



SERVICES BUILDING

Brackenridge, PA

December 20, 1991



FIRE INVESTIGATIONS

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Summary Investigation Report

Four Fire Fighter Fatalities Brackenridge, Pennsylvania December 20, 1991

**Prepared by
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At 5:47 a.m. on Friday, December 20, 1991, the Pioneer Hose Company of Brackenridge, Pennsylvania responded to a report of a fire at the West Interior Services Building. First arriving fire fighters found smoke in and about the building, and the Pioneer Hose Fire Chief requested the assistance of the Hilltop Hose Company from a township adjacent to Brackenridge. Four of the Hilltop fire fighters entered the first story to search for extension of the fire that was burning in the basement. Approximately 40 minutes after the initial dispatch of Pioneer Hose, a section of the first-story floor assembly fell into the basement, cutting off the primary means of escape for the four Hilltop fire fighters. An ensuing fireball engulfed the four men, immediately killing them.

Publishers of the National Fire Codes® and National Electrical Code®

A non-profit membership organization dedicated to promoting safety from fire, electricity, and related hazards through research, codes and standards, technical advisory services, and public education since 1896.

The National Fire Protection Association cooperated with the Pioneer Hose Company, Hilltop Hose Company, Allegheny County Fire Marshal's Office, and the Bureau of Alcohol, Tobacco and Firearms (ATF) during the investigation of this incident. The purpose of the NFPA investigation was to document factors that may have led to the loss of the four fire fighters, to establish any lessons learned information, and to communicate those lessons learned to the fire service community and others interested in firesafety.

Background

The fire occurred in a two-story building that had a full basement and was approximately 65 ft x 75 ft. The exterior bearing wall assemblies included brick exterior components and terra cotta interior components. The first- and second-story floor assemblies were 2-1/2-inch-thick concrete slab placed over a wire mesh that was supported by unprotected metal beams. The beams were, in turn, supported by the exterior bearing walls or by large, unprotected metal girders, depending upon the beam's location within the structural frame. (See *Figure 1.*) Beam ends that were supported by the exterior walls were secured in place with mortar. However, beam ends that were supported by metal girders were layed on the girder and were not secured in place by any apparent means. Unprotected metal columns supported the floor assembly girders and assisted in the transfer of loads to the building's foundation.

The wood-frame roof assembly was also supported by large, unprotected metal girders. Unlike the floor assemblies, however, the entire roof load was carried to the exterior bearing wall by the girders. No columns were provided on the second story.

According to NFPA 220, *Standard on Types of Building Construction*, 1985 ed., the structure would be classified as Type III (200), i.e., ordinary construction.* The extensive amount of wood in the roof assembly does not allow the structure to be considered Type II, i.e., unprotected noncombustible, even though most structural members in the building were constructed with noncombustible materials.

The building was estimated to be 60 years old and had been occupied by more than one user. The current occupant, West Interior Services, a furniture refinishing company, had been in the building for only 8 years. The top story was used for storage of finished products, and the first story had both storage and office space. No fire detection or automatic fire suppression equipment was provided anywhere in the building.

All work on furniture was performed in the basement, which opened out to grade at the rear of the building. The basement production area was divided into several sections that included a dipping/stripping area, a machinery/equipment area, materials storage areas, and a finishing room. (See Figure 1.)

* NFPA 220, *Standard on Types of Building Construction*, 1985 edition. A Type III (200) structure would have a 2-hour fire rating for the exterior bearing walls (first digit); a 0-hour fire rating for structural frame or columns and girders supporting loads for more than one story (second digit); and a 0-hour fire rating for the story assembly (third digit).

The finishing room was approximately 30 ft x 30 ft and was designed to provide a clean environment to apply finishes and to contain the flammable vapors. Two spray booths were installed in this area and were vented to the exterior by an exhaust system. The exhaust duct carried the vapors along the interior west wall of the structure and exited the structure through the south wall. The duct then ran up the exterior wall and exhausted the vapors approximately at roof level.

