



AUTO DEALERSHIP

Hackensack, NJ

July 1, 1988



FIRE INVESTIGATIONS

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SUMMARY INVESTIGATION REPORT

Five Fire Fighter Fatalities
Hackensack, New Jersey
July 1, 1988

Prepared by

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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.

ABSTRACT

Five fire fighters from the Hackensack, New Jersey Fire Department were killed while they were engaged in interior fire suppression efforts at an automobile dealership when portions of the building's wood bowstring truss roof suddenly collapsed. The incident occurred on Friday, July 1, 1988 at approximately 3:00 p.m., when the fire department began to receive the first of a series of telephone calls reporting "flames and smoke" coming from the roof of the Hackensack Ford Dealership.

Two pumpers, a ladder truck, and a battalion chief responded to the first alarm assignment. The first arriving fire fighters observed a "heavy smoke condition" at the roof area of the building. Engine company crews investigated the source of the smoke inside the building while the truck company crew assessed conditions on the roof. For the next 20 minutes, the focus of the suppression effort was concentrated on these initial tactics.

During this time however, little headway appeared to have been made by the initial suppression efforts, and the magnitude of the fire continued to grow. The overall fire ground tactics were shifted to a more "defensive" posture (exterior operation) and the battalion chief gave the order to "back your lines out." However, before suppression crews could exit from the interior, a sudden, partial collapse of the truss roof occurred, trapping six fire fighters. An intense fire immediately engulfed the area of the collapse. One trapped fire fighter, was able to escape through an opening in the debris. The other five died as a result of the collapse.

This incident and an earlier similar incident at a supermarket fire in Brooklyn, New York provide important lessons to the fire service regarding the fire ground hazards of wood truss roof assemblies.

Introduction

The National Fire Protection Association investigated the Hackensack, New Jersey fire fighter fatality incident in order to document and report lessons learned for fire fighter safety purposes. The investigation was conducted at the request of Fire Chief Anthony A. Aiello, of the Hackensack Fire Department. The purpose of the investigation was to provide technical assistance to the fire department and the Bergen County Prosecutor's Office, to support local analysis of the incident, in addition to preparation of this summary report, for distribution to the fire service.

The report documents the sequence of events before and after the partial structural collapse, discusses the variables of fire growth, and the hazards presented on the fire ground by wood truss construction. The scope of this report does not include an analysis of training, fireground tactics or fireground command.

Following the request from the fire department, Thomas J. Klem, Director, NFPA Fire Investigations Division travelled to Hackensack on July 26, 1988. A three-day on-site study and subsequent analysis were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the fire department and the prosecutor's office.

This report is another of NFPA's studies of fires having particular educational or technical interest. The information presented is based on the best data available during the on-site data collection phase and during the report development process. It is not NFPA's intention that this report pass judgment on, or fix liability for, the loss of life and property at the fire fighter fatality incident in Hackensack.

NFPA would like to thank Fire Chief, Anthony A. Aiello; Bergen County Prosecutor, Larry McClure; Detective Lieutenant, Robert A. Scanlon; Senior Investigator, William D. Hinters, and Investigator, Adrian J. Cales, of the Bergen County Prosecutor's Office; and Investigator, Robert P. Horner, of the New Jersey Department of Community Affairs for their cooperation. Further, the cooperation of the fire fighters involved in this tragic incident is acknowledged and appreciated.

BACKGROUND

The city of Hackensack, New Jersey is located within a short commuting distance of New York City. The city is 4.4 square miles in area and has a mixture of residential, commercial, and light industrial, type occupancies. The residential population is 40,000; however, because the city is also the location of the county seat (Bergen County), the daytime population swells to 200,000 people.

Public fire protection is provided by 101 career members of the Hackensack Fire Department. Administrative and operational control of the department is the responsibility of the fire chief. In addition to its fire suppression and emergency rescue and care responsibilities, the department operates a fire prevention bureau, which is responsible for code enforcement and building inspection.

The majority of the department's manpower is assigned to the suppression force. The department operates a four platoon system, and fire fighters work shifts consisting of 10-hour days and 14-hour nights.

