UNTREATED WOOD-SHINGLE GROUP
APARTMENT FIRE
Davis, CA
March 14, 1988

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Investigation Report
Untreated Wood-Shingle Group Fire
Davis, California
March 14, 1988

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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

On March 14, 1988 at 7:08 p.m., the Davis Fire Department received a telephone call reporting a fire at the Drake Apartments. Before the fire was brought under control four hours later, firefighters from Davis and several other communities were involved. The fire originally involved the apartment complex office and spread to six other buildings, damaging 29 apartments.

The apartment complex had 17 two-story and one one-story wood-frame structures with a mixture of stucco and combustible exterior wall finishes. The residential buildings had roofs covered with untreated wood shingles. According to building plans, the office/recreation building had fire-resistant wood shingles covering its roof.

The first Davis firefighters on the scene found the office building completely engulfed in flames. Flames also erupted on the exterior of the two exposed buildings, and fire brands ignited the wood-shingle roofs of other buildings. Early in the incident, firefighters could not contain the fire because of the speed with which it spread over the wood-shingle roofs, communications problems, SCBA resupply difficulties, and other problems.

The Davis Fire Department ultimately sounded four alarms, bringing in assistance from the University of California--Davis Fire Department, three other communities, and four fire districts. As more fire units arrived, many of the operational problems were resolved, and the fire was declared under control at 11:19 p.m.

The following significant factors contributed to the severity of property loss:

1. The magnitude and spread rate of the fire exceeded the suppression capabilities of arriving firefighters.

2. The untreated wood shingles covering the apartment buildings allowed fire to spread rapidly over buildings and produced burning brands that spread fire to other buildings.

3. The fire suppression operations were impeded by limited space between buildings, the presence of trees and shrubbery, and the distance to fire hydrants on the north side of the building.
INTRODUCTION

The National Fire Protection Association (NFPA) investigated the Drake Apartment complex fire in order to document and analyze significant factors that resulted in the loss of property. This investigation is part of the NFPA's continuing effort dedicated to the documentation of technically significant fires and to the reporting of "lessons learned" data for fire safety purposes.

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

The NFPA became aware of the fire at the Drake Apartments on March 15, 1988. Michael S. Isner of the Fire Investigations Division traveled to Davis, California to document the facts related to this fire. An initial three days of on-site study and subsequent analysis of the event were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the Davis Fire Department. This report presents the findings of the NFPA's data collection and analysis effort.

This report is another of NFPA's studies of fires that has particularly important educational or technical value. 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 property resulting from the Drake Apartment fire.

This report describes fire safety conditions at the apartment complex and presents findings on contributing factors to the loss of property based on NFPA analysis of collected data and observations during the investigation. Current codes and standards were used as criteria for this analysis so that conditions at the complex on the day of the fire could be compared with current fire protection practices. It is recognized that these codes and standards may not have been in effect during construction or operation of the Drake Apartments. NFPA has not analyzed the buildings to determine whether they comply with the codes and standards that were in existence when the Drake Apartments were built or during their operation.

The cooperation and assistance of Fire Chief Don Sylvia, Fire Captain Tom Burton, and others at the Davis Fire Department are greatly appreciated.
General Description

The Drake Apartment complex was constructed in 1971 in a suburban area about one mile from the University of California--Davis campus. The front (south side) of the complex faced Drake Drive, a residential street, and the north side of the complex faced Covell Boulevard, a busy thoroughfare. (See Figure 1.) Both commercial and residential buildings were directly north of Covell Boulevard, and these buildings had noncombustible roofs, such as composite roofs and roofs covered with asphalt-type shingles. The east and west sides of the complex faced parking lots.

The complex contained 18 buildings; these included one office building, two laundry areas, five buildings with "flat" apartments (i.e., all rooms in the dwelling unit are on the same floor), and 11 buildings with town house apartments (i.e., the rooms in the same dwelling are on two floors; for example the bedrooms are on the second floor and the kitchen and living room are on the first floor). Except for the one-story laundries, all buildings were two-story, wood-frame structures. A fenced courtyard with an inground pool was located north of the office building in the center of the complex. The courtyard and all the grounds in the complex were landscaped with many trees and bushes.