The walls of the finishing room were constructed with gypsum wallboard on wood studs, framed into the building structure. Air intake filters were installed in one of the walls to provide for air intake. A set of double doors allowed for large pieces of furniture to be moved in and out of the finishing room.

Inside the finishing room was some shelving which appeared to be made of wood or metal. The shelving appeared to contain product for finishing in quantities of 1- and 5-gallon containers. The finishing materials included lacquer and lacquer thinner. A large quantity of aerosol containers was kept on a shelf in one corner of this room; these appeared to be touch-up paint and other special finishes. Other materials used in the finishing process were stored on shelves in the finishing room. A safety container for rags was provided in the room.

An area outside the double doors was provided for the storage of 35- and 55-gallon drums of flammable liquids, which were connected to a grounding system. Several other drums containing flammable and nonflammable liquids were stored throughout the basement area.

Approximately 1 month before this incident, the Pioneer Hose Company had elected a new fire chief, and he was in the process of adjusting the organization of the fire department. Reportedly, the former Pioneer Hose Company fire chief had visited the West Interior Services building during his years as fire chief. The purpose of those visits was to familiarize himself with the processes and operations and with the interior layout of the structure.

The Fire

At approximately 5:44 a.m., an employee of West Interior Services opened the first-story entrance door and found smoke in the building. He immediately called the fire department and then opened the exterior entrance door to the basement located in the back of the building. The employee found smoke in the basement also.

Pioneer Hose Company was dispatched to this fire at 5:46 a.m. The Pioneer Hose Company fire chief (C-50) responded directly to the scene, which was almost directly across the street from the Pioneer Hose Company fire station. (See *Figure 2*.) The chief found light smoke surrounding the building, and requested assistance from Hilltop Hose Company at 5:48 a.m. Because the fire was in his district, C-50 automatically became the incident commander, and responding units reported to him as they arrived.

While the incident commander was performing his size-up, Pioneer Hose Company fire fighters began to arrive at the scene and at the fire station. One fire fighter responded directly to the scene and entered the first story. He found that the floor slab only a few feet inside the first-story entrance

door was hot. This fire fighter decided that the fire must be in the basement and went to the rear of the building to access that area. By this time, the first Pioneer Hose Company engine (E-50) had arrived on the scene. The fire fighter who had found the hot floor slab joined with three other fire fighters equipped with a 2-in. attack line, and they entered the basement through a personnel door. The fire fighters found moderate to heavy grey smoke from the floor to the ceiling, but saw no flames at any time. They decided to attempt to open an overhead door in order to remove some of the smoke.

A second Pioneer Hose Company engine (E-51) also responded and was told to establish a water supply from a fire hydrant. This engine company experienced problems with the hydrant, and they informed the incident commander. He, in turn, requested that the Eureka Fire Department in Tarentum respond to assist in the establishment of a water supply.

While these activities were in progress, a Pioneer Hose Company assistant chief (C-53), who was responding from his home, arrived on scene and assumed responsibility for the interior operations on the first story. He and the property owner entered the building through the first-story front door and found light smoke, and soon after, both men left the building. Moments later, C-53 re-entered the first story with four fire fighters from the Hilltop Hose Company truck (T-33) that had arrived at the scene. Equipped with a hose line and forcible entry tools, the Pioneer Hose Company officer and the Hilltop Hose Company fire fighters began to search for fire extension to the first story.

Shortly after 6:00 a.m., a second Pioneer Hose Company assistant chief (C-5) arrived on scene and met with the incident commander. C-5 was assigned to supervise the activities at the rear of the building, and he confirmed the number of four Pioneer Hose fire fighters who had entered the basement. While these four fire fighters were attempting to open the overhead garage door, C-5 remained outside of the basement and monitored conditions at the rear of the building. As time passed, C-5 noted that the steady grey smoke coming out of the personnel door was quickly changing to heavy, hot, black smoke.

