FIRE JOURNAL®

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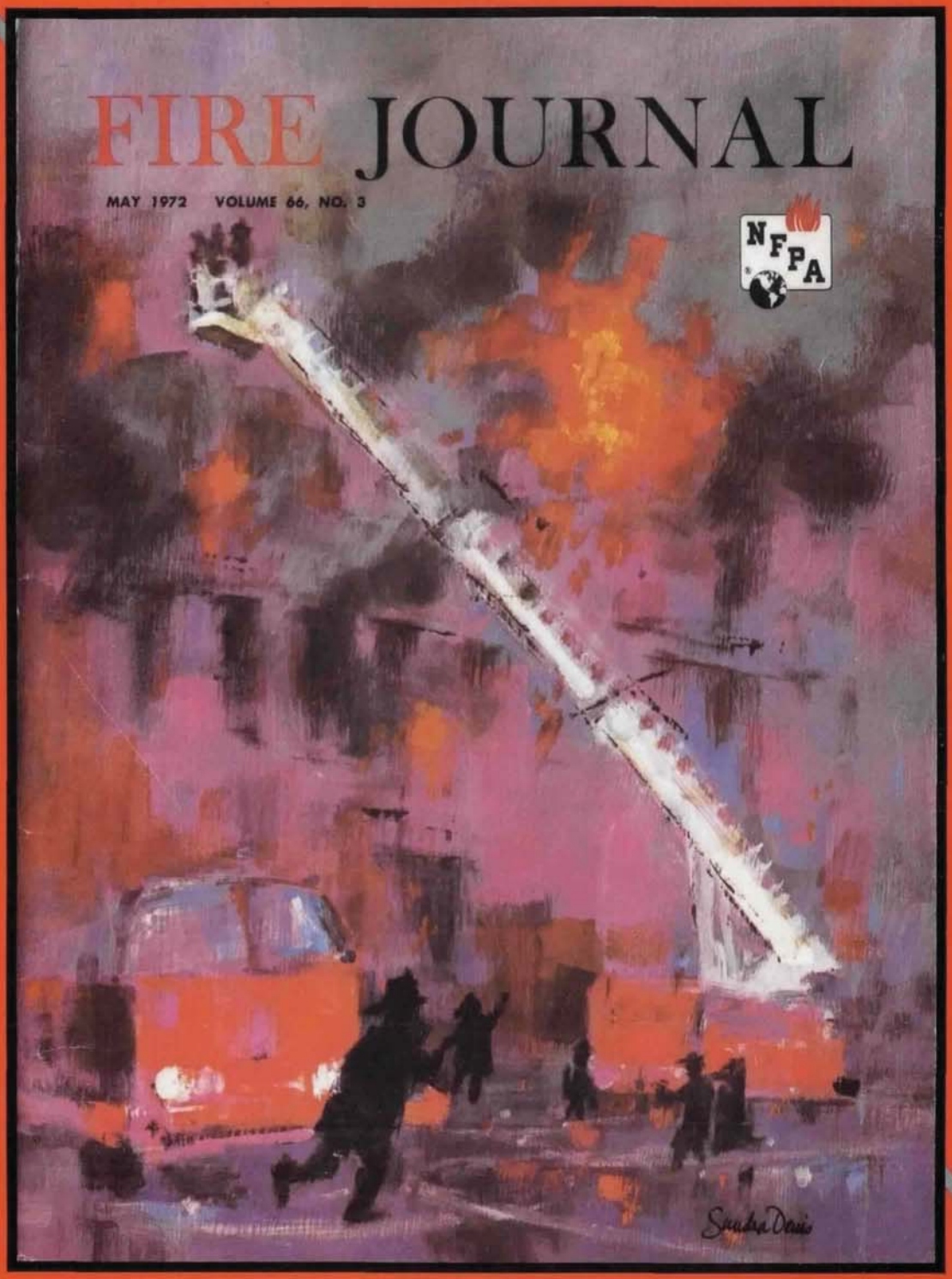


To mark Fire Journal's 20th anniversary, our 1985 covers showcase the best covers of the past 20 years.

ERRATA

Several errors in composition were made in the NFPA Investigation Report *Haunted Castle Fire Kills Eight* that begins on page 45.

In Paragraph 1 under the subheading Code Analysis on page 54, the following sentence is presented as a direct quotation from the 1981 edition of NFPA 101 *Life Safety Code:*

> "The floors of means of egress shall be illuminated at all points including angles and intersections of passageways and exit doors to values of not less than 1 footcandle measured at the floor."

Since this paraphrases Section 5-8.1.3 of NFPA 101 and it is not a direct quotation from NFPA 101, it should not appear in quotation marks.

In Paragraph 2 on page 55, the following sentence is presented as a direct quotation from the 1981 edition of NFPA 101 *Life Safety Code:*

> "Emergency lighting facilities shall be arranged to maintain not less than 1 footcandle of illumination throughout the means of egress for a period of 1½ hours in the event of failure of the normal lighting."

Since this paraphrases Section 5-9.2.1 of NFPA 101 and it is not a direct quotation of NFPA 101, it should not appear in quotation marks.

NFPA INVESTIGATION REPORT

NFPA

Fire in Haunted Castle Kills Eight

JOHN BOUCHARD

In the early evening hours on May 11, 1984, a rapidly spreading fire destroyed the Haunted Castle amusement facility at the 200-acre Six Flags Great Adventure Park in Jackson Township, New Jersey. At the time of the fire, there were three employees and an estimated 28–34 visitors in the Haunted Castle. Eight of the visitors, unable to immediately exit from the structure, died in the fire.