At the beginning of each new shift, roll call is taken and fire fighters are assigned to specific emergency apparatus and to the communications center. Normally, an officer, driver, and fire fighter are assigned to each emergency vehicle.

The department operates out of four fire stations including the headquarters station, where administrative and fire prevention offices and the communications center are also located. Equipment dispatch to incidents depends on the type of alarm. On structural fires, two engine companies, a truck company, a rescue unit, and a battalion chief are normally dispatched.

When a working fire requires additional resources a "recall" is requested by the officer in charge to supplement the on duty manpower. An off-duty, but on-call platoon is then subject to supplemental fire fighting duties.

On July 1, 1988 the weather conditions at the time of the incident were reported as cloudy, temperature 68° F, winds from the northwest at 12 to 22 mph.

The Building

The Hackensack Ford building was approximately 40 years old and was located along River Street in a commercial section of the city. Apparently, the structure had always been occupied as an auto dealership. The dealership offered a full range of customer services including new car sales, repair and service, auto parts and auto body repair.

The new car showroom and a quick service area were arranged along the front, western portion of the building, closest to River Street. New cars were also displayed on the exterior of the building between the showroom and the street. An approximately 30-foot wide service road provided access to the remaining sides of the building. The auto service area was located in the center portion of the building accessible from the north and south sides of the building. The body shop was located at the east end of the building. (See Figure 1.)

Additional autos were also stored on the north exterior side of the building, adjacent to the Hackensack Mazda building. There was a narrow access road off of River Street between the dealerships. However, early in the fire incident, fire department apparatus had difficulty gaining access to the north side of the fire building by this route, and many of the cars had to be relocated.

The building was a one-story structure with an attic area above the service area. There was also a small second-floor area located in the northwest portion of the building. Exterior walls were masonry and had openings such as overhead and service doors or large glass windows set in metal frames at several locations. Interior partitions, both masonry and wood frame, separated the service areas from the administrative and sales office areas. An interior masonry wall separated the service area from the parts department and the new car sales room. A cinder block wall separated the service area from the body shop.

The building's approximate dimensions were: north side, 224 feet; south side, 175 feet; width 100 feet. The total ground floor area was approximately 18,000 square feet.

The building was not provided with automatic sprinklers or a fire detection system. Other fire protection provisions could not be determined due to the destruction by the fire and the lack of a complete set of building plans.

Several alterations had been made to the building over the years, including modifications in 1974 that slightly expanded the service area, provided a stairway to the 7,800 square foot attic area above the service area, and consisting of various other modifications.

The building was of mixed construction type. The new car sales, auto body, and parts department areas appeared to have been of ordinary construction and had a flat, composition roof. In the service area, steel framing materials (columns and beams) provided the main structural support, including its roof support. The unprotected steel columns along the north side of the service area were located on the interior side of the non-bearing, exterior masonry wall. The structural beams between the columns were located above the finished ceiling of the service area. The columns on the north side

were at locations parallel to the original overhead door locations. When the service area was expanded, its five overhead doors were located to a position approximately 20 feet beyond their original position. This 20 foot by 78 foot expansion of the service area was the only portion of the service area that had a flat roof. The remainder of the area had an arch-shaped, composition roof.

The roof construction of the arched roof above the service area consisted of five bowstring wood trusses. A truss was located at each of the structural columns. (See Figure 2.) The trusses were spaced just over 16 feet apart, ran north to south, and spanned approximately 78 feet of the nearly 100 foot wide service area. The construction details of the bowstring truss could not be fully determined; however, it is estimated that there was a 10-foot distance from the bottom chord to the top chord at the highest peak of the truss.¹ A short metal beam was attached to the vertical column at the ceiling level, and the bottom chord of the truss was then connected to the beam with a series of bolts. The top chord reportedly was made of laminated 2-inch by 4-inch wood material, the bottom chord was made of 2-inch by 6-inch members bolted together, and web members were 2-inches by 6-inches. The connections were bolted steel plates, and all the web members are thought to have been wood. It is not known if metal components were also used as web members or tie rods, although it is common to do this.

The entire finished ceiling of the service area was lath and cement plaster (at least 1/2-inch thick) attached to wood purlins, which were nailed to the bottom chord of the truss. The finished ceiling also extended to the service area addition. The distance from the floor to the finished ceiling was estimated to be 12 feet.

