

**PRINTING OFFICE FIRE**

Denver, CO

September 28, 1992



# **FIRE INVESTIGATIONS**

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## **SUMMARY FIRE INVESTIGATION REPORT**

**PRINTING OFFICE FIRE**

**DENVER, COLORADO**

**SEPTEMBER 28, 1992**

**PREPARED BY**

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At approximately 2:00 a.m. on Monday, September 28, 1992, Denver fire fighters responded to a fire in a two-story printing office. During the fire suppression operations one Denver fire fighter died.

Upon arrival, fire fighters found that the building was full of smoke. When they entered the building, they found separate fires in several areas. The fire fighters attempted to suppress the fires as they found them, and reportedly, the suppression crews felt they were beginning to control the fire.

One fire fighter was temporarily working by himself inside the fire building when a section of floor collapsed and the fire intensity suddenly increased. It was about this time that he encountered some type of difficulty. The fire fighter was eventually able to reach a second-story window and shine his handlight through the window alerting other fire fighters who were outside.

The partially collapsed floor and intense fire prevented potential rescuers from reaching the trapped fire fighter through the interior of the building. Other fire fighters laddered the building and entered the room containing the trapped fire fighter. Over a period of approximately 55 minutes, an estimated 15 rescuers attempted to remove the victim through a window; however, they were unsuccessful due to the confinement of the space in which they were working. The fatally injured fire fighter was removed through a hole that fire fighters cut in a wall.

This fire highlights the importance of fire fighters working in pairs during fire suppression and related operations. This fire also reveals difficulties associated with rescue in small spaces.

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

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## **Introduction**

The National Fire Protection Association (NFPA), with the cooperation of the Denver Fire Department, investigated this fire as part of its ongoing program to investigate technically significant incidents. It was not NFPA's intention that the investigation and resulting report pass judgment on or fix liability for the loss of life resulting from this fire. Rather, the NFPA documented and analyzed this incident intending to determine the significant factors that resulted in the loss of life and to report the lessons learned in order that the fire service and other concerned parties may reduce the potential for similar losses.

## **Background**

The fire occurred in a two-story, split-entry building that was approximately 48 feet wide and 60 feet long and was being used as the sales offices for three printing businesses. (See Photo 1.) The top floor was 1/2-story above the main entrance and was divided into numerous offices and storage rooms. The first floor was 1/2-story below the main entrance and had additional offices, several production areas, and larger storage areas. There was a minimal amount of flammable solvents in the building so the primary fuels were large quantities of paper stored throughout the building, office furnishings, and office equipment.

The building most closely resembled ordinary construction. It had concrete block exterior bearing walls and engineered light weight members (i.e., wood I-beams)<sup>1</sup> supporting the floors and roof decking. The finished ceiling in all first and second story areas was a suspended ceiling with a metal frame and 2 ft x 4 ft tiles. The interior bearing and non-bearing walls were constructed with wood studs covered by gypsum wallboard.

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1 The I-beams were 16 inches high, were approximately 48 feet long, had 3/8-inch plywood for the web and had 2x4-inch wood top and bottom chords.

There was no automatic fire detection or suppression system installed in this building. All windows, except for one, were covered by metal security grates.

The fire fighter who was fatally injured was 39 years old and had 16 years of experience with the Denver Fire Department. On the morning of the fire, he was working at the truck company where he had been assigned for 14 years; he was the engineer/operator of that truck. The truck company officer, who was a knowledgeable and experienced officer, had also worked at this company for several years. According to the company officer, the fire fighters under his direction worked well as a team, and he had an especially high regard for the skill and fire fighting abilities of the fatally injured fire fighter. Over the years, the T-16 officer had come to rely on the fire fighter's professional abilities.

The Denver Fire Department typically staffs truck companies with four fire fighters. Since truck company personnel may be responsible for simultaneous tasks on a fire ground, Denver Fire Department policies allowed these companies to split up into smaller units in order to accomplish their tasks. However, there is a departmental safety guideline requiring members to work in pairs. In addition, the Denver Fire Department training division, as a standard practice, teaches all new fire fighters to work in, at least, pairs while on the fire ground. The concept of working in pairs is reinforced when on-line fire fighters receive additional training at the Denver Fire Department training facility.

