BOARDING HOUSE FIRE
Beverly, MA
July 4, 1984

Includes:
Boarding House Fire Causes Fifteen Deaths
By Ron Cote and Tom Timoney
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FIRE INVESTIGATIONS
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Investigation Report

Elliott Chambers Boarding House Fire
Beverly, Massachusetts
July 4, 1984

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In Cooperation with

Federal Emergency Management Agency/
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and

National Bureau of Standards/
Center for Fire Research

(Revised 10/15/84)
This investigation was conducted by the National Fire Protection Association (NFPA) under an agreement with the Federal Emergency Management Agency/United States Fire Administration (FEMA/USFA) and the National Bureau of Standards/Center for Fire Research (NBS/CFR). The investigation was jointly funded by these agencies and the NFPA.

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ABSTRACT

At approximately 4:00 a.m. on July 4, 1984, fire in a three-story, unsprinklered, wood-frame structure in downtown Beverly, Massachusetts, used as a boarding house on its two upper floors, resulted in the death of 15 residents and injury to 9 others.

A total of 36 residents, including seven former mental patients, occupied the 17 second-floor and 18 third-floor guest rooms that opened onto two centrally located exit access corridors, one on each floor. There was a single open stairway serving one end of the corridors and an exterior fire escape serving the other end. The ground floor of the 48-foot by 97-foot building was occupied by several commercial establishments.

The residential portion of the building was equipped with a combination corridor smoke detection and guest room heat detection system. Activation of a detector would sound an alarm horn on each level of the building. The system was not designed to notify the fire department automatically.

Investigators from the Massachusetts State Fire Marshal's Office determined that the fire was incendiary in nature. Once ignited, the fire spread quickly, involving the 3/16-inch wood paneling interior finish in the stairway and the exit access corridor. Heat and smoke easily penetrated the upper levels of the building through the open stairway. The fire spread rapidly throughout the remainder of the residential floors of the building. Fire fighters, assisted by the police, rescued approximately nine guests over ground ladders from the building.

The significant factors contributing to the loss of life in this incident are considered to be the nature of the ignition scenario, the open stairway, the combustibility of the interior finish, and a delay in notifying the fire department.
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I. INTRODUCTION

The National Fire Protection Association (NFPA), with the assistance of the Building Officials and Code Administrators International (BOCA), investigated the Beverly, Massachusetts Elliott Chambers boarding house fire in order to document and analyze significant factors that resulted in the loss of life.

This study was conducted under a major fires investigation agreement among the Federal Emergency Management Agency/United States Fire Administration (FEMA/USFA), the National Bureau of Standards/Center for Fire Research (NBS/CFR), and the NFPA. The agreement, funded by FEMA/USFA, NBS/CFR, and the NFPA, provides for the investigation of technically significant fires by the NFPA's Fire Investigations and Applied Research Division to document and analyze incident details and report lessons learned for loss prevention purposes.

The NFPA was assisted in data collection and analysis by the Building Officials and Code Administrators International (BOCA) under an agreement among NFPA and the three model building code organizations to investigate significant structural fires throughout the United States. In addition to BOCA, the other cooperating building groups are the International Conference of Building Code Officials (ICBO) and the Southern Building Code Congress International (SBCCI). The three model building code groups are supporting NFPA by lending technical staff support for on-site field work and a building code analysis.

The NFPA became aware of the fire on the day of occurrence, July 4, 1984. Ron Cote', Life Safety Specialist; Thomas Klem, Director, Fire Investigations and Applied Research Division; and Tom Timoney, Fire Protection Specialist, visited Beverly, Massachusetts to document the facts related to the fire. The NFPA investigators were joined and assisted by Bruce Larcomb, of the Building Officials and Code Administrators International. A two-day, on-site study and
subsequent analysis were the basis for this report and NFPA's analysis of the event. Entry to the fire scene and data collection activities were made possible through the cooperation of the Beverly Fire Department and the Massachusetts State Fire Marshall's Office. This report presents the findings of the NFPA data collection and analysis effort.

This report is another of NFPA's studies of fires having particular educational or technical interest. The information presented is based on the best data available during the on-site data collection phase and further data acquired through subsequent follow-up. It is not NFPA's intention that this report pass judgment on, or fix liability for, the loss of life and property at the Elliott Chambers boarding house.

The cooperation and assistance of Chief Dean Palmer and Fire Prevention Captain Richard Jutras, Beverly Fire Department, and Massachusetts State Fire Marshal Joseph O'Keefe, are acknowledged and appreciated.

Special thanks is given to Mr. Bruce Larcomb of BOCA for his on-site assistance in the data collection phase and for his input to the code analysis portion of the report.
The Building

The fire occurred in a three-story with basement, unsprinklered, wood-frame structure in downtown Beverly, Massachusetts used as a boarding house on its upper two stories. The ground floor of the 48-foot by 97-foot, circa 1900, building was occupied by a variety of commercial establishments: a barber shop, a drug store, a T.V. repair shop and law offices. The building fronted Elliott Street to the south along its longer dimension and Rantoul Street to the east (see Figure 1).

The building had 17 second-floor and 18 third-floor guest rooms that opened onto two centrally located exit access corridors, one on each floor (see Figure 2). There was a single unenclosed stairway, open from street level to the third floor, which served the east end of the corridors. An exterior fire escape served the west end of the building. Access to the fire escape was gained through a door located off the corridor on each residential level.

Heights and Areas

Each floor covered approximately 4650 square feet. The lower level of the two residential floors was approximately 15 feet above sidewalk level on the two sides of the building which fronted streets. Recent demolition of a building on adjacent property to the north left an excavation approximately 10 feet lower than sidewalk level. The overall height of the three-story building was approximately 35 feet above sidewalk level.

On two sides the building was adjoined by public streets for a width of at least 40 feet. Portions of a strip-type shopping building under construction were approximately 50 feet from the fire building on the "excavated" north side. To the west and within six feet of the fire building was a single-story business occupancy adjoined by a four-story apartment building.
Construction Details

The wood-framed building most nearly resembled unprotected wood frame construction (Type V(000) construction per NFPA 220-1979, Standard Types of Building Construction and Type 5B construction according to the 1984 edition of the Basic/National Building Code). When constructed in approximately 1900, the exterior walls were wood studs sheathed with boards and wood clapboards. At a subsequent time, fiberboard underlayment and asphalt shingles with the appearance of red brick were added as exterior wall finish materials. The inside face was covered by plaster on wood lath to which, in recent years, had been added 3/16-inch thick plywood paneling with cardboard underlayment.

The partitions separating the corridor from the guest rooms and the partitions between rooms were wood framing with plaster on wood lath with an exterior finish of a wood wainscot to 40 inches above floor and plywood paneling with cardboard underlayment above that to ceiling height.

The floor/ceiling assembly consisted of painted tongue-and-groove wood flooring over 1-inch thick boards on 16-inch centered 2-inch by 10-inch joists with a ceiling membrane of plaster on wood lath. A few of the guest rooms had exposed fiberboard on wood furring strips covering the original plaster ceiling.

The roof/ceiling system was very similar to the floor/ceiling assembly except that built-up roofing sat over the 1-inch thick boards and the joists were only 8 inches deep. The roof had a slight pitch which created an approximately 2 1/2-foot deep cockloft at the peak which tapered to the 8-inch depth of the joists along the longer walls of the building. A roof-top skylight, approximately 8 feet by 10 feet in size, with glass walls on all sides was positioned over, and open to, the third floor corridor approximately 15 feet from the west end of the building.

Mounted on the roof at the east end of the building on steel supports was a billboard that measured approximately 60 by 20 ft.
Each guest room had two exterior windows with the exception of the eight rooms at the building corners which had additional windows. The double-hung wood-frame windows were 32 inches by 66 inches in overall dimensions and 28 inches off the floor. Aluminum-frame combination windows had been added on the building exterior.