¹ At the time of the NFPA investigation, detailed drawings were not available, and the materials were heavily damaged by fire.

The automobile service area comprised nearly one half of the ground floor area of the building. Access from the exterior to the service area could be gained from the south side of the building through five overhead, garage-type doors. There was also one overhead door in the northwest portion of the north exterior wall. Several large metal-frame windows (casement type) were set in the masonry of the north exterior wall, comprising over 75 percent of the total surface area of the wall.

The interior of the service area was a large, open area of approximately 10,000 square feet. At the southeast corner of the service area there were three rooms: a tool room, an office, and a storage room. The walls were constructed with masonry materials, and they ran to the underside of the finished ceiling. The east wall of the tool room was a common wall with the body shop, and it had no openings. The only opening to the tool room was an entrance door that was located along its north side. One 275-gallon storage tank (containing transmission oil) was positioned along the west wall of the tool room, and another storage tank (containing antifreeze) was stored in the tool room. A door opening in the east masonry wall gave access to the area between the rear of the service area and the body shop. (See Figure 2.)

An interior stairway from the parts department connected the ground floor and the attic. There was a door located at the top of the stairs that led to the attic. Apparently, at some time over the years, someone began to use the attic space formed by the truss roof for storage. Plywood was nailed to the ceiling purlins, to facilitate use of the space. At the time of the fire, an undetermined amount of automobile parts (both combustible and noncombustible) and other combustible materials were stored over most of the attic floor. These reportedly included noncombustible auto parts wrapped in protective paper or stored in cardboard boxes. The materials included floor mats,

fenders, bumpers, exhaust components, windshields, and janitorial supplies. Further, "peg board" material was nailed to truss members at some locations to provide a means of hanging some of the parts for easy access. It is estimated that these materials presented a moderate to heavy fuel load. It was not determined if the weight of the stored materials exceeded the structural design limits of the truss.

FIRE INCIDENT

The fire department received reports of a fire in the Hackensack Ford building at 2:59 p.m. The initial report came from a woman, at a recreational facility across the street from the dealership, who saw smoke and flames coming from the roof of the building. At about the same time, workmen in the service area noticed that a flexible emissions exhaust duct was burning at the point where it passed through the finished ceiling. Also at about the same time, another workman was in the attic area retrieving automotive parts when he suddenly discovered smoke.

Since the first due engine company, E-305, was committed to another fire emergency, E-304, E-301, T-307, and a battalion chief were dispatched to the first alarm assignment. A total of ten fire fighters responded on the initial alarm.² E-304 and T-307 arrived at the scene in about one minute. E-304 took a position on the south side of the building near the first overhead door to the service area. The captain from E-304 first reported that heavy smoke was at the rear portion of the roof. The crew further observed some "light smoke" coming out from under the open overhead door. T-307 took a position just behind E-304. E-301, positioned at a hydrant on River Street, advanced a supply line to E-304.

² Rescue 308, manned by one fire fighter, was also dispatched but was on special assignment and did not respond until 3:18 p.m.

The officer from E-304 investigated the source of the smoke and attempted to locate an access point to the attic area, from which the smoke from the interior appeared to be coming. The remainder of his crew advanced a 1 1/2-inch handline into the service area. The officer apparently determined that conditions did not allow an attack by way of the stairway from the parts department, or that access could most easily and quickly be gained from scuttles located in the finished ceiling.³ Meanwhile, the truck crew was making an assessment of conditions on the roof. Upon his arrival at 3:03 p.m. the battalion chief received a report of the conditions and initial actions taken by the first arriving fire fighters. He apparently decided to continue with the initial decisions and actions.

In the process of gaining access to the roof, the truck company crew reported heavy smoke in the roof area. The crew, equipped with ventilation tools, moved along the roof to a position toward the rear of the building. The truck company officer checked for signs of intense heat or of indications of structural weakness such as tar bubbles or spongy roof sections. He did not observe any of these indications and led the crew to a point in the rear portion of the roof where a 48-inch attic ventilation fan was located. The ventilation fan was positioned at the midpoint of the service area roof where the arch-shaped roof sloped to meet the the body shop's flat roof. (See Figure 3.) The fan was enclosed by wood housing which projected beyond the sloping roof. The truck crew confirmed that the roof level smoke, that was initially observed, was coming from the ventilation fan. Meanwhile, fire fighters working to gain access to the attic were having difficulty opening a scuttle because materials were stored on top of it.