At approximately 6:11 a.m., C-5 ordered the Pioneer Hose Company fire fighters out of the basement. C-5 also told the incident commander over the radio that "this thing is going to light off soon, and this will roll." C-5 assigned some of these Pioneer Hose fire fighters to cut open the garage door from the outside, and he assigned the remaining fire fighters to open the basement windows on the Morgan Street side of the building in order to ventilate the basement. These fire fighters found light smoke coming out of the first few windows they opened. However, a large amount of hot, black smoke poured out of the last window they opened. This was the basement window closest to Brackenridge Avenue.

After providing water supply lines to E-51, the Eureka fire fighters assigned to this task advanced a second hose line to the rear of the building. By this time, C-5 had left the rear of the building, and the Pioneer Hose Company fire fighters had cut open the lower part of the overhead door. Several Eureka fire fighters equipped with the hose line prepared to enter the basement through that opening.

At about the same time, a second crew from Hilltop Hose Company was beginning to open second-floor windows using ground ladders. It was also about this time that C-53 (the assistant chief assigned to the first-story interior activities) found that a door on the first floor that led to the basement was hot. He had the four Hilltop fire fighters back their hose line away from the door and told them to stand by at their position in the event the fire burned through the door. The officer then left the building to confer with the incident commander.

As C-53 was stepping out of the building, a Pioneer Hose Company fire fighter who was previously venting windows along Morgan Street stepped into the building. Almost immediately after this fire fighter entered the building, the floor directly inside the first-story entrance door began to fall in. (See *Figure 3*.) Fire fighters outside saw what was happening, and as the fire fighter just inside began to jump out, they reached for him and pulled him to safety. The four Hilltop fire fighters in position on the first story were trapped, however. Moments after the concrete floor fell in, a huge blue fireball erupted out of the resulting opening and filled the first and second stories with fire.

Fire fighters at the front of the building immediately directed all available hose lines into door and window openings in the front of the building, but the enormous amount of fire at this time made their efforts fruitless. The incident commander began to request mutual aid assistance, and the fireground tactics concentrated on both controlling the fire in the building and protecting an exposed dwelling only a few feet away from the fire building.

At some time close to the collapse, the Eureka fire fighters at the rear of the building entered the basement, and after crawling several yards into the building, they found free-burning flames to their left. The fire fighters felt, however, most of the severe burning was occurring in the front right corner of the basement. They were able to advance far enough into the basement to apply water on the main body of fire. Their hose stream apparently had no effect against the large fire they found filling the front part of the basement. These fire fighters then backed out of the basement.

A Pioneer Hose officer (C-53) went to the rear of the building and informed the Eureka fire fighters of the collapse trapping several Hilltop fire fighters. The Eureka fire fighters re-entered the basement and attempted to reach the fire fighters via the stairway in the center of the building. The Eureka fire fighters were able to enter onto the first story only a few feet before intense heat and fire forced them to retreat. The Eureka fire fighters attempted to enter the first story a second time, but the intense heat forced them back again.

At some time during the interior rescue attempts, another building collapse occurred. During this collapse, the front of the building apparently fell away and sections of the roof also fell in. The large openings created during the collapse apparently allowed trapped heat and fire to vent freely.

After the collapse, the Eureka fire fighters attempted their third rescue entry onto the first story. They were able to search a larger area compared to the two previous attempts because of the venting that occurred during the second collapse. Despite their ability to search a larger area, the rescue

team was unable to locate the missing fire fighters. They realized then that any other attempts to find the missing fire fighters would probably be a recovery activity.

When the county "collapse response team" arrived at the scene, they began to use heavy equipment to clear debris in order to locate and recover the fire fighters' bodies. This activity was completed at approximately 1:30 p.m. the same day.

Analysis

Fire Cause and Origin

Officials at the Allegheny County Fire Marshal's Office, who coordinated the cause and origin investigation, determined the fire to be of an accidental cause. Their investigation found that a ceiling-mounted electric heater in the finishing room probably was involved in the ignition. The investigators determined that built-up overspray and deposits of combustible residues became heated as the electric heater operated. These built-up materials eventually liquefied, and the hot, molten material dropped onto flammable and combustible materials stored on shelving directly below the heater. The stored materials were ignited at the same point in time, and the resulting fire eventually involved all materials in the finishing room.