The unenclosed stair was constructed of wood. The single stair run from ground level to the floor level of the second floor had partitions separating it from the first floor business/mercantile occupancies. The partitions were constructed the same as the corridor partitions described above, complete with wainscotting along the lower 40 inches and plywood paneling on cardboard underlayment above.

The single run of stairs from the second to the third floor was 44 inches wide and located within a 54-inch wide by 14-foot long floor opening. Both runs of stair employed a 7 1/2-inch height riser and a 9-inch tread depth.

The door to the outside at street level was metal clad, 36 inches wide, 72 inches high and equipped with a hydraulically operated door closer. Above the door were fixed glass windows divided into four sections with overall dimensions of 40 inches wide by 36 inches high which, with the door below, separated the stairway from the outside. The 54-inch wide by 40-inch deep exterior alcove had a concrete floor. The alcove walls were finished in wood wainscot to a 40-inch height from the floor and plywood on wood furring strips above.

The 30-inch by 80-inch wood doors to the guest rooms had 1 1/2-inch thick frames with five 1/4-inch thick horizontal inset panels. On the corridor side a subsequently applied single piece of 3/16-inch plywood paneling covered the inset panels. The doors were not self-closing. A wood frame 30-inch by 18-inch glass-light transom topped each door. The transoms appeared to be operable.
Doors leading from the west end of the corridor on each residential floor to the exterior fire escape were 34-inch by 82-inch wood frame panel doors similar in construction to the guest room doors described above. A screw eye-and-hook catch secured the door from the inside. A wood frame screen door was installed at the corridor-side of the door opening. The panel door swung outward in the direction of egress travel; the screen door swung back into the corridor.

The exterior fire escape was of steel grate construction. Stairs were 22 inches wide with a 10-inch high riser, 7 1/2-inch deep tread and 32 inch high handrail. A counterweighted swinging stair section connected the second floor landing with the alley at ground level.

**Fire Protection Systems**

The building was equipped with a four-zone (basement and floors 1 through 3) automatic alarm system. As part of the building system a combination smoke detection/heat detection system had been installed on the two residential floors. Smoke detectors were provided within the exit access corridors; each guest room had a combination fixed-temperature/rate-of-rise heat detector. Each first floor business/mercantile occupancy was equipped with a smoke detector, as was the basement. Activation of any detector would sound alarm horns on each level of the building and provide audible and visual indication on the exterior of the building. In addition, the alarm signal would illuminate an indicating lamp on a four-zone annunciator panel located on the second floor near the manager's quarters. Components of the system are depicted in Figure 2. There were no manual pull stations. The system was not designed to automatically notify the fire department.

Rechargeable emergency lighting was provided in the corridors. A Class ABC dry chemical portable fire extinguisher, in a wall-mounted glass-fronted cabinet, was provided at each end of the two corridors.
Operating Status

At the time of the fire, all but three of the 35 guest rooms were occupied by 36 persons including a child visitor; one room was unrented; one resident was away; and one resident, who was ill, was being cared for in the manager's suite.

Weather Conditions

At the time of initial fire discovery, weather conditions were clear, temperature 66 degrees F, with an 8-knot wind from the southwest.

Public Protection

The City of Beverly encompasses an area of approximately 15 square miles with a population of 38,000. The Beverly Fire Department has a fully paid force of 105 career fire fighters operating 5 stations with 5 engine companies and 2 truck companies.

The fire prevention division of the Beverly Fire Department has fire protection responsibilities which include building plan review, alarm system design review and testing, building inspections, and public education.

On April 20, 1982, members of the fire prevention division tested the fire alarm system in the building following the system's installation. The test procedure involved the operation of all devices in the fire alarm system per the recommended method outlined in the manufacturer's documentation. Local codes require the owner to maintain the building fire alarm system and test all the devices in the system annually.

Fire department engine companies inspect all the buildings in their "first in" area annually to familiarize the fire fighters with the building layout and to identify any basic fire problems which may exist. Any fire problems identified during these inspections are forwarded to the fire prevention division for follow-up action.
Code Enforcement

As part of the Beverly Fire Prevention Bureau's on-going inspection program, on September 14, 1978, a fire safety recommendation was issued to the owner of the Elliott Chambers with the following recommendations:

1. "Enclose stairways with fire rated walls and self-closing doors on second and third floors."

2. "Install smoke detectors in hallways and stairways and connect them together so if one sounds it will alarm both floors."

3. "Install single station smoke detectors in each room."

The two-year old automatic detection and alarm system (see description in Fire Protection System section) had been installed by the owner due to Beverly adopting a state ordinance* in 1981 which required smoke detection systems in rooming houses. Further, fixed temperature/rate of rise heat detectors had been installed in guest rooms. At the time of the fire the stairway remained open.

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*The State of Massachusetts adopted the 1978 BOCA Basic Building Code in 1980 for local and/or state enforcement.
III. THE FIRE INCIDENT

Ignition Sequence and Discovery

A resident of Room 33, located on the third floor and in the immediate vicinity of the open stairway (see Figure 2), awoke to his alarm clock at 4:00 a.m. Within a "couple of minutes" an alarm horn in the corridor sounded. Upon opening his room door, the resident saw flames penetrating the third-floor stairway opening. There was some smoke obscuration in the corridor.

At 4:18 a.m. a policeman passed the building entrance on Rantoul Street and found the entrance alcove in flames. His immediate radio communication to police headquarters, which was also monitored by the fire department, was the first notification of the fire to be received by the fire department.

Subsequent investigation showed that the fire, which the Massachusetts State Fire Marshal's Office has determined to be incendiary in nature, originated in newspapers in the entrance alcove outside the locked street-level entrance door to the rooming house. The fire involved the wood wainscot and spread vertically on the plywood alcove wall finish materials to the fixed glass windows above the door. Once the windows broke, the fire traveled horizontally into the interior stairway to the second floor. The horizontal fire spread hit the stair at approximately the seventh riser from the bottom and continued its vertical spread into the rooming house corridor.

Fire Growth and Development

The fire spread, which was through the open stairways and involved the combustible interior finish materials in the stairway and corridors, is believed to have been very rapid. Flames had reached the third floor when the smoke detection alarm sounded. The first responding fire department personnel
reported flames at second and third floor windows along Rantoul Street at approximately 4:20 a.m. Failure of glass in the rooftop skylight, at an early point in the fire, provided a vented chimney effect which allowed for additional fire spread. At later stages of the fire, individual guest rooms were involved.

Fire Fighting and Rescue

The Beverly Fire Department was notified by the Beverly Police Department of the fire at the Elliott Chambers. Fire Department units were dispatched at 4:18 a.m. The initial assignment included two engine companies, one truck company, and a Deputy Chief. At the time of the fire, these units were operating at "minimum manning" levels which resulted in the initial apparatus assignment being limited to one 2-man engine company, one 3-man engine company, and one 3-man truck company.

"First in" Fire Department units, on scene at approximately 4:20 a.m., observed "fire showing at the ground level entrance, the second story corridor windows, and the third floor windows above, on the front of the building" (Rantoul Street). The fire ground commander immediately called for second and third alarms, emphasizing the need for "mutual aid" truck companies. The tillerman on the first due truck company responding westerly on Elliott Street observed fire through the skylight above the west end of the third floor corridor. These "first in" units also observed an occupant at a third floor window (who was later rescued by the truck company) and several occupants at second floor windows on the Elliott Street (south side) of the building. In addition, one occupant had already jumped from a third floor window, struck a traffic light control box, and was lying on the pavement when the "first in" truck company arrived at the Elliott Street side of the building.

Initially all fire fighters, except the two pump operators were committed to rescue. Fire fighters rescued a total of eight occupants: six from the second floor and two from the third floor. Six of the eight occupants rescued
were removed from the building over ground ladders, one over an aerial ladder, and the eighth via the fire escape at the west end of the building. Three of the six occupants rescued from the second floor were located at windows on the south side of the building; two were located at windows at the north side of the building and the sixth at the fire escape at the west end of the building as described above. One of the two third floor occupants was rescued over the "first in" truck's aerial ladder and the other was rescued over a ground ladder from a third floor window on the west side of the building.