³ The officer verbally reported to his crew that he had found a door leading to the attic, but that he "could not get in."

Based on these conditions, the battalion chief ordered a second alarm for additional manpower at 3:06 p.m. E-302, with three fire fighters, was dispatched to the scene. T-307 also was ordered to ventilate the roof at this time.

The truck crew began to open the roof on the top portion of the ventilation fan housing. Using a circular blade power saw, the crew was able to open a ventilation hole and reported "moderate smoke" coming from the opening. The truck crew decided to enlarge the original hole by cutting into the sloped portion of the arch-shaped roof. The crew experienced difficulty in expanding the hole because the saw kept binding on an estimated 3/4-inch of tar on the roof. The enlarged ventilation hole seemed to effectively vent the build-up of hot, dense gases in the attic area.

While the roof was being opened by the truck company crew, the officer on E-302 was ordered to bring his manpower and an additional 1 1/2-inch handline into the building to assist in the ongoing effort to gain access to the attic. This effort involved fire fighters working from a ground ladder placed below a scuttle located at the east portion of the service area. One fire fighter at a time climbed the ladder and attempted to open the hatch. The hatch was eventually partially opened, and a hose line was advanced up the ladder to extinguish the fire that was burning materials adjacent to the opening. A second scuttle at the west end of the service area was reported to fire fighters as not being blocked, and a crew was sent to its location. Apparently, fire fighters working at the west scuttle were able to open and partially enter the attic but were driven back by the intense heat. This crew observed "brown" smoke in the attic; they did not observe fire, but directed a handline through the scuttle.

After venting the roof, the truck company crew, positioned on the flat portion of the roof over the body shop, advanced an 1 1/2-inch handline to the roof to prevent the lateral spread of fire on top of the roof.

These efforts continued for approximately 20 minutes, until the truck company crew reported "fire in the vent hole"⁴ at 3:22 p.m. During the next several minutes an additional engine, E-305, which was returning to headquarters station from another emergency, was called to the scene and Rescue 308, with one fire fighter, arrived at the scene. Further, the battalion chief requested an engine and truck recall. T-314 was instructed to report to the fire scene to help fulfill the request.

At approximately 3:27 p.m., the battalion chief began preparing for a defensive attack on the fire. He relocated T-307 to the north side for master stream operations, and E-305, en route to the scene, was ordered to supply water to the ladderpipe.

The battalion chief made several direct observations of conditions within the building and verbally communicated with the operating crews. Further, he made several observations of the roof conditions. Due to the continued growth of the fire and the fire fighters' inability to intervene, at 3:34 p.m. the battalion chief ordered the attack crews inside the building to "back your lines out." At this time, the battalion chief was positioned at the east scuttle along with six other fire fighters, and three fire fighters were working in the area of the west scuttle. There was no evidence of an extensive amount of heat or smoke build-up below the finished ceiling in the service area, but there was an indication of fire and intense heat above the ceiling.

At 3:35 p.m., the truck crew reported "heavy fire breaking through rear of roof" and the battalion chief was summoned to the exterior of the building by

⁴ At 3:09 p.m., a fire prevention officer also reported, "we have fire in the back."

the chief of the department for an assessment of the fire. Soon after this transmission and this action, the roof and ceiling in the area of the east scuttle collapsed on the six fire fighters who were working in the area.⁵ Those fire fighters working at the west scuttle were only partially affected by the collapse and escaped unharmed from the building. The truck crew left the roof by way of a ground ladder.

After the partial roof and ceiling collapse, the fire engulfed the rear (east) portion of the service area. One fire fighter initially trapped by the collapse and engulfed by the fire managed to spot an opening in the rubble and scrambled to the outside of the building. His protective clothing was burning as he reached the exterior, and fire fighters quickly extinguished the fire by rolling him on the ground. He was fully utilizing his protective clothing, and he was not injured.⁶ The five other fire fighters were trapped inside the building, which was now heavily involved with fire.