The one-story structure was comprised of 17 commercial trailers that measured approximately 8 feet wide by 40 feet long by 8 feet high, connected together by means of plywood and wood framing. The front facade of the structure consisted of a wall

John Bouchard is Assistant Division Director in the NFPA's Engineering Services 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.

INVESTIGATION REPORT: HAUNTED CASTLE FIRE

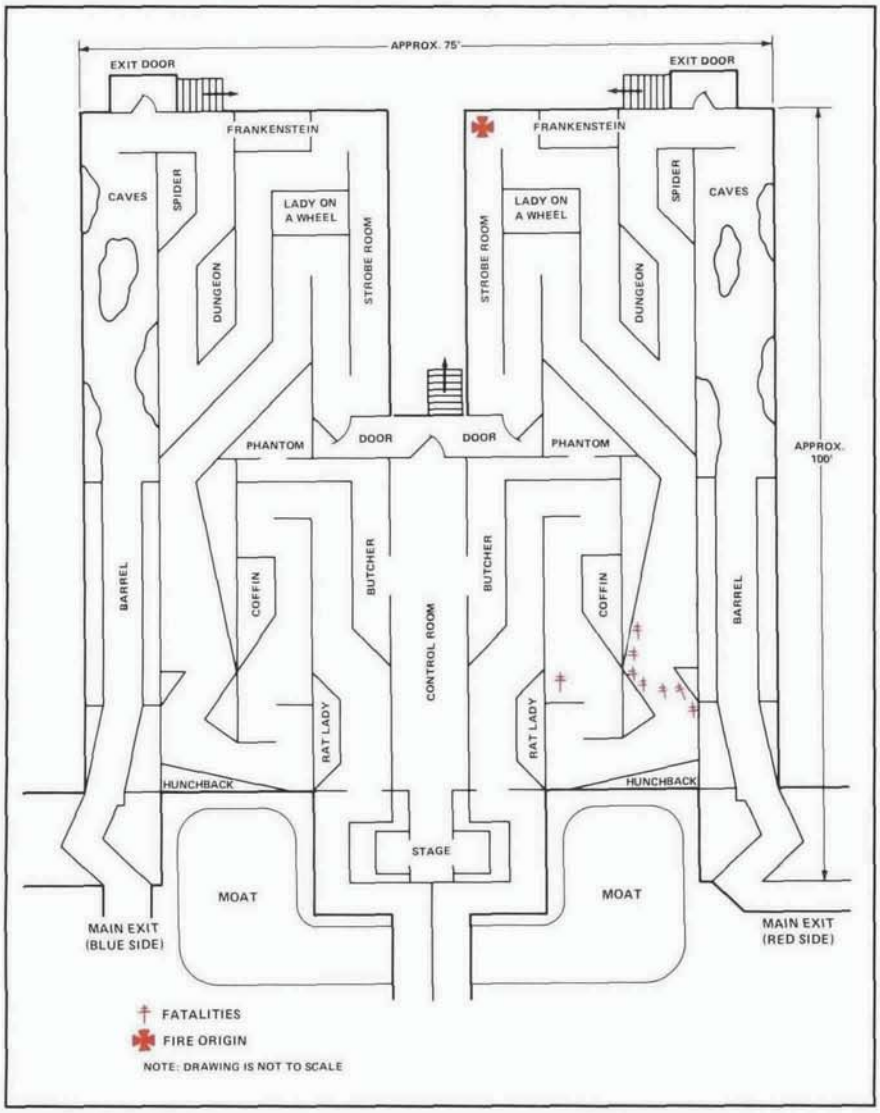


Figure 1. Floor plan of Haunted Castle. Shaded area indicates the Red Side, which was open on the day of the fire.

approximately 35 feet high by 109 feet long, with three smaller portions that projected into the park area.

The interior of the Haunted Castle was constructed of plywood partitions that created a convoluted path of travel approximately 450 feet long. Materials used for the interior of the Haunted Castle included synthetic foam, various fabrics and plastics, plywood, and tarpaper.

The structure had a total of seven exits, including the main entrance. Fire protection features included emergency lighting and portable fire extinguishers. No automatic detection or automatic sprinkler protection was provided in the facility.

County fire investigators determined that the fire was caused by accidental ignition of a wall-mounted polyurethane foam pad by a cigarette lighter.