While rescue operations were underway, the two pump operators from the "first in" engine companies stretched supply lines and attempted to advance a 1 3/4-inch hand line up the open stairway at the front of the building but were driven back by intense heat. After rescues of the visible occupants were completed, fire fighters attempted to advance a 1 3/4-inch hand line through a second floor window (room 3) on the south side of the building but were again driven back by intense heat. The fire ground commander decided not to attempt any further interior attacks because of the advanced stage of the fire and the serious concern with the potential for roof collapse created by a billboard mounted above the building on unprotected steel supports.

The fire was extinguished with assistance from mutual aid companies using master stream appliances. The building was then overhauled and victims removed after the billboard was secured by a rigging company.

The Fatalities

Fifteen individuals died as a result of the fire, fourteen persons at the time of the fire and one burn victim approximately one month later. Fatalities occurred in guest rooms (10), in corridors (2), on a stair that was open to the corridor (1), at street level (1, a jumper) and away from the fire site at a later date (1, an escapee who had been burned). Fatality locations are indicated in Figure 2.
The Massachusetts Chief Medical Examiner's Office attributed all but three of the 15 deaths to smoke inhalation and respiratory failure. One individual jumped to his death from a third floor window. One victim died of severe burns and respiratory failure. The death of the individual who lived for nearly a month after the fire was a result of burns.

Results of toxicological examination on blood samples are summarized in Table 1.
<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Cause of Death</th>
<th>Blood CO (Carboxyhemoglobin Normal = less than 1.5%)</th>
<th>Blood Ethanol</th>
<th>Blood Cyanide (Normal = 0.015mg%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>74</td>
<td>Smoke Inhal.</td>
<td>68%</td>
<td>None Det.</td>
<td>0.08 mg%</td>
</tr>
<tr>
<td>M</td>
<td>73</td>
<td>Smoke Inhal.</td>
<td>76%</td>
<td>0.16%</td>
<td>0.19 mg%</td>
</tr>
<tr>
<td>M</td>
<td>72</td>
<td>Smoke Inhal.</td>
<td>78%</td>
<td>None Det.</td>
<td>0.12 mg%</td>
</tr>
<tr>
<td>M</td>
<td>70</td>
<td>Smoke Inhal.</td>
<td>73%</td>
<td>None Det.</td>
<td>0.11 mg%</td>
</tr>
<tr>
<td>M</td>
<td>63</td>
<td>Smoke Inhal.</td>
<td>72%</td>
<td>None Det.</td>
<td>0.09 mg%</td>
</tr>
<tr>
<td>M</td>
<td>59</td>
<td>Smoke Inhal.</td>
<td>54%</td>
<td>0.22%</td>
<td>0.15 mg%</td>
</tr>
<tr>
<td>M</td>
<td>53</td>
<td>Smoke Inhal.</td>
<td>77%</td>
<td>0.24%</td>
<td>0.07 mg%</td>
</tr>
<tr>
<td>M</td>
<td>52</td>
<td>Burns &amp; Smoke*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>38</td>
<td>Fall Injuries</td>
<td>10%</td>
<td>None Det.</td>
<td>0.01 mg%</td>
</tr>
<tr>
<td>M</td>
<td>37</td>
<td>Smoke Inhal.</td>
<td>79%</td>
<td>0.10%</td>
<td>0.18 mg%</td>
</tr>
<tr>
<td>M</td>
<td>31</td>
<td>Burns</td>
<td>31%</td>
<td>0.13%</td>
<td>0.003 mg%</td>
</tr>
<tr>
<td>M</td>
<td>30</td>
<td>Smoke Inhal.</td>
<td>73%</td>
<td>None Det.</td>
<td>0.17 mg%</td>
</tr>
<tr>
<td>M</td>
<td>21</td>
<td>Smoke Inhal.</td>
<td>60%</td>
<td>None Det.</td>
<td>0.09 mg%</td>
</tr>
<tr>
<td>M</td>
<td>18</td>
<td>Smoke Inhal.</td>
<td>80%</td>
<td>None Det.</td>
<td>0.06 mg%</td>
</tr>
<tr>
<td>M</td>
<td>9</td>
<td>Smoke Inhal.</td>
<td>79%</td>
<td>None Det.</td>
<td>0.05 mg%</td>
</tr>
</tbody>
</table>

Note 1: Data in this table are from Commonwealth of Massachusetts Chief Medical Examiner's Office autopsy reports.

Note 2: Lethal level of cyanide in the blood is generally reported to be 0.5 mg% or greater.

*INFORMATION UNAVAILABLE AT TIME OF REPORT.
Fire Damage

Fire damage was so extensive as to render the third floor gutted structurally and devoid of furnishings. Roof collapse was nearly complete including the skylight and the west end of the roof-top billboard. Second floor guest rooms in the vicinity of the open stairway (east end) received fire damage. Rooms to the west of the octagonally shaped janitor's closet, which was positioned in the middle of the corridor, suffered mainly heat, smoke and water damage.

IV. ANALYSIS

Discussion

Cause of the fire has been determined by the Massachusetts State Fire Marshal's Office to be incendiary in nature and to have involved newspapers initially. Testing found no traces of accelerants in the area of the fire origin. Specific ignition details remain undetermined.

Combustible wall finish materials within an alcove, on the exterior side of the metal clad entrance door which was locked to outsiders, provided the transport mechanism by which the newspaper fire spread to the alcove ceiling and fixed transom-like windows over the entrance door. Once the windows broke, the fire entered the open stairway and ignited its combustible wall finish.

The open interior stairways allowed the fire and products of combustion to travel first to the second floor and then quickly to the third floor. Fire spread along the second floor was hampered by the janitor closet which sat in the middle of the corridor. Fire spread along the third floor was unhindered and fueled by the combustible interior wall finish materials. Failure of glass windows in the skylight, which was open to the third floor corridor,
provided a vented chimney effect which further assisted the fire spread, but is believed to have limited the fire spread on the second floor to an area in the immediate vicinity of the open stairway. In spite of venting, however, heat and smoke conditions resulted in untenable conditions in the second floor exit access corridor.

The initial fire development was rapid with flames penetrating the third floor stairway opening at the time the smoke detection alarm first sounded. The point of fire origin and the initial vertical fire spread rendered the only interior exit access stairs unusable. Residents were left totally dependent on the emergency escape routes, i.e., the exterior fire escape and the operable guest room windows. Since access to the fire escape was through the exit access corridors, this escape route was only available during the early portions of the fire. If the guests were located in rooms adjacent to the open stairway, early escape was essential since the transoms provided an ineffective barrier to the fire spread.

The delay in fire department notification played heavily in the deterioration of tenability within the exit access corridors. As heavy smoke conditions developed quickly, visibility within the corridors was obscured. Two fatalities occurred at the door to the second floor fire escape. It appears that the two individuals were unable to locate and unlock the screw eye-and-hook catch mechanism as evidenced by finger and hand impressions found on the door surface from the door's base to the door knob, in the soot deposit. The screen door, opening back into the corridor, could also have complicated occupant egress. The outside door was later pried open from the outside by the fire department personnel. Second floor residents who used the fire escape gained access to it through a corridor window broken out by the resident of Room 9.
The delay in fire department notification may also have played a part in the death of a resident who jumped from his third floor window prior to fire department rescue efforts.

Fifteen individuals died as a result of the fire; ten of those fatalities occurred in guest rooms. See the subsection on "The Fatalities" in the section on "The Fire Incident."

**Performance of Fire Protection Features**

The corridor smoke detection system alerted residents soon after the fire, which originated outside the street level entrance door, entered the interior stairway. However, the unprotected vertical openings, created by the unenclosed stairs, and the combustible interior wall finish materials soon negated the benefits of the early warning and made the exit access corridors untenable.

