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NIOSH Fire Fighter Fatality Investigation and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation *January 15, 2003*

First-Floor Collapse During Residential Basement Fire Claims the Life of Two Fire Fighters (Career and Volunteer) and Injures a Career Fire Fighter Captain - New York

SUMMARY

On March 7, 2002, a 28-year-old male volunteer fire fighter (Victim #1) and a 41-year-old male career fire fighter (Victim #2) died after becoming trapped in the basement. Victim #1 manned the nozzle while Victim #2 provided backup on the handline as they entered the house. After entering the structure, the floor collapsed, trapping both victims in the basement. A career fire fighter captain joining the fire fighters near the time of the collapse was injured trying to rescue one of the fire fighters. Crew members responded immediately and attempted to rescue the victims; however, the heat and flames overcame both victims and eliminated any rescue efforts from the garage entrance. NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should

- ***ensure that the Incident Commander is clearly identified as the only individual responsible for the overall coordination and direction of all activities at an incident***
- ***ensure that the Incident Commander conveys strategic decisions to all suppression crews on the fireground and continually reevaluates the fire condition***
- ***ensure that Incident Command conducts an initial size-up of the incident before initiating fire fighting efforts and continually evaluates the risk versus gain during operations at an incident***
- ***ensure that fire fighters from the ventilation crew and the attack crew coordinate their efforts***
- ***ensure that fire fighters report conditions and hazards encountered to their team leader or Incident Commander***
- ***ensure fire fighters are trained to recognize the danger of operating above a fire***

Front of Structure

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at

www.cdc.gov/niosh/firehome.html

or call toll free **1-800-35-NIOSH**

First-Floor Collapse During Residential Basement Fire Claims the Life of Two Fire Fighters (Career and Volunteer) and Injures a Career Fire Fighter Captain - New York

INTRODUCTION

On March 7, 2002, a 28-year-old male volunteer fire fighter (Victim #1) and a 41-year-old male career fire fighter (Victim #2) died after becoming trapped in the basement when the floor collapsed while they were advancing a handline on the first floor of a residential structure. A career fire fighter captain was injured in a rescue attempt. On March 11, 2002, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On April 15, 2002, two Safety and Occupational Health Specialists from the NIOSH Fire Fighter Fatality Investigation and Prevention Program investigated this incident. Meetings and interviews were conducted with the county fire coordinator, the county sheriff, and members of the fire departments who were at the scene. The investigators reviewed the victims' training records, the departments' standard operating procedures (SOPs), the county fire investigation report, the fire department's incident report, and a transcription of the dispatch tapes. The incident site was visited and photographed.

The combination department in command of this incident is comprised of 51 uniformed fire fighters. The department serves a population of approximately 4,000 in a geographical area of about 49 square miles.

Both victims and the injured captain were from a combination fire department providing mutual aid during this incident. The department is comprised of 77 uniformed fire fighters. The department serves a population of approximately 9,500 in a geographical area of about 23 square miles.

Training

The State of New York requires fire departments to train career fire fighters to a minimum level equivalent to National Fire Protection Association (NFPA) 1001 Levels I and II when the department employs six or more career fire fighters. This standard is not required for volunteer fire fighters. Victim #1 had received the following training: apparatus operator, wildland fire suppression, rescue technician, confined space awareness, hazardous materials first responder operations, State building code compliance technician program, coaching the emergency vehicle operator, hazardous materials awareness, engine company operations, fire fighter survival, and fire fighting essentials. Victim #1 had over 5 years of fire fighting experience. Victim #2 had received State building code compliance certification and training in fire fighting essentials, pump operations, radiation safety, inspecting existing structures, low-rise residential construction, general building construction, and basic wildland fire suppression. Victim #2 had over 11 years of fire fighting experience.

Structure

The structure involved in this incident was a two-story, wood-frame, single-family dwelling with a one-story section that attached to a two-stall garage. A basement extended under the two-story and one-story sections of the house, but it did not extend under the garage. The foundation and basement walls were made of hollow masonry blocks.

The roof system consisted of pre-engineered trusses covered by plywood and asphalt shingles. The exterior walls were cedar clapboard siding over 2 by 4 wood-frame construction. The basement and garage floors were concrete slab. The floor system throughout the first and second floors of the house consisted of lightweight, pre-engineered trusses covered with plywood sheathing and various floor coverings.

Weather

The weather conditions during the time of this incident included an average ambient air temperature of 33"F, a relative humidity of 92%, average wind speed of 3 mph, and a barometric pressure of 29.94 Mb Hg.