The Collapse

During the initial collapse, the section of the first-story floor assembly in the area of the finishing room fell into the basement. This collapse area extended from the building's front foundation wall to the first line of girders (a distance of approximately 15 ft). The falling floor assembly apparently ruptured many of the containers of flammable liquids stored in the basement, and the leaking material was ignited, forming the huge fireball that filled the first and second stories with fire. It was this fireball that engulfed and killed the fire fighters before they had time to react.

The initial collapse of the first-story floor assembly appears to be the function of both fire exposure and corrosion. Like all the beams in the structure, the beams above the finishing room were not protected with any

type of fire-rated material. Since the area of fire origin was considered to be the basement finishing room, the beams above this room were exposed to the fire for the longest period of time and would have experienced the greatest reduction in strength due to heat. At least one beam, and reportedly others, above the room of origin were corroded to such a degree that the cross-sectional area of the beam was substantially reduced, also reducing the strength of the beam. It appears that the combined reductions in beam strength due to corrosion and fire impingement allowed the failure to start in the area above the basement finishing room.

Some time after the initial collapse, the single column in the basement supporting the line of girders closest to Brackenridge Avenue failed, allowing these girders to drop several feet. The girder movement allowed any beams remaining in place between the foundation wall and the first line of girders to fall into the basement. In addition, beams between the first and second rows of basement girders and in the second-story floor assembly also pulled free of their mountings, allowing these beams to fall into the basement, too.

Except for a few beams above the finishing room, the collapsed beams in the first-story floor assembly area remained attached to the foundation wall at one end and were pulled off the girder at the other end. It appeared that the beams were able to pull free readily because they were not welded, bolted, pinned, or otherwise held to the girder. This type of failure is not common because small beams are usually permanently fixed to the larger structural members by some positive means. As a result of the beam/girder connections, the entire first-story floor assembly up to the first line of

girders and even part of the first-story floor assembly between the first and second lines of girders were able to fall into the basement.

Discussion

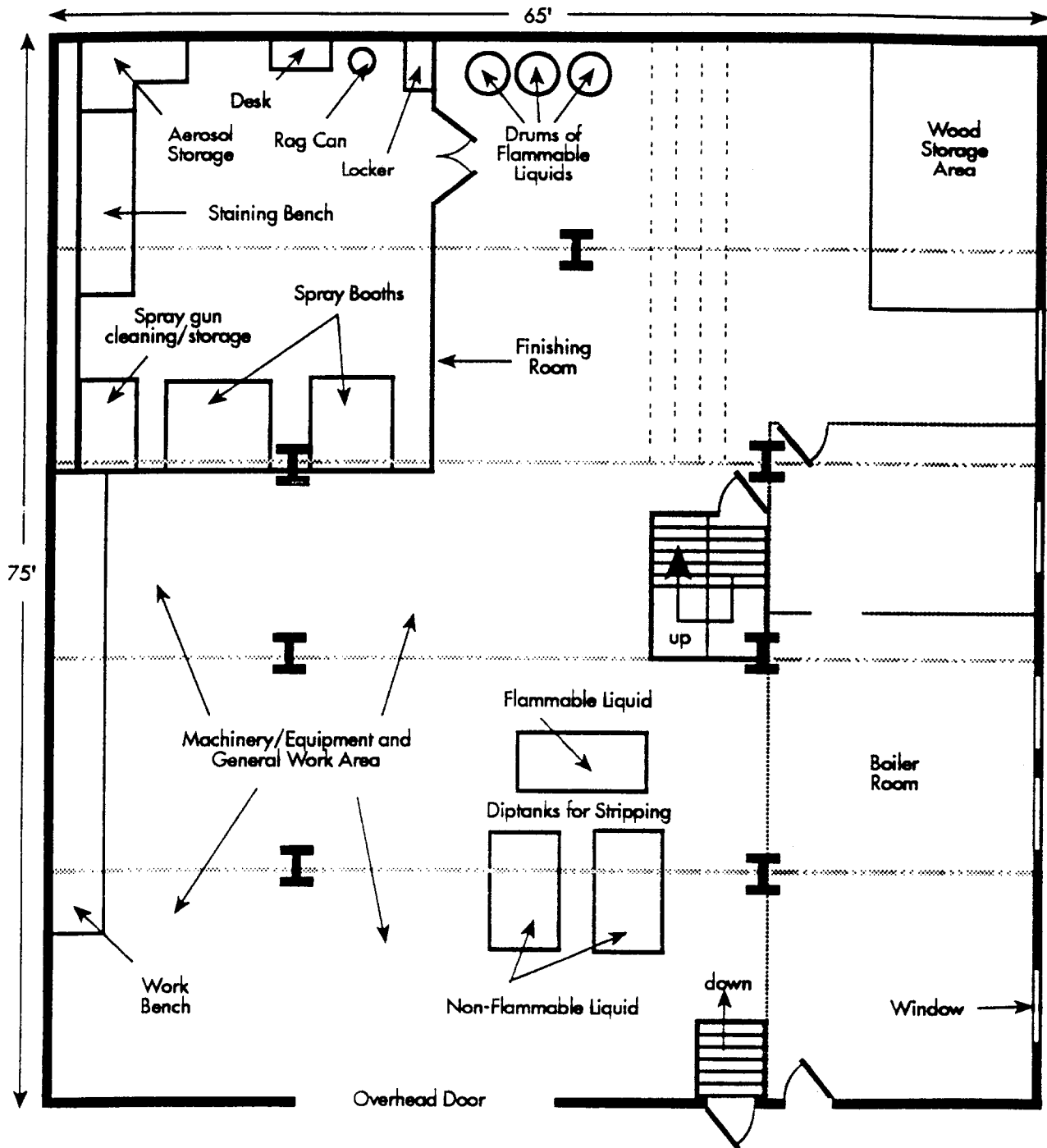
All interior fire suppression operations present an element of risk to the safety of fire fighters. In the early stages of an operation when there is incomplete information about building layout and construction features, and when the fire has not yet been located, risk to the fire fighters can be especially severe. As more information is developed regarding a particular fire situation and structure, fire officers can more readily assess risks and can formulate procedures to minimize the risk of injury or death to fire fighters.