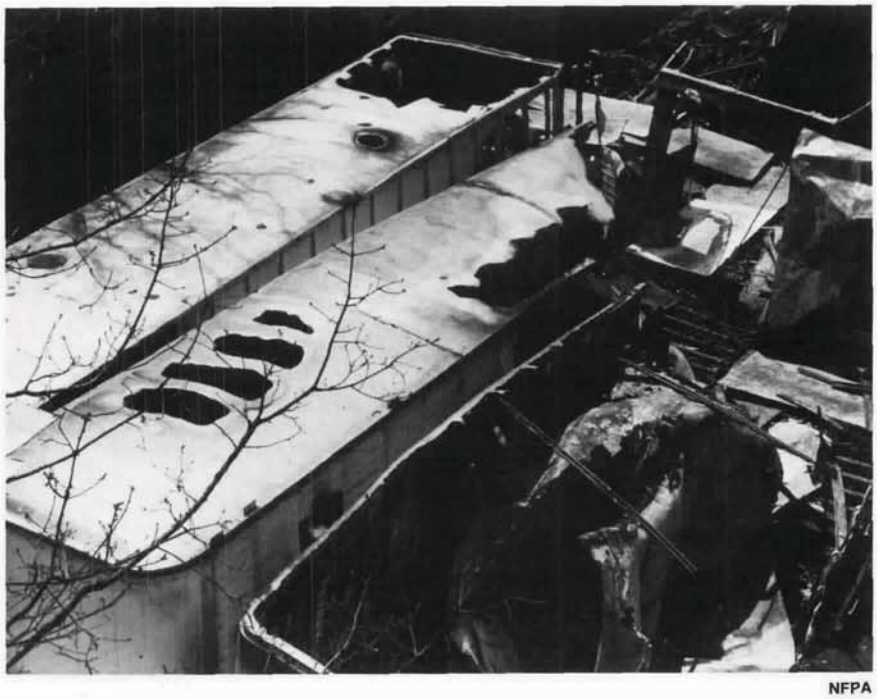
The Facility

The Six Flags Great Adventure Park is located in Jackson Township, New Jersey, approximately 50 miles south of New York City. The park offers visitors a wide variety of amusement rides, shows, and special entertainment events. During 1983, more than 3.3 million people visited the park.

In the fall of 1978, a Haunted Castle facility consisting of four trailers was located at the park for several weeks. The attraction proved to be popular and a larger 17-trailer Haunted Castle facility was erected at the park in early 1979. In 1980, the facility was air-conditioned and in 1981, the interior of the Haunted Castle was refurbished. Since the Haunted Castle opened in 1978, approximately 7.4 million visitors had ventured through it.

The Haunted Castle facility was a single-story structure comprised of

Photo 1. Overview from the rear, showing the configuration of the trailers.



NFPA

17 used commercial trailers of various manufacture plus a wood-frame facade. Fifteen were box trailers, and two were open flatbed trailers. The trailers had been fabricated using either steel or aluminum bodies, with wood floors and ¼-inch plywood riveted to the interior of the trailer frame. Each box trailer measured approximately 8 feet wide by 40 feet long by 8 feet high. The two flatbed trailers were approximately 35 feet long. The trailers were arranged in a symmetrical fashion, forming two rectangular sections. The spacing between the trailers varied from as little as a few inches to as much as 2½ feet (see Figure 1 and Photo 1).

The trailer portion of the building was divided into two identical eight-trailer (mirror-image) sections, each of which constituted a complete and separate Haunted Castle. One or both of the sections (known as the Red Side and the Blue Side) could be in operation, depending on the crowd size. The seventeenth trailer served as the control room where employees donned their costumes and make-up prior to participating as haunted-house characters. The control room contained electrical panels for both mirror-image sections of the Haunted Castle, as well as tables and chairs, lockers, a telephone, and two pressurized water fire extinguishers.

The trailers were connected by means of plywood and wood framing. The interiors were designed to simulate the atmosphere of a Haunted Castle through the use of a darkened, convoluted series of passageways that were intended to disorient and frighten visitors for amusement purposes as they progressed through the facility.