All of the residential buildings were 30 ft wide, but the building length varied according to the number of living units per building and according to the type of dwelling unit, because flat apartments and town houses had different dimensions. The largest building with flat apartments had six 26 ft X 30 ft living units on each floor, making the building 156 ft long. The longest building with town house apartments had nine 16 ft X 30 ft living units and was 144 ft long. However, most buildings with town house apartments had four or five living units and were 64 ft or 80 ft long.
The most common distance between the exterior walls of the buildings was 20 ft. This measurement does not include the 2-1/2 ft section of roof that overhangs the building's exterior walls. However, in one situation the separation distance between buildings was only 13 ft.

Applicable Codes and Code Enforcement

In 1971, the City of Davis was enforcing the 1970 Uniform Building Code and its supplemental documents, the Uniform Mechanical Code, the Uniform Plumbing Code, and the Uniform Fire Code. The Davis Building Department is responsible for code enforcement and building inspections. Prior to issuing permits, the building department reviews plans to ensure that the design meets the applicable code requirements. During this review process, plans are sent to the fire department, which ensures that the firesafety details are in accordance with the code.

Occupancy Classification

According to the 1988 Uniform Building Code, the residential buildings in the complex are classified as Group R, Division 1 and the office/recreation building is classified as Group B, Division 2.

According to the 1988 NFPA Life Safety Code, the buildings containing apartments have the occupancy classification of Existing Apartment Building. The office/recreation building has two occupancy classifications. The NFPA

The 1988 Uniform Building Code (ICBO), the 1988 edition of NFPA 101 Life Safety Code, and other current codes will be used in this report to compare existing conditions in the facility to selected requirements of current national building and fire codes. It is recognized, however, that these codes were not in effect during construction of this facility.
criteria classifies the first floor of this building as an Existing Business Occupancy, and the second floor meets the NFPA criteria for a Class C Existing Assembly Occupancy.

**Building Occupants**

Approximately 300 people resided in the 93 apartments of this complex. The property manager and family lived in one apartment, and several families with working adults also were residents. The majority of apartments were occupied by undergraduate and graduate students who attended the university on a full-time basis.

**Building Construction**

The buildings containing flats and town houses were similar in construction. None had a basement and all had walls framed with 2 in. X 4 in. wood studs. Some of the exterior walls had 4 ft X 8 ft sheets of 3/8-in. thick textured hardboard nailed directly to the wood studs. However, most exterior walls had a stucco finish and no base sheathing. Wrap wire was nailed directly to the wood studs and then three layers of plaster, (scratch coat, browncoat, and finish coat), were applied to and supported by the wrap wire.

All interior walls were gypsum board nailed to wood studs; however, the number of gypsum board layers and the type of gypsum board used varied according to the wall use. Walls within a flat or town house had a single layer of gypsum board on each face of the wood studs. Party walls between most flats or town houses were double-wide walls constructed with 1/2 in., nonrated gypsum board, and they terminated at ceiling level. Three residential buildings were subdivided by two-hour fire walls. (See Figure 1 for the location of these walls.) These walls were also double-wide and had two layers of UL labeled 5/8-in. fire-resistant gypsum board nailed to the 6.
wall surface facing the room. Unlike the party walls, the fire walls continued up to the top chord of the roof trusses. However, they did not extend through the roof and had no parapet. Gypsum board was nailed to the underside of the roof assembly and was extended horizontally for approximately 6 ft from the fire wall, providing additional protection.

The residential buildings had gable roofs with a 6/12 pitch, and the sloping surfaces were covered with untreated cedar shingles nailed to 1 in. X 4 in. boards called spaced roof sheathing.²,³ (See Figure 2.) The sloping roof surfaces did not meet at a typical ridge. Instead, the two roof surfaces met at a flat area running the full length of the building. The flat part of the roofs was used as a mounting surface for heating, ventilation, and air conditioning (HVAC) equipment and was enclosed by a 2-ft high wall. The flat area was covered with built-up roofing materials.

Every building had roof access ladders, which were provided for maintenance personnel. A ladder was externally mounted on both gable ends of every building and was enclosed in a wood structure. The access point to this

² The 1988 edition of the Uniform Building Code now requires Class B roofs on apartment buildings with the following exceptions:

- "Nonrated roof coverings may be used on buildings that are not more than two stories in height and have not more than 3000 sq ft of projected roof area and there is a minimum distance of 10 ft from the extremity of the roof to the property line on all sides except for street fronts.

