measures, the use of highly flammable room contents in student housing should be limited.

2.2.3 Alarm and Notification Systems

In a fire, the notification of occupants is very important. Without proper notification, occupants are at high risk from fire and smoke. In the ten cases studied, there were varying degrees of notification and alarm methods used to make the occupants aware of the fire situation.

Many of the fires that occurred in the 1970s were in buildings lacking any alarm or notification system. In the more recent fires, many buildings are equipped with pull-type alarms that notify occupants of the fire danger. In some cases, smoke detectors were installed in rooms and common areas. Table 2.7 details the ten fires studied and the alarm and notification systems that were in use at the time of the fire.

Table 2.7 Alarm and Notification

University or City	Housing Type	Alarm	Detectors	Fatalities	Injuries
Bloomsburg State (PA)	Fraternity	Not Reported	Smoke	3	0
Seton Hall University	Dormitory	Manual	Smoke	3	54
Univ. Of N.C.	Fraternity	None	Thermal in Basement and Rooms, Smoke in Halls	5	3
Bloomsburg State (PA)	Fraternity	None	Smoke and thermal	5	0
U of C Berkeley (CA)	Fraternity	Manual	Some Smoke Detectors	3	0
Wesley College	Dormitory	Manual	None	1	4
Providence College	Dormitory	Manual	Thermal Detectors in Stairs	10	12
Baker State, (KA)	Fraternity	None	None	5	2
Skidmore College	Dormitory	Manual	Thermal Detectors	1	60
Ohio State	Fraternity	None	None	2	6

Table 2.7 shows that when there are no fire detection or alarm systems in place the results can be devastating. Although several of the fires had both smoke detectors and pull alarms, still there were deaths. There are several possible factors for these fatalities. According to a report in Campus Firewatch, the Seton Hall dormitory had many false alarms during the year which led to the students ignoring the alarm when there was an actual fire.[29] In the Bloomsburg Fire of 2000, many of the detectors were reportedly not operating because batteries were removed for use in remote controls. In the University of California fire, the fraternity had detectors that were not yet installed in the rooms. It is apparent from these cases that that the alarm and notification systems are not a positive factor if not operating properly.

Because human error can be a factor in the improper implementation of pull-type alarms and battery operated smoke detectors, these alarm systems should be considered successful fire warning devices only when the occupants are fully aware of the responsibility inherent in their use. Chapter 3 will give a description of fire alarm methods that are available for current applications.

2.2.4 Sprinkler Systems

In all ten of the cases studied there were no automatic sprinkler systems installed at the time of the fires. Automatic sprinkler systems are currently the best agent for fighting fires during the early developing stage. According to the NFPA, in both the University of California and University of North Carolina cases, the lack of sprinkler systems was a determining factor in the loss of life. This report will examine automatic sprinkler systems further in the next few chapters.

2.3 Summary

In this chapter, the most common sources of fire ignition have been determined to be arson, cooking, electrical, smoking, appliances, candles and incense. To improve fire safety in student housing, the prevention of these ignition factors is important.

The first factor that has been shown to have contributed to student deaths is building construction, specifically construction materials, stairways, and escape exits. When choosing building construction materials, every attempt should be made to utilize fire resistant materials. Since open stairways are a proven factor in increasing fire growth and limiting occupant exits, open stairways should be eliminated from student housings if at all possible. Because occupants are at high risk without proper escape routes, they should be made available and occupants should be familiar with means of egress.

Other factors contributing to student deaths are room contents involving highly flammable or easily ignitable sources, improperly implemented alarm and notification systems, and the lack of automatic sprinkler systems. Chapter 3 will address the use of a complete fire safety system for improving fire safety in all of these areas.

3.0 The Fire Safety System

Fire safety cannot be implemented by one aspect alone. Based on the sources that have contributed to fire ignition and student death, this chapter will identify the various components that are optimal for prevention. The fire safety system is a total system designed to limit common fire ignition sources and to prevent factors contributing to student deaths or injury. The complete system is comprised of several components: fire prevention measures, fire safety measures, fire awareness techniques, smoke detectors, monitored alarm systems, and automatic sprinkler systems.

The implementation of fire prevention measures, limiting flammable room content and common ignition sources, is key in reducing the probability of a fire occurring. Fire safety measures, including closed stairways, means of egress, and fire resistant construction help to limit fire growth and provide occupants with safe escape routes. Fire awareness techniques aim to provide occupants with proper instruction for procedures in case of fire. Fire awareness techniques also help to prevent fires by educating occupants about the causes of fires, as well as measures that can be undertaken to prevent them. Smoke detectors, monitored alarms, and notifications systems are vital elements in the evacuation of occupants in a fire. Monitored alarms also improve fire department response times. Automatic sprinkler systems are the primary agent in extinguishing fires during their early stages. This chapter provides a detailed description of each component.

3.1 Automatic Sprinkler Systems

3.1.1 Introduction

The history of automatic sprinkler systems traces back to 1878 when Henry Parmelee developed the first practical and extensively used system. Since that time, sprinkler system design and use has greatly evolved.[30] According to www.firesprinkler.org, "Currently the automatic sprinkler system is recognized as the single most effective measure for fighting the spread of fires in their early stages-before causing extensive damage."[31]

3.1.2 How do Sprinklers work?

Familiarization with the components of an Automatic Sprinkler System is imperative to understanding how a system works. The components of an automatic Sprinkler System are:

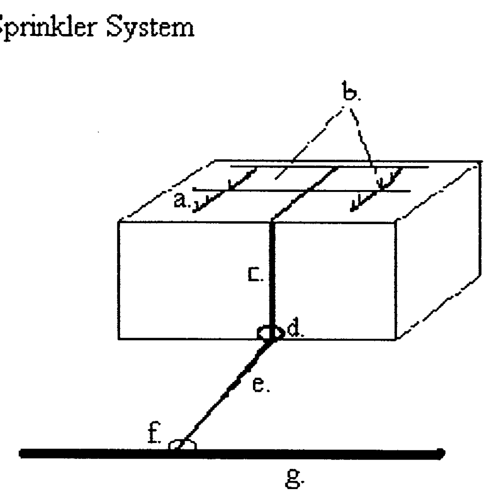

Figure 3.1 The Sprinkler System

- Sprinkler Heads (a)
- Water Supply Pipes (b)
- Riser Pipes (c)
- Sprinkler Control Valve (d)
- Feed Main (e)
- Street Valve (f)
- Street Main (g)

3.1.2.1 Sprinkler Heads

The distinguishing feature of a sprinkler system is the commonly seen sprinkler head. Automatic sprinklers are sealed nozzles that hold back water under pressure within the pipes, utilizing the same concept as a faucet.[32] Typical coverage area given by one sprinkler head can range from 12'x12' to 20'x20' of water coverage. Sprinkler heads can be placed practically anywhere where fire protection is deemed necessary. Figure 3.2 illustrates a typical sprinkler head design.