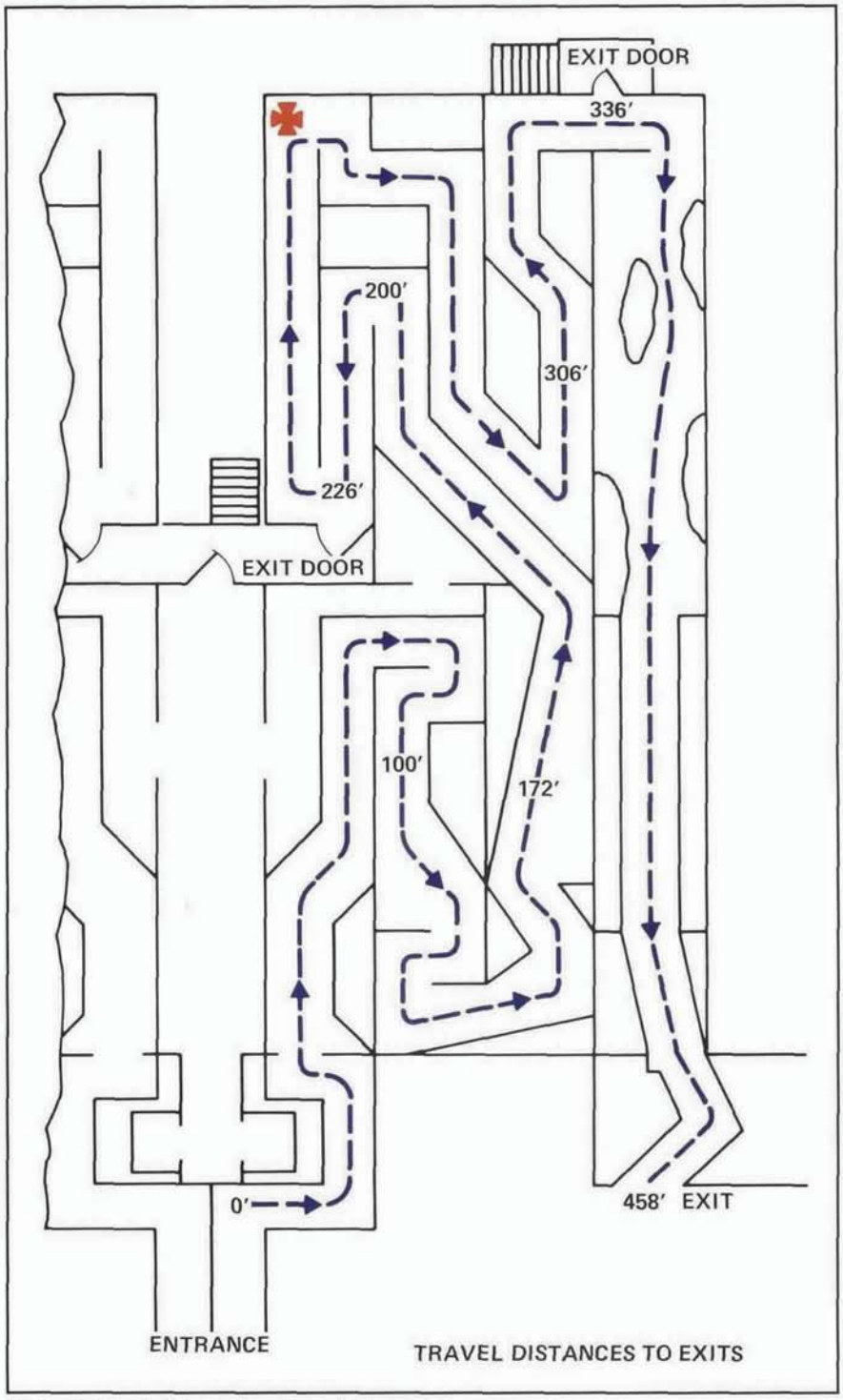


Figure 2. Travel distances to exits in feet.

A facade providing a castle-like appearance was built in front of the trailers and contained the main entrances and exits for each of the two sections. The facade was composed of a wall approximately 109 feet long and 35 feet high, with three attached smaller structures that projected into the park area. The total area of the facade was approximately 1,128 square feet. The facade was of unprotected wood-frame construction. Its walls were constructed of wood studs placed 16 inches on center, covered with plywood and composite sheathing board, while the roof was formed from prefabricated wood trusses. In the main exiting areas of the facade, studs that formed the interior walls were exposed. These areas provided space for displays and included a wooden ramp. The front of the facade had an exterior finish consisting of sprayed and painted urethane foam. In some areas, wire mesh with 55-gallon drums were arranged in various shapes and sprayed to achieve the desired effect. The rear of the

facade was constructed of ½-inch plywood with a tarpaper covering to provide weather resistance.

General interior construction in the trailer portions of the facility included plywood and wood stud partitions and ceilings of plywood-on-wood structural members suspended below the trailer roofs. Other available construction details are noted later in this report.

Entering the darkened, convoluted passageways, visitors first encountered a rat lady, a butcher, and then a coffin display (see Figures 1 and 2). The butcher display was designed to be manned by an employee who entered the display through a passageway connected to the control room. The interior walls of the display area consisted of 2-inch-by-3-inch wood studs on which ½-inch plywood sheets, painted black, had been nailed. Some of the displays were protected from visitor damage by plexiglass windows, metal grates, and bars.

Continuing further through the Haunted Castle, visitors encountered a Phantom of the Opera display and then a corridor with strobe lights. Wood partitions in this area were constructed of 2-inch-by-3-inch wood studs covered by ¼-inch plywood, and the ceiling here was also finished with ¼-inch plywood. Synthetic foam (identified as polyurethane during the investigation by Ocean County authorities) had been installed on the walls to provide bumper protection for visitors traveling through the strobe-lighted corridor.[1] An emergency exit door was located at the beginning of the strobe light corridor, approximately 226 feet from the entrance. The door was equipped with panic hardware and marked with a lighted exit sign adjacent to the exit.

The next area that the visitors encountered was the spider room and the second emergency exit door, which was approximately 336 feet from the main entrance. This exit door was also equipped with panic hardware and marked with a lighted exit sign located adjacent to the exit. The interior of the spider room consisted of loosely applied tarpaper and fabric from which spider-like webs had been suspended. In that area were two human-like figures constructed of papier-mache and an assortment of various-sized rubber spiders. Special effects were achieved with low-wattage colored lights and small motors that moved the webs and spiders.

Visitors then entered a tunnel, cave-like passage. This passage was constructed of 2-inch-by-3-inch wood stud partitions that were arranged in rough shapes and heights. Tarpaper was stapled to the partitions and wire mesh was fastened over it. A plaster mix was applied over the wire mesh and painted.