The guest room doors with operable glass-light transoms above performed differently in different portions of the building. Burn patterns indicate that fire-spread into some guest rooms was initially through transom openings. The jump from the window, early in the fire, by the occupant of Room 18 on the third floor might indicate an untenable condition within the guest room at an early time. The room was immediately adjacent to the third floor stairway opening. Direct fire impingement on the door and transom could have been expected early in the fire.

Contrast the above with Room 7 on the second floor which was shielded from direct fire spread by the mid-corridor janitor closet. The occupant, who was on medication, slept through the alarm and awoke at 4:35 a.m. She smelled smoke; opened the room door; encountered heavy smoke in the corridor; closed the door; went to the window; and was immediately rescued by fire department personnel.

In the absence of direct fire involvement, the transoms and doors served as reasonably effective smoke barriers.
As previously stated, the building which housed the Elliott Chambers boarding house was constructed around 1900. Thus, it was not subject to building code requirements. The following analysis is presented in the interest of comparing life safety problems observed in the aftermath of this incident to the requirements of the 1981 edition of the NFPA 101, Life Safety Code® and the 1984 edition of the Basic/National Building Code (B/NBC). The areas addressed in this section are not all-inclusive of the code sections that might apply to a building of this type but are those areas believed to impact the greatest on the life safety problems.*

Although the Elliott Chambers has been referred to throughout this report as a boarding house, its occupant load of approximately 35 places it, by Life Safety Code® and the B/NBC definitions, in the category of a hotel occupancy. The Code limits a lodging or rooming house to providing sleeping accommodations for 15 or fewer persons, while the B/NBC defines this occupancy for 6 or more persons. Classification as either a hotel or boarding house assumes that the residents are capable of self-preservation. Given a facility such as the Elliott Chambers, which housed a number of former mental patients, the occupancy classification could be an issue which transgresses the boundaries of simply assigning one of the subclasses of residential occupancies to the facility. In some cases, classification as a health care

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*The 1981 edition of the Life Safety Code and the 1984 edition of B/NBC was used for this analysis so that the conditions at the Elliott Chambers on the date of the fire could be compared to the latest edition of the Codes. It is recognized that these Codes were not in effect in Beverly during construction or operation of the Elliott Chambers.
occupancy might be more appropriate. The requirements discussed below address application of protection features for new and for existing hotels as specified in the codes used in the analysis.

1. Vertical Opening Protection. The Code provisions for both new and existing hotel occupancies are similar. Paragraphs 16-3.1.1 (new) and 17-3.1.1 (existing) require that every stairway be enclosed or protected in accordance with the Chapter 6 requirements for compartmentation. Section 2-9, specifically referenced by 17-3.1.1 for existing hotels as an option to the enclosure requirements of 6-2.2, requires that every vertical way of exit and other vertical opening between floors of a building be suitably enclosed or protected, as necessary, to afford reasonable safety to occupants while using exits and to prevent spread of fire, smoke, or fumes through vertical openings from floor to floor before occupants have entered exits. For new hotels, the Code does not recognize the means specified in Section 2-9 as an alternative to the more stringent enclosure requirements of Chapter 6. The B/NBC would also have required enclosure. Section 804.0 of B/NBC and the Basic/National Existing Structures Code (B/NESC)* would require a one-hour fire resistance rated enclosure. The open stairways at the Elliott Chambers created unprotected vertical openings and left the exit stairs unenclosed and, therefore, not separated from all other portions of the building as is required for an exit.

2. Number and Types of Exits. Paragraph 16-2.4.1 (new) and 17-2.4.1 (existing) require that not less than two "exits" be accessible from every floor. Although the list of exits or exit components allowed by the Code for

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*Jurisdictions may elect to adopt the B/NESC in support of the provisions in B/NBC.
an existing hotel does not include fire escape stairs, paragraph 17-2.2.2 (existing) would have allowed the existing fire escape to be continued in use subject to the approval of the authority having jurisdiction. The B/NBC treats the use of a fire escape in a similar manner. Section 809.0 of the B/NBC also requires two accessible exits; the B/NESC would require two exits in most cases.

3. **Interior Finish.** Code paragraphs 16-3.3.1 (new) and 17-3.3.1 (existing) limit interior finish materials within hotel occupancies as follows:

- **a. Vertical exits**
  - **NEW:** Class A
  - **EXISTING:** Class A or B

- **b. Exit access**
  - **NEW:** Class A or B
  - **EXISTING:** Class A or B

- **c. Lobbies, corridors**
  - **NEW:** Class A or B
  - **EXISTING:** Class A, B, or C

  that are not exit access

- **d. Individual guest**
  - **NEW:** Class A, B, or C
  - **EXISTING:** Class A, B, or C

  rooms and other rooms

Similar control of interior finish materials is accomplished by Section 1421.0 of the B/NBC. Typically, thin plywood wall covering as found throughout the Elliott Chambers rates no better than Class C.

4. **Detection and Alarm System.** Code paragraphs 16-3.4.1 (new) and 17-3.4.1 (existing) require that an alarm system be provided in a hotel in accordance with Section 7-6. Additionally, a corridor smoke detection system is required for new hotel occupancies. The B/NBC Section 1716.0 requires an automatic fire alarm system with single station smoke detectors in every sleeping room. The B/NESC requires single station smoke detectors in sleeping rooms in buildings that are not required to have a complete automatic alarm
system. Although the Elliott Chambers had no manual pull stations, its
corridor smoke detection system provided, in this incident, the occupant
notification function anticipated by the manual alarm system requirements.

5. Fire Department Notification. Code paragraphs 16-3.4.6 (new) and
17-3.4.4 (existing) require that provisions be made for the immediate
notification of the public fire department by telephone or other means in case
of fire. It has been reported that the smoke detection alarm had sounded by
4:05 a.m. and the fire department received notice of the fire only at 4:18
a.m. from a passing policeman.

6. Doors and Closers. Code paragraphs 16-3.6.2 (new) and 17-3.6.2
(existing) require that each guest room door which opens onto an interior
corridor have a fire protection rating of at least 20 minutes. In new hotels
the doors are also required to resist the passage of smoke. Also, per
16-3.6.3 (new) and 17-3.6.3 (existing), doors between guest rooms and
corridors are required to be self-closing. Paragraph 16-3.6.5 (new) prohibits
transoms in partitions of sleeping rooms. Sections 810.4.2 and 812.5.6 of the
B/NBC have similar requirements for fire protection rating of doors and the
provision of self-closing. Paragraph 17-3.6.5 (existing) requires that
existing transoms installed in corridor partitions of sleeping rooms be fixed
in the closed position and covered or otherwise protected to provide a fire
resistance rating at least equivalent to that of the wall in which they are
installed. Sections 810.4.2 and 812.5.6 of the B/NBC have similar
requirements for fire protection rating of doors and the provisions of
self-closing. The operable glass-light transoms in the Elliott Chambers did
not meet these requirements. The doors were not self-closing. Code paragraph
5-2.1.2.1.2 requires that if a latch or other fastening device is installed on
a door that such device be provided with a knob, handle, panic bar, or other
simple type of releasing device, the method of operation of which is obvious
even in darkness.
7. **Emergency Lighting.** Code paragraphs 16-2.9.1 (new) and 17-2.9.1 (existing) require that any hotel with 26 or more rooms have emergency lighting in accordance with Section 5-9. Section 804.0 and 824.0 of the B/NBC requires means of egress lighting as well. Emergency lighting was present at the Elliott Chambers.

**Summary**

The ignition scenario, the open stairway, the combustibility of the interior finish, and a delay in notifying the fire department were the major factors contributing to loss of life in this fire. Once ignited, the fire spread vertically via the unenclosed stairs and was fueled by the combustible interior wall finish materials. Additional factors which may have contributed to the loss of life include the screw eye-and-hook catch mechanism which secured the second floor exterior fire escape door and the operable glass-light transoms over the guest room/corridor doors.