Parts of the Sprinkler head and their functions[33]:

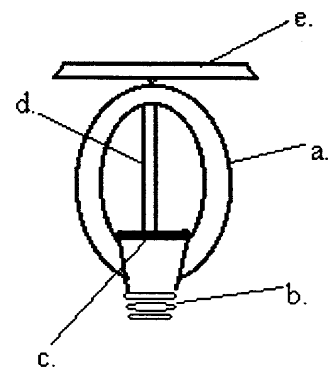

Figure 3.2 Sprinkler Head

a) The sprinkler head frame connects to the water supply pipes via

b) the threads on the hollow pipe where the water is held.

c) The cap holds back the flow of water. When open the water will flow at a normal rate of 8 to 24 gallons per minute.

d) The fusible link maintains the cap in place by a system of levers. The link will fuse typically at temperatures of around 165° F. Once the link fuses, the water will to flow in a stream until it hits

e) the deflector, causing a specific pattern of water to flow onto the fire below. This allows for the variation of sprinkler head design and gives manufacturers the ability to place sprinkler heads in the most desirable location, to include sidewalls, ceilings, stairwells, and hard to reach areas.

3.1.2.2 Water Supply Piping

The water supply piping consists of an intricate system of piping that varies in size and length determined by room size and sprinkler head size. Installers use distinct methods to determine piping area, the water flow, and the number of sprinkler heads that are needed. In the consideration of these aspects, installers will refer to N.F.P.A. Standard 13[34]. The water supply piping is designed to ensure that adequate water flow and water pressure will be available at the most remote sprinkler heads. The piping is designed to be of proper sizing to permit the delivery of the required flow of water.

A majority of college housing is considered to be residential housing. The water supply piping required for these types of residencies is much less intricate than that required by industrial and commercial automatic sprinkler systems.

Typical sleeping rooms in these residences require the installation of only one sprinkler head for protection. For simplification of the design, sidewall sprinkler heads may be installed near the entrances to some of the rooms.

This will minimize the amount of piping required for the rooms and add to the aesthetic view of the room.

3.1.2.3 Riser Pipes

The water, which flows through the water supply piping, flows in through the riser piping. Risers are typically installed in exit stairways where aesthetics are not as important. In many buildings standpipe systems are already located in stairwells. These may easily be converted to combined risers for use as standpipe systems as well as automatic sprinkler systems[35].

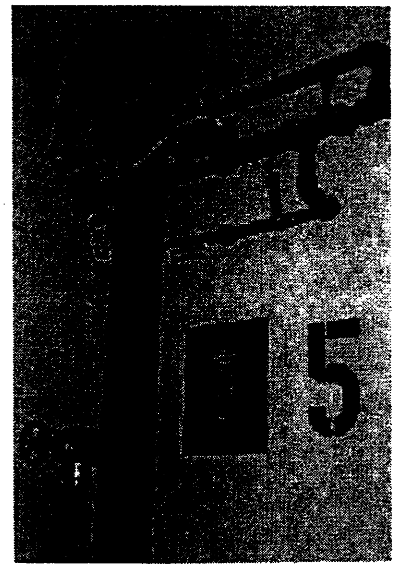

Figure 3.3 Riser Piping

Figure 3.3 illustrates a riser pipe in a stairwell. In this case the riser pipe has been converted to serve both standpipe and sprinkler system operations.

3.1.2.4 Sprinkler Control Valve

The sprinkler control valve is used to turn the system of and on for maintenance. This is where the water initially enters the building from the outside source. The valve can be found in most maintenance areas of commercial buildings and basements in residential buildings. To prevent tampering, these valves should be secured either in a locked room or the valves themselves may be locked with a chain and lock apparatus. Many locales have regulations requiring these valves remain locked open to prevent tampering. Part of the normal maintenance of the sprinkler system will require that the valve be checked to ensure that the water supply is reaching the system.

3.1.2.5 Feed Main

The feed main is the pipe that supplies the building with the water from the street main. The diameter of the feed main must supply enough water flow and pressure to ensure that adequate pressure is kept at all of the sprinkler heads in the system.

3.1.2.6 Street Valve

The street valve is used to shut the entire system off from the street main. The overhaul of a system or replacement of the feed main would require this valve to be in place and turned off.

3.1.3 Facts about Automatic Sprinkler Systems

Sprinkler systems have been an important factor in saving lives for over a century. There are however, still many facts about sprinklers most people do not know. There are also many myths and misnomers that are prevalent in the media and film making industries.

Some information regarding sprinkler systems:

- Sprinkler systems do not activate when someone pulls a fire alarm. They are actuated by the heat fusing element in the sprinkler heads.
- When one sprinkler head actuates it does not mean that every sprinkler head actuates. Since sprinkler heads hold water back individually by the heat elements, they actuate only when the individual head fuses.
- The installation of fire sprinklers in new residential construction is estimated to make up around 1% of the total building cost (www.firesprinkler.org).
- A 1984 report by the Bureau of Standards/National Institute of Standards and Technology estimated that the effect of adding fire sprinklers when smoke detectors are already present could reduce the number of fire fatalities by 63 percent (www.nfsa.org).

- Building codes over the past two decades have increasingly called for sprinklers throughout buildings for life safety, especially buildings in which rapid evacuation of occupants is difficult or the hazard posed by contents is high (www.nfsa.org).

- Automatic fire sprinklers keep fires small. The majority of fires in sprinklered buildings are handled by one or two sprinklers (www.nfsa.org).

- Sprinklers do not rely upon human factors such as familiarity with escape routes or emergency assistance. They go to work immediately to reduce the danger.

- The NFPA has no record of a fire killing more than two people in a completely sprinklered building where the system was properly operating, except in an explosion or flash fire or where industrial fire brigade members or employees were killed during fire suppression operations (www.firesprinkler.org).

3.1.4 Conclusion

Automatic sprinkler systems are excellent methods of fire safety. They have proven to be an asset in preventing catastrophic results in many fires. Sprinkler systems can be installed, in practically every occupancy type; once installed they require little maintenance. The automatic sprinkler system's proven record of saved lives and property should be strongly measured when considering installation. One of the distinct benefits of the automatic sprinkler system is that it does not rely on human involvement to work properly. It is due to all of these factors that the main recommendation of this report is that all dormitories, fraternity, and sorority houses be equipped with sprinklers. Chapters 5 and 6 will deal solely with the costs and benefits of implementing these systems in student housing.

3.2 Notification

The notification of occupants during a fire situation is critical to the survival of those occupants. If left unaware of the pending dangers, students may easily succumb to rapidly spreading smoke and heat. There are a variety of notification systems that can be used in student housing. The two types of notification devices that will be discussed in this chapter are smoke detectors and fire-alarm systems.

3.2.1 Smoke Detectors

Smoke detectors work by detecting the airborne products that are produced during a fire. These products are associated directly with the smoke that comes from fire combustion. The products flow into the detector when the smoke rises in the room and into the detecting chamber. There are several technologically different detection methods that all rely on the same principle. All detection methods have some sort of stream (either light or electricity) that is affected by the airborne particles found in the smoke. Once the stream is affected, an attached alarm sounds. The most common detector found in residential applications is the ionization smoke detector. According to Fitzgerald[36], the ionization smoke detector works because:

> An ionization smoke detector has an effective electrical conductance between two charged electrodes in the sensing chamber. The air between these electrodes has been made conductive by the ionization of the air in the chamber by a small amount of radioactive material. When smoke particles enter the sensing chamber, the normal current flow due to the ion migration is reduced. This decrease in current flow is sensed by the electronics of the detector and actuation occurs.