- Buildings that are not more than two stories in height and have not more than 6000 sq ft of projected roof area and there is a minimum distance of 10 ft from the extremity of the roof to the property line or assumed property line on all sides except for street fronts may have Class C roof covering."

³ No information was available regarding the assumed property lines when the construction plans were approved by the Davis Building Department. Since building distance to property lines as well as the projected roof area and number of stories affect the current requirements for roof ratings, it was not possible to determine whether untreated wood shingles would have been permitted according to the 1988 Uniform Building Code.
ladder was protected with a wood door and two padlocks to prevent unauthorized
people from using the ladder.

The 20 ft X 30 ft office/recreation building differed in many ways from
the residential buildings. (See Figure 3.) This structure had a full
basement, which contained equipment and supplies for the pool. The exterior
walls were either large glass panels or 4 ft X 8 ft sheets of hardboard. A
large redwood stairway on the south side of the building provided access to
the first floor. A second exterior wood stairway on the north side of the
building ran from a patio to the first floor. This stairway also provided
access to a wooden walkway that encircled the entire building at the
second-floor level. Unlike the residential buildings, the office had a hip
roof and the four sloping surfaces were covered with fire retardant cedar
shingles, according to the building plans.⁴

Fuel Load

Except for the tongue-and-groove cedar ceilings in the living rooms of all
apartments, the fuel load in the dwelling units appeared to be about average
for a residential environment. Interior walls were painted or covered with
wallpaper. Wood trim work, pictures, and fabrics that were hung on the walls
slightly increased the combustibility of wall surfaces. The majority of the
fuel in the apartments appeared to be furnishings, clothing, and other
personal possessions of occupants.

⁴ Due to the extensive fire damage, wood shingles from the office/recreation
building could not be found and the fire retardance of the reported
treated wood shingles could not be physically verified. In addition, the
Davis Building Department had no records that documented that treated wood
shingles had been installed in accordance to the plan requirements.
However, since there is no written variance in the Drake Apartment
building file, the local building official assumes that the apartments
were constructed according to the plans.
Reportedly, the interior finishes in the office/recreation building were similar to those in the apartments. Partitions were painted gypsum wallboard and ceilings were finished with the wood planks and beams. The first-floor offices contained chairs, desks, and cabinets, and the second-floor recreation room had furnishings such as couches, tables, and chairs. This building also had an open, combustible stairway between the first and second floors.

**Mechanical Equipment**

A roof-mounted heat pump was provided for each dwelling unit. The heat pumps, which provided both heating and air conditioning, were gas-fired units with a bonnet capacity of 45,000 BTU/hr, and each unit weighed approximately 300 lbs. Conditioned air was brought to the occupied spaces by a network of flexible ducts.

**Fire Protection**

Single-station, battery-powered smoke detectors were provided in all the living units. The flat apartments had one smoke detector and the town house apartments had one smoke detector on each level.

Several 2A 10BC fire extinguishers were provided throughout the complex. The extinguishers were mounted on the exterior of buildings and were positioned so that all apartments were no more than 75 ft from one.

A system of underground piping was installed and could provide water to several 1 1/2-in. discharge connections located throughout the complex. The 1 1/2-in. connections were dedicated to fire suppression and were provided because there were no municipal fire hydrants installed within the complex. A single 2 1/2-in. fire department connection was located next to a municipal fire hydrant on Drake Drive. This arrangement allowed firefighters to connect an engine to a municipal hydrant and to pump into the underground piping system.
Two fire hydrants were adjacent to the complex on Drake Drive, but the closest hydrant on the south side of Covell Boulevard was about 1500 ft away from the complex.

**Municipal Water Supply**

Sixteen wells with capacities ranging from 800 gpm to 2200 gpm per well supply water to the Davis municipal water system. Though all wells are available at all times, the number of wells used varies according to the demand. In addition to the wells, the water system includes an elevated 200,000 gallon storage tank that is 140 ft tall.