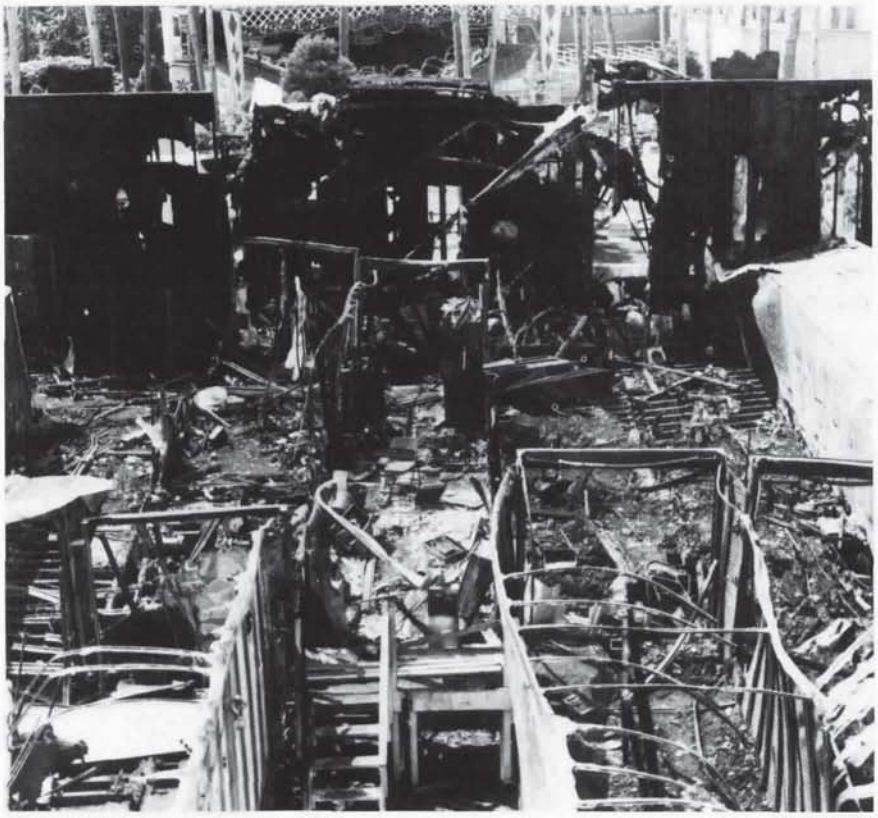


Photo 2. Exterior view of the left front, showing the facade construction and a display figure. NFPA

The final area that the visitors encountered was different, because it was built on a flatbed trailer. A fiberglass barrel, approximately 7 feet in diameter and 20 feet long, was mounted on the flatbed trailer. The barrel was supported from the bottom by tires that were inflated and mounted on their rims. One wheel, driven by an electric motor, provided rotation of the barrel using a gear/chain arrangement. This flatbed trailer was covered by a wood-frame structure. After passing through this area, visitors traveled a short distance and left the Haunted Castle through a main exit at the front.

In addition to the exit facilities described earlier, fire protection provisions included emergency lighting arranged to illuminate interior passageways in the event of power failure; due to the extent of fire damage, further details were not determined by the NFPA. No detection and alarm systems or automatic sprin-

[1] Exact dimensions of the foam bumper could not be obtained during the investigation because the material was consumed by the fire. The estimated overall dimensions were 3½ feet wide by 5 feet high, based on burn pattern observation.

klers were installed in the facility.

The Park Fire Brigade

The Great Adventure Park maintains a fire brigade that operates a 750-gpm pumper equipped with a 750-gallon booster tank. Two men are assigned to each shift, and additional manpower and equipment are provided through a formal mutual-aid plan with Jackson Township. Public fire protection in Jackson Township is provided by four volunteer fire companies.

Water Supply

The Great Adventure Park has its own water system maintained by the Jackson Municipal Utilities Authority. A one-million-gallon storage tank located at ground level supplies water to the park's underground water mains and fire hydrants. Water for the ground-level storage tank is supplied by pumps from artesian wells. Investigators were unable to collect any detailed data on the water supply system; however, fireground officers stated that the water supply was not a problem during the fire.

The Fire

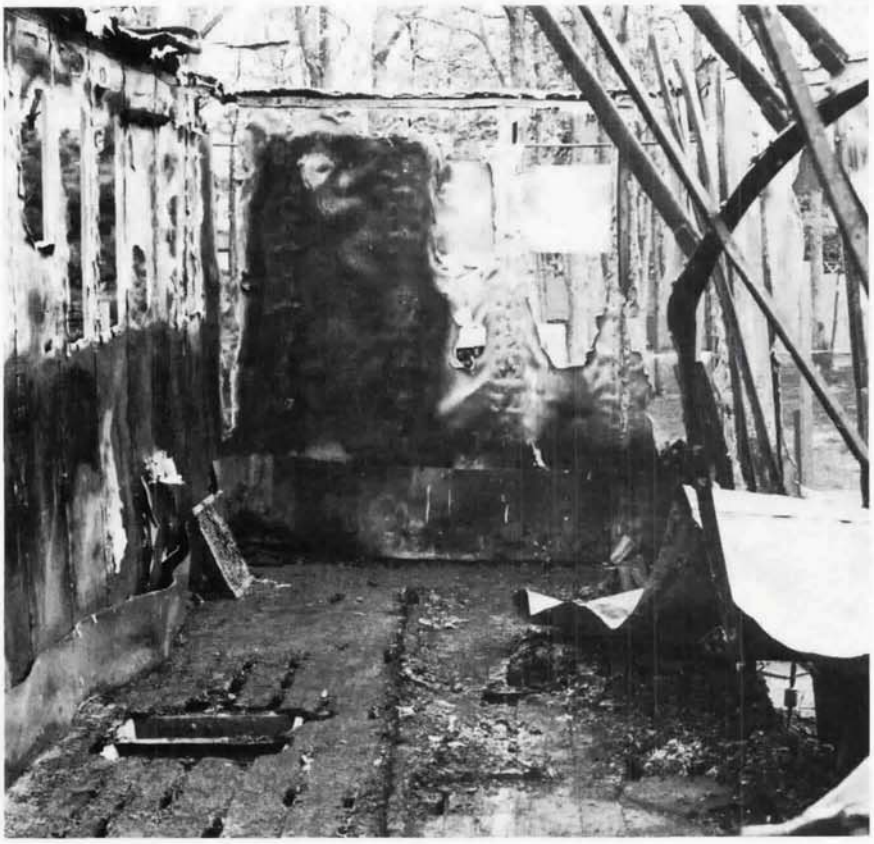
On Friday, May 11, 1984, an average crowd of approximately 15,000 visitors thronged the Great Adventure Amusement Park. One of the two mirror-image sections (the right-hand or Red Side) of the Haunted Castle (see Figure 1) was open to the public, and three employees were on duty there.