Battery or AC current can power this type of detector.

Another detector suitable for use in student housing is the photoelectric smoke detector. This type of detector utilizes a beam of light that is transmitted across the detection chamber from a transmitting source to a receiving source. If smoke enters the chamber and disturbs the light beam, the receiver detects the change and transmits a signal to the detector, which sets off the attached alarm.

Photoelectric smoke detectors are a newer technology than ionization detectors and are more resistant to false alarms. Another benefit of the photoelectric smoke detector is that it can be equipped with a LED that signals whether the detector is operating properly or not.[37] These types of detectors can be AC or battery operated.

One benefit of the AC or "hard-wired" smoke detector is that there is a much lower chance for human error. When using battery-powered detectors, people may neglect to perform the required maintenance and perhaps even utilize the batteries for other operations. The hard-wired system costs approximately $100 to $150 per detector. The control panel associated with these systems usually costs a few thousand dollars (depends on the manufacturer and size of the system). "Including installation and control panel costs, a total cost of approximately $300 per detector is sometimes used for estimating purposes.[38]" The cost of implementing an effective detection system in student housing is a worthwhile expense to consider. The loss of life far outweighs any cost incurred by installing these systems.

Smoke detector placement should be in every room and common area. Room alarms should be single station alarms that only sound the alarm that is affected. Common area smoke detectors should be multiple station alarms that sound off alarms in the entire building. This is effective in notification in fires that may occur in large open areas, which typically promulgate faster than room fires.

3.2.2 Alarm systems

Alarm systems are a primary source of occupant notification used today. The alarm system can be a manual, monitored, or combined system. The manual system relies on human intervention to actuate the alarm system by pulling an alarm center box. This transmits a signal, which sets off a distressing alarm throughout the residence.

The monitored system involves an outside agency, which monitors the detection and suppression systems status and sets off the alarm system when there is a change in the status signifying a fire. This type of system typically notifies the fire department, allowing for a faster arrival time by fire departments. This is crucial to improving fire safety because, according to a fire inspector, "A fire can double in size every 10 seconds[39]."

A combination system has the manual pull stations and a monitored system. This system is excellent for the notification of occupants since it allows the occupants to pull the alarm box at the start of a fire before a detection system may pick up the signals that there is a fire.

The technology of fire alarm systems has greatly increased in the past years. New alarm systems can pinpoint the location of a detector transmitting an alarm. Fire alarm systems are an essential element of a fire safety system. However, "many fires develop too fast for effective suppression by the fire department before they become hazardous, even with prompt detection and notification. In these cases, automatic fire suppression is desirable.[40]" Alarm notification systems alone are an important element in alerting occupants of imminent danger but, without sprinkler systems, do not provide the highest level of fire safety and loss prevention.

3.3 Prevention Methods

Fire prevention attempts to prevent the situations that may lead to fires. In student housing, prevention efforts should be aimed at reducing the most common ignition factors. The prevention methods should also address limiting the potential fuels that can be present in student housing.

The most effective manner to administer a good prevention program is through periodic inspection of student housing. In the case of dormitories, Resident Advisors can be taught to identify typical ignition sources and fuel sources in student rooms. The RA should also be empowered to correct safety problems in student rooms in order to prevent disaster. In this case, the safety of the entire student group should be considered a priority over the individual's privacy.

In fraternities and sororities, a licensing commission typically is empowered to conduct safety inspections in these residences. The inspections should be conducted more frequently than the required yearly inspection to ensure that these residences (which are self-governing) consistently meet all safety regulations as prescribed by the licensing authority.

Another factor in prevention that should be considered is limiting highly flammable furniture in student housing. One of the primary causes of fire and smoke growth has been highly combustible furniture. In student housing, furniture should be required to be fire resistant. The same is true for draperies, curtains, rugs and wall finishes. When purchasing new furniture for student housing, every effort should be made to find the most fire resistant furniture available. The implementation of these measures would ensure a slower fire growth, thus allowing more time for evacuation and suppression.

3.4 Awareness

Fire awareness techniques in student housing must focus on two areas: fire prevention training and fire response training. Fire prevention training should educate students about the most common factors involved with the ignition and promulgation of fires in student housing. "Students should be trained to recognize potentially hazardous situations, such as smoking in bed, careless use of candles and cooking, use of excessive flammable decoration, poor housekeeping practices and blockage of exit paths.[41]"

Fire response training should give the residents a clear understanding of the seriousness of fire as well as proper evacuation procedures. Occupants must be aware of the locations of all fire exits, the proper way to open doors during a fire, and how to stay low to the ground to avoid smoke. Residents should also be made aware of the importance of fire safety and fire safety features in their buildings. This will allow for easier detection of problems with fire safety systems by the residents.

Currently the NFPA has several resources available for use in student housing training including a video entitled "Get Out - Stay Out." There are also a variety of fire awareness programs available through the USFA that can be found at the following website: www.usfa.fema.gov

Student awareness can be implemented quite easily. New student orientation should be designed to include an awareness program that highlights all of the areas that have been discussed. A follow-up program should be implemented after the return from the fall semester, and may be run by the RA or house president.

3.5 Summary

When considering how to implement improvements to fire safety in student housing, there are several factors that should be considered. The first factor is the prevention of possible ignition, the second is the notification of residents during a fire, the third is the awareness of students about fire safety (to include evacuation procedures), the final factor is fire suppression by an automatic sprinkler system. Every effort should be made to implement a plan including these factors.

4.0 Statistical Analysis of Automatic Sprinkler System Installations

This chapter will address the issues of implementing an automatic sprinkler system. The first section will describe NFIRS in detail, the second section will use NFIRS data to prove the importance of implementing these systems financially. Showing the difference in loss associated with sprinklered verses non-sprinklered housings is how this chapter will prove the importance of these systems.

4.1 NFIRS

Each fire in the United States represents a challenge to those in the fire protection industry. The National Fire Incident Reporting System is a tool for those in the industry to collect and analyze important data about each fire. Currently there are approximately 16,000 fire departments in the United States submitting information to the NFIRS database. Data is transmitted using a standard form that the participating departments fill out for each fire. The department submits each form to an office, which is responsible for the submission of data to one of the NFIRS databases. One of the NFIRS databases is located at

Worcester Polytechnic Institute. This database enables access to crucial data about fires from 1984 thru 1998.

The form that every participating Fire Department fills out is an Incident Reporting Form (Appendix A). Each line and question has a set of possible answers, which in turn can be coded. The end result is a 144 character string telling the complete tale of the fire. Each number or letter in the string represents a characteristic about the fire. Table 4-1 gives the full list of what each column in a string means.

Currently, approximately 65% of all fires in the United States are reported through NFIRS. This extensive database is an excellent source for analyzing data about fires in the United States. Sources of possible error in reporting may come from forms filled out improperly or electronic errors during information transfers. Participating fire departments submit roughly 1,000,000 fire sheets annually.