### **The Fire Incident<sup>2</sup>**

At approximately 2:03 a.m., the Denver Fire Department received telephone notification of a fire in a two-story masonry building, and at 2:04 a.m. Truck 16 (T-16), Pumper 16 (P-16), Pumper 21 (P-21), and an assistant chief (C-3) were dispatched to the scene. These fire companies found smoke showing

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<sup>2</sup> Due to the limited scope of this report, many details regarding the response to this three-alarm fire and details regarding the incident management activities were not provided.

upon their arrival. Fire fighters from the truck forced open the front door and fire fighters from P-16 advanced a 1 3/4 -inch hoseline about one quarter the way down the second-floor corridor. The P-16 fire fighters found heavy smoke and a hot floor so they thought the fire was on the first floor. Moving their hoseline down to the first floor, the P-16 fire fighters began to find and extinguish fires in rooms on the left side of the corridor.

While the P-16 fire fighters were operating in the front part of the building, the T-16 officer and the T-16 engineer/operator were also working in the same general area. The officer and engineer/operator from T-16 were attempting to locate the fire, searching for any victims and ventilating as they moved through the building. While working in the building, the T-16 officer and fire fighter primarily stayed together. They would, however, occasionally separate to perform various tasks. For example, at one point in time, the T-16 engineer/operator went outside of the building to ventilate the first-floor windows. The P-16 engineer/operator saw that the T-16 engineer/operator was by himself so the fire fighter from P-16 assisted him during that task.

The remaining two fire fighters from T-16 went to the rear, laddered the building and opened second-floor windows from the outside. The P-21 crew also went to the rear of the building and advanced a second 1 3/4-inch hoseline into the building. These fire fighters eventually became involved in extinguishing fire in a second floor room at the southwest corner of the building.

At approximately 2:21 a.m., the T-16 officer, who was still working in the general area of P-16 crew, radioed that he believed the fire was knocked down in his area but more ventilation was needed. Apparently, heavy smoke prevented the fire fighters from finding and completely extinguishing all burning in the area where he and the P-16 crew were operating. C-3, in turn, made a request for a rescue company so their fans could be used.

While the P-16 fire fighters were working on the first floor, the fire on the second floor continued to grow. At approximately 2:27 a.m., C-3 radioed to

the P-16 crew and told them that there was a lot of fire on the second floor. C-3 ordered the P-16 crew to take their hoseline up to that floor. The T-16 officer and engineer/operator also went to the second floor at about this time.

A short time after, the T-16 officer and another fire fighter moved up to the second floor and were in the vicinity of the P-16 hoseline. The low air alarm for the T-16 officer's SCBA began to operate. Thinking that he was with the T-16 engineer operator, the T-16 officer told the fire fighter closest to him that he was going to leave the building.

### **Rescue Operations**

The T-16 officer was outside of the building changing his air cylinder when the rescue crew arrived and reported to C-3 who was standing at the front of the building. Initially, C-3 ordered the rescue crew to take another hoseline into the building to assist the P-16 and P-21 crews. Before they could complete this task, however, C-3 saw a fire fighter shining his handlight through a second story window at the front of the building. Realizing that the fire fighter needed assistance, C-3 ordered the rescue crew to make entry into the building. In addition, C-3 radioed the P-16 officer who was still in the building with his crew and informed him of the trapped fire fighter. C-3 asked the P-16 officer to see if he could get to the fire fighter in distress. This transmission occurred at 2:37 a.m.

C-3 also ordered some fire fighters to ventilate the roof. Before these fire fighters could begin their work to cut open the roof, a section of the roof toward the rear of the building collapsed, allowing the fire to vent through that opening.