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INVESTIGATION

At approximately 1920 hours Central Dispatch notified the commanding combination department of a basement fire in a residential structure. The Assistant Chief arrived on the scene in Car 4 (C4) at 1928 hours and assumed Incident Command (IC). He notified Central Dispatch of a basement fire with a light smoke condition in the garage of a two-story wood-frame residence. The IC met with the homeowner who informed him that he was grinding metal in the basement and that sparks from the grinding operation had entered a void in the suspended ceiling and ignited accumulated dust and lint from the dryer. The owner reported that he had tried to put out the fire with a garden hose until the water pump failed. The IC obtained the location of the fire and asked the owner to direct him to any other entrances into the basement. The owner informed the IC that a stairway inside the rear of the garage led to the room where the fire was located and that another door to the basement was located at ground level at the rear of the structure (Diagram #1).

The IC called for a second alarm at 1930 hours just after Tanker/Pumper 2 (TP2) arrived on the scene with a Lieutenant, a driver/operator, and three fire fighters, and parked in the driveway between the IC and the structure. The IC ordered a 1 3/4-inch preconnect to be pulled off TP2 and directed a crew of two fire fighters through the garage down the stairs to the fire. At 1933 hours Rescue 1 (R1) arrived with a crew of seven fire fighters. The IC directed a three-man crew to pull the other 1 3/4-inch preconnect off TP2 and to make forcible entry through the door on Side 3. At approximately 1934 hours another Assistant Chief with the department arrived and took over as the Officer in Charge (OIC) of operations on Side 3. At approximately 1935 hours Tanker 1 (TA1) arrived with 2,000 gallons of water. The IC ordered TA1 to position at the end of the driveway so that it could receive water shuttles and could supply the water to TP2 through a 4-inch supply line (Diagram #2).

The two-man crew attempted to advance the handline down the garage stairs into the basement. Flames were exiting the basement through the top of the open door at the base of the steps (Photo #1). The crew operated the nozzle on the flames but could not reach the seat of the fire as the flames rolled up the ceiling of the stairs into the garage behind them. They pulled back to the top of the stairs. The nozzleman operated the handline on the flames while his backup checked for extension in a room just inside the house that was accessed through a man door in the garage. *Note: The room just inside the house was a laundry/bath area. The origin of the fire was in the suspended ceiling of the workshop in the basement directly under this room.* He found no extension with a moderate smoke condition and very little heat. He then returned to his position as backup on the handline at the top of the stairs in the back of the garage. The crew attempted to go back down the stairs but could not push back the flames. They took the hoseline with them to recheck the interior through the man door in the garage. The door was extremely hot. Just as they opened the door, the nozzleman's low air alarm sounded. They closed the door and set the handline on the garage floor (Diagram #1). Upon exiting the garage to exchange their air tanks, they saw a fire fighter arriving from a mutual aid department and requested to be relieved.

During this time, the crew at Side 3 gained entry into the basement and encountered a light smoke condition with no fire and very little heat. They experienced low-pressure problems while trying to advance the 1 3/4-inch handline. *Note: It is believed that pressure was lost in the handline due to a stone which stripped out the ball valve which entered the mechanical system of TP2 at an unknown time.* The OIC notified the IC that they

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could not advance due to the lack of water. The IC ordered the remaining crew of R1 to advance a 2 1/2-inch line to Side 3. The crew advanced the 2 1/2-inch handline only 3 to 5 feet into the structure from Side 3. The smoke and heat conditions were increasing before they were relieved on the handline by an engine crew (E5) that had just arrived from a mutual aid department.

At 1944 hours Truck 32 (TK32) from a mutual aid department arrived with a driver, fire fighter, Victim #1, and Victim #2. They reported to their Deputy Chief (C2), who received instructions from the IC to conduct ventilation. Victim #1,Victim #2, and C2 cut a 4-foot by 6-foot hole in the roof, which still had a covering of ice on it, and released heavy smoke and heat. The IC then requested the truck crew to report the interior conditions through the front door.

At approximately 1958 hours, the crew from TK32 exited the roof and met the Captain from their department and a County Fire Coordinator (CC1) who both had just arrived. The County Fire Coordinator informed the roof crew that the initial crew had requested relief on the handline remaining in the garage. Victim #2 instructed the Captain to gear up to provide backup on the handline. Victim #1 picked up the nozzle and Victim #2 provided backup as they entered the house through the door inside the garage.

During this time at Side 3, the crew from E5, consisting of an officer operating the nozzle and three fire fighters providing backup, entered the basement. The crew made it to the door leading to the fire room and encountered fire rolling across the ceiling. The officer opened the nozzle and attacked the fire in the workshop area. They lost pressure in the handline and were forced to back out of the basement. *Note: It is believed water pressure was lost during the transfer to a tanker relay operation which included TA1 drafting from a portable water tank. The portable water tank was setup in the road to receive water shuttles from responding tankers. This fire district does not have a water hydrant system and the cold temperatures hampered drafting from the rural water supply system.* While backing out of the basement, the crew heard a rumble, possibly from the floor collapse at approximately 2000 hours.