A line of visitors was waiting to travel through the Haunted Castle, and employees were allowing approximately 10 visitors to enter per minute. At the time of the fire, it was estimated that there were about 30 visitors in the facility, based on an estimated travel time of approximately 3 minutes through this attraction. At approximately 6:30 pm, an employee positioned at the butcher display smelled smoke. He went to investigate and entered the passageway connecting the butcher display to the Phantom of the Opera display. As the employee traveled through the passageway, he saw heavy smoke coming from the Phantom area and went back through the butcher display to the main gate to alert the other employees and instruct them to discontinue further entry of visitors. He then re-entered the Haunted Castle, went to the control room, and notified the Great Adventure Fire Brigade by telephone, then left the Haunted Castle by way of the control room door. Looking to his right, he saw smoke and flames around the emergency exit door located at the strobe room. Meanwhile, an adult visitor traveling through the darkened passageways discovered the fire, ran through the remainder of the castle, and alerted an employee at the front entrance.

Specific details on visitor evacuation were not determined; however, individuals and groups of visitors apparently left by way of the main entrance, the main exit, and both rear exits. One visitor was rescued from the coffin area by an employee. (See also the "Analysis" section of this report.)

Photo 3. Area of fire origin. A synthetic foam pad was located over the darkened area in the left center of the photograph.

NFPA



Fire Brigade Operations

The Great Adventure Fire Brigade received telephone notification of the fire in the Haunted Castle at 6:35 pm. While en route to the scene, the captain, observing a heavy smoke condition, instructed security personnel to notify the Jackson Township Police Department and implement the mutual-aid plan.

Upon his arrival, the captain advanced a 1½-inch handline through the front entrance of the Haunted Castle. He was able to advance approximately 20 feet into the building when he encountered heavy fire conditions that forced him to withdraw. The captain then attacked the fire

from the rear of the trailers and later assisted mutual-aid fire department units.

Mutual-Aid Fire Departments

The Jackson Township Police Department received telephone notification of the fire at 6:41 pm, and two of the four Jackson Township volunteer fire companies were dispatched. The first mutual-aid company was located approximately four miles from the Park and arrived on the scene approximately 11 minutes after receiving the alarm. The second mutual-aid company, located approximately 15 miles from the park, arrived on the scene at 6:56 pm. These units were directed to enter through the employee gate and set up behind the Haunted Castle.

The first-arriving mutual-aid fire department units also attempted, unsuccessfully, to mount an interior attack on the Haunted Castle, then used 2½-inch handlines and master stream appliances to extinguish the fire from the exterior.

Fire-fighting operations eventually involved a total of 15 mutual-aid fire department units and 300 fire fighters before the fire was declared under control shortly after 7:45 pm.

Damage and Casualties

The 17 trailers and the facade that comprised the Haunted Castle facility were destroyed by the fire.

According to the Ocean County Coroner's office, eight young adults, who ranged in age from 15 to 19, died as a result of smoke inhalation and carbon monoxide poisoning. Seven of the victims were found in the corridor near the hunchback display; the eighth victim was found in the vicinity of the coffin display (see Figure 1).

Analysis

Investigators from the Ocean County Prosecutor's Office, the Ocean County Fire Marshal's office, and the New Jersey State Police determined that the cause of the fire was accidental ignition of polyurethane foam padding on the wall of the strobe room.

According to investigators, on the night of the fire a 14-year-old youth was using a lighter to illuminate his path of travel. Apparently, it was common practice for visitors in the Haunted Castle to light matches or lighters to illuminate their way. Reportedly, the employees were constantly instructing guests to extinguish the matches or lighters. The investigators also determined that a strobe light was malfunctioning on the day of the fire and failed to operate for periods of 3 to 4 minutes, leaving the corridor in total darkness. The youth accidentally walked into the foam pad on the strobe-room wall, setting it on fire. The youth then attempted to beat out the fire, but was unsuccessful, and apparently continued through the Castle.

NO AMUSEMENT PARK IS IMMUNE TO FIRE

Fatal theme park fires are rare. In fact, until the Haunted Castle fire of last year, the most recent multiple-death amusement park fire in the United States occurred in August 1964, when three children died in a funhouse in Wildwood, New Jersey. The 1964 fire took place in a darkened tunnel, as did the 1984 fire, and the children were trapped by the smoke and fire that spread through the structure.

Customizing any environment, even temporarily, can have a drastic impact on its fire-safety. In October 1973, for example, a "haunted house" was created for a Halloween carnival in two rooms of an elementary school in Prince William County, Virginia. The passageways of the attraction were constructed of flannel cloth panels eight feet long mounted on wood strips and sprayed with black lacquer-based paint. Thirty minutes before the children were to enter the haunted house, a lighting effects test ignited these combustible materials, and the ensuing fire killed one person and injured two others. If the lights had not been tested before the children arrived, the death toll could have been far higher.[2]

Many of the features that contributed to the large loss of life in the 1984 Haunted Castle fire and earlier fatal fires pose problems for every funhouse, permanent and temporary. Key fire hazards are combustible interior finishes, darkened passages that have no obvious access to exits, illusions or special effects that may delay recognition of a real emergency, and the lack of automatic detection and suppression systems and staff training for such emergencies.