Learning of a fire fighter in distress, the T-16 officer reentered the building and joined the P-16 crew as they attempted to reach the fire fighter through the interior of the building. Reportedly, the amount of smoke and heat had increased dramatically in the brief time that the T-16 officer was outside of the building. As these fire fighters approached the area where the trapped fire fighter was located, they found the floor was sloping downward and the

heat was intense. They realized a section of floor must have collapsed and that they would not be able to reach the trapped fire fighter through the interior of the building.

Meanwhile, the rescue crew fire fighters laddered the building and removed the security grate covering the window with a power saw. After breaking out the glass, fire fighters entered the room and found the injured fire fighter lying stretched out in a narrow aisle with his head against the exterior wall. The room was full of dense smoke so fire fighters were unable to effectively evaluate the condition of the fire fighter nor could they see details regarding the space he was in. Not knowing exactly why the space they were in was limited to a narrow width (measurements taken after the fire revealed that the space in which the fire fighters were working was approximately 28 inches wide at its narrowest point), the rescuers unsuccessfully attempted to lift the injured fire fighter to the window.

After several unsuccessful attempts to remove the injured fire fighter, C-3 decided to have fire fighters cut a large hole in one of the walls so the fire fighter could be removed through the hole. The exact time that this plan was formulated and put into effect was not known; however, a radio transmission at 2:53 a.m. made reference to this plan.

While the new rescue strategy was being implemented, fire crews directed hoselines and a master stream appliance at the fire with the sole intention of preventing it from spreading into the rescue area. Only two or three fire fighters could enter the room at any one time because the area in which they were working was small. Over the course of the rescue, however, approximately 15 different fire fighters entered the room and attempted unsuccessfully to lift the injured fire fighter out. During these attempts, rescuers came to believe that the injured fire fighter must have been entangled in some manner. However, due to the heavy smoke in the area, rescuers could not see the problem nor could they identify any entanglement by feeling over the body of the injured fire fighter.

At approximately 3:32 a.m. the hole had been cut through the wall and the fire fighter was quickly removed from the room. The injured fire fighter

was rushed to a hospital where he was pronounced dead. An autopsy revealed that the fire fighter had an elevated carboxyhemoglobin level and that he died of smoke inhalation.

### **Fire Cause, Origin, and Spread**

At the time this report was prepared, the fire was under a continuing joint investigation that included the Denver Fire Investigation Bureau and the Denver Police Department. Following their initial nine-day examination of the fire scene and other work, the investigators considered the incident to be an arson-burglary-felony murder.

Their scene examination revealed evidence of a burglary, with forcible entry through a ground floor window. In addition, there was evidence of widespread ransacking of offices, and numerous items of equipment were verified as being missing. Finally, the on-scene work revealed evidence of four separate and (initially) unattached areas of fire origin; three on the first floor and one on the second. (See Figure.) The investigators also believed that a flammable liquid was used in all four locations.

At some time during the development of the fire, flames entered the combustible, concealed space above the suspended ceilings. There were approximately 24 inches between the ceiling tiles and the wood sheathing for the floor (or roof) above. Once in this space, the fire was able to ignite the wood, 16-inch high I-beams, the wood floor sheathing and other wood materials. The fire spread horizontally within channel spaces between I-beams, and it was also able to spread horizontally in directions perpendicular to the I-beams because of the 8-inch space between the bottom chord of the wood I-beam and the ceiling tiles.

The investigators believed extensive fire spread within the combustible concealed space contributed to the failure of the floor and roof assemblies approximately 20 to 30 minutes into fire suppression operations. Once these assemblies began to fail, very rapid vertical fire spread followed.



## Analysis

In August 1992, the NFPA Fire Analysis and Research Division released the report *Analysis Report on Fire Fighter Fatalities*, which indicated that in the period of 1982 to 1991 there were 134 traumatic fire fighter deaths inside structure fires.<sup>3</sup> Of these, 33 deaths (24.6 percent) involved victims who were lost inside buildings and died of asphyxiation. Moreover, of these 33 "lost" fire fighters, 13 were killed while working separately from their partners inside the building. The following statement was among the conclusions and recommendations included in that NFPA report:

"(The) analysis looked at fire fighters who died as a result of becoming lost inside structures. These incidents demonstrated the need for fire department procedures that mandate fire ground operations in teams of two or more, careful monitoring of the overall emergency situation and an accounting of all members at all times throughout the incident. Standards requiring these procedures exist and should be adopted and enforced."