The Captain geared up and followed the handline to the doorway where he encountered intense heat, but he could not see any flames. The Captain was unaware the floor had collapsed but heard Victim #2 yelling for assistance. He did not hear nor see Victim #1. Victim #2 was standing on top of a workbench in the basement with his head still below floor level. (Diagram #3 & Photo #1). The Captain attempted to lift Victim #2 out of the basement from the doorway. During this time fire began rolling out from the top of the doorway. The Captain's arm and helmet were on fire and his faceshield was melting. The Captain grabbed Victim #2's air pack harness, and while attempting to lift him out, Victim #2 grabbed the Captain's high-pressure hose, ripping the mask from his face. The captain received second degree and partial thickness burns to his face and was forced to exit the garage and was later transported to a local hospital where he was treated. The CC1 and C2 then attempted to remove Victim #2, but they were overcome by intense flames shooting through the doorway from the basement, eliminating further rescue attempts from the garage area. The area of entrapment was inaccessible through Side 3 due to the collapse. At approximately 2330 hours, crews breached the foundation wall on Side 3 and recovered both victims.

CAUSE OF DEATH

The county medical examiner listed the cause of death for both victims as asphyxia due to the inhalation of smoke and soot.

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RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: Fire departments should ensure that the Incident Commander is clearly identified as the only individual responsible for the overall coordination and direction of all activities at an incident.[1]

Discussion: The Incident Commander (IC) should be responsible for the overall coordination and direction of all activities at an incident. The incident management system shall clearly identify who is in overall command at the scene for the duration of the incident. The IC shall make assignments based on the availability, qualifications, and expertise of individuals. It is imperative that the IC clearly be in charge of all operations on the fireground to ensure the successful completion of an operation. This incident had an established IC, but some of the operations at this particular incident were directed by personnel other than the IC, and some operations were not in line with the tactics of the IC. An effective fireground operation revolves around one IC. Companies responding as assigned or mutual aid companies must ensure that they report to the IC to establish a unified command system. If there is no command, or if there are multiple commands, fireground operations can quickly break down.

Recommendation #2: Fire departments should ensure that the Incident Commander conveys strategic decisions to all suppression crews on the fireground and continually reevaluates the fire condition.[2,3]

Discussion: The Incident Commander (IC) should develop fireground strategies to support the incident action plan and manage assigned personnel. The IC should routinely evaluate the effects of initial decisions, reevaluate fire conditions, and fine tune the attack plan, making changes when necessary. Upon reevaluating the fire conditions, the IC should convey safety-related information to all personnel and maintain incident command communications. On small fireground operations, this information could be relayed through face-to-face contact. However, on larger fireground operations, as crews become spread out, the use of two-way radios may be needed.

From the initial report obtained from the homeowner, the IC estimated the fire could easily be extinguished from the stairwell in the garage. The fire's progression during the time the owner tried to suppress it, and the time it took the department to arrive on the scene, did not allow the initial crew to enter the basement from the garage stairs to attack the seat of the fire. Constantly reevaluating the fire conditions provides an opportunity to change the offensive tactics, in this case to confine the fire and push it to where it was naturally venting, up the stairwell into the garage.

Recommendation #3: Fire departments should ensure that Incident Command conducts an initial size-up of the incident before initiating fire fighting efforts and continually evaluates the risk versus gain during operations at an incident.[2, 4-10]

Discussion: One of the most important size-up duties of the first-in officers is locating the fire and determining its severity. This information lays the foundation for the entire operation. It determines the number of fire fighters and the amount of apparatus and equipment needed to control the blaze, assists in determining the most effective point of fire extinguishment attack, and the most effective method of venting heat and smoke. A proper size-up begins from the moment the alarm is received, and it continues until the fire is under control. Several factors must be evaluated in conducting the size-up - e.g., type of structure, time of day, contents of the structure, potential hazards, etc. The size-up should also include risk versus gain during incident operations. The following factors are important considerations:

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1. Available resources. The resources available at the time of the fire should dictate the strategy used during fireground operations. The resources should include fire fighters and equipment as well as incident location, water resources, and weather conditions. In rural locations, natural water resources may be sparse and can be affected by the weather. These resources can be identified during the initial size-up and should be continually evaluated to determine if any changes in strategy need to be made. If water problems occur during an operation, a defensive attack should be considered.