Factors that contributed to limiting further life loss and injuries were the early occupant notification achieved by the corridor smoke detection system and the operable guest room windows which allowed residents ventilation and facilitated rescue operations by first responding fire department personnel.

This fire again illustrates common problems associated with hotel and boarding house fires. A hotel fire that occurred on November 26, 1978 and claimed ten lives in Greece, New York \(^1\), another on July 31, 1979 which resulted in ten fatalities in Cambridge, Ohio \(^2\), and yet another on June 14, 1983 with five fatalities in Fort Worth, Texas \(^3\), had primary factors leading to the fatalities similar to the Elliott Chambers, Beverly, Massachusetts incident. These included unprotected vertical openings and, to a lesser degree, combustible interior finish materials.
The following boarding house fires also had similar major factors contributing to the loss of life.

<table>
<thead>
<tr>
<th>TABLE 2 - SIMILAR BOARDING HOUSE FIRES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Kirkwood Lane (4)</td>
</tr>
<tr>
<td>Nashville, TN</td>
</tr>
<tr>
<td>February 1, 1978</td>
</tr>
<tr>
<td>4 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Halfway House (5)</td>
</tr>
<tr>
<td>Washington, D. C.</td>
</tr>
<tr>
<td>April 11, 1979</td>
</tr>
<tr>
<td>10 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Coats Rooming House (6)</td>
</tr>
<tr>
<td>Pioneer, OH</td>
</tr>
<tr>
<td>November 11, 1979</td>
</tr>
<tr>
<td>14 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Brinley Inn (7)</td>
</tr>
<tr>
<td>Bradley Beach, N.J.</td>
</tr>
<tr>
<td>July 26, 1980</td>
</tr>
<tr>
<td>24 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Donehue Adult Foster (8)</td>
</tr>
<tr>
<td>Care Home</td>
</tr>
<tr>
<td>Detroit, MI</td>
</tr>
<tr>
<td>November 30, 1980</td>
</tr>
<tr>
<td>5 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Beachview Rest Home (9)</td>
</tr>
<tr>
<td>Keansburg, N.J.</td>
</tr>
<tr>
<td>January 9, 1981</td>
</tr>
<tr>
<td>31 Fatalities</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

Although the installation of automatic sprinklers would not be required in this building by the NFPA 101, Life Safety Code, or the B/NBC, sprinklers probably would have affected the outcome of this fire. The life safety record in similar facilities protected by complete automatic sprinkler systems is excellent. Control by a sprinkler system during the early stages of the fire is a plausible scenario.

The requirements contained in the Life Safety Code and other fire safety and building codes and laws are intended to mitigate such multiple fatality incidents.
References


FIGURE 2: FLOOR PLAN OF THE FIRE BUILDING.
BOARDING HOUSE FIRE CAUSES FIFTEEN DEATHS

RON CÔTE and TOM TIMONEY

INTRODUCTION

At approximately 4:00 am on July 4, 1984, fire broke out in the Elliott Chambers building, a wood-frame structure in downtown Beverly, Massachusetts, whose two upper floors were used as a boarding house. The fire resulted in the deaths of 15 residents and injury to 9 others.

Thirty-six people, including seven former mental patients, occupied second- and third-floor guest rooms that opened onto corridors. A single open stairway served one end of the corridors and an exterior fire escape served the other end. The ground floor of the building was occupied by several commercial establishments.

The residential portion of the building was equipped with corridor smoke detection and guest-room heat detection systems. Activation of a detector sounded an alarm on each level of the building, but did not automatically notify the fire department.

Investigators from the Massachusetts State Fire Mar-

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Mr. Coté is a Life Safety Specialist in the NFPA’s Engineering Field Services Division. Mr. Timoney is a Fire Protection Specialist in the NFPA’s Fire Investigations and Applied Research Division.

This investigation was conducted by the NFPA under an agreement with the Federal Emergency Management Agency/United States Fire Administration (FEMA/USFA) and the National Bureau of Standards.

Center for Fire Research (NBS/CFR). The investigation was jointly funded by these agencies and the NFPA.

The substance of this investigation report is dedicated to the public. It may be freely reprinted with the customary crediting of the source. The authors and publisher are solely responsible for the accuracy of statements or interpretations contained herein.
The building the fire occurred in was built in 1900. It had three stories above ground and a basement. It was also unsprinklered.

The ground floor of the structure contained a barber shop, a drug store, a television repair shop, and law offices. On the second floor, there were 17 guest rooms and on the third floor, there were 18. They opened onto two centrally located exit access corridors, one on each floor (see Figure 1). A single, unenclosed stairway, open from street level to the third floor, served the east end of the corridors. An exterior fire escape served the west end of the building. Access to the fire escape was gained through a door located off the corridor on each residential level.

The building measured 48 by 97 feet. Thus, each floor covered approximately 4,650 square feet.

Along its longer southern dimension, the building faced Elliott Street (see Figure 2). To the east, it fronted Rantoul Street. The lower of the two residential floors was approximately 15 feet above sidewalk level on these two sides. Recent demolition of an adjacent building to the north left an excavation approximately 10 feet lower than sidewalk level. The overall height of the three-story building was approximately 35 feet above sidewalk level.

Elliott and Rantoul streets separated the building from its southern and eastern neighbors by at least 40 feet. On the north, it was separated from a strip-type shopping building under construction by approximately 50 feet. To the west, the building was within six feet of a single-story business occupancy adjoined by a four-story apartment building.

Construction Details

The building most nearly resembled unprotected wood-frame construction, or Type V (000) construction per NFPA 220–1979, *Standard Types of Building Construction* and Type 5B construction according to the 1984 edition of the Basic/National Building Code. When it was built in 1900, wood studs sheathed with boards and
wooden clapboards were used for the exterior walls. Later, fiberboard underlayment and asphalt shingles that looked like red brick were added as exterior wall finish materials. The inside face was originally covered by plaster on wood lath; in recent years, ½-inch-thick plywood paneling with cardboard underlayment had been added.

The partitions separating the corridors from the guest rooms and the partitions between the rooms were of wood framing with plaster on wood lath. A finish of wooden wainscoting extended 40 inches above the floor. Plywood paneling with cardboard underlayment ran from that to the ceiling.

The floor/ceiling assembly consisted of painted tongue-and-groove wood flooring laid over 1-inch-thick boards. These boards were on 16-inch centered, 2-by-10-inch joists with a ceiling membrane of plaster on wood lath. The ceilings of a few of the guest rooms had exposed fiberboard-on-wood furring strips covering the original plaster.

The roof/ceiling system was similar to the floor/ceiling assembly, except that the inch-thick boards were covered by built-up roofing and the joists were only 8 inches deep. The roof had a slight pitch that created a cockloft. This was approximately 2½ feet deep at the peak and tapered to the 8-inch depth of the joists along the longer walls of the building. About 15 feet from the west end of the building, a rooftop skylight opened onto the third-floor corridor. This skylight was approximately 8 by 10 feet in size, with glass walls on all sides. Also on the roof was a billboard mounted on steel supports. This was at the east end of the building and measured approximately 60 by 20 feet.

Most of the guest rooms had two exterior windows. Exceptions were the eight rooms at the building corners, which had more. These were double-hung wood-frame windows measuring 32 by 66 inches and located 28 inches above the floor. Aluminum-frame combination windows had been added to the building's exterior.

The unenclosed stairway was constructed of wood. From ground level to the second floor, it had partitions separating it from the first-floor business occupancies. The partitions were of the same construction as the corridor partitions, complete with wainscoting along the lower 40 inches and plywood paneling on cardboard underlayment above.

From the second to the third floor, the stairway was 44 inches wide. It was located within a floor opening that was 54 inches wide by 14 feet long. Both runs of stairs had risers 7½ inches high and treads 9 inches deep.