Feeling that all the fire fighters did not have time to carry out his order to evacuate, the battalion chief ordered a general alarm and ordered handlines from locations on the north and south sides to be directed toward the area of the collapse. Handlines were not advanced into the structure for fear of further collapse and fire fighter injury. Further, a full platoon recall was ordered for the department's remaining platoons, and all apparatus was requested at the scene.

Approximately three minutes after the collapse, a radio message was transmitted by portable radio from one of the trapped fire fighters who reported that he (a lieutenant) and another fire fighter were "stuck inside

5 Just seconds before the collapse, there was an indication that the finished ceiling was sagging. This observation apparently was not able to be communicated to, or was not observed by, the battalion chief.

6 Fire fighters were wearing protective hoods, coats, helmets, self-contained breathing apparatus (SCBA) and three-quarter length boots.

the rear of the building." Apparently due to the initial confusion that existed on the fire ground after the collapse and the sounding of tones for the recall over the only emergency fire ground radio frequency, the initial calls for help from the fire fighters were not acknowledged. After approximately three minutes, and with the help of radio messages relayed from headquarters to the fire ground, it was realized that at least two fire fighters had survived the collapse and were trapped inside the building.

During the next 11 minutes, radio transmissions continued with one of the trapped fire fighters, who was attempting to communicate their position. The best information that could be obtained from the fire fighter was that they were "stuck" in the "right rear" of the building, and that they were in a "closet."

While handlines were being directed from the north and south sides of the building toward the area of the collapse, fire fighters also prepared and then advanced handlines through the door opening between the body shop and service area and were able to advance down the corridor. They were able to search the rooms adjacent to the corridor, but they did not locate the trapped fire fighters. Fire fighters then attempted to advance the line into the service area but were driven back by the intensity of the fire.

After this attempt, it was decided that fire fighters would breach the masonry wall of the body shop in an attempt to locate the missing men. Tool chests and other heavy equipment had to be moved from their stored location against the wall before the breach could be started. The location of the breakthrough was based on the best estimate of where the two fire fighters might be located. Fire fighters used a battering ram to make an opening; they described the conditions on the other side of the wall as "a furnace."

Soon after the collapse, master stream appliances and large-caliber handlines were utilized to extinguish the fire and to protect the area of the

building where the fire fighters might be located. The recall brought additional manpower to the scene, and with the assistance of mutual aid companies, they were eventually able to bring the fire under control.

After the fire was extinguished, rescue crews located the bodies of a captain and two fire fighters at positions approximately 20 feet north of the east scuttle. Their positions indicate that they may have been in the process of backing one of the handlines out of the building. The bodies of two additional fire fighters (who had been in radio contact) were found in the tool room in the rear of the service area. Bergen County Medical Examiner's Office reported that the fire fighters died as the result of "multiple burn injuries"; carboxy hemoglobin levels ranged from 6 to 47 percent.

DISCUSSION

Investigators from the Bergen County Prosecutors Office have determined that the probable cause of the fire at the Hackensack Ford Dealership was accidental. The investigation to determine the precise cause remains open.

Investigators determined that the fire originated in the attic area above the service area. This area contained an abundant amount of stored combustible materials representing a substantial fuel load that was significant in the growth and spread of the fire. The combustible material included not only the automobile parts, partitions, wood ceiling, and roof purlins, but also the combustible wood truss members. There were no automatic fire detection or suppression systems in this unoccupied attic area to aid in the early detection or suppression of the fire. As a result, the fire burned undetected for a significant length of time and was likely to have been well advanced soon after fire department crew arrival.

The stored materials likely affected the structural integrity of the truss because of the additional load they imposed and because of the degradation of the truss caused by the rapid burning of the materials.

Heavy smoke was observed by first arriving fire fighters who investigated the source but were hindered due to their inability to gain access to the attic. Due to the inaccessibility, hose streams did not reach the seat of the fire, and it continued to develop. The increased severity of the fire resulted in the decision of the battalion chief to withdraw the manpower from the interior of the building, 33 minutes after the arrival of the first crew. However, two minutes later and before the order could be carried out, a partial roof collapse occurred.