A grid system of 6-in. and 8-in. cast iron water mains and 10-in. ductile iron water mains distributes water throughout the community. Normal pressure in the water main system is about 50 psi.

**Fire Department**

The Davis Fire Department provides protection for the 43,219 city residents. To accomplish this task, the fire department employs 27 firefighters and nine officers, two division chiefs, and the department chief. In addition, the department has 15 volunteer firefighters, including three employees from the other City departments who augment the fire department. Three fire stations contain the department's five engines, one brush vehicle, a water tender, and a light rescue vehicle. The firefighters work a 24-hour shift with six assigned to the headquarters station and three firefighters assigned at the other two fire stations.

The Davis Fire Department has an automatic mutual aid agreement with the University of California--Davis Fire Department. This department normally has six to eight firefighters on duty per shift and has three engines and one

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5 Based on 1988 data.
truck with which to protect the University which has a student and staff population of 25,000. Under the mutual aid agreement, either jurisdiction dispatches one engine for a second alarm and another for a third alarm. The agreement also makes the University ladder truck available for special calls in the city.

Weather Conditions

Weather information was recorded at the Sacramento Airport approximately 10 miles from Davis. At 7 p.m. the skies were clear, temperature was 60° F, SW winds were 4 mph, and the relative humidity was 43 percent. At 10:00 p.m. the skies were still clear but the temperature dropped to 52° F, the SW winds had risen to 7 mph with gusts up to 9 mph, and the relative humidity was 60 to 65 percent.

THE FIRE

Discovery and Fire Department Notification

On the evening of March 14, 1988, many residents of the Drake Apartments were in their respective town houses and flats. It was early in the evening so the non-student occupants were home from work, most students were not at classes, and the occupants of numerous apartments were having dinner. Final examinations were only a few days away and, as a result, many students were in their apartments studying and finishing projects.

At 7:08 p.m., the Davis Fire Department dispatch center received a telephone call from a man who reported a fire at the Drake Apartments. In the next two minutes, the dispatch center received 19 calls reporting the fire.

One of the calls was from a woman who lived across Drake Drive and could see the office/recreation building. Reportedly, she saw the fire on the
outside and near the south entrance to the office/recreation building. After calling the fire department, she went back to her front windows and saw that the fire was beginning to spread across the front of the building.

At approximately 7:09 p.m., a Davis police officer arrived on the scene and found that the fire covered the wooden steps leading to the office/recreation building. In addition, the front of the building appeared to be a wall of flames and the officer thought that the flames had already penetrated into the second floor.

Initial Fire Department Response

The Davis Fire Department dispatch center completed the dispatch of the first alarm assignment at 7:09 p.m. Davis Engines 4, 5, and 6 and Squad 1 responded with a total of 10 firefighters and dispatch informed the crews that multiple calls were being received. Engine 5 was only a few blocks from Station 2 when the captain saw a glow in the sky. He asked for a second alarm and a few minutes later made a special request for the University truck.

The first engine company on the scene was Engine 5 from Station 2. The engine was a triple combination 1250 gpm pumper carrying 5-in. supply line, two 1 3/4-in. preconnected hose, one 2 1/2-in. preconnected hose, and two hose reels. The crew consisted of a captain and two firefighters.

Engine 5 approached the complex from the west end of Drake Drive and the captain had his crew connect to the hydrant at the southwest corner of the complex. (See Figure 4.) Laying their 5-in. supply, Engine 5 and crew continued down Drake Drive. The office/recreation building appeared to be totally engulfed with flames over south, east, and west sides and extending to the roof. In addition, the crew saw that smoke was starting to come from the exterior walls of Buildings F and I, the west and east exposures.
Fire Suppression

The captain of Engine 5 considered the office/recreation building beyond control and assigned his crew to the protection of the west exposure. While the crew was setting up the apparatus-mounted deck gun and a 2 1/2-in. attack line, the captain attempted to determine whether anyone was trapped. He spoke with several people in the large crowd that was mostly comprised of residents from the apartments. The officer got the impression that everyone had safely escaped so he continued to commit the first crews to fire control and planned to assign search and rescue duties as more firefighters became available.