The door to the outside at street level was 36 inches wide and 72 inches high. It was metal-clad and equipped with a hydraulically operated door closer. Above this door were fixed glass windows divided into four sections. Overall, the windows were 40 inches wide by 36 inches high. The door and windows separated the stairway from the outside.

Just outside the door was an alcove 54 inches wide and 40 inches deep. It had a concrete floor, and its walls were finished in wood wainscoting to a height of 40 inches from the floor and plywood-on-wood furring strips
that were applied above the wainscoting.

Each 30-by-80-inch wooden guest-room door had a 1½-inch-thick frame with five ¼-inch-thick horizontal inset panels. On the corridor side, a single piece of ¾-inch plywood paneling covered the inset panels. These doors were not self-closing. Above each door was a wood-frame, 30-by-18-inch glass transom that appeared to be operable.

Doors leading from the west end of the corridor on each residential floor to the exterior fire escape were 34 inches wide by 82 inches high and of the same wood-frame panel construction as the guest-room doors. A screw-eye-and-hook catch secured each door from the inside. In the same door openings, wood-frame screen doors were installed. These were inside the building on the corridor side, and opened into the corridor. The panel door swung outward.

The exterior fire escape was made of steel grating. Steps were 22 inches wide, with a 10-inch riser and a 7½-inch tread. The handrail was 32 inches high. A counterweighted swinging stair section connected the second-floor landing with the alley at ground level.

The fire department engine companies inspect all the buildings in their “first-in” area annually to familiarize the fire fighters with the building layout and to identify any basic fire problems that may exist. Any fire problems identified during these inspections are forwarded to the fire prevention division for follow-up action. The fire prevention division of the department is responsible for building plan review, alarm system design review and testing, and building inspections.

On April 20, 1982, members of this division tested the fire alarm system in the Elliott Chambers building following its installation. The test procedure involved operating all the devices in the fire alarm system according to the recommended method outlined in the manufacturer's documentation. Local codes require an owner to maintain a building's fire alarm system and test all the devices in the system annually.

Code Enforcement

As part of the Beverly Fire Prevention Bureau's ongoing inspection program, a fire safety recommendation was issued to the owner of the Elliott Chambers on September 14, 1978. The following changes were recommended:

1. Enclose stairways with fire-rated walls and self-closing doors on the second and third floors.
2. Install smoke detectors in hallways and stairways, and connect them together so that if one sounds, it will alarm both floors.
3. Install single-station smoke detectors in each room.

The owner complied fully with only the second recommendation. In 1981, an automatic detection and alarm system was installed when Beverly adopted a state ordinance requiring smoke detection systems in dwelling houses. The owner put fixed temperature/rate-of-rise detectors in each room. However, the stairway remained open at the time of the fire.

Ignition Sequence and Discovery

On the morning of July 4, the weather was clear. The temperature was 66°F, and an 8-knot wind was blowing from the southwest.

All but three of the 35 guest rooms were occupied. Of the empty rooms, one was unrented. The resident of another was away. The occupant of the third was ill, and being cared for in the manager’s suite. Altogether, 36 people, including a visiting child, were in the building that morning.

A resident of Room 33, located on the third floor near the open stairway (see Figure 1), awoke to his alarm clock at 4:00 am. Within a "couple of minutes," he heard an alarm horn sound in the corridor. When the resident opened his door, he saw flames penetrating the third-floor stairway opening and found smoke beginning to obscure the corridor.

At 4:18 am, a policeman passing the building entrance on Rantoul Street found the entrance alcové in flames and immediately radioed police headquarters. The call was monitored by the fire department. It was the department's first notification of the fire.

Subsequent investigation showed that the fire began in the entrance alcove outside the locked street-level door to the boarding house. The fire involved the wooden wainscoting and spread vertically up the plywood wall finish materials of the alcove to the fixed glass windows above the door. Once the windows broke, it traveled through them into the interior stairway. The fire hit the seventh riser of the stairway and spread vertically up the steps into the second floor of the boarding house.

Fire Growth and Development

Fire spread through the open stairways involved the combustible interior finish materials in both the stairways and corridors, and is believed to have been very rapid. Flames had reached the third floor by the time the smoke detection alarm first sounded. At approximately 4:20 am, the first-responding fire department personnel reported flames at second- and third-floor windows along Rantoul Street.

Failure of the glass in the rooftop skylight early in the fire provided a vented chimney effect that allowed for additional fire spread. During later stages of the fire, individual guest rooms were involved.

Fire Fighting and Rescue

The Beverly Police Department officially notified the fire department of the fire and the department dispatched units at 4:18 am. The initial assignment included two engine companies, one truck company, and a deputy chief. Because these units were operating at "minimum manning" levels at the time of the fire, the initial apparatus assignment was limited to one two-man engine company, one three-man engine company, and one three-man truck company.

First-in fire department units arrived on the scene at approximately 4:20 am and saw "fire showing at the ground-level entrance, the second-story corridor windows, and the third-floor windows above, on the front of the building" along Rantoul Street. The fireground commander immediately called for second and third alarms, emphasizing the need for mutual-aid truck companies.

The tillerman on the first due truck company responding on Elliott Street from the east saw fire coming through the skylight above the west end of the third-floor corridor. First-in units also observed one occupant at a third-floor window and several others at second-floor windows on the Elliott Street side of the building. One occupant had already jumped from a third-floor window, struck a traffic/light control box, and was lying on the pavement when the first-in truck company arrived at the Elliott Street side of the building.

Initially, all the fire fighters but the two pump operators were committed to rescue. Fire fighters rescued a total of eight occupants from the building, six from the second floor and two from the third. Three of the six occupants rescued from the second floor were located at windows on the south side of the building. Two others were located at windows at the north side of the building. These five were rescued over ground ladders. The sixth was at a second-floor window at the west end of the building and was pulled to safety over the fire escape. One of the two third-floor occupants was rescued over the first-in truck's aerial ladder and the other was removed over a ground ladder from a third-floor window on the west side of the building.

While rescue operations were underway, the two pump operators from the first-in engine companies stretched supply lines. They also attempted to advance a 1 3/4-inch hand line up the open stairway at the front of the building, but were driven back by intense heat.

After all the visible occupants had been rescued, fire fighters tried to advance a 1 3/4-inch hand line through the second-floor window of Room 3 on the south side of the building. They were again driven back by intense heat. The fireground commander decided the fire was
The Fatalities

Fifteen individuals died as a result of the fire, 14 at the time of the fire and one about a month later of burns. Of the 14 who died during the fire, 10 were found in guest rooms, two were in the corridors, one was on a stair that was open to the corridor, and one was found on the street. The locations of these fatalities are indicated in Figure 1.

The Massachusetts Chief Medical Examiner’s Office attributed all but three of the 15 deaths to smoke inhalation and respiratory failure. (Results of the toxicological examination of samples of their blood are summarized in Table 1.) One individual died of injuries he received when he jumped from a third-floor window. Another died of severe burns and respiratory failure during the fire. The third died of burns nearly a month after the fire.

Fire Damage

The fire caused the roof, the skylight, and the billboard to collapse almost completely. It also gutted the third floor structurally and destroyed its furnishings. Second-floor guest rooms in the vicinity of the open stairway at the east end suffered fire damage, while rooms to the west suffered mainly heat, smoke, and water damage. The ground-floor businesses suffered water and smoke damage.

Analysis

The Massachusetts State Fire Marshal’s Office determined that the cause of the fire was incendiary in nature. However, tests found no traces of accelerants in the area of the fire origin, and specific ignition details remain undetermined.

The fire was set in a pile of newspapers in the entrance alcove of the building. Combustible wall finish materials served to spread the newspaper fire to the alcove ceiling and the fixed, transom-like windows over the entrance door. The windows soon broke and the fire passed through them into the building.

The open interior stairways allowed the fire and products of combustion to travel first to the second floor, then quickly to the third floor. Fire spread from east to west along the second floor was hampered by an octagonal janitor’s closet located in the middle of the corridor. Fire spread along the third floor was unhindered and fueled by the combustible interior wall finish materials.