2. Type of construction. The type of construction will be one of the most important areas to identify. The type of structure could provide the Incident Commander information such as how the building may hold up under fire conditions, or if the building is generally subject to collapse under fire conditions. One type of construction component is the lightweight truss. It is generally formed by 2- by 4-inch or 2- by 6-inch lumber, attached together with metal gusset plates. The structural idea of the lightweight truss is to distribute loads over a large area. Standard fire engineering calculations show that lightweight trusses may be expected to collapse after about 10 minutes in a fully developed fire.

3. Time considerations. Information such as time of incident, time fire was burning before arrival, time fire was burning after arrival, and type of attack, is some of the most important information the Incident Commander could have.

Recommendation #4: Fire departments should ensure that fire fighters from the ventilation crew and the attack crew coordinate their efforts.[2,4]

Discussion: Fire can quickly spread upward into the structure, causing potential problems such as a flashover, a backdraft, or a weakened structure. Ventilation timing is extremely important and must be carefully coordinated between both fire attack and ventilation crews. Ideally, ventilation should occur just prior to interior crews advancing their hoselines. Proper venting of heat and smoke from buildings can reduce the possibility of dangerous situations that confront fire fighters. The fire fighters performing ventilation tasks should be in communication with the fire fighters attacking the fire or entering the structure to coordinate their efforts. In this incident, ventilation of the basement was not performed on the fireground. The fire was venting itself up the stairway in the garage where the initial attack crew was trying to make entry to the fire room. Venting the first floor above the fire in conjunction with venting the roof may have released the heat and smoke trapped inside the basement and allowed the crew to attack the seat of the fire from the garage stairwell. Another option might have been to allow the fire to vent up the stairwell in the garage while making an attack from Side 3. This option did not develop due to the loss of water on Side 3.

Recommendation #5: Fire departments should ensure that fire fighters report conditions and hazards encountered to their team leader or Incident Commander.[11]

Discussion: Individual fire fighters should keep their team leader (a senior fire fighter or officer) advised of conditions and hazards they find as work is performed. The team leader can relay conditions and hazards encountered (i.e., not finding the seat of the fire) by their crew to the Incident Commander (IC) by portable radio or face-to-face communications. This information would allow the IC to continuously evaluate the risks and benefits of tasks being performed on the fireground.

Recommendation #6: Fire departments should ensure fire fighters are trained to recognize the danger of operating above a fire.[12,13]

Discussion: The danger of being trapped above a fire is greatly influenced by the construction of the burning building. Of the five basic building construction types (fire resistive, noncombustible, ordinary construction, heavy timber, and wood-frame) the greatest danger to a fire fighter who must operate above the fire is posed by wood-frame construction. Vertical fire spread is more rapid in this type of structure. Flames may spread vertically and trap fire fighters operating above the fire in four ways: up the interior stairs, through windows (autoexposure), within concealed spaces, or up the combustible exterior siding. Extreme caution must be used in determining if the structural stability of the flooring system is adequate to facilitate the operations.

The floors of the structure involved in this incident consisted of a lightweight wooden parallel-chord truss system. These trusses typically consist of wooden members measuring 2 inches wide by 4 inches deep and are held together by sheet metal surface fasteners referred to as gusset plates (Photo #2). The gusset plates have numerous V-shaped points cut through them that may penetrate the wood's surface approximately 1/4 inch to 1/2 inch. This steel plate could act as a heat collector which can transfer heat to the V-shaped points, destroying the tensioned wood fibers holding the gusset plate in place (Photo # 3). No specific time limit has been established for how long fire fighters should operate under or on truss floors that are exposed to fire. Even though standard fire engineering calculations show that lightweight trusses may be expected to collapse after about 10 minutes in a fully developed fire, it is not recommended that a time limit be set. When it is determined that the building's trusses have been exposed to fire, any fire fighters operating under or above them should be immediately evacuated.

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INVESTIGATOR INFORMATION

This incident was investigated by Jay L. Tarley and Mark McFall, Safety and Occupational Health Specialists, Division of Safety Research, NIOSH.

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Photo 1: Basement area into which victims fell