Recognizing that independent operations can increase the risk of fire fighter injuries and deaths, NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition contains several paragraphs that are intended to reduce the potential for independent operations. For example, paragraph 2-1.2(b) requires that a fire department have written criteria that identify the minimum number of members needed to safely perform each identified fire fighting function or evolution, based on written standard operating procedures. In addition, NFPA 1500 specifically requires that members operate in teams of two or more (see paragraph 5-3.4, which addresses operations while using SCBA, and paragraph 6-4.3, which addresses operations in hazardous areas).

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<sup>3</sup> *Analysis Report on Fire Fighter Fatalities*, prepared for Federal Emergency Management Agency, U.S. Fire Administration, Contract No. EMW-90-C-3332, August 1992.

The concept of working in pairs is fundamental and is generally recognized as an approach that will enhance fire fighter safety and health while on the fire ground. It is thought that in situations where at least two fire fighters are working together and one becomes impaired, the impaired fire fighter can be assisted by the other fire fighter(s). This approach to fire fighter safety will be most effective when fire department officers, at all levels of command, ensure that fire fighters under their direction operate in teams of two or more. In addition, each fire fighter must understand that operating in pairs can enhance his/her own safety. In fire ground situations where fire fighters may have to separate briefly from other fire fighters, the members need to minimize the distance, time and frequency of such separations. The member must also recognize that he/she may be increasing the risk to himself/herself during the separations.

As stated earlier, the Denver Fire Department has a safety guideline requiring members of its fire department to work in pairs. In addition, the Denver Fire Department training division teaches both new fire department candidates and on-line fire fighters that they must work in pairs. However, disparities may develop between written departmental procedures and the procedures actually being used on the fire ground, and such a disparity apparently occurred during suppression activities on the morning of September 28, 1992. Specifically, the T-16 driver/operator was observed ventilating windows at the front of the building without another fire fighter or officer from his company, and the T-16 officer also left the building without his partner in order to change his air bottle. The actions of the T-16 officer and engineer/operator appear to have been inconsistent with the Denver Fire Department safety guidelines and the procedures being taught at the Denver Fire Department training center. Furthermore, these actions also appear to have been inconsistent with the NFPA 1500 requirements to operate in teams of two or more.

While T-16 driver/operator was working on the second story of the building, something resulted in him apparently being impaired. Unless the type of impairment was of a nature that it would have impacted a second fire fighter at the same time, it is reasonable to expect that a second fire fighter might have been able to take actions increasing the potential for the injured

fire fighter's survival. Moreover, had the second fire fighter been equipped with and able to use a radio, the potential for the injured fire fighter's survival may have been increased even more.

Another factor which appears to have contributed to the loss of the T-16 fire fighter was the collapse of the floor assembly. The initial collapse involved a section of the second-story floor assembly and appeared to be a result of the fire spreading from the multiple areas origin on the first floor into the combustible concealed space above suspended ceiling. The collapse most likely occurred at some time before C-3 realized that the fire fighter inside the building was experiencing some type of trouble. Investigators were unable to determine the exact nature of the fatally injured fire fighter's problem when he signalled for assistance. Therefore, it was impossible to determine whether the fire fighter's escape was prevented by the collapsed floor, by the nature of his apparent impairment, by a combination of both factors or by some other condition. Potential rescuers did, however, clearly indicate that the collapsed floor prevented them from reaching the injured fire fighter through the interior of the building. Had the rescuers been able to reach him through the interior of the building, it appears likely that the potential for the injured fire fighter's survival would have been greatly increased.