Shortly after Engine 5 began setting up for the fire attack, Engine 4 and the squad from headquarters arrived on the scene and approached from the east end of Drake Drive. The captain from Engine 4 met with the captain from Engine 5, who had assumed the role of incident commander, and was instructed to protect the east exposure, Building I. The two firefighters from Engine 4 and two more from the squad connected the engine to the hydrant near Building I and set up a deluge set at street level to protect that building.

As the firefighters were putting the equipment into place, the officer from Engine 4 could see that flames had entered the first and second floors of Apartment 149 in Building I. Fire had also penetrated the attic and was spreading on the wood shingles covering the roof. The captain from Engine 4 established the goal of stopping the fire in Building I before it reached the first two offset apartments. To accomplish this, he directed hoselines to be positioned on both the Drake Drive and courtyard sides of the building.

Firefighters from Engine 4 forcibly entered Apartment 153 of Building I and brought hoselines through that apartment to expedite the positioning of attack lines on both sides of the building. Once in the courtyard, firefighters could see that burning brands were being entrained in the fire plume and were being carried away by the wind coming from the south.
Facing a fire that was involved three buildings and was still spreading, some firefighters maintained positions on Drake Drive and found that several obstructions hampered their suppression efforts. The firefighter from Engine 5 who was protecting the west exposure with a 2 1/2-in. hoseline found that his hose stream had to be directed between trees and parked cars. Thus, the areas that he could protect from his position were limited. Similarly, the monitor nozzle had to be removed from Engine 4 and positioned on Drake Drive because trees obstructed the fire stream when the nozzle was left on the engine.

Once the crews from Engine 4 and Engine 5 had their hoses and monitor nozzles in place and began to discharge at full capacity, (1500 gpm), the drivers of both engines became concerned about the adequacy of their water supply, because their pressure gauges were showing residual pressures as low as 5 psi. The drivers informed their respective officers that they could not provide water to any more hoselines. Several well pumps automatically operated and the residual pressures climbed to approximately 40 psi about 30 minutes after the low pressures were noted. The pump operators did not experience low pressure at any other time during the fire.

While the first crews began their attack from the Drake Drive side of the complex, Engine 6 was responding from Station 3. As the number of apparatus responding to the scene increased, the radio transmissions also increased and the radio network became congested. The captain of Engine 6 thought he heard, among the many transmissions, that his unit was being assigned to protect houses in a specified area. Unable to confirm the instruction because of the radio congestion, he had his crew connect to a hydrant appropriate for the assignment. While laying their supply line, the officer realized that he had misunderstood the assignment. The officer had his crew disconnect the hose that had been laid and respond to the north side of the complex to properly fill his assignment.
The officer then had Engine 6 connect to the closest hydrant that did not require laying hose across Covell Boulevard. Due to the traffic volume, he felt that it would be unsafe for both the firefighters and motorists. The driver connected Engine 6 to a hydrant approximately 1500 ft from the scene and began to lay a supply line for the second time. Engine 6 did not have enough 5-in. supply line to complete this hose lay, so the driver connected a triple wye to the large diameter hose and continued the hose lay with 2 1/2-in. hose. The supply of 2 1/2-in. hose was also exhausted before Engine 6 reached the scene.

Requesting support from another engine company, the captain of Engine 6 had his unit proceed to the scene and park near Building G. He assumed command of the north division and had his crew begin stretching hoselines so they could begin an attack using tank water.

In response to the request, a second engine from the university, which had been dispatched in the third alarm, was assigned to complete the hose lay between Engine 6 and the supply line already stretched out. Apparently, the instructions were not clearly relayed over the congested airways because the university engine crew attempted to lay a new supply line all the way back to the hydrant. This engine also ran out of supply line and had to get additional lengths from the unused Davis supply line in order to complete the lay to the hydrant.

By the time the crew from Engine 6 began to position their attack lines, the wind was pushing the fire plume and burning brands in a northerly direction. As the north division supervisor, the officer from Engine 6 was concerned that buildings were being exposed to the burning embers. He was most concerned with the apartment buildings on the north side of the complex because the burning embers had already ignited the roof of Building E and small spot fires were noticed on the roofs of Buildings D and G. The officer also checked conditions in the buildings north of Covell Boulevard and found
that the embers were not igniting roofs in this area. Therefore, he
concentrated his crew on the protection of exposed buildings on the north side
of the complex. The first attack line, from Engine 6, which was a 2 1/2-in.
hose wyed into two 1 1/2-in. lines, brought into position for the protection
of Building E.