Table 4.1 Table describing each column in a NFIRS string

Definition of String	Value in Column	Definition of String	Value in Column
Fire Dept. Identification	2 thru 6	Mobile Property Use	86 thru 87
Incident Number	7 thru 12	Area of Fire Origin	88 thru 89
Exposure Number	13 thru 14	Level of Origin	90
Filler	15 thru 17	Stories	91
Record Type	18 thru 19	Equipment in Ignition	92 thru 93
Filler	20	Form of heat	94 thru 95
Date	21 thru 27	Material ignited first TYPE	96 thru 97

Alarm Time	28 thru 31	Material ignited first FORM	98 thru 99
Time in Service	32 thru 35	Ignition Factor	100 thru 101
Area Zip Code	36 thru 40	Filler	102
Census Tract	41 thru 46	Type of Construction	103
Method of Alarm	47	Filler	104
Situation Found on Arrival	48 thru 49	Extent of Flame Damage	105
Action Taken	50	Extent of Smoke Damage	106
District	51 thru 53	Form of Material Generating Smoke	107 thru 108
Shift on duty	54	**DETECTORS**	109
Number of Alarms Transmitted	55	**SPRINKLERS**	110
Filler	56	Arrival Time	111 thru 114
Number of Personnel Responding	57 thru 59	Type of Material Generating Smoke	115 thru 116
Number of Pumpers Responding	60 thru 62	Avenue of Smoke Travel	117
Number of Arials Responding	63 thru 65	Method of Extinguishment	118
Other Vehicles Responding	66 thru 68	Estimate of Dollar Loss	119 thru 127
# of Fire Service Injuries	69 thru 71	Property Damage Classification	128
# of Civilian Injuries	72 thru 74	Filler	129 thru 134
# of Fatalities (Fire Service)	75 thru 77	Occupancy	135
# of Fatalities (Civilian)	78 thru 80	Occupancy coding	136 thru 137
Multi-use Property operated	81 thru 82	Gas/Liquid	138
Fixed Property Use	83 thru 85	Priority/Cause Grouping code	139 thru 140
Mobile Property Use	86 thru 87	Priority/Cause Code	141 thru 142
Area of Fire Origin	88 thru 89	State	143 thru 144

4.2 NFIRS Analyzed for This Report

For the purpose of this report, the data analyzed is comprised of all fires from 1984 through 1998. Since this represents approximately 14,000,000 fires and analyzing this amount of raw data would prove a difficult task, a search program was used to sort through the data for all fires occurring in college housing.

This was accomplished using an MS-DOS written program, which searched through each year and outputted all strings matching values of 164 and 165 for columns 83 through 85.

Columns 83 through 85 are defined as fixed property uses. Values 164 and 165 represent school, college, university, dormitory or fraternity, sorority house. The output consisted of data comprised exclusively of fires in school dormitories and fraternity and sorority houses.

The first step in analyzing the data was to import the raw data from the MS-DOS format to a Microsoft Word Pad then import the data to Microsoft Excel. Once this was accomplished, each value was sorted by column and given a heading under which the values below would be categorized. The next step was to compress each year into one data field which was accomplished by cutting and pasting together the consecutive years until the result was one comprehensive listing. Once this was accomplished it was found that from the years 1984 through 1998 there were 13,888 fire incidents reported with the values 461 or 462 in the columns 83-85. This means that there were 13,888 incidents in the United States from 1984-1998 occurring in residences classified as student housing. Of these, 10,124 were classified as "structure fires" by designating a value of 11 in the "situation" column. It was these incidents that were analyzed for this report.

4.2.1 Student Housing Structure Fire Data Analyzed

The data was analyzed in several areas of interest. A comparison was made between fires with automatic sprinkler systems and fires without sprinkler systems. In order to accomplish such a task, data was sorted according to the category "Sprinklers" (Column 110) in descending order from 0 to 9. Figure 4-1 shows the figures used by NFIRS and the corresponding value for each figure.

0 Performance of automatic sprinklers undetermined or not reported.
1 Equipment operated.
2 Equipment should have operated but did not.
3 Equipment present but fire too small to require operation.
4 UNUSED
5 UNUSED
6 UNUSED
7 UNUSED
8 No equipment present in room or space of fire origin.
9 Performance of automatic sprinklers not classified above.

Figure 4.1 Values corresponding to Sprinkler Classifications

Using Excel, all strings corresponding to values 1-3 were pasted on a separate worksheet. The same was done for the strings with the values of 8. Now there were two separate data spreadsheets of data, the first one contained fires occurring in student housings with sprinklers, the second one containing fires occurring in student housings without sprinklers.

This data made it possible to calculate the mean, median, mode, trimmed mean, mean absolute deviation, and quartiles for the dollar values associated with each separate data field. Table 4-2 summarizes the findings.

Table 4.2 Data analyzed-Dollar loss associated with Sprinklered/Non-Sprinklered Residences

	Average Dollar Cost	Trimmed Average Dollar Cost	Median	Mode	Mean Absolute Deviation
With Sprinklers	$3473	$890	$25	$0	$6073
Without Sprinklers	$6081	$3189	$75	$0	$10507

Table 4-2 demonstrates a definite decrease in dollar loss in buildings equipped with sprinklers. The average dollar loss in a sprinklered building was $3473, while the average dollar loss in an unsprinklered building was $6081, a difference of $2608 during an average fire.

The most interesting statistic is the mean absolute deviation. This statistic shows the average deviance from the mean in each data set. For sprinklered buildings, it is much more likely to be close to the mean than a building that is not sprinklered. The mean absolute deviation for an unsprinklered building was $10507, meaning that there is a great amount of variance in the data set, as compared with $6073 in sprinklered buildings. This is very important because it shows that, although the average fire loss difference between sprinklered and non-sprinklered buildings is only $2608, there is a greater probability for higher loss fires in unsprinklered buildings.

It was also possible using information from column 128, (property damage classification) to construct histograms of the two separate data fields. Figure 4-2 shows the values corresponding to the figures in column 128.

```
0 'Classification not reported, or undetermined'
1 '$1 - $99'
2 '$100 - $999'
3 '$1,000 - $9,999'
4 '$10,000 - $24,999'
5 '$25,000 - $49,999'
6 '$50,000 - $249,999'
7 '$250,000 - $999,999'
8 '$1,000,000 +'
9 'No dollar loss'
```

Figure 4.2 Values corresponding to Property Damage Classification

Figures 4.3-4.5 are three histograms representing the Property Damage Classifications. These three histograms exemplify a marked decrease in the dollar loss for fires in buildings equipped with sprinklers. The histogram shifts to the left slightly from Figure 4.4 to Figure 4.5, signifying a decrease in dollar loss. Also noticeable are the larger numbers of fires that have high dollar loss in unsprinklered buildings. In Figure 4.5 classifications 6, 7, 8, and 9 all represent loss of 25,000 or more. In unsprinklered buildings, fires resulting in dollar loss of $25,000 or more account for 5.96% of the fires. In sprinklered buildings, these classifications combined account for only 3.26% of the fires. This supports the argument that fires resulting in high dollar loss are more likely to occur in unsprinklered buildings.

5.0 Costs and Benefits Associated with Sprinkler Systems

5.1 Costs of Sprinkler System Installations

This section provides information for the cost of installing automatic sprinkler systems in various student housings. The cost data is per square foot and must be multiplied by the area to obtain the total cost for a building.

Initially, one can group student housing into five categories. Representing the five major types of student housing. These categories will be used to describe average costs for each type of student housing.