Worlds of fantasy and fun must be built with a realistic idea of the fire hazards they create firmly in mind. Those who construct such fantasies should apply fire codes and standards, as well as engineered solutions, to the life safety problems these attractions pose. And state and local authorities must ensure that local codes are adequate and that they are enforced at all — even temporary — amusement parks and carnivals in their jurisdictions, including those hidden in out-of-the-way places.

[2] See "School's Haunted House Burns," FIRE JOURNAL, Vol. 68, No. 2 (March 1974), pp. 14–15.

Once ignited, the wall-mounted polyurethane foam pad burned rapidly and spread the fire vertically in the trailer corner. Fire spread down the strobe room corridor, further fueled by the plywood construction of the ceiling, floor, and walls. Once the fire had spread through the corridor, it extended past the Phantom of the Opera area and to other portions of the Haunted Castle.

Material identification tests and small-scale fire tests were performed on fire scene samples by the National Bureau of Standards/Center for Fire Research and the Consumer Products Safety Commission. Flexible foam samples were identified as polyurethane, and it was determined that the material did not show any of the elements normally used in flame retardants for foams of this type, suggesting that no such retardants were present. In addition, the foam was found to ignite readily with an approximately 1-second application of a small flame from a butane cigarette lighter. Because of the limited amount of foam available, no heat-release testing was possible.

Flame spread tests were conducted on two different plywoods, ¼-inch and ½-inch, using the Radiant Panel Test Method, ASTM E-162.[3] The ¼-inch plywood was found to be typical of untreated plywoods with a flame spread index near 200 (Class D). The ½-inch plywood sample was typical of fire retardant treated plywoods with a flame spread index near 40 (Class B). Treated plywoods such as these generally contribute little to a fire until near flashover, at which time they will burn, but even then they release energy substantially slower than untreated plywood.

[3] This test method is generally recognized for research and development purposes only, and is useful for such research work as fire investigations because smaller sample sizes can be used. It should be noted that the ASTM E-162 method does not correlate well with NFPA 255 (ASTM E-84), *Method of Surface Burning Characteristics of Building Materials*, which is referenced by such codes as NFPA 101, the *Life Safety Code*®.

Investigators determined that the victims were traveling through the Haunted Castle in two groups. As the first group of five teenagers made its way through the darkened passages, it passed the hunchback display and then a view of the revolving barrel.[4] As the five visitors were nearing the Phantom of the Opera exhibit, they encountered smoke and heat. Investigators believe it was most likely at this point that they started to retreat back through the darkened passageways.

Meanwhile, a second group of four young adults was still advancing through the Haunted Castle and was approaching the revolving barrel display when it met the first group of teenagers in retreat. All nine visitors then attempted to reverse their path and exit through the main entrance of the Haunted Castle.

Two of the nine visitors were able to retreat as far as the coffin display when they were overcome by smoke and collapsed. A Great Adventure employee was able to rescue one of these two visitors. The other seven victims were found in a corridor near the hunchback display.

A review of employee actions during the early stages of the fire indicates there was a delay of approximately five minutes between the time the employee working in the Haunted Castle at the butcher display first smelled smoke (approximately 6:30 pm) and the time he telephoned the Great Adventure Fire Brigade at 6:35 pm. The fire by this point was well established, as the captain of the Fire Brigade reported observing heavy smoke while en route to the scene. By the time the two Fire Brigade members arrived at the front of the Haunted Castle and one of them advanced a 1½-inch handline through the entrance, the fire was already of such intensity that the captain was only able to progress approximately 20 feet into the structure before he was driven back by intense heat.

[4] Visitors were able to view the barrel from the adjacent passageway.

It was not until 6:41 pm that the first mutual-aid fire department units from Jackson Township were dispatched. The first of these units did not arrive on the scene until approximately 6:52 pm, at which point the structure was fully involved in fire.

Code Analysis

The following discussion is presented in order to compare life safety problems observed in this fire with the requirements of the 1981 edition of NFPA 101, the *Life Safety Code*®, (the *Code*) and the 1984 edition of the BOCA 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 structure of this type, but include those areas believed to have the greatest impact on the life safety problems.[5]

Before a code analysis could be made, the Haunted Castle's use group or type of occupancy under each code had to be determined. Sections 8-1.4.1 and 9-1.4.1 of the *Code* classify this occupancy as a Class C place of assembly, while Section 302.4 of the B/NBC classifies this occupancy as a use group A-3 place of assembly. The requirements discussed below address the application of protection features for both new and existing places of assembly, as specified in the codes used in the analysis:

1. *Means of Egress Lighting*. The *Code* provisions for both new and existing assembly occupancies are the same. Sections 8-2.8 (new) and 9-2.8 (existing) require compliance with Section 5.8, which states: "The

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[5] The 1981 edition of the *Life Safety Code* and the 1984 edition of the BOCA Basic/National Building Code were used for this analysis so that the conditions at the Great Adventure Park on the date of the fire could be compared to the latest editions of the codes. It is recognized that these code editions were not in effect in Jackson Township during the construction of the Haunted Castle facility. In this jurisdiction, the *Code* was not adopted; however, the 1981 edition of the Basic/National Building Code was in effect at the time of the fire.

floors of means of egress shall be illuminated at all points including angles and intersections of passageways and exit doors to values of not less than 1 footcandle measured at the floor." Section 824.0 of the B/NBC also requires that all means of egress be illuminated so that the intensity of floor lighting is not less than 1 footcandle.