Before the firefighters could position other hoselines, the fire began to
spread rapidly across the roof of Building D. In addition, burning embers
which were landing on the roof of Building G ignited many spot fires at the
north end of this building. These small fires grew rapidly and exceeded the
control capabilities of the firefighters. The fire then spread in a southerly
direction along the roof of Building G. Firefighters indicated that the fire
spread at a rate faster than they could move their hoselines. They also
stated that the fire appeared to burn under the shingles and the water being
applied had little or no effect on this burning.

Engine 1 and Truck 1 from the university responded to the Drake Drive side
of the complex. The truck was positioned near Davis Engine 4, where the truck
raised its ladder and used a ladder pipe to suppress the fire in Building I.
Engine 1 was assigned to supply water to the truck and the officer from Engine
1 who assumed the role of west division supervisor had his crew use hoselines
from Davis Engine 5 to begin attacking the fire in his sector. The university
firefighters attempted to suppress the roof fire from positions on the ground
but found that the distance and vegetation between buildings prevented them,
as it prevented firefighters in other locations, from using the hoselines
effectively in many instances.

As the number of firefighters on the scene increased, some became involved
with a preliminary search of apartments and others began to attack interior
fires that had started in several apartments. The interior operations were
limited, however, by a shortage of replacement air bottles for SCBA. The
shortage affected interior operation until two county operated "air" units
16.
responded to the scene, approximately 1 1/2 hours into the fire. The interior operations were also affected by concern regarding the heavy, roof-mounted heat pumps. As the fire weakened the roof structure, these units were falling into the apartments, posing a threat to the firefighters.

The exterior operations also increased as additional firefighters and equipment arrived at the scene. Some firefighters used ground ladders or climbed the service ladders at the building gable ends in order to get closer to the fire and to improve the effectiveness of the hose streams. Many more hoselines were brought into the complex. Some were used against the spreading of fire and others were used for the protection of exposures.

Before the fire was brought under control at 11:19 p.m., four alarms were sounded and all off-duty Davis firefighters were recalled. Mutual aid calls brought firefighters from the University of California--Davis; the cities of Woodland, West Sacramento, and Dixon; and the districts of Capay, Winters, West Plainfield, and Willow Oak. At the height of activity, approximately 70 firefighters and 10 fire apparatus were committed to the fire.

Casualties and Damage

One university firefighter reported a minor smoke inhalation injury and there were no reported injuries to civilians in this incident.

Preliminary damage information estimates the loss at 1.39 million dollars but the amount is expected to go as high as 1.5 million dollars. These values reflect damage to the apartment buildings, office building, and contents. The preliminary loss figures, however, have not included the estimated losses to property owned by the many tenants who were not insured. Also, the loss estimates do not reflect the impact that this fire had on 100 to 120 students when they lost their books, notes, and research data a few days before finals and the end of the quarter.
Nine of the 18 buildings were damaged by this fire. (See Figure 5.) The least severe damage was to Building H, which was missing a few roof shingles on its west side. Building J had a 2-ft X 3-ft area of burned roof shingles near the west end of its roof. The most severe damage occurred to Building N, the office/recreation building, which was completely destroyed. The only remaining identifiable parts of the building were the floor of the office level and the foundation.

Though not totally destroyed, five other buildings were heavily damaged by the fire. The roofs covering Buildings E and G were severely burned, but they were not totally consumed, like the roofs covering Buildings D and F were. The damage to Building I ranged from heavy structural and roof damage at the west end to minor damage to the roof that was east of the fire wall.

Collectively, the damaged buildings contained 29 town house apartments that were heavily damaged on the second floor. In several of these apartments, burning materials dropped to the first floor through the open stairway and spread fire to the first floor level. Apartment 149 in Building I was the only town house that was gutted on both floor levels.

ANALYSIS

Fire Origin

Fire investigators from the Davis Fire Department and the Yolo County Arson Unit considered this incident to be a suspicious fire, probably involving flammable liquids. Though tests for flammable liquids have provided negative results, the rapid fire growth as described by the woman in the house, the police officer's observation that fire was spreading down the stairs, and other information strongly suggest that flammable liquids were involved in the ignition. The eyewitness accounts have also placed the point
of fire origin at the outside of the building near the front entrance to the office. The investigation revealed that there was nothing in the area of fire origin that could explain the observed fire growth.