Trusses are vulnerable to collapse under fire conditions because they are composed of relatively lightweight members, compared to the weight of material that would be required if ordinary nontruss construction were used. A characteristic of wood trusses is that failure of one part (member) causes the entire truss to fail. As mentioned earlier, the additional load provided by the stored materials and their rapid burning affected the integrity of the truss. The exact failure mechanism that caused the structural collapse in this incident is not known. A similar collapse of a heavy bowstring truss in the early stages of a supermarket fire, killed six New York City fire fighters.⁷

One author offers the following rule regarding fire fighting tactics involving truss construction: "In the case of a trussed roof if there is enough heat and fire to require ventilation, the roof is unsafe; men ventilating the roof should be supported independently of the roof. It is just as hazardous to be under the trussed roof as on top of it."⁸

7 Investigative Report, Six Fire Fighter Fatalities, 2892 Ocean Avenue, Brooklyn, New York, August 2, 1978. National Fire Protection Association, Quincy, MA.

8 Francis L. Brannigan, Building Construction for the Fire Service, Second Edition, National Fire Protection Association, Quincy, MA, pp. 85-86.

Unfortunately, in this incident the inherent wood truss construction hazard was again a primary contributing factor resulting in fire fighter fatalities. This and earlier tragic incidents provide important lessons that must be stressed throughout the fire service to avoid future loss of life.

SUMMARY TIME LINE*

2:59 p.m. Fire department begins to receive the first of a series of telephone calls about a fire at the Hackensack Ford Dealership.

3:00 p.m. E-304, E-301, T-307, and battalion chief are dispatched to the scene.

3:01 p.m. Units E-304 and T-307 arrive at the scene.

3:03 p.m. Battalion chief arrives at the scene.

3:06 p.m. Second alarm, E-302 dispatched to the scene; Order given to ventilate the roof.

3:22 p.m. Fire in ventilation hole reported.

3:27 p.m. Engine and truck recall: E-305, T-314 requested to the scene.

3:28 p.m. T-307 ordered to relocate to the north side; E-305 to supply truck operations.

3:34 p.m. Order is given to back lines out.

3:35 p.m. Heavy fire breaking through the roof noted.

3:36 p.m. Partial ceiling and roof collapse; general alarm requested.

4:36 p.m. Fire controlled.

*All times are approximations.