The first type of student housing is a single-family dwelling. This is generally rented to students on a floor-to-floor basis similar to apartments. The second type of student housing is an apartment-style dormitory. These dormitories are generally one to two stories high and each unit is a separate entity with multiple residents. The units are generally grouped together into a large complex with each unit adjoining another unit. The third type of student housing is a large house or duplex structure. This is the basis for most fraternity/sorority houses as well as many smaller, community oriented dormitories. The fourth type of student housing is the classic dormitory hall, which may have up to four floors of occupants and single rooms or suites branching off of main hallways. The final type of classification used in this cost analysis is the high-rise dormitory. Any dormitory building with five more floors of living space is considered a high-rise dormitory for this cost analysis.

5.1.1 Process for determining an average price

Several steps were followed to determine average prices for automatic sprinkler systems for each of the previously cited classifications. The first step involved contacting sprinkler companies directly. Five companies from varying parts of the United States were contacted and asked to give pricing estimates (see Additional Sources). The five types of buildings were identified and each company was asked to give an estimate based upon what they considered to be an average installation for each building type.

Secondly, the NFPA and NFSA were contacted to find additional estimates and/or guidelines. The NFSA has an index based upon commercial or residential properties and the NFPA gave statistical based estimates.

5.1.2 Cost Analysis Data

Each classification has been assigned an average price for new construction installation and retrofit installation. The high and low-end estimates have also been included so that the range of values is apparent. All values were rounded to the nearest cent.

Table 5.1: Single-family house

	Average price	Low end estimate	High end estimate	
New construction	0.97 ($/sq. foot)	0.80 ($/sq. foot)	1.20 ($/sq. foot)	
Retrofit Installation	2.72 ($/sq. foot)	2.25 ($/sq. foot)	3.75 ($/sq. foot)	

Note: The prices for single family homes have been dropping rapidly, especially in the retrofit area due to the increased demand.

Table 5.2: Apartment style dormitories

	Average price	Low end estimate	High end estimate
New construction	1.01 ($/sq. foot)	0.85 ($/sq. foot)	1.25($/sq. foot)
Retrofit installation	2.23 ($/sq. foot)	1.75 ($/sq. foot)	3.50($/sq. foot)

Table 5.3: Large house/ Duplex

	Average price	Low end estimate	High end estimate
New construction	.94 ($/sq. foot)	0.80 ($/sq. foot)	1.25($/sq. foot)
Retrofit installation	2.45 ($/sq. foot)	2.00 ($/sq. foot)	3.00($/sq. foot)

Table 5.4: Classic dormitory hall

	Average price	Low end estimate	High end estimate
New construction	1.14 ($/sq. foot)	0.95 ($/sq. foot)	1.40 ($/sq. foot)
Retrofit installation	1.86 ($/sq. foot)	1.45 ($/sq. foot)	2.80 ($/sq. foot)

Table 5.5: High Rise Dormitory

	Average price	Low end estimate	High end estimate
New construction	1.29 ($/sq. foot)	1.00 ($/sq. foot)	1.75($/sq. foot)
Retrofit installation	2.43 ($/sq. foot)	2.00 ($/sq. foot)	3.25 ($/sq. foot)

These tables display the different costs for the installation of automatic sprinkler systems. Costs run higher for the retrofitting of sprinkler systems because the labor required for these systems is much more involved. The highest retrofitting price is that for a standard one family house. The need for retrofitting is increasing, and costs are dropping as the demand increases. This is especially true in single-family homes.

5.2 Benefits Associated with Sprinkler Systems

There are six ways in which automatic sprinkler systems can be an excellent investment for building owners. The information in this section is based on a report by Kenneth Isman, Director of Engineering Standards, National Fire Sprinkler Association, Inc. Mr. Isman's report is included in Appendix B for reference.

Mr. Isman's report identifies the following ways in which sprinklers "put money in the pocket of the building owner." They are:

- Insurance Savings
- Income Tax Deductions
- Life Safety Code Compliance
- Federal Legislation
- Liability Avoidance
- Business Interruption

This report provides detailed examples of several building types. Though every type does not apply to student housing, the office building and condominium are most applicable since they are the closest in size (office building) and resident space (condominium).

This report shows that sprinkler systems are not only effective in saving the lives of students, they also can be considered an investment that can produce positive returns over time. In the case of an office building, the payback time was approximated at 25 years. After this time, the owner will make money for an additional 16 years. In the case of the condominium, the approximated payback time was estimated to be 10 years. The building owner would make money on the investment for 40 more years. These cases demonstrate that automatic sprinkler systems can make money for building owners, in time essentially paying for themselves.

6.0 Analysis and Conclusions

This report has identified the fire risks associated with student housing. The dangers present in student housing can be separated into two categories: dangers that lead to fires (ignition sources) and dangers that surface after fires have begun.

Dangers that lead to fires in student housing are:

- Incindiarism
- Cooking
- Electrical systems
- Smoking materials
- Appliances
- Candles and incense

In student housing, preventing ignition sources has proven to be a difficult task because many residents and advisors are unable to identify and prevent ignition sources. Inspection and awareness are effective only so long as residents assume the responsibility that is required of them. It is unlikely that the identified ignition sources will be completely eliminated from student housings because many students do not consider fire safety a paramount concern. The fact that prevention and awareness are not entirely effective must be considered when determining the objectives of fire safe student housing.

Dangers that surface after fires have begun are:

- Building construction variables
    - Open stairways
    - Dead end hallways
    - Improper fire escape routes
    - Fire resistant materials not used in building construction
- Highly flammable room contents
- Missing smoke detectors and alarm systems
- Indifference to detectors and alarm systems
- No automatic sprinkler systems

All of these dangers have led to student deaths in the past. The prevention of these dangers is achieved through the use of properly implemented fire escape routes, properly installed detectors and alarm systems, and by limiting the amount of flammable room contents. Limiting the amount of flammable room contents is not a valid possibility, however, since the availability and cost of fire-resistant materials prevent many college administrations from purchasing and using them. Likewise, in fraternities and sororities operating on a much smaller budget, this goal is nearly impossible.

The real tragedy of fatal fires in student housing is that they need not result in fatalities. Fire situations present a myriad of problems that require multi-faceted measures in order to ensure optimal safety. Prevention measures are only half of the equation. When the prevention measures no longer apply, (i.e. when a fire has started), the next phase of safety is detection and alarm. When implementing detection systems, every effort should be made to use a monitored service that can protect the safety of residents around the clock. Alarm systems should also be monitored to provide a level of protection that will ensure proper evacuation and prompt response from fire service personnel.

Because of the complexities of prevention and detection, the most effective manner of preventing fire loss is the automatic sprinkler system. The automatic sprinkler system has an impeccable record of effectiveness. There has never been a fire with multiple fatalities where properly working sprinkler systems were installed.[42] The US Congress is currently proposing legislation that will make automatic sprinkler systems mandatory in all dormitories, fraternity, and sorority houses. Also included in these legislations are recommendations to appropriate funds to assist in the installation of the automatic sprinkler systems.