**Fire Spread and the Hazard of Untreated Wood Shingles**

The ignition scenario and type of building construction contributed to the rapid and complete destruction of the office/recreation building. The suspected flammable liquid fire involving the office's front stairs quickly ignited the wood window frames and hardboard panels, which had a fire-resistance rating similar to that of plywood.\(^6\) The rapidly growing fire also impinged upon the wood walkway that encircled the entire second floor, broke through the windows and spread fire to the interior of the building, and spread to the wood-shingle roof.

By the time firefighters arrived at the scene, the fire had developed to such a point that the officer in charge considered the office/recreation building unsaveable. Because the exposed exterior walls of the two adjacent buildings were emitting smoke, it was obvious that Buildings F and I were receiving dangerously high levels of radiant heat from the burning office/recreation building that was 20 ft away. Before the first due companies could position hoselines, the radiant heat ignited the exposed buildings and the fire quickly spread to the wood-shingle roofs of these buildings.

Firefighters who approached the scene from the north side were the first to realize that fire was spreading to buildings other than the building of fire origin and the two immediate exposures. They found that lightweight burning brands, embers, and sparks from all three buildings were being carried into the air, landing on other roofs and igniting those roofs. The release of

\(^6\) UL Fire Resistance Index.
burning embers and subsequent ignition of other wood shingle roofs is a documented characteristic of fires involving untreated wood-shingle roofs and has been the concern of the NFPA since the 1930s. Similar fire spread has been described in many NFPA investigation reports, including the study of the 1961 Los Angeles conflagration titled, "The Devil Wind and Wood Shingles."  

This study of the Los Angeles conflagration also reported that burning embers were blown up under shingles, causing the dry undersides to ignite. Even though firefighters were close by with hoselines, they could not extinguish the fire and it spread to the attic spaces. During the Davis incident, firefighters attacking the fire involving the roof of Building G also reported that the fire appeared to get up under the shingles and could not be extinguished by external hose streams.

During the wood-shingle conflagration that occurred in Houston, Texas, in July 1979, the fire appeared to skip over buildings instead of spreading from building to building. Fire spread similar to this was reported during the Davis incident. For example, the fire on the roof of Building D became a severe fire faster than the fire on Building E even though Building E was closer to the area of fire origin. Similarly, the end of Building G's roof that was furthest from the area of fire origin ignited first. Despite the wind from the south and the efforts of firefighters, the fire on Building G spread in a direction back toward the area of fire origin.

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9 Ibid.

The north division supervisor during the Davis fire was concerned about the burning brands that were landing on the roofs of buildings north of Covell Boulevard. However, he found that the fire had not spread over these buildings, apparently because these structures did not have wood-shingle roofs. A similar observation was made by fire officials during the Houston conflagration in which the officials felt that the fire did not spread to buildings across a thoroughfare because those buildings did not have wood-shingle roofs."

Fire Suppression

The captain of the first engine company on the scene immediately assumed the role of incident commander and was faced with several simultaneous tasks, such as coordinating units still en route, assessing the need for further assistance, assessing the status of building occupants and more. The officer also recognized that he could not effectively function as an attack crew member so his engine company had to operate as a two-firefighter crew.

Even though the Davis engine companies and units from the university were on the scene within minutes of the ignition, the rapidly spreading fire exceeded their extinguishing capabilities. Initially, all the available personnel were committed to the placement of hoselines. Since fire apparatus could not drive into the complex and little or no ground ladder work was initially performed, firefighters attempted to attack the roof fires from positions on the ground. The close spacing of buildings, trees, and bushes prevented firefighters from making effective attacks against the fire from ground.

The problems experienced on the fire ground were complicated by the congested radio frequency. Commands were not relayed and were misunderstood, which created additional problems, such as that experienced when the crew of

"Ibid."
Engine 6 attempted to lay their supply line. Many officers on the fire ground found that the most reliable method for communicating was to seek out the necessary parties and talk to them in person.