Fire suppression personnel have several opportunities to obtain information and to reduce the risk to fire fighters during a fire suppression operation. The first opportunity to obtain information that can reduce the risk to fire fighters occurs before the fire starts. Prefire inspections and operational planning can provide fire suppression officers with details about a building that may be impossible to obtain during a fire incident. Details regarding fuel loads, special hazards, life hazards, building construction, interior features that can contribute or complicate fire suppression operations, installed fire protection equipment, etc., can assist an incident commander and other fire fighters while performing size-up, preparing a fire attack plan, and modifying the fire attack plan should it become necessary.

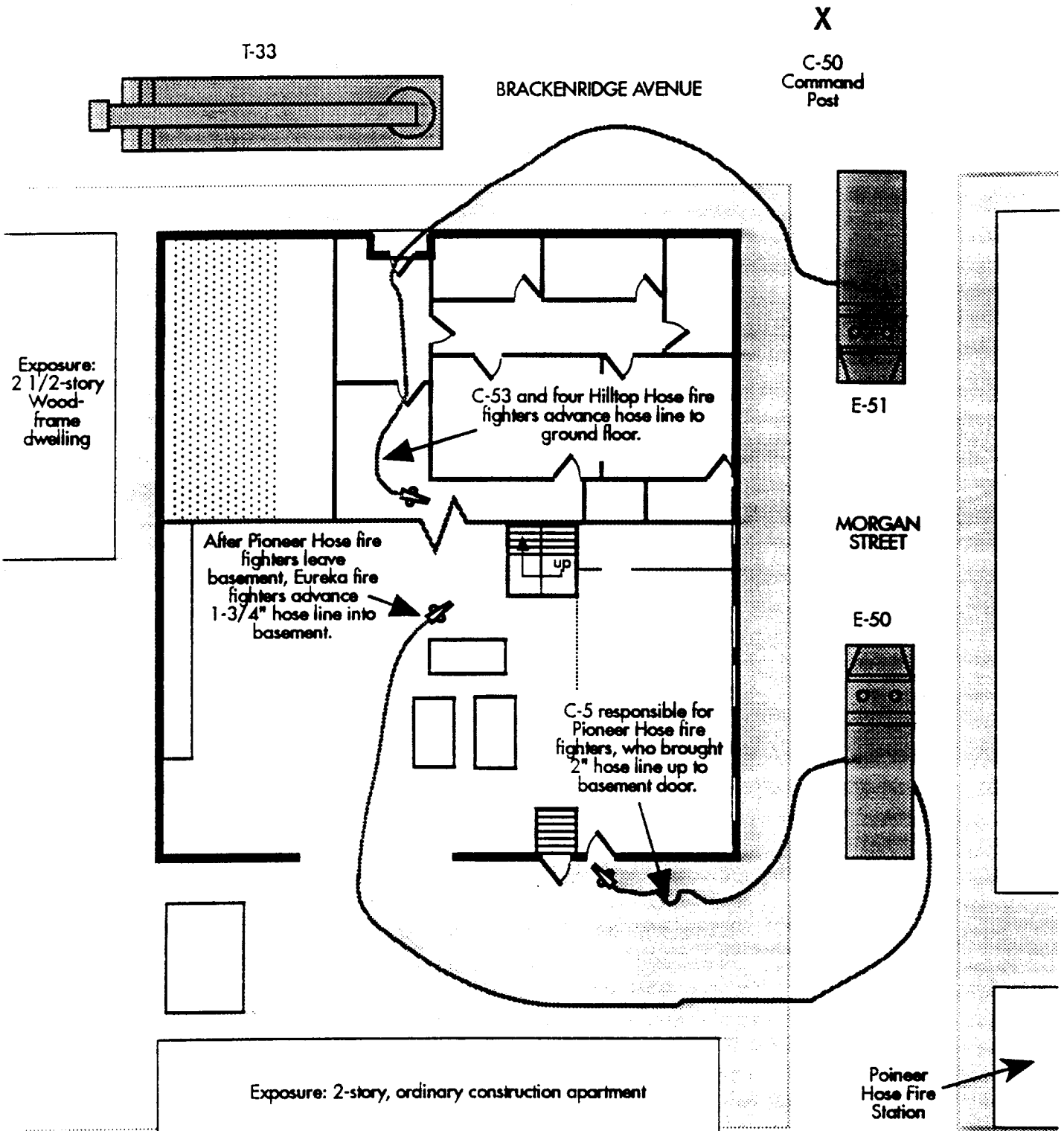
Another opportunity to obtain information and to reduce the risk to fire fighters occurs on the fireground. Fire suppression crews should be trained and equipped to properly manage information on the fireground. A fireground information management system needs to allow information from the fire fighter/crew level to effectively pass up to the senior fire officer, commonly referred to as an incident commander. The observations of fire fighters/crews positioned throughout the fireground and information regarding the effectiveness of their current tactics and strategies can help the incident commander formulate the overall strategy and make appropriate changes as necessary. In addition, information from the incident commander also must be able to reach the fire crews. Efficient transfer of information from the incident commander, through supervising officers to the crews and fire fighters, will contribute to a safe and effective fire attack.

Further, fire codes such as the NFPA *National Fire Codes*[®], contain requirements that can also help reduce the risk to fire fighters by minimizing or controlling the fire hazards in buildings. For example, NFPA 30, *Flammable and Combustible Liquids Code*, limits the quantities of flammable liquids that can be stored in industrial buildings. Similarly, fire codes provide minimum protection requirements when flammable liquids are to be stored in industrial buildings. These requirements include, but are not limited to, the use of storage cabinets (or other storage arrangements when large quantities of liquids are involved), the prohibition of the use and storage of flammable liquids in basements, and minimum requirements for fire-resistant construction.