It cannot be stressed enough that fire is a real danger in student housing. The costs associated with implementing automatic sprinkler systems are outweighed by the six benefits outlined in chapter 5. More importantly, sprinkler systems have been proven to be the best protection against fire fatalities. Because of these benefits, it is recommended that all student housings be equipped with complete sprinkler systems in order to prevent the loss of lives and property. Many institutions have never experienced fire, but the possibility for disaster is always present. Every attempt should be made to provide students with a safe environment to live in while attending institutions of higher learning.

Notes

[1] A Back to School Special Report on the Baby Boom Echo, No End in Sight. August 19, 1999 U.S. Department of Education www.ed.gov/pubs.html.

[2] College Fire Safety Forum. September 24, 1999, NFPA/USFA College Fire Safety Forum

[3] Fire Safe Student Housing. Feb 1, 1999, United States Fire Administration (Page 2)

[4] Fraternity House Fire: Chapel Hill, NC. 1997, NFPA, Prepared by, Michael Isner

[5] Fire Investigation Report: Fraternity House Fire, Berkeley, CA. 1990, NFPA, Prepared by, Michael Isner

[6] Fire Safe Student Housing. (Page 6)

[7] College Fire Safety Forum. (Page 3)

[8] Fire Safe Student Housing. (Page 43)

[9] Special Data Information Package: Dormitories and Fraternity and Sorority Houses. 1995, NFPA Fire Analysis and Research Division, Quincy, MA 02269 (Page 51)

[10] Ibid (53)

[11] College Fire Safety Forum. (Page 3)

[12] ibid (Page 46)

[13] Fire Safe Student Housing. (Page 11)

[14] ibid (Page 12)

[15] Special Data Information Package.

[16] Fire Investigation Report: Fraternity House Fire, Berkeley, CA.

[17] Fraternity House Fire: Chapel Hill, NC.

[18] Fire Safe Student Housing.

[19] http://www.campus-firewatch.com/documents/CFWNewsletter%20May.pdf, (Pages 6-12)

[20] Fire Safe Student Housing. (Page 38)

[21] Fraternity House Fire.

[22] Special Data Information Package.

[23] Paragraph 5-1.3.1 of the Life Safety Code[23] Chapter 5, NFPA

[24] Fraternity House Fire. (Page 3)

[25] Fire Investigation Report. (Page 2)

[26] ibid. (Page 33)

[27] Fire Safe Student Housing. (Page 31)

[28] Fire Safe Student Housing. (Page 8)

[29] http://www.campus-firewatch.com/documents/CFWNewsletter%20May.pdf, (Pages 6-12)

[30] The Anatomy of Building Firesafety. 1999, Robert Fitzgerald, Worcester, MA 01609 (Page 5.1)

[31] www.firesprinkler.org

[32] Fire Safe Student Housing. (Page 19)

[33] The Anatomy of Building Firesafety (Page 5.2)

[34] N.F.P.A. Standard 13

[35] Fire Safe Student Housing (Page 19)

[36] The Anatomy of Building Firesafety (Page 6.3)

[37] http://www.cerbpyro.com/detconv.html

[38] Fire Safe Student Housing. (Page 18)

[39] Conversation with Worcester Fire Inspector Joseph Scampini, April 2000, Worcester Fire Department, Worcester MA 01609

[40] ibid.

[41] ibid. (Page 14)

[42] www.firesprinkler.org

Appendix A – Sample NFIRS form used by Fire Departments across the country

NIRS 4.0 INCIDENT REPORT

NFIRS 1

FILL IN THIS REPORT
IN YOUR OWN WORDS

North Thompsonville Fire Dist.

1 DELETE
2 CHANGE

FDID	INCIDENT NO	EXP	DATE	DAY OF WEEK	ALARM TIME	ARRIVAL TIME	TIME IN SERVICE
?2113	000290	00	05/05/2000	6-Friday	16:08		

TYPE OF SITUATION FOUND	TYPE OF ACTION TAKEN	MUTUAL AID 1 REC'D 2 GIVEN

FIXED PROPERTY USE	IGNITION FACTOR

CORRECT ADDRESS	ZIP CODE	CENSUS TRACT
	06082	

OCCUPANT NAME (LAST, FIRST, MI)	TELEPHONE	ROOM OR APT.
,		

OWNER NAME (LAST, FIRST, MI)	ADDRESS	TELEPHONE
,	,	

METHOD OF ALARM FROM PUBLIC	DISTRICT	SHIFT	NO. OF ALARMS

NUMBER OF FIRE PERSONNEL RESPONDED	NUMBER OF ENGINES RESPONDED	NUMBER OF AERIAL APPARATUS RESPONDED	NUMBER OF OTHER VEHICLES RESPONDED

NUMBER OF INJURIES FIRE SERVICE	OTHER	NUMBER OF FATALITIES FIRE SERVICE	OTHER

COMPLEX	MOBILE PROPERTY TYPE

AREA OF FIRE ORIGIN	EQUIPMENT INVOLVED IN IGNITION

FORM OF HEAT OF IGNITION	TYPE OF MATERIAL IGNITED	FORM OF MATERIAL IGNITED

METHOD OF EXTINGUISHMENT	LEVEL OF FIRE ORIGIN	ESTIMATED LOSS (DOLLARS ONLY)
		0

NUMBER OF STORIES	CONSTRUCTION TYPE
EXTENT OF FLAME DAMAGE	**EXTENT OF SMOKE DAMAGE**
DETECTOR PERFORMANCE	**SPRINKLER PERFORMANCE**

IF SMOKE SPREAD BEYOND ROOM OF ORIGIN	TYPE OF MATERIAL GENERATING MOST SMOKE	AVENUE OF SMOKE TRAVEL
	FORM OF MATERIAL GENERATING MOST SMOKE	

	YEAR	MAKE	MODEL	SERIAL NO.	LICENSE NO.
IF MOBILE PROPERTY					
IF EQUIPMENT INVOLVED IN IGNITION					

OFF IN CHARGE (NAME, POSITION, ASSIGNMENT)	DATE
MEMBER MAKING REPORT (IF DIFFERENT FROM ABOVE)	**DATE**

Appendix B –"Fire Sprinklers Save Lives and Money… The Economics of Retrofit" by Kenneth Isman, P.E.

Appendix C – Proposed Legislation

Federal Legislation

College Fire Prevention Act (Introduced in the Senate)

S 2100 IS

106th CONGRESS

2d Session

S. 2100

To provide for fire sprinkler systems in public and private college and university housing and dormitories, including fraternity and sorority housing and dormitories.

IN THE SENATE OF THE UNITED STATES

February 24, 2000

Mr. EDWARDS (for himself, Mr. LAUTENBERG, and Mr. TORRICELLI) introduced the following bill; which was read twice and referred to the Committee on Health, Education, Labor and Pensions

---

A BILL

To provide for fire sprinkler systems in public and private college and university housing and dormitories, including fraternity and sorority housing and dormitories.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `College Fire Prevention Act'.

SEC 2. FINDINGS.

Congress makes the following findings:

(1) On Wednesday, January 19, 2000, a fire occurred at a Seton Hall University dormitory . Three male freshmen, all 18 years of age, died. Fifty-four students, 2 South Orange firefighters, and 2 South Orange police officers were injured. The dormitory was a 6-story, 350-room structure built in 1952, that housed approximately 600 students. It was equipped with smoke alarms but no fire sprinkler system.