As more firefighters arrived at the scene, most of the problems, especially those related to staffing shortages, were resolved. Communication problems were never totally resolved.

Significant Factors

In view of the previous discussion, the following significant factors contributed to the severity of property loss:

1. The magnitude and spread rate of the fire exceeded the suppression capabilities of arriving firefighters.

2. The untreated wood shingles covering the apartment buildings allowed fire to spread rapidly over buildings and produced burning brands that spread fire to other buildings.

3. The fire suppression operations were impeded by limited space between buildings, the presence of trees and shrubbery, and the distance to fire hydrants on the north side of the building.
APPENDIX I

Diagrams

23.
APPENDIX II

Fire Hazards of Untreated Wood-Shingle Roofs

The NFPA has been concerned with the fire problem associated with the use of untreated wood shingles and shakes as a roof covering for many decades. The NFPA campaigned vigorously for ordinances restricting the use of these materials as a roof covering. In more recent years, there has been considerable lessening of the problem, not because the nature of untreated wood shingles and shakes has changed, but rather because of the concern for the problem by fire protection and building code groups in limiting the use of such materials.

In 1966, Mr. Rexford Wilson presented a paper titled, "Some Answers to the Shingle and Shake Roof Problem" at the NFPA Fall Meeting in Los Angeles. Wilson's discussion of the performance of untreated wood shingles under fire conditions and of many other issues is still applicable today. Wilson also indicated that a process for treating wood shingles was being developed and that this process would produce wood shingles capable of attaining a Class C fire rating.

Since Wilson wrote his paper, the treatment process has been developed and the wood products industry now markets pressure-treated wood shingles. Roof assemblies constructed with pressure-treated wood shingles have attained Class A, B, and C fire ratings in UL tests performed at independent testing facilities. In addition, the International Conference of Building Officials (ICBO) Evaluation Service, Inc. reported that pressure-treated wood shakes and shingles may be used in Class A, B, and C roof assemblies and Underwriters
Laboratory of Canada (ULC) has also listed some pressure-treated wood shingles for use in Class A, B, and C roof assemblies.\(^1\)

The United States Department of Agriculture Forest Products Laboratory (USDAFPL) in Madison, Wisconsin has been testing the permanence of fire resistant treatments for wood shingle roofs. Their research has shown that good cedar shingles with quality pressure treatments have passed burning brand tests and fire spread tests after two, five and ten years of actual exposure.\(^2\)

In years past, bans against untreated wood shingles as a roofing material left the property owners who desired the aesthetic effect of wood shingles with no alternative choices. The new pressure treatments, which permit wood shingles and shakes to pass the fire tests provide a property owner with a viable alternative in an area where "Class C" roof covering is required. Pressure-treated wood shakes and shingles do cost a little more, but the extra cost of such material is certainly a small price to pay to protect one's home against ignition due to flying brands or other ignition sources.

Unfortunately, major fires continue to be reported to NFPA in which the ease of ignition of untreated wood-shingle roof coverings has been an important factor. Fireworks and sparks from incinerators and other sources have easily ignited the roof covering in some cases. In other cases, the fire originated inside the building and, upon involving the wood-shingle roof covering, has resulted in the ignition of other buildings in the area that have wood-shingle roofs. Group building fires and conflagrations are still possible, as evidenced by recent major fire incidents where wood-shingle roofs were documented as a factor in the fire spread.


In many areas, the fire service today is severely strained and may have to perform with limited staffing. Fires in buildings with untreated wood-shingle roof coverings place increased demands on firefighters to limit fire spread and protect the surrounding property and its occupants. Unfortunately, in some cases, the alarm is given too late, or the firefighters are not readily available to meet the challenge.

In many areas, prolonged dry spells and high winds, as well as the close proximity of buildings to each other, provide the ingredients for a continuation of the disastrous fires which have been experienced in the past if untreated wood shingles and shakes are allowed to be used. Also, across the country the increasing number of dwellings in the vicinity of forests and wildlands presents a major conflagration problem. Untreated wood shingles continue to be identified as a factor in major wildland and urban fire losses.

The NFPA strongly supports the action taken by local governments to prohibit the use of untreated wood shingles and shakes as a roof covering material in the interest of ensuring a more firesafe environment.