FIGURE 1: TOP VIEW AND SOUTH ELEVATION

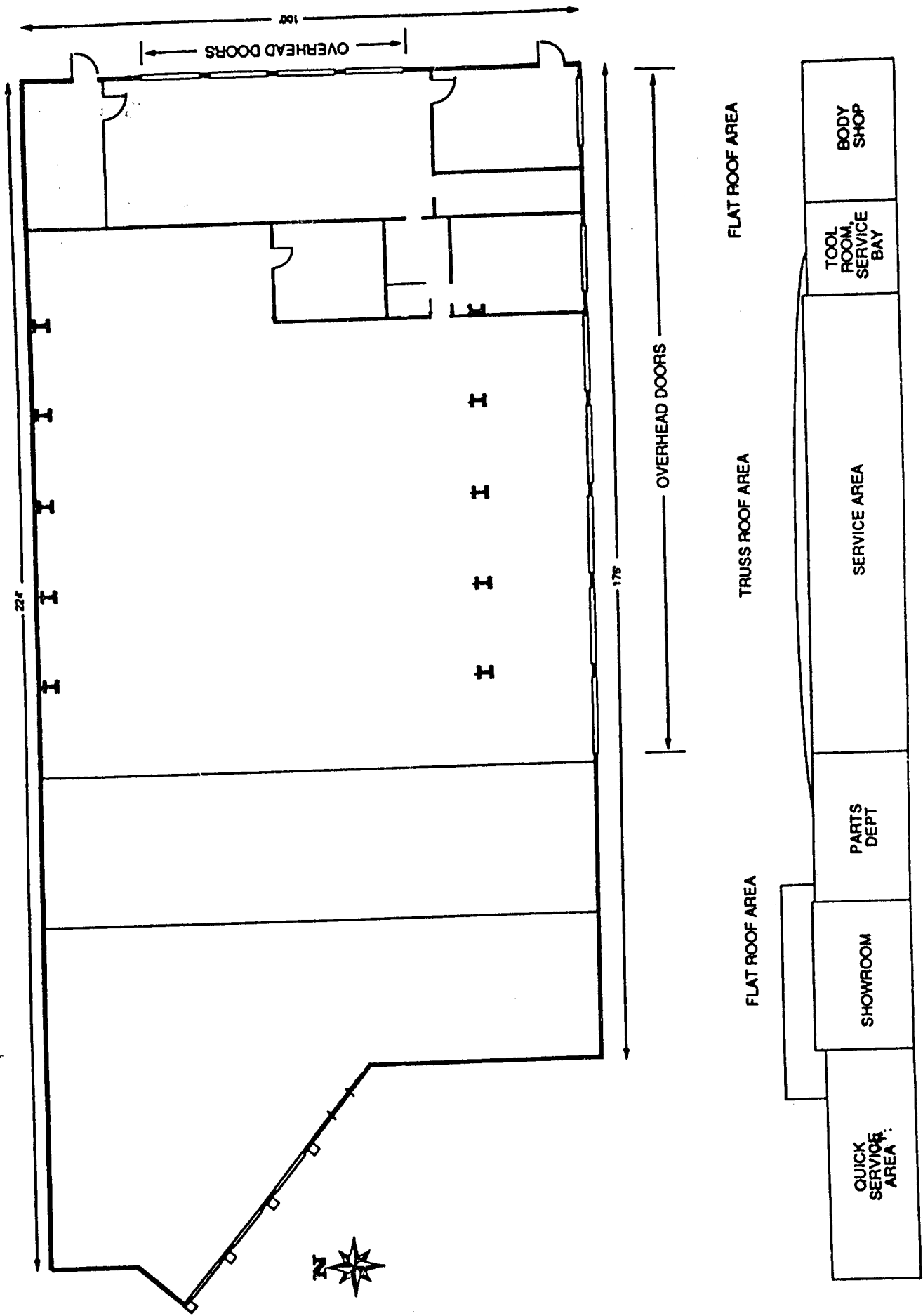
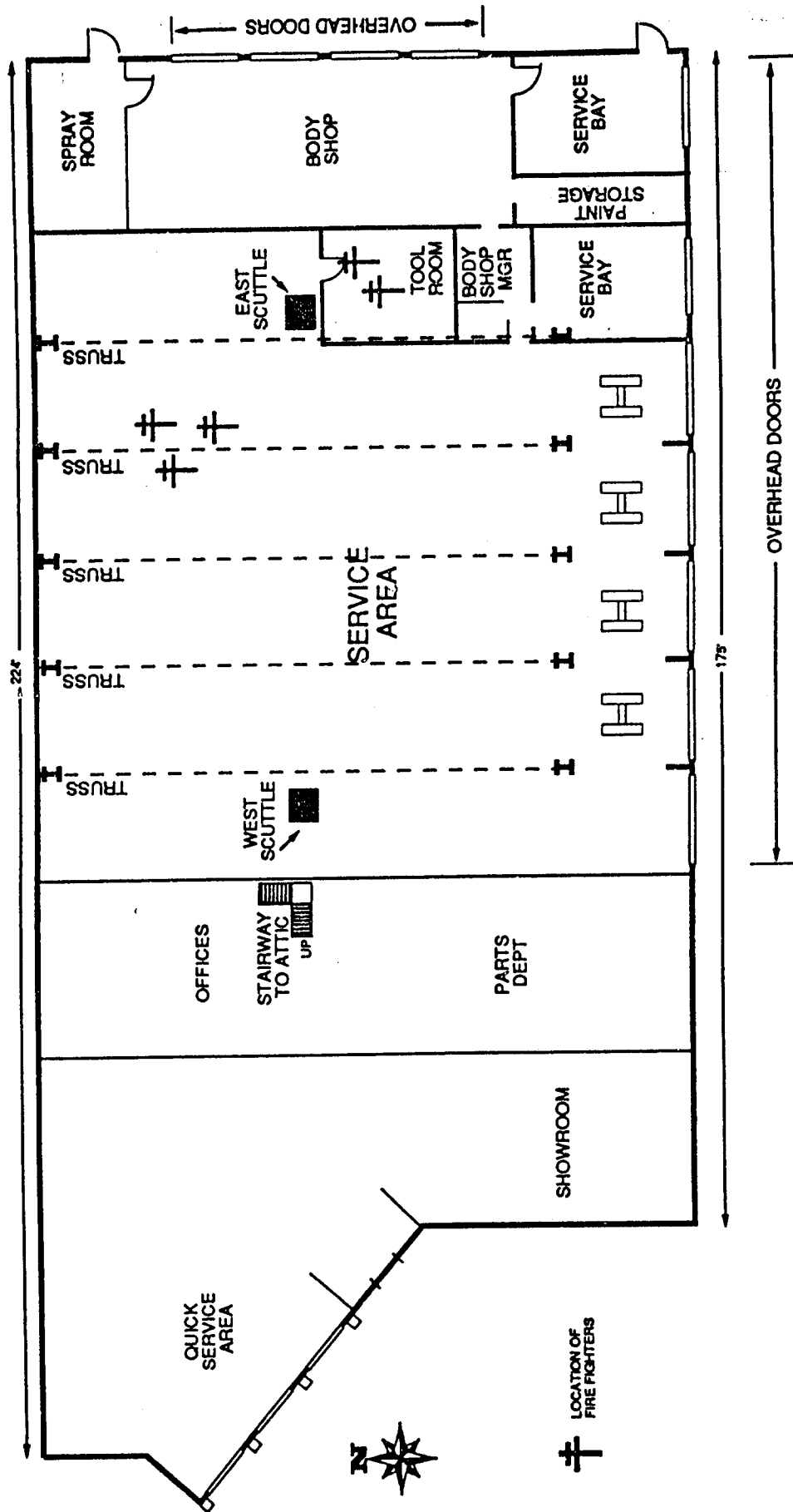