(2) On Mother's Day 1996 in Chapel Hill, North Carolina, a fire in the Phi Gamma Delta Fraternity House killed 5 college juniors and injured 3. The 3-story plus basement fraternity house was 70 years old. The National Fire Protection Association identified several factors that contributed to the tragic fire, including the lack of fire sprinkler protection.
(3) It is estimated that in a typical year between 1980 and 1997, there were an average of 1,800 fires at dormitories, fraternities, and sororities, involving 1 death, 69 injuries, and $8,100,000 in property damage.
(4) Within dormitories the number 1 cause of fires is arson or suspected arson. The second leading cause of college building fires is cooking, while the third leading cause is smoking.
(5) The National Fire Protection Association has no record of a fire killing more than 2 people in a completely fire sprinklered public assembly, educational, institutional or residential building where the sprinkler system was operating properly.
(6) New dormitories are generally required to have advanced safety systems such as fire sprinklers. But such requirements are rarely imposed retroactively on existing buildings.
(7) In 1997, over 90 percent of the campus building fires reported to fire departments occurred in buildings where there were smoke alarms present. However, only 28 percent had fire sprinklers present.

SEC. 3. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to carry out this Act $100,000,000 for each of th fiscal years 2001 through 2005.

SEC. 4. GRANTS AUTHORIZED.

(a) PROGRAM AUTHORITY- The Secretary of Education, in consultation with the United States Fire Administration, is authorized to award grants, on a competitive basis, to States, private or public colleges or universities, fraternities, or sororities to assist them in providing fire sprinkler systems for their student housing and dormitories.

(b) MATCHING FUNDS REQUIREMENT- The Secretary of Education may not award a grant under this section unless the entity receiving the grant provides, from State, local, or private sources, matching funds in an amount equal to not less than one-half of the cost of the activities for which assistance is sought.

SEC. 5. PROGRAM REQUIREMENTS.

(a) AWARD BASIS- In awarding grants under this Act the Secretary of Education shall take into consideration various fire safety factors and conditions that the Secretary determines appropriate.

(b) LIMITATION ON ADMINISTRATIVE EXPENSES- An entity that receives a grant under this Act shall not use more than 4 percent of the grant funds for administrative expenses.

SEC. 6. DATA AND REPORT.

The Comptroller General shall--

(1) gather data on the number of college and university housing facilities and dormitories that have and do not have fire sprinkler systems and other forms of built-in fire protection mechanisms; and

(2) report such data to Congress.

Federal Legislation

Fire Safe Dorm Act of 2000 (Introduced in the Senate)

S 2178 IS

106th CONGRESS

2d Session

S. 2178

To amend the Higher Education Act of 1965 to require colleges and universities to disclose to students and their parents the incidents of fires in dormitories, and their plans to reduce fire safety hazards in dormitories, to require the United States Fire Administration to establish fire safety standards for dormitories, and for other purposes.

IN THE SENATE OF THE UNITED STATES

March 2, 2000

Mr. LAUTENBERG introduced the following bill; which was read twice and referred to the Committee on Health, Education, Labor, and Pensions

---

A BILL

To amend the Higher Education Act of 1965 to require colleges and universities to disclose to students and their parents the incidents of fires in dormitories, and their plans to reduce fire safety hazards in dormitories, to require the United States Fire Administration to establish fire safety standards for dormitories, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Fire Safe Dorm Act of 2000'.

TITLE I--OBLIGATIONS OF INSTITUTIONS OF HIGHER EDUCATION

SEC. 101. IMPROVED DISCLOSURE OF FIRES AND FIRE PREVENTION MEASURES IN COLLEGE DORMITORIES.

Section 485(f) of the Higher Education Act of 1965 (20 U.S.C. 1092(f)) is amended--

(1) in paragraph (1), by adding at the end the following new subparagraphs:
`(I) Statistics concerning the occurrence of fires and fire alarms in dormitories on campus during the most recent calendar year, and during the 5 preceding calenda years for which data are available.
`(J) A statement describing whether the institutions' dormitory rooms currently have sprinklers, smoke detectors, and furniture made of flame retardant material.'
(2) in paragraph (4), by adding at the end the following new subparagraph:
`(C) Each institution participating in any program under this title shall make, keep, and maintain a daily log, written in a form that can be easily understood, recording all fires reported to local fire departments, including the nature, date, time, and general location c each fire. Such logs shall be open to public inspection.'; and
(3) in paragraph (5)--
(A) in the matter preceding subparagraph (A), by inserting `or paragraph (1) (I)' after `paragraph (1)(F)'; and
(B) in subparagraph (C), by inserting `and campus fires' after `campus crime

SEC. 102. DISCLOSURE OF PLANS TO BRING RESIDENTIAL FACILITIES INTO COMPLIANCE WITH NEW BUILDING CODES.

Section 485(a)(1) of the Higher Education Act of 1965 (20 U.S.C. 1092) is amended--
(1) by striking `and' at the end of subparagraph (N);
(2) by striking the period at the end of subparagraph (O) and inserting `; and'; and
(3) by adding at the end the following new subparagraph:
`(P) a summary of the specific plans that the institution has adopted for constructio or renovation to ensure that all campus residential facilities comply, by January 1, 2010, with the standards established by the Administrator of the United States Fire Administration under section 201 of the Fire Safe Dorm Act of 2000.'.

SEC. 103. COMPLIANCE WITH FIRE SAFETY STANDARDS FOR DORMITORIES.

Section 487(a) of the Higher Education Act of 1965 (20 U.S.C. 1094(a)) is amended by adding at the end the following new paragraph:
`(24) The institution will adopt, within 10 years after the date of enactment of the Fire Safe Dorm Act of 2000, plans to install sprinklers, smoke detectors, and open flame resistant furniture in dormitories in compliance with the standards establishe by the Administrator of the United States Fire Administration under section 201 of such Act.'.

SEC. 104. EXEMPTION.

The amendments made by this title shall not be construed to require the installation of sprinklers in any building or other structure that is listed on the National Register for Historic Places as maintained by the National Park Service under the authority of the National Historic Preservation Act (16 U.S.C. 470 et seq.), if such installation would destroy historic materials, features, and spatial relationships that characterize the historic nature of the property. The Secretary of Education shall determine disputes concerning the application of this exemption by reference of the matter to the Secretary of the Interioı

TITLE II--DORMITORY FIRE SAFETY STANDARDS

SEC. 201. STANDARDS.

(a) ESTABLISHMENT- Not later than 6 months after the date of the enactment of this Ac the Administrator of the United States Fire Administration shall establish measurable standards for dormitory fire safety. Such standards shall include mandatory fire sprinklers, smoke detectors, and open flame resistant furniture and mattresses.

(b) OUTREACH- The Administrator of the United States Fire Administration shall undertake appropriate activities to encourage the adoption by State and local authorities of the standards established under subsection (a).