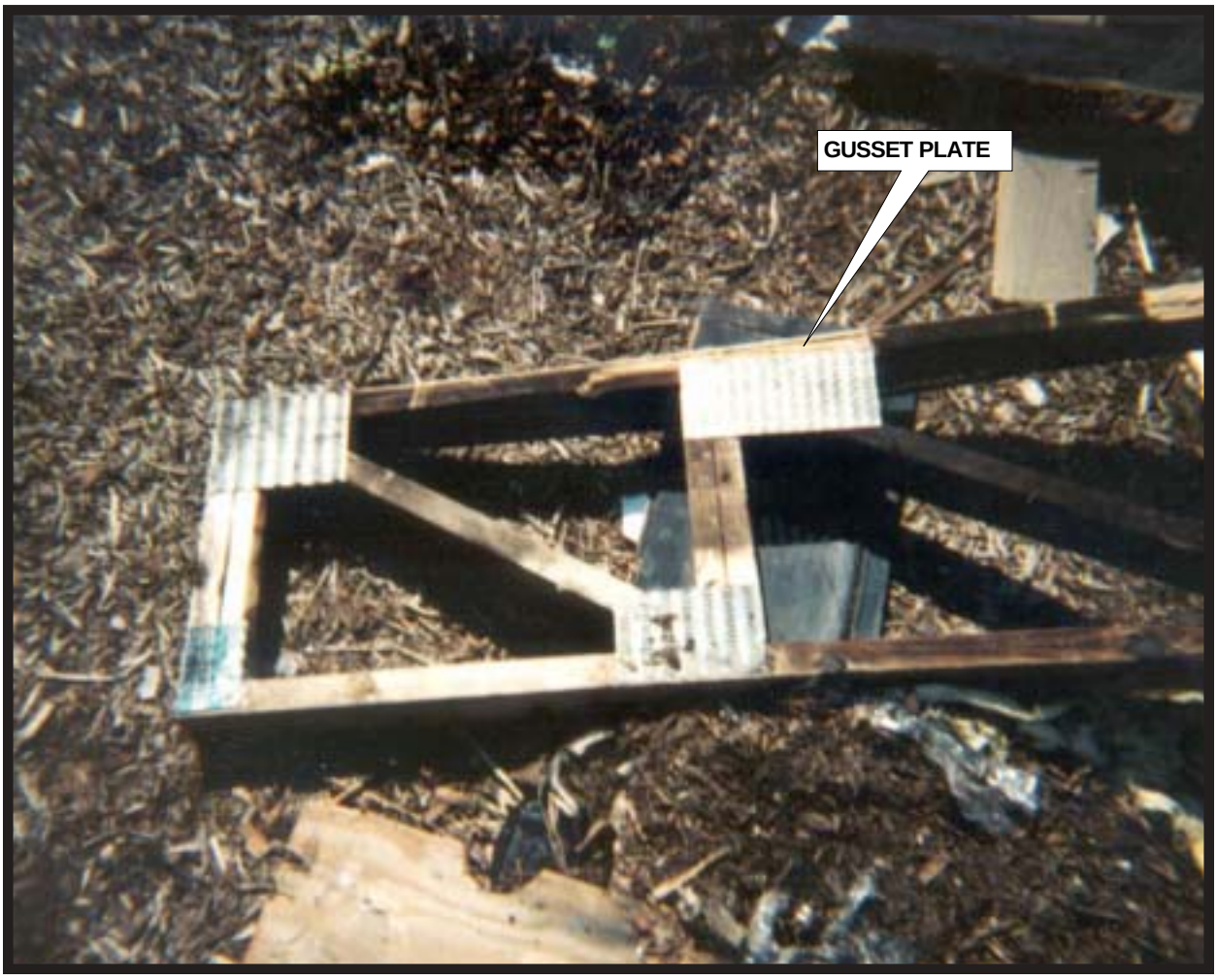

Photo 2. Lightweight wooden parallel-chord truss

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