Failure of glass in the skylight, which was open to the third-floor corridor, provided a vented chimney effect that further helped spread the fire, although it is believed

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Cause of Death</th>
<th>Blood CO</th>
<th>Blood Cyanide†</th>
<th>Blood Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Carboxy-</td>
<td>(Normal level is</td>
<td>(Normal level is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hemoglobin</td>
<td>less than 1.5%)</td>
<td>0.015 mg%)</td>
</tr>
<tr>
<td>Female</td>
<td>74</td>
<td>Smoke Inhalation</td>
<td>68%</td>
<td>None Detected</td>
<td>0.08 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>73</td>
<td>Smoke Inhalation</td>
<td>76%</td>
<td>0.16%</td>
<td>0.19 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>72</td>
<td>Smoke Inhalation</td>
<td>78%</td>
<td>None Detected</td>
<td>0.12 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>70</td>
<td>Smoke Inhalation</td>
<td>73%</td>
<td>None Detected</td>
<td>0.11 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>63</td>
<td>Smoke Inhalation</td>
<td>72%</td>
<td>None Detected</td>
<td>0.09 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>59</td>
<td>Smoke Inhalation</td>
<td>54%</td>
<td>0.22%</td>
<td>0.15 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>53</td>
<td>Smoke Inhalation</td>
<td>77%</td>
<td>0.24%</td>
<td>0.07 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>52</td>
<td>Burns and Smoke</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Male</td>
<td>38</td>
<td>Fall Injuries</td>
<td>10%</td>
<td>None Detected</td>
<td>0.01 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>37</td>
<td>Smoke Inhalation</td>
<td>78%</td>
<td>0.10%</td>
<td>0.18 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>31</td>
<td>Burns</td>
<td>31%</td>
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<td>0.003 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>Smoke Inhalation</td>
<td>73%</td>
<td>None Detected</td>
<td>0.17 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>Smoke Inhalation</td>
<td>60%</td>
<td>None Detected</td>
<td>0.09 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>Smoke Inhalation</td>
<td>90%</td>
<td>None Detected</td>
<td>0.06 mg%</td>
</tr>
<tr>
<td>Male</td>
<td>9</td>
<td>Smoke Inhalation</td>
<td>79%</td>
<td>None Detected</td>
<td>0.05 mg%</td>
</tr>
</tbody>
</table>

* Data in this table are from Commonwealth of Massachusetts Chief Medical Examiner's Office autopsy reports.
† Lethal level of cyanide in the blood is generally reported to be 0.5 mg% or greater.
N/A: Information unavailable at time of report.
to have limited fire spread on the second floor to the immediate vicinity of the open stairway. In spite of this venting, heat and smoke caused the second-floor exit access corridor to become untenable.

The fire developed rapidly, quickly rendering the only interior exit access stairs unusable. Residents were left totally dependent on the exterior fire escape and the operable guest-room windows for escape. Since the fire escape was accessible only through the exit access corridors, this escape route was available only during the early portions of the fire. Guests located in rooms adjacent to the open stairway had to escape early if they were to get out at all because the transoms over their doors provided an ineffective fire barrier.

The delay in notifying the fire department played heavily in the deterioration of conditions within the corridors. Heavy smoke developed quickly, obscuring visibility and contributing to the deaths of the two individuals who were found in the corridor at the door to the second-floor fire escape. It appears that these victims were unable to locate and unlock the screw-eye-and-hook that held the door shut; their finger and hand impressions were found in the soot deposit on the door's surface from base to knob. The screen door, opening as it did back into the corridor, could also have complicated their escape attempt. The fire escape door had to be pried open from the outside by fire department personnel. Second-floor residents who managed to use the fire escape reached it through a corridor window that the resident of Room 9 broke.

The delay in fire department notification may also have played a part in the death of the resident who jumped from his third-floor window before the fire fighters began their rescue efforts.

Performance of Fire Protection Features

The corridor smoke detection system alerted residents soon after the fire entered the interior stairway. However, the unprotected vertical openings created by the unenclosed stairs and the combustible interior wall finish materials soon negated the benefits of this early warning.

Guest-room doors with operable glass transoms performed differently in different portions of the building. Where fire did not directly involve them, the transoms and doors served as reasonably effective smoke barriers. However, they became ineffective when fire impinged on them. In fact, burn patterns indicate that fire initially spread into some guest rooms through transom openings.

This could have been the case in the room of the occupant who jumped from his window early in the fire. His action might indicate that conditions within the room were already untenable. The room was immediately adjacent to the third-floor stairway opening, and flames could be expected to have impinged directly on the door and transom early in the fire.

Two occupants died trying to open the second-floor door to the rear fire escape. Fire fighters eventually forced it open from the outside.

Contrast the actions of the man who jumped with those of the woman in a second-floor room shielded from direct fire spread by the mid-corridor janitor's closet. The woman, who was on medication, slept through the alarm and awoke at 4:35 am. She smelled smoke, opened the room door, encountered heavy smoke in the corridor, closed the door, went to the window, and was immediately rescued by fire department personnel.

Code Analysis

Because the building that housed the Elliott Chambers boarding house was constructed around 1900, it was not subject to building code requirements. In light of the life safety problems observed in the aftermath of this fire, however, the NFPA wishes to apply the requirements of the 1981 edition of NFPA 101, the Life Safety Code®, and the 1984 edition of the Basic/National Building Code (B/NBC) to the building in order to show what protection features might have been present in the building had the codes been applied. The areas addressed do not include every code section that might apply to a building of this type, but they do address the sections


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that are believed to have the greatest impact on life safety problems.²

Although the Elliott Chambers has been referred to throughout this report as a boarding house, the number of occupants it contained places it, by Life Safety Code and B/NBC definition, in the category of a hotel occupancy. The Code states that a lodging or rooming house can provide sleeping accommodations for just 15 persons or fewer, while the B/NBC allows this type of occupancy to provide sleeping accommodations for 6 persons or more. The protection features discussed here are those that the codes used in the analysis require for new and existing hotels.

1) Vertical Opening Protection. The Code provisions for both new and existing hotels are similar. Paragraphs 16-3.1.1, which deals with new hotels, and 17-3.1.1, which deals with existing hotels, require that every stair- way be enclosed or protected in accordance with the requirements found in Chapter 6 for compartmentation. Paragraph 17-3.1.1 specifically references Section 2-9 as an alternative to the enclosure requirements presented in Section 6-2.2. Section 2-9 requires that every vertical exit and any other vertical opening between the floors of a building be suitably enclosed or protected, to allow occupants to use the exits in reasonable safety and to prevent the spread of fire, smoke, or fumes from floor to floor before the occupants have had a chance to escape. The Code does not allow new hotels to use this alternative to the more stringent enclosure requirements listed in Chapter 6.

The B/NBC also requires enclosure. Section 804.0 of B/NBC and the Basic/National Existing Structures Code (B/NESC)³ specifies that the enclosure should have a one-hour fire resistance rating.

The open stairways of the Elliott Chambers did not meet these code requirements. They created unprotected, unenclosed vertical openings that were not separated from all other portions of the building.

2) Number and Types of Exits. Paragraphs 16-2.4.1 and 17-2.4.1 of the Code require that at least two exits be accessible from every floor. Although the list of exits allowed by the Code for an existing hotel does not include fire escape stairs, Paragraph 17-2.2.2 does allow continued use of existing fire escape stairs subject to the approval of the authority having jurisdiction.

The B/NBC treats the use of a fire escape in a similar manner, and its Section 809.0 also requires two accessible exits from each floor. The B/NESC requires two exits in most cases, as well.

³ The 1981 edition of the Life Safety Code and the 1984 edition of B/NBC were used for this analysis so that the conditions at the Elliott Chambers on the date of the fire could be compared to the latest edition of the codes. It is recognized that these codes were not in effect in Beverly during construction or operation of the Elliott Chambers.