2. *Emergency Lighting. Code* Sections 8-2.9 (new) and 9-2.9 (existing) require compliance with Section 5-9, which states: "Emergency lighting facilities shall be arranged to maintain not less than 1 footcandle of illumination throughout the means of egress for a period of 1½ hours in the event of failure of the normal lighting." The B/NBC requires, in Section 824.4.1, that means of egress lighting be connected to an emergency electrical system to assure continued illumination for a duration of not less than one hour in case of primary power loss.

3. *Interior Finish. Code* Sections 8-3.3 (new) and 9-3.3 (existing) require means of egress corridors to have a minimum of a Class B interior finish in accordance with Section 6-5. Section 6-5.1.5 defines Class B interior finishes as those with a flame spread of 26–75 and smoke development of 0–450 as determined by NFPA 255, *Method of Test of Surface Burning Characteristics of Building Materials*. Table 1421.5 of the B/NBC requires means of egress corridors to have a minimum of a Class I interior finish, which corresponds to flame spread ratings determined by the ASTM E-84 test. Section 1421.5.3 defines Class I as having a flame spread of 0–25.

4. *Exit Marking. Code* Sections 8-2.10 (new) and 9-2.10 (existing) require means of egress to have signs in accordance with Section 5-10, which states that access to exits be marked by readily visible signs in

HOW THE INVESTIGATION WAS CONDUCTED

The NFPA, with assistance from the Building Officials and Code Administrators International, Inc. (BOCA), investigated the Haunted Castle amusement facility fire at the Six Flags Great Adventure Park in Jackson Township, New Jersey, in order to document and analyze significant factors that resulted in the rapid spread of the fire and loss of life.

This study was conducted under a major fires investigation agreement between 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 that 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 life safety and loss prevention purposes.

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

The NFPA became aware of the Haunted Castle fire on the night it occurred. John Bouchard, Assistant Division Director of Engineering Services, and William D. Dupler, Staff Engineer, BOCA, traveled to the Six Flags Great Adventure Park to document the facts related to the fire.[6] A two-day on-site study and subsequent analysis of the fire are the basis of this report. Data-collection activities were made possible by the cooperation of the Ocean County Fire Marshal's office.

This report is another of the 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 the NFPA's intention that this report pass judgment on, or fix liability for, the loss of life in the Haunted Castle amusement facility fire. The report describes fire protection conditions at the facility and presents findings on factors contributing to the rapid spread of the fire and loss of life based on the NFPA's analysis of the collected data and observations made during the investigation. The cooperation and assistance of John Garcia, Ocean County Fire Marshal, are greatly appreciated.

Special thanks are extended to William D. Dupler, Staff Engineer, BOCA, for his on-site assistance in the data-collection phase and for his input into the code analysis.

[6] Mr. Dupler has since left the employ of BOCA.

(Continued on page 81)

INVESTIGATION REPORT: HAUNTED CASTLE FIRE

(continued from page 55)

cases where the exit or way to reach it is not immediately visible to the occupants. Section 5-10 further states that every exit sign shall be suitably illuminated and shall be visible in both the normal and emergency lighting mode. Section 823.0 of the B/NBC requires that all required means of egress be indicated with internally illuminated signs reading "EXIT," visible from the exit access and, when necessary, supplemented by directional signs in the exit access indicating the direction and way of egress. Section 823.4 requires that all exit signs be illuminated at all times when the building is occupied and be connected to an emergency electrical system.

Life Safety Problems

Some evidence in this fire indicates special life-safety problems related to the darkened, haunted-house type of environment. Some of the visitors seemed to initially accept a smokey condition as part of the environment, and one group of youngsters within the structure apparently viewed the actual fire in its incipient stage and remarked how real the *illusion* seemed . . . only to comprehend on closer examination that the fire was real. These facts would appear to support the necessity for both early detection and alarm systems in such a facility to: 1) establish that an emergency situation exists, and 2) activate emergency lighting to facilitate an orderly evacuation from an otherwise darkened environment.

This facility was designed with a darkened, convoluted series of passageways without a clear line of sight toward exits. This arrangement, typical of this type of amusement facility, may require special considerations in the design, arrangement, and marking of exits.

As exemplified by the fire growth and development in this facility, where combustible interior finishes and contents had been used to create passageways and displays, automatic sprinklers could have controlled the fire in the incipient stage, allowing time for safe evacuation.

Summary

The ignition scenario, involving synthetic foam at the point of fire origin, the combustibility of the interior finishes and contents, and the lack of detection and extinguishment of the fire in its incipient stages contributed to the loss of life in this fire. It is quite possible that even further loss of life could have occurred if both sections of the facility had been in operation at the time of the fire.

Special life safety problems exemplified in this fire may have contributed to the failure of some occupants to escape safely. These problems appear to be related to the haunted-house type of environment that utilizes a darkened, convoluted series of passageways. The application of code requirements and basic fire protection engineering principles would have greatly reduced the potential for fatalities in this fire.

The following are considered to be major factors contributing to loss of life in this fire:

- The failure to detect and extinguish the fire in its incipient stage by means of fixed fire detection and suppression systems;
- The ignition of synthetic foam material and subsequent fire and smoke spread involving combustible interior finishes and contents;
- The difficulty of escape by occupants because of fire conditions in the haunted-house type of environment. △