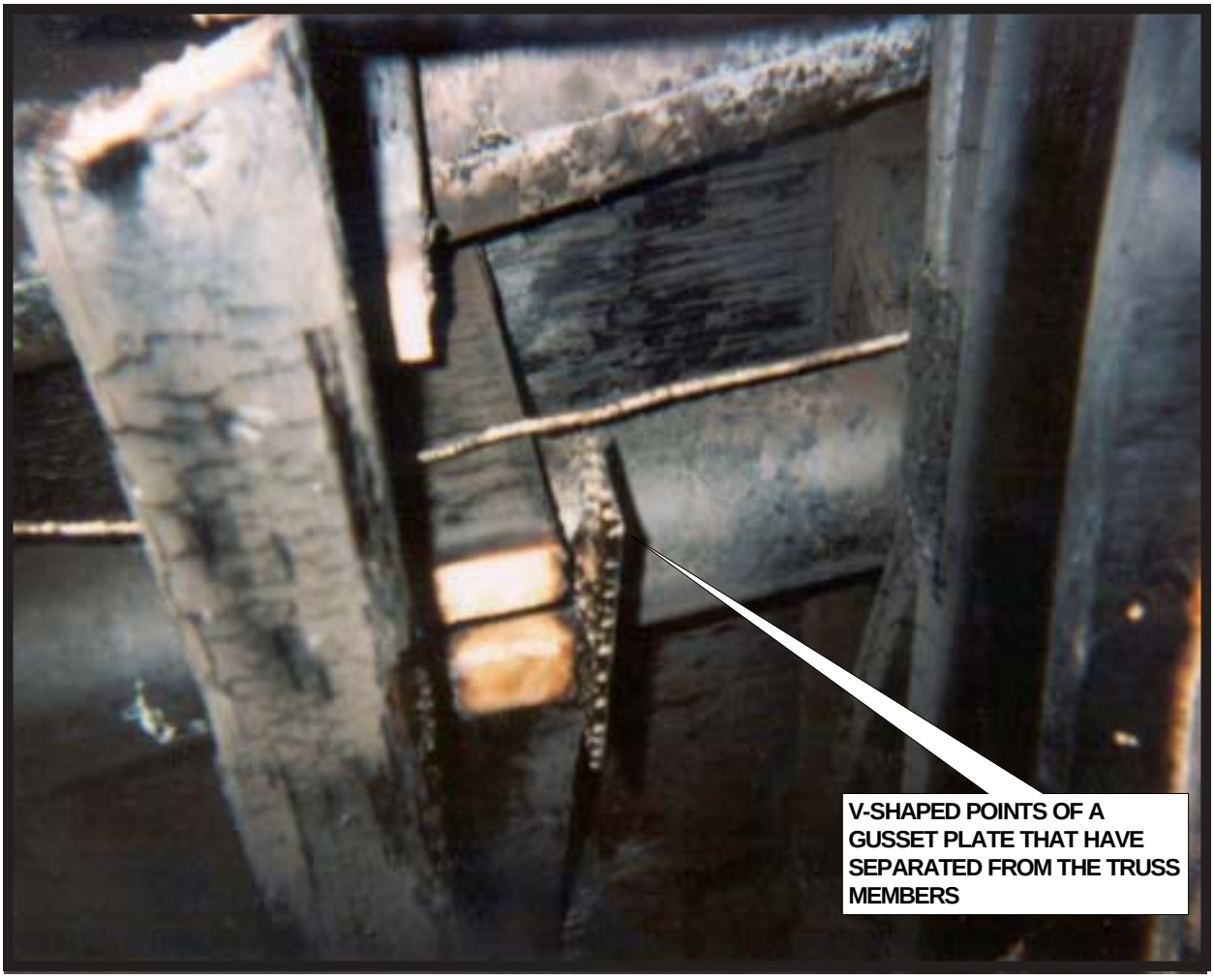

Photo 3. Failed floor truss

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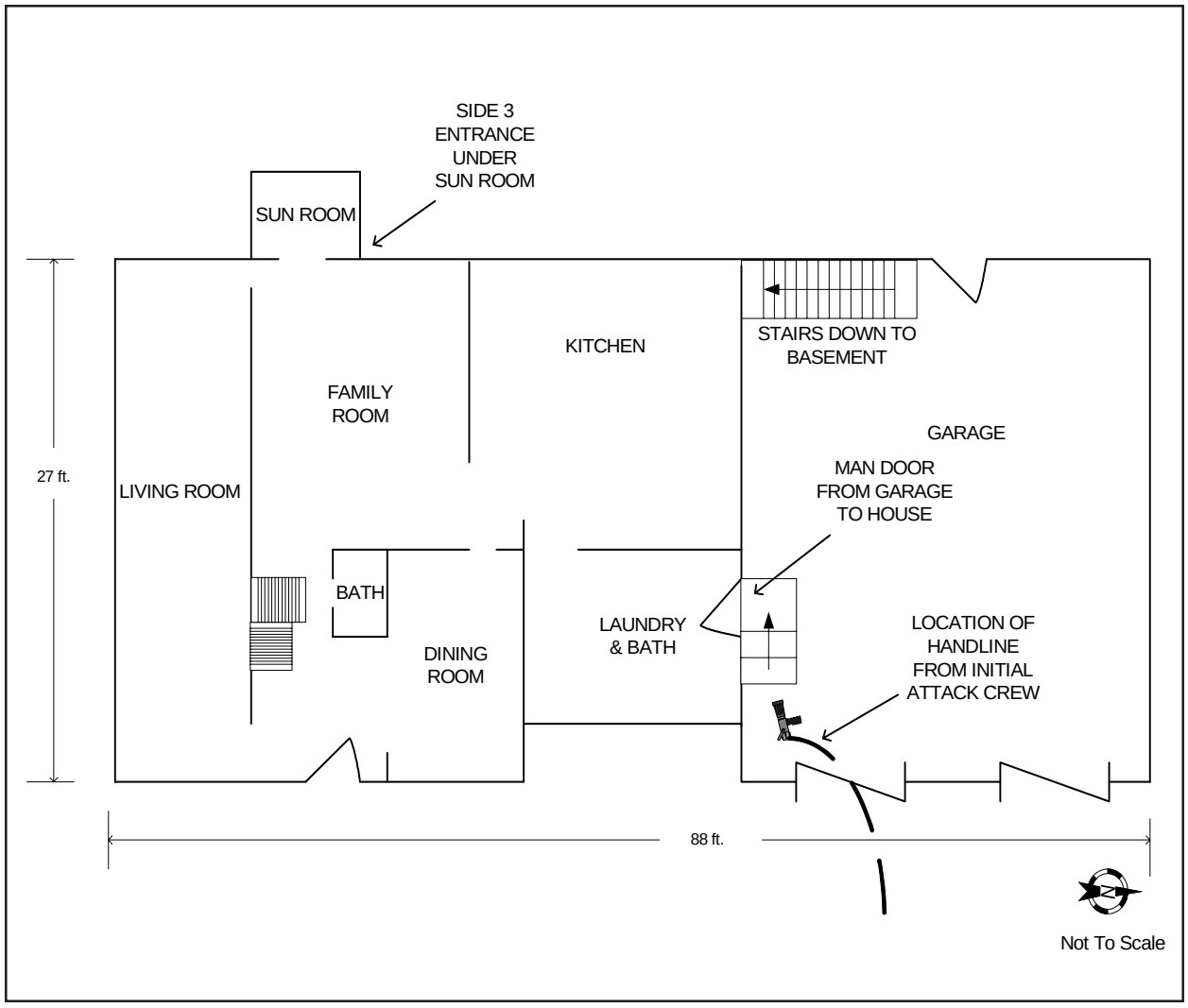