FIGURE 2: TOP VIEW DETAIL



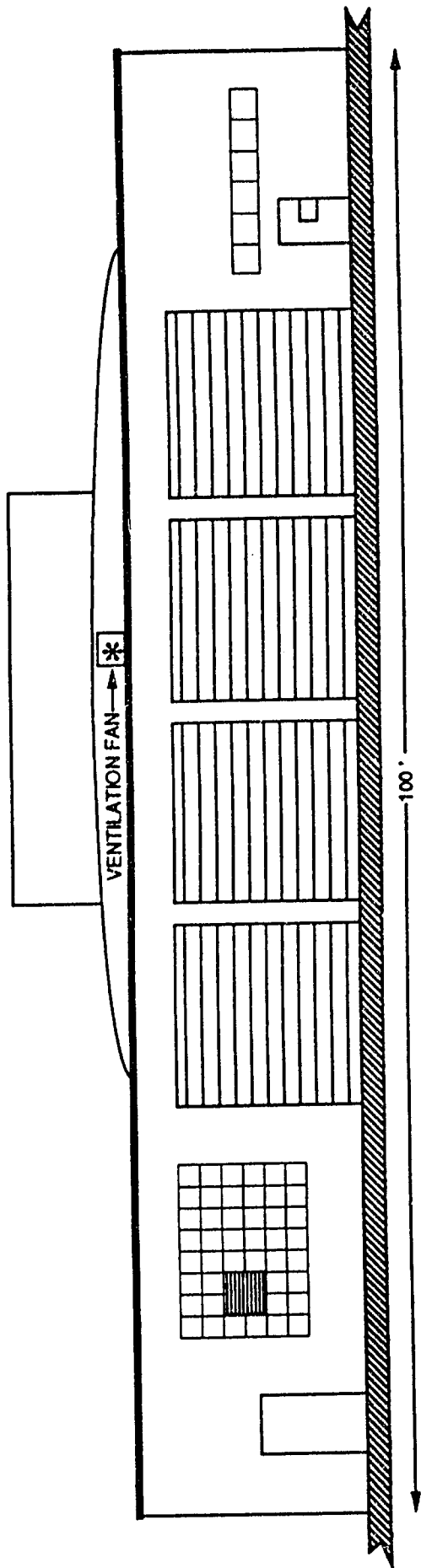


FIGURE 3: EAST ELEVATION