Federal Legislation

Fire Safe Dorm Act of 2000 (Introduced in the House)

HR 3831 IH

106th CONGRESS

2d Session

H. R. 3831

To amend the Higher Education Act of 1965 to require colleges and universities to disclose to students and their parents the incidents of fires in dormitories, and their plans to reduce fire safety hazards in dormitories, to require the United States Fire Administration to establish fire safety standards for dormitories, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

March 2, 2000

Mrs. MALONEY of New York (for herself and Mr. HOLT) introduced the following bill; which was referred to the Committee on Education and the Workforce, and in addition to the Committee on Science, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned

---

A BILL

To amend the Higher Education Act of 1965 to require colleges and universities to disclose to students and their parents the incidents of fires in dormitories, and their plans to reduce fire safety hazards in dormitories, to require the United States Fire Administration to establish fire safety standards for dormitories, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Fire Safe Dorm Act of 2000'.

TITLE I--OBLIGATIONS OF INSTITUTIONS OF HIGHER EDUCATION

SEC. 101. IMPROVED DISCLOSURE OF FIRES AND FIRE PREVENTION MEASURES IN COLLEGE DORMITORIES.

Section 485(f) of the Higher Education Act of 1965 (20 U.S.C. 1092(f)) is amended--

(1) in paragraph (1), by adding at the end the following new subparagraphs:

`(I) Statistics concerning the occurrence of fires and fire alarms in dormitories on campus during the most recent calendar year, and during the 5 preceding calenda years for which data are available.

`(J) A statement describing whether the institutions' dormitory rooms currently hav sprinklers, smoke detectors, and furniture made of flame retardant material.';

(2) in paragraph (4), by adding at the end the following new subparagraph:

`(C) Each institution participating in any program under this title shall make, keep, and maintain a daily log, written in a form that can be easily understood, recording all fires reported to local fire departments, including the nature, date, time, and general location c each fire. Such logs shall be open to public inspection.'; and

(3) in paragraph (5)--

(A) by inserting `or paragraph (1)(I)' after `paragraph (1)(F)'; and

(B) by inserting `and campus fires' after `campus crime'.

SEC. 102. DISCLOSURE OF PLANS TO BRING RESIDENTIAL FACILITIES INTO COMPLIANCE WITH NEW BUILDING CODES.

Section 485(a)(1) of the Higher Education Act of 1965 (20 U.S.C. 1092) is amended--

(1) by striking `and' at the end of subparagraph (N);

(2) by striking the period at the end of subparagraph (O) and inserting `; and'; and

(3) by adding at the end the following new subparagraph:

`(P) a summary of the specific plans that the institution has adopted for constructio or renovation to ensure that all campus residential facilities comply, by January 1, 2010, with the standards established by the Administrator of the United States Fire Administration under section 201 of the Fire Safe Dorm Act of 2000.'.

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SEC. 104. EXEMPTION.

The amendments made by this title shall not be construed to require the installation of sprinklers in any building or other structure that is listed on the National Register for

Historic Places as maintained by the National Park Service under the authority of the National Preservation Act of 1966 (P.L. 89-665), if such installation would destroy histori materials, features, and spatial relationships that characterize the historic nature of the property. The Secretary of Education shall determine disputes concerning the applicatioi of this exemption by reference of the matter to the Secretary of the Interior.

TITLE II--DORMITORY FIRE SAFETY STANDARDS

SEC. 201. STANDARDS.

(a) ESTABLISHMENT- Not later than 6 months after the date of the enactment of this Ac the Administrator of the United States Fire Administration shall establish measurable standards for dormitory fire safety. Such standards shall include mandatory fire sprinklers, smoke detectors, and open flame resistant furniture and mattresses.

(b) OUTREACH- The Administrator of the United States Fire Administration shall undertake appropriate activities to encourage the adoption by State and local authorities of the standards established under subsection (a).

Appendix D – Current Massachusetts Legislation

Search Terms: lodging houses

ANNOTATED LAWS OF MASSACHUSETTS

*** THIS DOCUMENT IS CURRENT THROUGH 2000 CH. 76, ENACTED 4/17/00 ***

PART I. ADMINISTRATION OF THE GOVERNMENT
TITLE XX. PUBLIC SAFETY AND GOOD ORDER
CHAPTER 148. FIRE PREVENTION

Mass. Ann. Laws ch. 148, § 26H (2000)

§ 26H. Automatic Sprinkler Systems; Lodging or Boarding Houses; Exceptions; Definitions.

In any city or town which accepts the provisions of this section, every **lodging house** or boarding house shall be protected throughout with an adequate system of automatic sprinklers in accordance with the provisions of the state building code. No such sprinkler system shall be required unless sufficient water and water pressure exists. In such buildings or in certain areas of such buildings, where the discharge of water would be an actual danger in the event of a fire, the head of the fire department shall permit the installation of such other fire suppressant systems as are prescribed by the state building code in lieu of automatic sprinklers. The head of the fire department shall enforce the provisions of this section.

For the purpose of this section "**lodging house**" or "boarding house" shall mean a house where lodgings are let to six or more persons not within the second degree of kindred to the person conducting it, but shall not include fraternity houses or dormitories, rest homes or group residences licensed or regulated by agencies of the commonwealth.

Any lodging or boarding house subject to the provisions of this section shall be equipped with automatic sprinklers within five years after acceptance of this act by a city or town.

Whoever is aggrieved by the head of the fire department's interpretation, order, requirement or direction under the provisions of this section, may within forty-five days after the service of notice thereof, appeal from such interpretation, order or requirement to the board of appeals of the fire safety commission as provided in section two hundred and one of chapter six.

HISTORY:
1986, 265; 1989, 330; 1989, 557, § 2

NOTES:

EDITORIAL NOTE--
The first 1989 amendment added the third paragraph relative to requiring automatic sprinkler systems in lodging or boarding houses.

The second 1989 amendment added the fourth paragraph providing that whoever is aggrieved by the fire department's interpretation, order, requirement or direction, is allowed 45 days within which to appeal such interpretation, etc., as provided in ALM GL c 6 § 201.

TOTAL CLIENT-SERVICE LIBRARY REFERENCES--
8 Mass Jur, Property §§ 25:478, 479, 499, 501.

13 Am Jur 2d, Buildings § 25.

78 Am Jur 2d, Warehouses § 166.

5 Am Jur Proof of Facts 3d 383, Negligent Failure to Install or Maintain Smoke Alarm or Sprinkler System.

ANNOTATIONS--
Sufficiency of warehouseman's precautions to protect goods against fire. 42 ALR3d 908.

CASE NOTES

Where city sought injunctive relief to require rooming house owner to install automatic sprinkler system after ALM GL c 148 § 26H was amended to give owner 5 years from city's acceptance of statute to make installation, judge should not have granted injunction. Chief of Fire Dep't v Allard (1991) 30 Mass App 128, 566 NE2d 628.

ALM GL c 148 § 26H is self-enforcing in sense that it imposes directly on boarding and **lodging houses** obligation to have automatic sprinkler systems, in contrast to statute authorizing head of fire department to issue order requiring their installation. Chief of Fire Dep't v Allard (1991) 30 Mass App 128, 566 NE2d 628.

When municipality accepts local option statute, it accepts with it any amendments that Legislature may thereafter see fit to make, unless amendatory legislation should otherwise indicate. Chief of Fire Dep't v Allard (1991) 30 Mass App 128, 566 NE2d 628.

Appendix E – Testimony given before the New Jersey Assembly Committee on Housing, Gerard J. Naylis