3) Interior Finish. Code Paragraphs 16-3.3.1 and 17-3.3.1 limit interior finish materials in hotel occupancies as follows:

<table>
<thead>
<tr>
<th>New</th>
<th>Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vertical exits</td>
<td>Class A</td>
</tr>
<tr>
<td>b. Exit access</td>
<td>Class A or B</td>
</tr>
<tr>
<td>c. Lobbies, corridors</td>
<td>Class A or B</td>
</tr>
<tr>
<td>that are not exit access</td>
<td></td>
</tr>
<tr>
<td>d. Individual guest</td>
<td>Class A, B, or C</td>
</tr>
<tr>
<td>rooms and other rooms</td>
<td></td>
</tr>
</tbody>
</table>

Section 1421.0 of the B/NBC calls for similar control of interior finish materials. Typically, thin plywood wall covering such as that found throughout the Elliott Chambers rates no better than a Class C material.

4) Detection and Alarm System. Code Paragraphs 16-3.4.1 and 17-3.4.1 require that an alarm system be provided in new and existing hotels in accordance with Section 7-6. New hotels must also provide a corridor smoke detection system.

B/NBC Section 1716.0 requires that an automatic fire alarm system with single-station smoke detectors be installed in every room in which someone will be sleeping. The B/NESC requires single-station smoke detectors in sleeping rooms in buildings that need not have a complete automatic alarm system.

The Elliott Chambers did not comply fully with these code requirements: the building had no manual alarm pull stations. During the fire, however, its corridor smoke detection system performed the required alarm function and notified residents of the fire.

5) Fire Department Notification. Code Paragraphs 16-3.4.6 and 17-3.4.4 require that provisions be made to notify the public fire department immediately if a fire by telephone or some other means. During the Elliott Chambers building fire, the smoke detection alarm had reportedly sounded by 4:05 am, but the fire department did not receive notice of it until 4:18 am from a passing policeman.

6) Doors and Closers. Code Paragraphs 16-3.6.2 and 17-3.6.2 require that each guest-room door that opens onto an interior corridor have a fire protection rating of at least 20 minutes. In new hotels, the doors are also required to resist the passage of smoke. These two paragraphs further require that doors between guest rooms and corridors be self-closing. Paragraph 16-3.6.5 prohibits transoms in the partitions of sleeping rooms in new hotels, while Paragraph 17-3.6.5 requires that existing transoms installed in the corridor partitions of sleeping rooms be fixed in the closed position and covered or otherwise protected to provide a fire resistance rating at least equal to that of the wall in which they are installed.
Sections 810.4.2 and 812.5.6 of the B/NBC have similar requirements for the fire protection rating of doors and the provision of self-closers. In Paragraph 5-2.1.2.1.2, the Code also requires that a latch or other fastening device installed on a door be provided with a knob, handle, panic bar, or some other simple type of releasing device whose method of operation is obvious even in darkness.

The door to the Elliott Chambers fire escape had no simple releasing device. The building’s transoms did not meet code requirements. Its doors were not self-closing.

7) Emergency Lighting. Code Paragraphs 16-2.9.1 and 17-2.9.1 require that any hotel with 26 or more rooms have emergency lighting in accordance with Section 5-9. Sections 804.0 and 824.0 of the B/NBC require egress lighting, as well. Emergency lighting was present at the Elliott Chambers.

Summary

The ignition scenario, the open stairway, the combustibility of the interior finish, and the delay in notifying the fire department were the major factors contributing to loss of life in this fire. Additional contributing factors include the screw-eye-and-hook catch mechanism that secured the second-floor fire escape door and the operable glass transoms over the doors between the guest rooms and corridors.

Factors that helped limit further loss of life and injuries were the operable guest-room windows, which allowed residents to ventilate their rooms and facilitated rescue operations by first-responding fire department personnel, and the corridor smoke detection system. This system performed its intended function. Given that the fire originated outside the building entrance, however, there was not enough smoke in the corridors to operate the detectors until the fire had grown in the outside alcove, broken the windows above the door, entered the building, and traveled up the open stairway. This rapid fire spread, fueled by combustible interior finish materials, negated the early warning the detection system provided by quickly making the corridor, the guests’ means of egress, untenable.

This fire again illustrates some common problems, such as unprotected vertical openings and, to a lesser degree, combustible interior finish materials, associated with hotel and boarding house fires. The primary factors that led to the fatalities at the Elliott Chambers were similar to factors that resulted in 10 deaths in Greece.

HOW THE INVESTIGATION WAS DONE

The NFPA became aware of the Elliott Chambers fire on July 4, 1984, the day it occurred. On July 5, 1984, Ron Coté, NFPA Life Safety Specialist, Thomas Klem, NFPA Director of the Fire Investigations and Applied Research Division, and Tom Timoney, NFPA Fire Protection Specialist, visited the site to document the facts related to the fire. Their two-day, on-site study and the subsequent analysis of what was found during and after the study formed the basis of this report and of the NFPA’s analysis of the event. It is not the NFPA’s intention that this report pass judgment on, or fix liability for, the loss of life and property at the Elliott Chambers boarding house.

The NFPA investigators were assisted by Bruce Larcomb, a representative of the Building Officials and Code Administrators International (BOCA), under terms of an agreement they and two other model building code organizations have with NFPA to investigate significant structural fires in the United States. The other cooperating building groups are the International Conference of Building Code Officials and the Southern Building Code Congress International. The three code groups lend the NFPA technical staff support for on-site field work and building code analysis.

Funds for this study were provided by the Federal Emergency Management Agency/United States Fire Administration (FEMA/USFA), the National Bureau of Standards/Center for Fire Research (NBS/CFR), and the NFPA under the terms of their Major Fires Investigation Agreement. This agreement allows the NFPA’s Fire Investigations and Applied Research Division to investigate technically significant fires, document and analyze details of the incident, and report its findings for use in preventing future losses.

The Beverly Fire Department and the Massachusetts State Fire Marshal’s Office allowed the NFPA investigators to enter the fire scene and collect data. The cooperation and assistance of Chief Dean Palmer and Fire Prevention Captain Richard Jutras, Beverly Fire Department, and Massachusetts State Fire Marshal Joseph O’Keefe are acknowledged and appreciated.

Special thanks is given to BOCA’s Bruce Larcomb for his help in collecting data and his input to the code analysis portion of the report.

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<table>
<thead>
<tr>
<th></th>
<th>Unprotected Vertical Openings</th>
<th>Combustible Interior Finish</th>
<th>Delayed Alarm to Fire Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirkwood Lane¹</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Nashville, Tenn.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February 1, 1978</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halfway House²</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Washington, D.C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 11, 1979</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coats Rooming House³</td>
<td></td>
<td>X</td>
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</tr>
<tr>
<td>Pioneer, Ohio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November 11, 1979</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brinley Inn⁴</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bradley Beach, N.J.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 26, 1980</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donehue Adult Foster</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Care Home⁵</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Detroit, Mich.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>November 30, 1980</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beachview Rest Home⁶</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kearnsburg, N.J.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January 9, 1981</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 fatalities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


New York⁴ on November 26, 1978; in another 10 fatalities in Cambridge, Ohio⁵ on July 31, 1979; and in yet another 5 fatalities in Fort Worth, Texas⁶ on June 14, 1983. See Table 2 for additional boarding house fires.

Although the installation of automatic sprinklers was not required in this building by the NFPA 101 Life Safety Code or the BNBC, sprinklers probably would have affected the outcome of this fire. An automatic sprinkler system could have controlled or extinguished the fire and provided an alarm for notification of the guests. A supervised automatic sprinkler system would have made possible an earlier fire department response. The life safety record of similar facilities protected by complete automatic sprinkler systems is excellent.

The requirements contained in the Life Safety Code and other firesafety and building codes and laws are intended to mitigate such multiple fatality incidents. △