Finally, the need to work in a small space prevented fire fighters from successfully rescuing the injured fire fighter. The fatally injured fire fighter had become incapacitated in a room that was approximately 6 feet wide and 11 feet deep. However, file cabinets and a desk were placed against one wall and shelves full of paper, books, and other materials covered the other wall. These furnishings created an aisle that was approximately 28 inches wide at its narrowest point, and this small aisle was the only area in which fire fighters could work. (See Photo 2.)

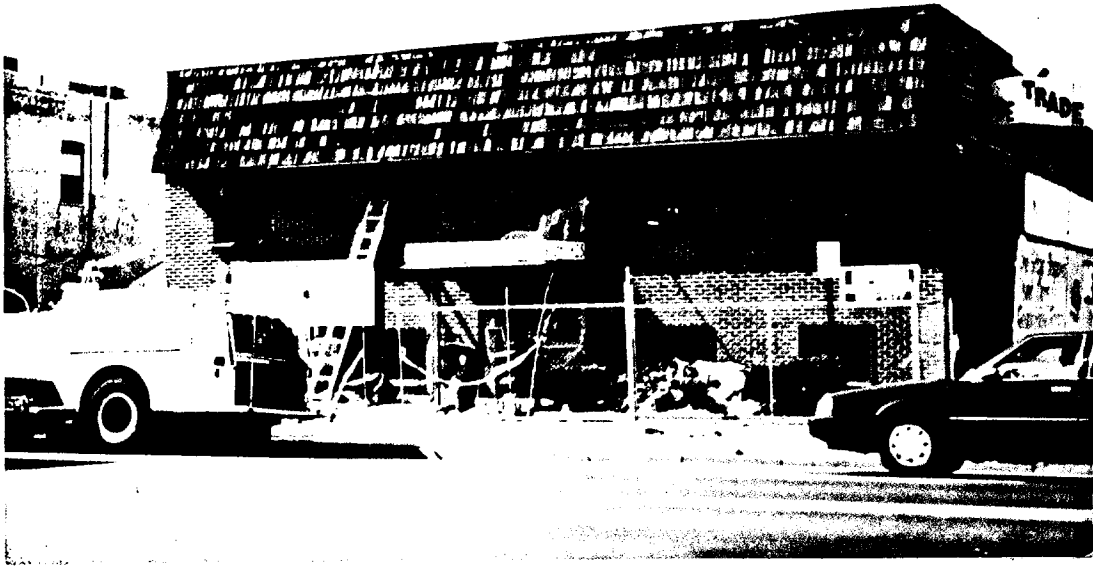
In addition to the narrow aisle, the window arrangement also increased the difficulty of the rescue operation. There was only one window in the room, and that window was approximately 22 inches wide with a sill 42 1/4 inches above the floor. Furthermore, the narrow window opening was

partially restricted by one of the file cabinets. All of these factors increased the difficulty of the victim removal operation.

The post-incident examination of the room revealed that there was no identifiable physical condition that prevented the injured fire fighter from being removed. In order to possibly gain some insight into the rescue operation, several rescue simulations were performed based on statements from personnel who attempted to rescue the injured fire fighter. It became clear through these simulations that the rescuers could not get the leverage necessary to lift a 190 lbs. fire fighter wearing full protective clothing and SCBA (adding an estimated 80 lbs. of weight) up to the window. The simulations also revealed that the victim was lying in the area where rescuers needed to stand in order to attempt to lift him, thus the location of the victim reduced the efficiency of the rescuers' actions.

In conclusion, the NFPA's investigation and analysis of this incident established the following lessons:

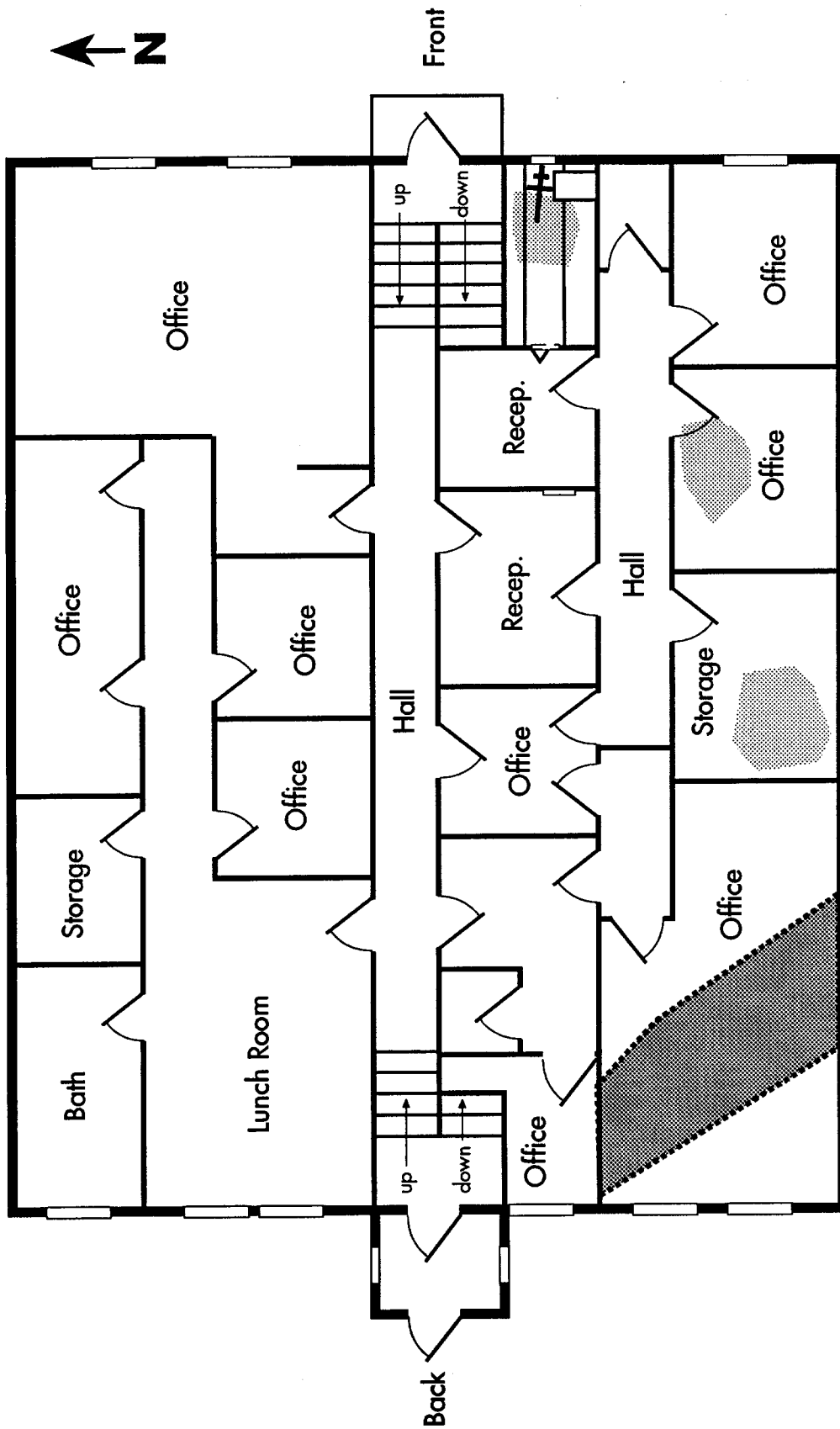
- All fire department officers and fire fighters must understand that operating in pairs while in hazardous areas can reduce the risk to individual fire department members while on the fire ground.
- In addition to entrapping fire fighters, a floor collapse can prevent rescuers from reaching fire fighters in need of assistance.
- Rescue personnel operating in a small space can be subject to impediments created by physical conditions that can prevent rescue or lengthen the time required for rescue.



**Photo 1. Front of 1625 S. Broadway  
Rescue operations were performed through the  
small second story window next to the ladder.**



**Photo 2. Position of the fire fighter before the  
rescue simulation was performed.**



## 1625 South Broadway - 2nd Floor

■ Area of Fire Origin on First Floor

■ Area of Fire Origin on Second Floor

⊠ Victim Location on Second Floor