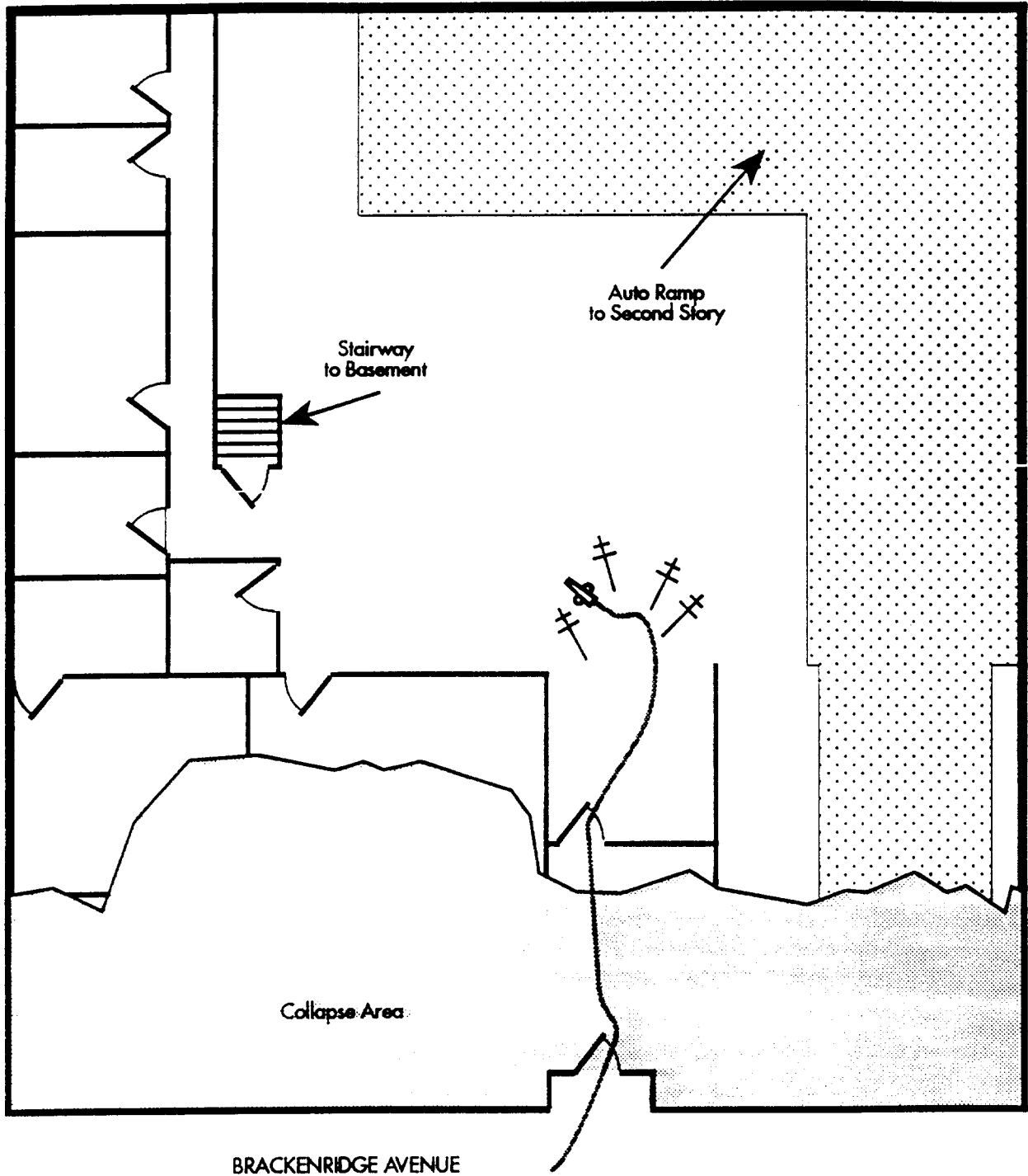
BRACKENRIDGE AVENUE



**WEST INTERIOR SERVICES
BASEMENT PLAN
Figure 1**



**BASEMENT AND FIRST FLOOR
FIRE SUPPRESSION CREW LOCATIONS**
Figure 2



**WEST INTERIOR SERVICES
COLLAPSE AREA - FIRST FLOOR
Figure 3**