Diagram 1. First Floor Aerial View

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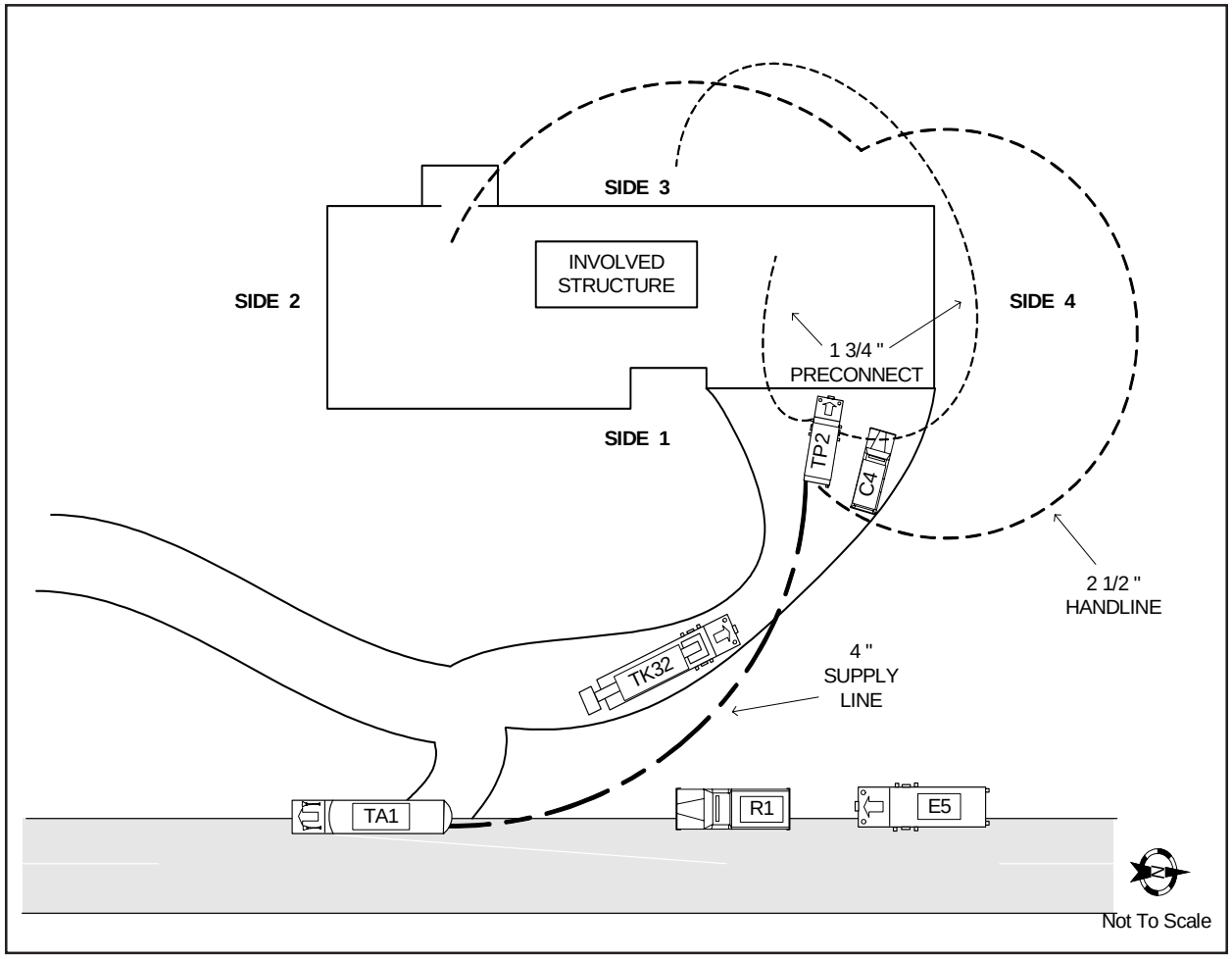

Diagram 2. Site Layout Aerial View

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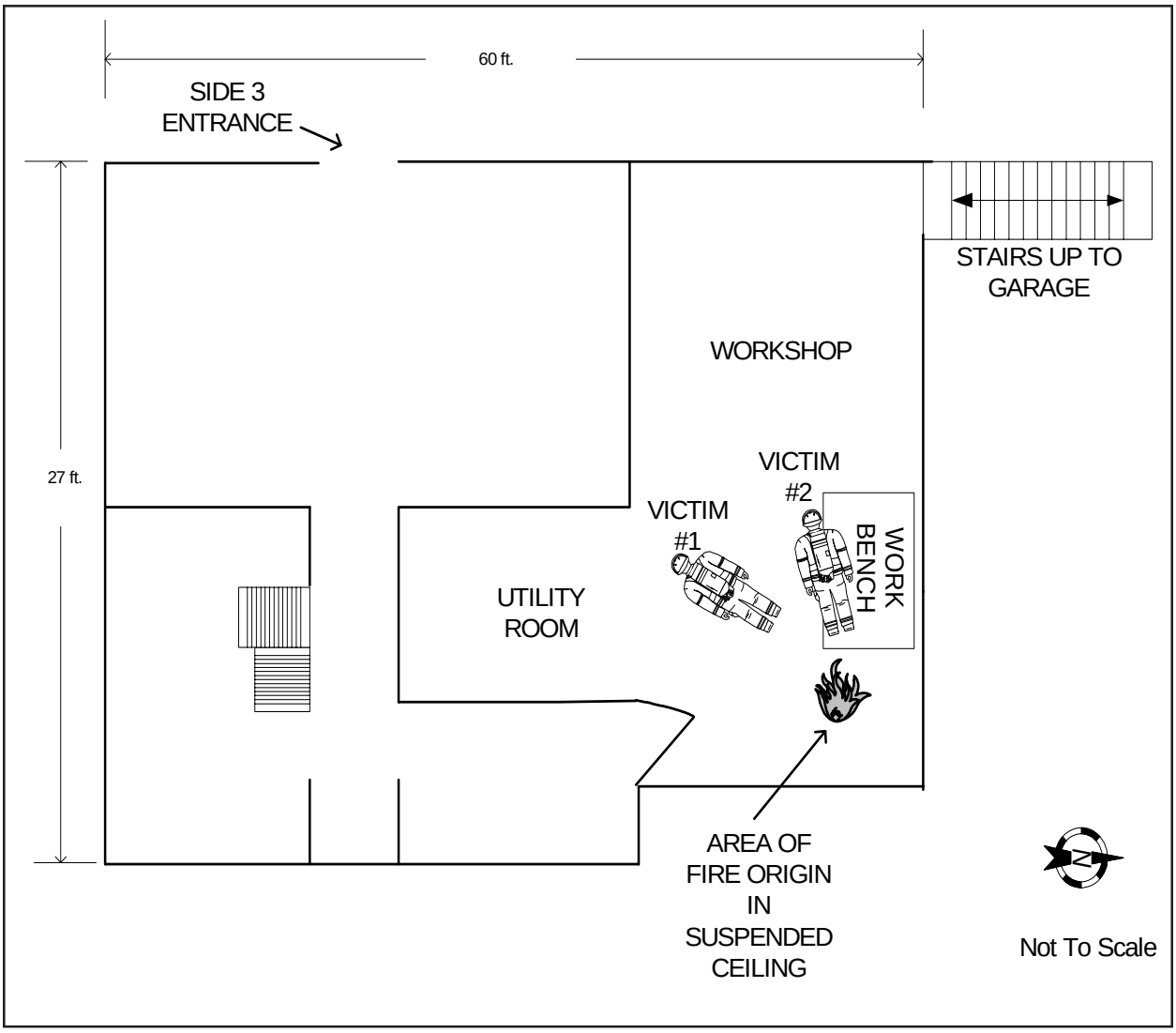

Diagram 3. Basement Aerial View

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